



# **Clean Sky 2 Joint Undertaking**

## **Work Plan 2015-2017**

*– June 2015 –*

*Important Notice on the Clean Sky 2 Joint Undertaking (JU) Work Plan 2015-2017*

This Work Plan covers the years 2015, 2016 and 2017. The information contained in this Work Plan (topics list, budget, planning of calls) may be subject to updates. Any amended Work Plan will be announced and published on the JU's website.

© CSJU 2015

Please note that the copyright of this document and its content is the strict property of the JU.

Any information related to this document disclosed by any other party shall not be construed as having been endorsed by to the JU. The JU expressly disclaims liability for any future changes of the content of this document.

*~ Page intentionally left blank ~*

# Clean Sky 2 Joint Undertaking

## Work Plan 2015-2017

<b>Document Version:</b>	V1	<b>Date:</b>	23/06/2015
--------------------------	----	--------------	------------

Revision History Table		
Version n°	Issue Date	Reason for change
V1	23/06/2015	First Release - Adoption by the Governing Board

## Table of Contents

1.	CLEAN SKY 2 JU - INTRODUCTION .....	7
<b>PART A – CLEAN SKY PROGRAMME .....</b>		<b>10</b>
2.	INTRODUCTION TO THE PROGRAMME .....	11
3.	CLEAN SKY PROGRAMME IMPLEMENTATION 2015-2017 .....	14
3.1.	SFWA – Smart Fixed Wing Aircraft .....	14
3.2.	GRA – Green Regional Aircraft .....	19
3.3.	GRC – Green Rotorcraft .....	24
3.4.	SAGE – Sustainable and Green Engines .....	29
3.5.	SGO – Systems for Green Operations .....	35
3.6.	ECO – Eco Design .....	39
3.7.	TE – Technology Evaluator .....	41
4.	PARTNERS ACTIVITIES IN 2015-2017 .....	45
5.	OBJECTIVES AND INDICATORS .....	46
6.	RISK ASSESSMENT .....	52
7.	JUSTIFICATION OF THE FINANCIAL RESOURCES .....	54
<b>PART B – CLEAN SKY 2 PROGRAMME .....</b>		<b>57</b>
8.	OVERVIEW OF THE CLEAN SKY 2 PROGRAMME .....	58
8.1.	Clean Sky 2 – Introduction to the Programme Structure and Set-up .....	58
8.2.	The multi-annual approach for the CS2 programme .....	61
9.	CLEAN SKY 2 PROGRAMME IMPLEMENTATION 2015 - 2017 .....	62
9.1.	IADP LARGE PASSENGER AIRCRAFT .....	62
9.2.	IADP REGIONAL AIRCRAFT .....	75
9.3.	IADP FAST ROTORCRAFT .....	85
9.4.	ITD AIRFRAME .....	97
9.5.	ITD ENGINES .....	117
9.7.	ITD SYSTEMS .....	136

9.8.	SMALL AIR TRANSPORT TRANSVERSE ACTIVITY .....	163
9.9.	ECO DESIGN TRANSVERSE ACTIVITY .....	176
9.10.	TECHNOLOGY EVALUATOR.....	181
10.	CALL ACTIVITIES IN 2015-2017.....	185
10.1.	CALLS FOR CORE-PARTNERS.....	185
10.1.1.	Role of Core Partners and their accession as JU Members .....	185
10.1.2.	Definition of Topics for the Calls for Core Partners .....	186
10.1.3.	First Call for Core Partners JTI-CS2-2014-CPW01 .....	188
10.1.4.	Second Call for Core Partners JTI-CS2-2015-CPW02 .....	188
10.1.5.	Third Call for Core Partners JTI-CS2-2015-CPW03 .....	188
10.1.6.	Fourth Call for Core Partners JTI-CS2-2016-CPW04 .....	188
10.2.	CALLS FOR PROPOSALS .....	189
10.2.1.	Definition of Topics.....	190
10.2.2.	Technical implementation of the Partner's actions within the IADP/ITD - Access rights between private Members and Partners .....	190
10.2.3.	First Call for Proposals (for Partners) JTI-CS2-2014-CfP01 .....	191
10.2.4.	Second Call for Proposals (for Partners) JTI-CS2-2015-CfP02.....	191
10.2.5.	Third Call for Proposals (for Partners) JTI-CS2-2016-CfP03.....	191
10.2.6.	Fourth Call for Proposals (for Partners) JTI-CS2-2016-CfP04.....	192
10.2.7.	Fifth Call for Proposals (for Partners) JTI-CS2-2017-CfP05.....	192
10.2.8.	Sixth Call for Proposals (for Partners) JTI-CS2-2017-CfP06.....	192
10.3.	Submission of proposals from applicants .....	192
11.	OBJECTIVES AND INDICATORS .....	193
11.1.	Clean Sky 2 Demonstrators and Technology streams .....	194
11.2.	Environmental forecast .....	208
11.3.	Indicators for Clean Sky 2 Programme.....	209
12.	RISK ASSESSMENT.....	210
13.	PRIVATE CONTRIBUTION TO THE PROGRAMME AND TO THE JTI OBJECTIVES .....	212
14.	JUSTIFICATION OF THE FINANCIAL RESOURCES .....	213
	<b>PART C – CLEAN SKY 2 JU – PROGRAMME OFFICE .....</b>	<b>215</b>
15.	COMMUNICATION AND EVENTS.....	216

16.	JU EXECUTIVE TEAM .....	218
17.	SUMMARY ANNUAL BUDGET.....	220
18.	EX-POST AUDITS .....	221
19.	PROCUREMENT AND CONTRACTS .....	223
20.	DATA PROTECTION.....	226
	<b>ANNEXES .....</b>	<b>227</b>
21.	ANNEX I: Annual Budget 2015-2017 and Establishment Plan 2015.....	228
22.	ANNEX II: 2 <sup>nd</sup> Call for Proposals: Summary List of Topics .....	229
23.	GENERAL ANNEXES OF THE WORK PLAN.....	262
	A. List of countries, and applicable rules for funding.....	262
	I. Calls for Core Partners .....	262
	II. Calls for Proposals (for Partners) .....	262
	B. Admissibility conditions and related requirements .....	264
	I. Calls for Core Partners .....	264
	II. Calls for Proposals (for Partners) .....	266
	C. Eligibility criteria .....	269
	I. Calls for Core Partners .....	269
	II. Calls for Proposals (for Partners) .....	269
	D. Types of action: specific provisions and funding rates' .....	270
	E. Technology readiness levels (TRL) .....	271
	F. Evaluation.....	272
	I. Calls for Core Partners .....	272
	II. Calls for Proposals (for Partners) .....	276
	G. Budget flexibility.....	278
24.	List of abbreviations .....	279

# 1. CLEAN SKY 2 JU - INTRODUCTION

## *Clean Sky Public Private Partnership*

*Clean Sky* today epitomises a true Public Private Partnership (PPP). It represents a strategic and successful input to the Europe 2020 objectives: boosting private investments in research and innovation and making the best use of public research funding in a vital and growing sector. Five years into the Programme, the step-change improvement potential targeted, such as up to 30% reduction in CO<sub>2</sub> emissions and (depending on the aircraft segment) 60% reduction in noise footprint, are all within reach. Stakeholder participation is a huge success: first time participation from many SMEs and their success rate in the Calls for Proposals is over twice that of any other FP7 instrument. Industry is increasingly using *Clean Sky* as the centrepiece of their R&T programmes because of the flexibility of the instrument; and the JU has proven its efficiency as a management body.

## *Horizon2020 and Clean Sky 2: new challenges and objectives*

This is one of the reasons why the European Commission proposed in July 2013, within the European Innovation Investment Package, to continue *Clean Sky* in the framework of Horizon 2020: a *Clean Sky 2* Regulation was built to address the **Joint Technical Proposal** put together by the leading companies, “founders” of *Clean Sky 2* and coordinated by the JU. Regulation No 558/204 of 6 May 2014 establishing the *Clean Sky 2* Joint Undertaking was adopted by the Council on 6<sup>th</sup> of May, 2014 after consultations with the European Parliament and published on the 7<sup>th</sup> of June 2014<sup>1</sup>.

The aeronautical sector, in particular through *Clean Sky 2*, will be a critical player in contributing to one of the key Societal Challenge ‘*smart, green and integrated transport*’ defined in **Horizon 2020**. The *Clean Sky 2* Programme will serve society’s needs and strengthen global industry leadership. It will enable cutting edge solutions for further gains in decreasing fuel burn and CO<sub>2</sub> and reducing NO<sub>x</sub> and noise emissions. It will contribute strongly to the renewed ACARE SRIA<sup>2</sup>.

*Clean Sky 2* will be more than twice the size of *Clean Sky*, with widened scope and objectives: higher level of integration of technologies while taking also into account some lower-TRL, longer-term targets; reaching for a new set of environmental targets – assuming that those of the current *Clean Sky* will actually been achieved as expected – while ensuring the future global leadership of the European industry and supply chain, creating jobs through a reinforced competitiveness.

---

<sup>1</sup> OJ L 169/77 of 7 June 2014.

<sup>2</sup> Advisory Council on Aviation Research in Europe, Strategic Research and Innovation Agenda (2012)

*Clean Sky 2* will build on the success of *Clean Sky* and will deliver full-scale in-flight demonstration of novel architectures and configurations. Advanced technology inserted and demonstrated at full systems level will enable step-changes in environmental and economic performance and bring crucial competitiveness benefits to European industry. By *jointly* pursuing this research on new breakthrough innovations and *demonstrating* new vehicle configurations in flight, the Programme will provide the proving grounds for concepts that would otherwise be beyond the manageable risk of the private sector. It will give the necessary funding stability to the private sector to develop and introduce game-changing innovations within timeframes that are otherwise unachievable. Compared to the best available aircraft in operation in 2014, up to a 30% reduction in fuel burn and related CO<sub>2</sub> emissions, similar or greater reductions in NO<sub>x</sub> emissions and up to a 75% reduction in noise affected communities will accrue from this focused and programmatic approach. These pace-setting gains will enable the European Aviation Sector to satisfy society's needs for sustainable, competitive mobility towards 2050. By doing this, *Clean Sky 2* will be *the key European instrument* to speed up technology development, overcome market failure and guarantee a sustainable advancement of aviation. *Clean Sky 2* will significantly contribute to the Innovation Union, create high-skilled jobs, increase transport efficiency, sustain economic prosperity and drive environmental improvements in the global air transport system.

The *Clean Sky 2* Programme is jointly funded by the European Commission and the major European aeronautics companies, and involves an EU contribution from the Horizon 2020 Programme budget of €1.755 bn. It will be leveraged by further activities funded at national, regional and private levels leading to a total public and private investment of approximately €4 bn. *Clean Sky 2* will run for the full duration of Horizon 2020 actions, i.e. from 2014 to 2023. A phased approach will be taken to the start-up of *Clean Sky 2* projects and align them closely and adequately with *Clean Sky* on-going projects (to be completed in the period 2014-2016). It will be endorsed and supported by the leading European aeronautic research organisations and academia. Small and medium-size enterprises and innovative sub-sector leaders will continue to shape promising new supply chains. In so doing, *Clean Sky 2* will engage the best talent and resources throughout Europe and over 3,000 highly skilled staff (FTEs) will be consistently employed over a ten year period.

### *Synergies with the structural funds*

The European Structural and Investment Funds (ESIF) will invest approximately €100 billion in innovation and research in the period 2014-2020. Article 20 of the Horizon 2020 Regulation and Article 37 of the Rules for Participation encourage synergies between Horizon 2020 and other European Union funds, such as ESIF. The Clean Sky 2 JU is called by its founding Regulation n° 558/2014 of 6th May 2014 to develop close interactions with ESIF.

Synergy does not mean to replace the private contribution to be brought in the CSJU action by ESIF or to combine them for the same cost item in a project although a CSJU project can



benefit from additional funding from ESIF at national or regional level for complementary or additional activities not covered by the CSJU grant. Synergy means to expand the scope and impact of a CSJU project through ESIF funds in terms of scientific excellence and contribution to the Clean Sky 2 Programme objectives.

In the framework of its calls, the CSJU encourages the submission of proposals containing a separate and clearly identified Work Package (ESIF WP) that is independently funded or eligible for funding through ESIF under the applicable national/regional funding scheme/call. Activities proposed under the ESIF WP, where applicable, should be of complementary nature to the core scope of the Call topic, should contribute to the overall objectives of the Clean Sky 2 Programme but are or may be exclusively funded through ESIF. In the context of the calls for proposals, the complementary activities will be assessed by the JU outside the call for proposal framework, its evaluation and applicable rules.

The CSJU encourages also synergies with ESIF also by amplification of the scope, parallel activities or continuation of a CSJU co-funded project through ESIF in synergy with the Programme and by stimulating the use of ESIF to build capacity and capabilities in the fields related to the Programme.

## **PART A – *CLEAN SKY PROGRAMME***

## 2. INTRODUCTION TO THE PROGRAMME

The Council Regulation setting up the Joint Undertaking was adopted by the Council of the European Union on 20 December 2007 and published in the Official Journal of the European Union on 4 February 2008.

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.

Joint Technology Initiatives are purpose-built, large scale research projects created by the European Commission within the 7th Framework Programme (FP7) in order to allow the achievement of ambitious and complex research goals. Set up as a Public Private Partnership between the European Commission and the European aeronautical industry, Clean Sky pulls together the formidable research and technology resources of the European Union in a coherent, €1.6 bn programme.

The Clean Sky goal is to identify, develop and validate the key technologies necessary to achieve major steps towards the ACARE (Advisory Council for Aeronautics Research in Europe) Environmental Goals for 2020 when compared to Year 2000 levels: fuel consumption and carbon dioxide (CO<sub>2</sub>) emissions reduced by 50%, Nitrous oxides (NO<sub>x</sub>) emissions reduced by 80%, reduction in perceived external noise of 50% ; another goal is to improve the environmental impact of the life cycle of aeronautical products (manufacturing, operation, maintenance and disposal).

Simultaneously, the programme aims to strengthen and anchor industrial competitiveness in the European Aeronautical industry by enabling an accelerated development and validation of differentiating technology, enduring networks of research collaboration and innovation, and a stable platform for integration and synthesis of technology into viable development platforms.

Clean Sky activities cover all sectors of the Air Transport System and the associated underlying technologies.

Clean Sky is built upon 6 different technical areas called Integrated Technology Demonstrators (ITDs), where preliminary studies and down-selection of work will be performed, followed by large-scale demonstrations on ground or in-flight, in order to bring innovative technologies to a maturity level where they can be applicable to new generation “green aircraft”. Multiple links for coherence and interfaces are ensured between the various ITDs.

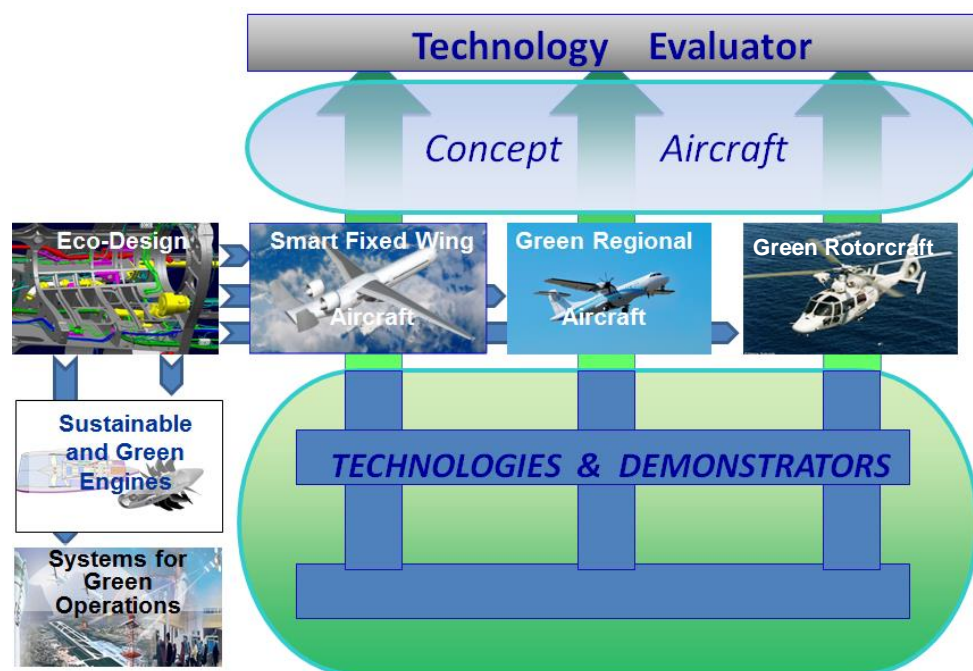
A “Technology Evaluator”, using a set of tools at different levels of integration, from the single aircraft mission to the worldwide fleet, provide for independent evaluation of the

environmental achievements. The innovative technologies developed by Clean Sky cover nearly all segments of commercial aviation.

Innovative technologies, Concept Aircraft and Demonstration Programmes form the three complementary instruments used by Clean Sky in meeting these goals:

- Technologies are selected, developed and monitored in terms of maturity or ‘Technology Readiness Level’ (TRL), the ultimate goal of Clean Sky is to achieve TRLs corresponding to successful demonstration in a relevant operating environment (i.e. TRL 6). This is the highest TRL achievable in research.
- Concept Aircraft are design studies dedicated to integrating technologies into a viable conceptual configuration. They cover a broad range of aircraft: business jets, regional and large commercial aircraft, as well as rotorcraft.
- Demonstration Programmes include physical demonstrators that integrate several technologies at a larger ‘system’ or aircraft level, and validate their feasibility in operating conditions. This helps determine the true potential of the technologies and enables a realistic environmental assessment. Demonstrations enable technologies to reach a higher level of maturity (TRL).

The Clean Sky Programme is shown schematically in the following figure:



## **The multi-annual approach**

Most of the Clean Sky full-scale, in-flight demonstrations will be taking place from 2014 to 2016.

Based on the multi-annual commitments approach of Clean Sky 2 under its new legal basis, this work plan includes a full description of activities for the years 2014 and 2015. As many activities are interlinked with previous years' work and tests performed, there are mentions of other years throughout this document in order to give the complete picture to the reader.

The period 2014 to 2016 will represent the peak of the Clean Sky programme with most of the demonstration activities taking place. All Integrated Technology Demonstrators (ITDs) will experience an intense activity:

- Most key technologies have been completed for integration in demonstrators that will enter the phase of detailed design, manufacturing and testing.
- Should however some ITDs fail to use in due time the full funding available, due to any technical contingencies, some further technologies may be introduced in several integrated demonstrators.
- The evaluation results of the call 16 which took place in December 2013 enabled the JU to have a clear picture of the target to reach (minimum 200 m € to be granted to partners arising from the calls process).

### **3. CLEAN SKY PROGRAMME IMPLEMENTATION 2015-2017**

#### **3.1. SFWA – Smart Fixed Wing Aircraft**

SFWA is developing two major large transport aircraft technologies; the first mainly related to the drag reduction by using laminar flow and known as 'smart wing', and the second related to the integration of advanced (ultra-) high bypass propulsion concepts such as Open Rotor. The objective is to achieve maturity levels in both technologies to a status close to a potential application through major, dedicated large scale ground and flight demonstrations.

#### **Activities for year 2015**

##### *Overview*

The preparation of the main demonstrators of the SFWA technologies will be completed at straddling the end of the year 2014 and the beginning of year 2015. Hence the activities in 2015 will focus for the majority on performing tests on large ground and flight demonstrators, such as the natural laminar flow wing, the smart flap for low speed applications, low speed vibration flight demonstration, and the business jet innovative after body demonstrator.

All major components for the Airbus A340-300 BLADE flight test demonstrator are scheduled to arrive in the first half year of 2015 “on dock” at the final assembly hangar in Tarbes, which will be exclusively dedicated for the preparation, maintenance, conduct and refurbishment activities for a period of, in total, two years. The laminar test wing articles are planned to arrive by end of the second quarter of 2015, shipped to Tarbes directly after completion of the assembly in Vitoria (Spain). Component assembly, installation of flight test instrumentation, calibration and ground tests of all major BLADE wing components will stretch over the second half of 2015, finishing into 2016.

The ground based demonstration associated to the development of the laminar wing for large transport aircraft, which is going on in parallel, will be concluded in early 2015 with a number of key contributions to TRL5 to the structural concept and the leading edge high lift kinematic.

The low speed vibration load control tests for business jets in 2015 will encompass all major simulator tests and tests with the full size Dassault Falcon ground rig. Parallel tests with advanced load control functions integrating real time loads monitoring will be conducted with target to accomplish technology readiness levels of 5 at the end of 2015 for Business jets and large passenger short range aircraft.

The so-called “smart flap”, a multifunctional control surface with extended high lift and flight control capability for business jets will be tested in a full size ground demonstrator over the

full domain of static and dynamic loads relevant for a the flight envelope in the second half of 2015. The analysis and exploitation of tests is scheduled to follow in 2016.

For the innovative rear empennage for business jets, the flutter test will be conducted in a high speed wind tunnel test and will be a key contribution to reach TRL4. The full scale ground test with a structural mock up is planned to take place behind a Dassault Falcon 7X to obtain realistic data about the thermal, acoustic and fatigue behaviour of the advanced V-tail concept, which shall lead to the accomplishment of TRL 5 before the end of 2015.

Most of the research and development activities for the Contra Rotating Open Rotor will be transferred to the Clean Sky 2 programme, while a number of topics (assigned by Call for proposal) concerning the propulsion system integration, the aerodynamic and acoustics, certification items, the physical integration and flight test, as well as the demonstration and instrumentation, will continue in SFWA during 2015. A significant number of related conclusive results are expected in 2015, to be completed in 2016.

In 2015 all SFWA activities associate to active flow control wing technologies are planned to be completed with the final testing of the robustness of the developed actuator concepts under operational conditions. A final analysis of experiments done in 2014 on the leading edge contamination effect for the application of hybrid laminar flow control, and a number of wind tunnel tests of active and passive buffet control technologies will be done in SFWA in 2015.

#### **Major milestones planned for 2015:**

- Dedicated dock and hangar ready to host the BLADE test aircraft;
- Start of the final assembly of the BLADE Airbus A340-300 test aircraft with all major components;
- Integration of Laminar wing test results for large passenger aircraft into a next generation short range aircraft concept;
- Completing of Low Speed Business Jet “Smart Flap” ground test campaign;
- Completing of simulator tests for active load control functions large transport aircraft;
- Completing of simulator tests for vibration control tests for business jets;
- Completing of buffet control technology wind tunnel tests;
- Completing of CROR shielding concept studies for primary structures;
- Availability of CROR-engine integration strategies and rules (result of coordinated action of SFWA and beyond, including relevant authorities);
- Completing of smart flap demonstrator structural integration;
- Starting of the test campaigns to develop and test In-flight CROR blade deformation measurement system based on “IPCT” and flow diagnostics based on “phase locked “PIV”;
- Completing of mid-scale validation wind tunnel tests of active flow control concept.

#### **Major deliverables planned for 2015:**

- Delivery of the Portboard laminar wing Upper Cover and leading edge for wing assembly
- Starboard and Portboard laminar wing test article on dock at BLADE final assembly line

- Wing diffusion zones, aero-fairings, wing tip pods and plasterons delivered on dock at BLADE final assembly line;
- Delivering of all major components for BLADE flight test instrumentation to final assembly line;
- VTP Camera pod manufactured, ready for assembly on test aircraft
- Completing of the leading edge “phase 4” demonstrator tests, results analysed;
- Completing of the Laminar Wing Ground Based Demonstrator Phase 4 assembly;
- Completing of the Smart Flap Low Speed Business-Jet (LSBJ) high Reynolds number aero performance tests. Completing and analysis of the Wind tunnel tests;
- Passive load control technology development and tests, preliminary results available;
- Starting of the large scale Innovative Bizjet afterbody demonstrator campaign;
- Simulator results to configure the for Low Speed Vibration Control of Business Jets ground test;
- CROR low speed test campaign with “Z49” package 1 test results;
- Completing of the CROR related impact & trajectory tests, preliminary results available;
- Completing of the Innovative Bizjet afterbody wind tunnel flutter test preliminary results available;
- Definition of the in-flight PIV diagnostic concept for CROR demo-engine flight test, integration concept for test aircraft available;
- PANEM model of CROR powered short and medium range transport aircraft including key system features from SGO-ITD updated with recent results accomplished in SFWA.

## **Activities for year 2016**

### *Overview*

The major shares of SFWA activities in 2016 will be dedicated to prepare, conduct, analyse large ground tests and prepare flight test demonstrations along the main SFWA technology streams, namely the BLADE natural laminar flow wing flight test demonstration, the Bizjet large scale rear end structural demonstrator, the low speed vibration control and smart flap ground test.

For the BLADE project the scope of activities in 2016 is planned to cover the completion of the mechanical rigging and integration of the two laminar wings with the diffusion zone aero-fairings, wing tip pods, plastron, ailerons and all due connection to the datum test aircraft systems. Parallel activities will deal with the installation and connection of the flight test instrumentation and all further associated modifications of the test entire aircraft. The next block of activities are ground tests with all equipment, the newly installed and modified aircraft systems and all elements of the aircraft that could have been affected of the changes. A variety of structural tests will be conducted to check the integrity of the wings and its mechanical behaviour. The flight test instrumentation, observation camera's and all related equipment will be tested and calibrated – as far as possible on ground. The working party will start at Tarbes in 2016 with a target for an A/C “power on” by end 2016. Following a flight clearance procedure including ground tests and Validation& Verification process, the aircraft shall be ready for flight testing in September 2017. The current plan is to conduct a flight test



campaign at a variety of condition relevant for the typical use of the laminar wing. Most of the integration and ground test activities are planned to be conducted at a dedicated Hangar in Tarbes, flight test activities will likely take place in the region of southern France or regions with meteorological conditions suitable for the test campaign. Please note that the plan includes a number of milestones and gate reviews which may lead to updates of the plan if required. The current baseline is to start and conduct the flight test campaign in September 2017. Critical paths have been identified and risks mitigated with CSJU and CfP partners during the critical Design and industrial reviews in April 2015.

The activities of assembly and testing of the NLF-wing ground based feature demonstrator (NLF-GBD) which are running in parallel to the preparation of the BLADE flight test shall be completed in 2015 with a final phase of analysis of the experimental data in early 2016.

The ground tests of the recently developed low speed vibration load control concept for business jets which are planned to start in May 2015 with the full size Dassault Falcon ground rig are scheduled to lead to a launch of a second campaign at the end of 2015. This follow-up campaign is planned to be pursued and completed and analysed in 2016. The detailed content and plan, including the decision to conduct a second full size ground rig or a flight test campaign is part of the technology roadmap and will depend on the outcome of the first test campaign. The analysis of the results will include the results from other research and development activities in load control functions for Business jets and large passenger short range aircraft which shall be completed by the end of 2015.

The tests with the so-called “smart flap”, a multifunctional control surface with extended high lift and flight control capability for business jets in a structural ground demonstrator together with the aero testing of the concept shall come to completion early 2016. The analysis and exploitation of tests is scheduled to be pursued and completed in 2016.

Another large ground test campaign in SFWA is scheduled 2016 with the full scale structural mock up for the Bizjet Innovative Empennage. By placing this demonstrator behind a Dassault Falcon 7X to obtain realistic data about the thermal, acoustic and fatigue behaviour of the advanced V-tail concept, the maturity of the concept shall be validated to TRL 5 in the first semester of 2016. Parallel wind tunnel tests on the flutter behaviour of critical components of the innovative rear end concept as well as to characterize the aerodynamic characterization are planned to be conducted and completed in the same period.

Most of the other SFWA activities related to active flow control, active and passive buffet control, hybrid laminar flow control and loads control are scheduled to be completed before the end of 2015. The final analysis, assessment and interpretation of work are considered to stretch into the first quarter of 2016. Note that the SFWA activities related to the CROR are being transferred respectively continued in Clean Sky 2. However, the analysis of two low speed wind tunnel test campaign conducted in the frame of SFWA Call for proposal topics in 2015 are planned to be completed by October 2016. The development of the CROR ground test demonstrator engine which continues in Clean Sky SAGE 2 which will be connected to the integration work in Clean Sky 2 will be supported through SFWA until the end of the Clean Sky programme.

#### **Major milestones planned for 2016:**

- BLADE NLF wing flight test aircraft assembly completed with all NLF wing components, test hardware and equipment

- BLADE test aircraft “Power on”, start of ground tests to qualify the equipment and the aircraft for flight test testing
- Perform flight clearance activities for BLADE flight test campaign
- Completion of Low Speed Business Jet “Smart Flap” ground test campaigns
- Completion of Bizjet low speed loads and vibration control ground rig tests
- Completion of ground test campaign with full scale Bizjet innovative rear empennage
- Completion of wind tunnel tests for bizjet innovative rear end on flutter and aerodynamic performance
- Completion of technical analysis and reporting of SFWA research and development activities on active flow control, hybrid laminar flow control, buffet control and loads control architecture and functions
- Transfer of activities related to CROR to Clean Sky completed

#### **Major deliverables planned for 2016:**

- BLADE test aircraft readily assembled for ground testing
- 1st Flight clearance readiness review
- Final report on NLF wing ground demonstrator
- Conclusive report on results of Bizjet innovative rear end large scale ground tests, wind tunnel tests and numerical simulation
- Conclusive report on results of Bizjet low speed vibration control
- Conclusive report on Smart Flap ground test campaign and synthesis on integration and performance on bizjets
- Summary report on low speed Wind Tunnel Test campaign on CROR noise and performance tests (done in 2015)
- Hardware, data and reports on CROR propulsion system integration and performance from wind tunnel tests, numerical simulation and analytical research (transfer for continuation in Clean Sky 2)
- Final Assessment with PANEM model of CROR powered short and medium range transport aircraft including key system features from SGO-ITD updated with latest results accomplished in SFWA

### **3.2. GRA – Green Regional Aircraft**

Future green regional aircraft will have to meet demanding weight reduction, energy and aerodynamics efficiency, a high level of operative performance, in order to be compliant regards to pollutant emissions and noise generation levels. Objective of the Green Regional Aircraft ITD is to mature, validate and demonstrate the technologies best fitting the environmental goals set for the regional aircraft entering the market in the years 2015 - 2020. The project has 5 main domains of research, in which several new technologies are under investigation in order to entirely revisit the aircraft in all of its aspects. The GRA technological areas structure is as follows:

- GRA1 - Low Weight Configuration (LWC)
- GRA2 - Low Noise Configuration (LNC)
- GRA3 - All Electric Aircraft (AEA)
- GRA4 - Mission & Trajectory Management (MTM)
- GRA5 - New Configuration (NC)

GRA will continue the work packages defined in the baseline program, with internal review of the technologies to be further enhanced. Main GRA ITD activities, in the period 2014 – 2016, will be largely involved in design, manufacturing and final testing of the demonstrators, according to the description given below. For every domain, a short summary of the activities carried out for the 'mainstream' technologies in 2013 is here presented, with the scope of introducing the activities planned for the next biennium 2104-2015.

#### **Work plan for year 2015**

##### *Overview*

Low Weight Configuration domain (GRA1) activities will totally focus on Testing the Ground Demonstrators (Fuselage Section, Wing Box Section and Cockpit Section). The major objectives in 2015 are represented by the static and fatigue tests to be executed on Ground Demonstrators together with some functionality testing (i.e electrical conductivity, modal analysis and acoustic). Structural and Systems modifications will continue to be applied on the ATR 72. A new composite stiffened panel will be installaed on crown area in place of the existing aluminium panel for flight tests. Pre-Flight Tests (preliminary strain check, acoustic evaluation and calibration of sensors for SHM) and Flight Tests will be executed, with unmodified and modified A/C, on ATR 72 (MSN 098). The overall assessment of the domain project results will be carried out including the final demonstrations results, focusing on the main achievements against initial targets. The Flight Readiness Review (FRR) will be achieved and the Flights will be executed in 2015.

Low Noise Configuration domain (GRA2) activities will be basically dealing with the demonstration of advanced aerodynamics (laminar flow technology), load alleviation (tests

performed on 1:7 half-A/C aero-servo-elastic model in the frame of project GLAMOUR under CfP) and low airframe noise technologies tailored to 130-seat A/C (tests of low-speed aerodynamic and aero-acoustic performance on 1:7 complete A/C powered WT model in the frame of the projects: ESICAPIA and EASIER both under CfPs) and 90-seat green regional A/C (tests of low-speed aerodynamic and aero-acoustic performance on 1:7 complete A/C powered WT model) and acoustic tests performed on a full-scale mock-up of a Main Landing Gear low-noise configuration. Respective tests will be executed in the frame of the projects LOSITA, WITTINESS and ARTIC, all under CfPs, through a variety of large-scale aerodynamic and aero-acoustic Wind Tunnel Tests on innovative models.

In addition, mechanical tests on a full-scale prototype of the morphing flap sized to the half-outboard flap of the 130-seat A/C will be carried out. Ground demo of LC&A system architecture through a representative test rig integrating real-time computer, active devices and control laws will be performed. Then, the overall assessment of the domain project results will be carried out by reviewing the different phases of the work programme, from the technologies development to the final demonstrations, focusing on the main achievements against initial targets.

Most of the activities performed in Mission and Trajectory Management domain will be dedicated to the final Flight Simulation Demonstration test according to the defined procedure. The overall assessment of the domain project results, collecting pilot feedback and environmental benefit due to the implementation of green FMS functions, will be carried out. Demonstration of the Green FMS (Flight Management System), using a realistic Regional Flight Simulator, will be executed.

New Configuration domain (GRA5) will focus on the low-speed aerodynamic wind tunnel test campaign to estimate the performance in high lift conditions of the 130-seat aircraft configuration by testing a 1:7 complete A/C powered WT model. The A/C Simulation Models (GRASMs) for the assessment of environmental targets achievement in terms of air pollutants emission (CO<sub>2</sub> & NO<sub>x</sub>) and external noise reduction, based on experimental results and enclosing the MTM Technologies, will be delivered to the Technology Evaluator.

#### **Major milestones planned for 2015:**

- Completion Ground Full Scale Test;
- WTT Demo Large Scale 90 Pax;
- E-ECS verification of integration on A/C on ground;
- Completion of Flight Test Demonstration;
- E-ECS for Regional A/C Completion Demonstration;
- Completion of Flight Simulator Demonstration;
- WTT Demo Large Scale 130 Pax;

#### **Major deliverables planned for 2015:**

- Fuselage Ground Test Demonstration results;
- Wing Box Ground Test Demonstration results;
- Cockpit Ground Test Demonstration results;

- Test Set-Up & FCS-EMA Delivery for Aircraft Flight Demo;
- Test Set-Up & LGS-EMA Delivery for Aircraft Flight Demo;
- E-ECS rack available;
- Systems FTI kit available;
- Flight test Engineering Station available;
- ATR (MSN098) modified A/C;
- Wind Tunnel demonstrators for 130-seat and 90-seat green regional A/C performances as above outlined and relevant tests results;
- Ground demonstrators of morphing flap and of LC&A system architecture and relevant tests results;
- Final MTM Report based on Simulation Test execution;
- GRASM (TP90 pax and GTF 130 pax A/C of Design Loop 3 and with MTM Technologies).

#### **Main events:**

- Static and Fatigue Full Scale Ground Demonstrators;
- WTT Demo Large Scale 90 & 130 Pax;
- Flight Test on ATR MSN 098;
- Demonstration of the Green FMS by a Regional Flight Simulator;
- GRA Annual Review Meeting (ARM).

During 2016, in the framework of GRA ITD, the technical activities included in the GAM 2014-2016 and listed below will be completed.

- ❖ **GRA1 – Low Weight Configuration (LWC)** domain activities will be totally dedicated to the completion of the Testing of the Full Scale Ground Demo :
  - ✓ **Fuselage Ground Demonstrator:** Completion of the Pressurization Cycles and Residual Strength at Ultimate Load. Introduction of damages. Execution of 9.000 Pressurization Cycles (first phase of the second life) and respective inspections. Residual Strength at Limit Load execution. Damages Repair performing. Completion of the second life cycles. Residual Strength at Ultimate Load execution.
  - ✓ **Inner Wing Box Ground Demonstrator:** Completion of Fatigue Tests. Execution of Static Test up to Limit Load and respective inspections. Execution of Failure Test.
  - ✓ **Cockpit Ground Demonstrator:** Completion of Fatigue Phase (30.000-60.000 flights) on second demonstrator. Damage introduction on demonstrator. Execution of damage tolerance test. Execution of Static Test up to Ultimate Load and respective inspections.

For all Ground Demonstrators and for the In-Flight fuselage panel demonstrator (from the FTB ATR 72 tested in 2015), Tests Results analyses and correlation will be performed. Relevant Test Reports will be issued.

❖ **GRA2 – Low Noise Configuration (LNC):** domain activities will concern the completion of a few Wind Tunnel Demonstrations and the overall assessment of the LNC domain project results.

- ✓ Analysis of results of the experimental demonstration of the transonic NLF wing design tailored to the GTF-engined 130-seat GRA and of relevant load control performances in high-speed steady conditions through aerodynamic WT tests ( $\text{Mach} \approx 0.7 - 0.8$ ) on 1:3 half-wing elastic model, (to be performed in October/November 2015) in the frame of project ETRIOLLA (under CfP JTI-CS-2012-01-GRA-02-019);
- ✓ Support to the analysis of results of the experimental demonstration of the GTF 130-seat GRA high-lift performances and Stability and Control (S&C) data set through aerodynamic low-speed WT tests ( $\text{Mach} \approx 0.2$ ) on 1:7 complete A/C powered model, (to be performed in November 2015) in the frame of project ESICAPIA (under CfP JTI-CS-2012-02-GRA-05-007) within the NC domain;
- ✓ Support to the analysis of results of the experimental assessment of the GTF 130-seat GRA airframe noise impact and of HLD (High Lift Devices) low-noise solutions through aeroacoustic low-speed WT tests ( $\text{Mach} \approx 0.2$ ) on the same model above, (to be performed in December 2015) in the frame of project EASIER (under CfP JTI-CS-2013-02-GRA-05-008) within the NC domain;
- ✓ Analysis of results of the experimental demonstration of MLG low-noise configuration tailored to TP 90-seat GRA through aeroacoustic low-speed WT tests ( $\text{Mach} \approx 0.2$ ) on full-scale model of the MLG installed architecture (gear, bay, part of fuselage lower surface), (to be performed in October/November 2015) in the frame of project ARTIC (under CfP JTI-CS-2013-01-GRA-02-021);
- ✓ Experimental demonstration of the TP 90-seat GRA high-lift performances and S&C data set through aerodynamic low-speed WT tests ( $\text{Mach} \approx 0.2$ ) on 1:6.5 complete A/C powered model, (to be performed in March 2016) in the frame of project LOSITA (under CfP JTI-CS-2013-01-GRA-02-020), and relevant test results analysis;
- ✓ Experimental assessment of the TP 90-seat GRA airframe noise impact and of HLD low-noise solutions through aeroacoustic low-speed WT tests ( $\text{Mach} \approx 0.2$ ) on the same model above, (to be performed in April 2016) in the frame of project WITTINESS (under CfP JTI-CS-2013-02-GRA-02-025), and relevant test results analysis;
- ✓ Second part of the overall assessment of the outcomes of the LNC domain, addressing the results of the relevant technologies demonstrations and the main project achievements against targets, for the maturation of advanced aerodynamics, LC&A (Load Control and Alleviation) and airframe noise reduction technologies toward future green regional air transport.

❖ **GRA3 – All Electrical Aircraft (AEA):** main activities in the year 2016 will concern the completion of the overall assessment of the outcomes of the AEA domain.

- ❖ **GRA4 – Mission and Trajectory Management (MTM):** no activities are planned in year 2016.
- ❖ **GRA5 – New Configuration (NC):** main activities in the year 2016 will concern the analysis and final reporting of the outcomes of the NC domain.

#### **Main deliverables in year 2016**

- Completion of Aerodynamic & Aeroacoustic investigation of LN A/C Configuration 90 pax (WTT6 & WTT7): Test results;
- Final assessment of Aerodynamic & Aeroacoustic WTT Large-Scaled A/C 130 Pax Model (WTT4 & WTT5);
- Completion of A/C Ground Tests (Fuselage, Cockpit and Wing Demo's)
- Final assessment of the outcomes of the LNC domain;
- Final assessment of LWC A/C Ground Tests;
- Final assessment of the outcomes of the NC domain;
- Final assessment of the outcomes of the AEA domain

#### **Main events in year 2016:**

- Completion of LWC Ground Tests;
- Completion of LNC WTT Tests;
- GRA Annual Review Meeting (ARM) in second half of 2016;

No technical activities are planned in year 2017.

### 3.3. GRC – Green Rotorcraft

The Green Rotorcraft ITD gathers and structures all activities concerning the integration of technologies and the demonstration on rotorcraft platforms, supported by activities performed within the Eco-Design ITD, the Sustainable and Green Engines ITD, the Systems for Green Operations ITD and the Technology Evaluator. It combines seven domains aiming at reducing the environmental footprint by reducing emissions and halving perceived noise for the next helicopter generation.

The main activities for the seven domains of the GRC ITD are:

*GRC1 - Innovative rotor blades* activities will be related to the design, manufacturing and testing of new blade devices including both active and passive systems, and the methodology and tools necessary to carry out parametric study for global rotor benefits. A flight test campaign is planned for the active Gurney flap rotor in 2016. In case additional funding can be made available a flight test campaign of an optimised passive rotor will be performed in early / mid 2016.

*GRC2 - Reduced drag of airframe and dynamic systems activities* will be related to the design of optimised shape, the manufacturing and testing of helicopter sub-parts such as the air inlet, rotor hub fairings and fuselage aft body for several rotorcraft configurations including the tilt-rotor. Passive shape optimisation approach and vortex generators will be complemented with active control systems. Flight test campaigns starting in late 2014 and 2015 for testing integrated technologies.

*GRC3 - Integration of innovative electrical systems activities* will be focused on new architectures for more electrical helicopters including new technologies such as electric tail rotor, brushless starter generator, electro-mechanical actuators, electric taxiing, electric regenerative rotor brake and the management of energy recovery. Performance assessment of the different electrical architectures in a representative environment performed in 2014 and 2015 using the Copper Bird Test Rig.

*GRC4 - Installation of a High compression engine on a light helicopter* will consist in the development of a specific high compression engine power pack demonstrator to be installed on a modified EC-120 helicopter. Important milestones test are expected in 2014 with ground tests of the High compression engine powered helicopter. A flight test campaign will conclude the work starting in late 2014.

*GRC5 - Environment-friendly flight paths activities* will focus on the optimisation of the helicopter flight path relying both on new procedures in take-off and landing phase (IFR based) and new flight envelope definition to reduce noise (steep approach) and pollutant emissions. An intensive work with SESAR (Single European Sky Air Traffic Management Research), EASA (European Aviation Safety Agency) and ICAO (International Civil Aviation Organization) is planned to introduce new solutions operational by 2020. Flight tests are planned in 2015.

*GRC6 - EcoDesign Rotorcraft Demonstrators activities* will be related to manufacturing and testing helicopter sub-assemblies such as a double-curved fairing, a tail unit section, an intermediate gear box, a tail gear box, including the relevant input shaft which will feature REACH compliant corrosion protection. Implementation of new eco-friendly materials and



processes (thermoplastic composites and relevant forming and joining processes,, metallic alloys with “green” surface protection) based on results from the EcoDesign ITD and earlier projects.

*GRC7 - Technology Evaluator for Rotorcraft activities* are related to the packaging of results obtained for the different rotorcraft subsystems and the delivery of consistent behavioural models representing the future helicopter fleet for the Technology Evaluator to assess their environmental impact as compared to the fleet operated in 2000. Six behavioural models will be delivered from 2013 to 2015.

## **Year 2015**

### *Overview*

Forecast and remaining activities planned from 2015 onwards for the seven domains are:

*Innovative rotor blades* activities will be related to the design, manufacturing and testing of new blade devices including both active and passive systems, and the methodology and tools necessary to carry out parametric study for global rotor benefits. The integration of the active gurney flap system in the rotor blade will be finished in 2015. The active twist concept will be further developed, which means in detail the manufacturing of the specimen and the bench testing in 2014/2015 and the final test report in 2015. The passive blade design will be finished by the CDR in 2015, followed by manufacturing and whirl tower testing starting in late 2015 / early 2016. This means demonstration on a whirl tower will be performed in 2015 for active Gurney flap and in 2016 with shape optimised blades. The whirl tower testing of the AGF rotor will be followed by a flight test campaign in 2016. Depending on the availability of additional funding a flight test campaign would conclude the work performed for the optimised passive blade.

*Reduced drag of airframe and dynamic systems activities* will be related to the design of optimised shape, the manufacturing and testing of helicopter sub-parts such as the air inlet , the rotor hub cap and fuselage aft body for several rotorcraft configurations including the tilt-rotor. Passive shape optimisation approach and vortex generators will be complemented with active control systems such as pulsed jets and continuous blowing. Wind tunnel campaigns will validate performance predictions all along the programme. Flight test campaigns will be completed in 2015 for testing integrated technologies.

*Integration of innovative electrical systems activities* will be focused on new architectures for more electrical helicopters including new technologies such as electric tail rotor, brushless starter generator, electro-mechanical actuators, electric taxiing, electric regenerative rotor brake and the management of energy recovery. Performance assessment of the different electrical architectures will keep being tested in a representative environment in 2015 using the Copper Bird Test Rig along with various equipment tests to be performed on specific test benches from 2014 onwards. The electric tail rotor technology will be tested on a AW in-house test rig.

The demonstration of integration of a *high compression Engine* on a Light Helicopter will be completed with flight demonstrations in early 2015. The assessment of the test campaign results will conclude the work in GRC4.

*Environment-friendly flight paths activities* will be related to the optimisation of the helicopter flight path relying both on new procedures in take-off and landing phase (IFR based) and new flight envelope definition to reduce noise (steep approach) and pollutant emissions. Along with the implementation of new devices in the flight management systems, an intensive work with SESAR (Single European Sky Air Traffic Management Research), EASA (European Aviation Safety Agency) and ICAO (International Civil Aviation Organization) is planned to make those new solutions operational by 2020. Flight tests are planned in 2015 to assess the benefits of new procedures in an operational environment.

*EcoDesign Rotorcraft Demonstrators activities* will be related to manufacturing and testing helicopter sub-assemblies such as a tail unit section, an intermediate gear box, a main helicopter mast and a tail gear box. New eco-friendly materials and processes (thermoplastic composites, metallic alloys with “green” surface protection) based on results from the EcoDesign ITD and earlier projects will be implemented on these demonstrators and evaluated. Overall assessment of benefits for the whole life cycle will continue in 2015.

*Technology Evaluator for Rotorcraft activities* are related to the packaging of results obtained for the different rotorcraft subsystems and the delivery of consistent behavioural models representing the future helicopter fleet for the Technology Evaluator to assess their environmental impact as compared to the fleet operated in 2000. The delivery of the six behavioural models will be completed in 2015 including updates of those already delivered.

#### **Major milestones planned for 2015:**

- Flight test on the AW light helicopter featuring the new beanie accomplished.
- Flight test about on the AH light helicopter featuring the new rotor head accomplished
- Wind-tunnel test of the optimised GRC2 common platform
- ETB Test
- HEMAS system and its adaptation kit delivery to Copper Bird
- T/R eco-IFR procedures validated by PITL simulations in laboratory environment (with ATC).
- Realisation of in-flight demonstrations
- Completion of HCE flight test campaign
- Final flight test demonstration of Low-Noise VFR Approach Guidance on EC145
- Flight test with EC135-ACT/FHS
- Delivery of Final Phoenix platform to the TE

#### **Major deliverables planned for 2015:**

- Summary on the flight test results for the AW light helicopter featuring the new beanie.
- Synthesis report on WT measurements on a AW Heavy helicopter fuselage
- Summary on the flight test results for the AH light helicopter featuring the new rotor head and fuselage fairings.
- Summary on the flight test results for the AH light H/C with the new air intake.
- Synthesis of the benefits and related penalties for the technology demonstrations of GRC2 (issue 2)

- Test report on wind tunnel experimental campaign of oscillating AGF airfoil in dynamic stall conditions
- Tooling ready for manufacturing
- Analysis 3D model rotor wind tunnel test
- Assessment of GRC1 Technology Benefits (all GRC1 partners) 2015
- Whirl Tower Test Report
- Synthesis report on the design and project study of tiltrotor fuselage in support of weight and performance.
- Synthesis report on the design of the air-Intake and exhaust of a tilt-rotor
- Synthesis Report of the Design Studies for an Optimised Green Tiltrotor
- Final report
- GRC3.4.6 final report
- HEMAS Final Report
- Final test plan for HEMASM21
- Final demonstration report
- HCE flight test report
- TRAVEL D5.3: Final report
- Synthesis report of flight demonstration at Toulouse-Blagnac
- Synthesis report of flight demonstration at Seo de Urgel
- Eco-Flight Planner Final Demonstration report. (AWS)
- Flight Test Report on VFR Approach Guidance for EC145 (ECD)
- Phoenix Black Box V6.1 for TE – TEH U1
- Phoenix Black Box V7.1 for TE – TEL U2
- Light Twin Engine Helicopter Models – EUROPA, TM Engine and HELENA V7.1
- Heavy Twin Engine Helicopter Models – EUROPA, TM Engine and HELENA V6.1

#### **Main events:**

- M23 - Final TE Assessment results using final updated PhoeniX simulation.

#### **Year 2016**

##### *Overview*

*2016 is the final year for GRC. All technical work is required to be completed by mid-2016 leaving the second half of the year for documentation, dissemination, financial run down of the project and the Final Review.*

*No activities shall be carried over into 2017.*

##### **GRC1:**

The focus is on the conclusion of the AGF flight test campaign and the associated final documentation.

Furthermore the whirl tower test with the optimised passive blade will be performed and documented.

In case additional funding is made available to the consortium a flight test campaign will be performed and hence lift the final TRL achieved for this activity to TRL6.

**GRC2:**

GRC2 activities will focus on the reduction of the helicopter and tilt-rotor overall drag by non-degrading its lift and handling quality, and by decreasing engine installation losses. Drag reduction of the tilt-rotor fuselage and lift over drag increase of its wing and empennages will be investigated and tested in wind tunnel and/or flight. Moreover, efficiency improvement (i.e. decrease pressure losses and distortions), noise emission reduction of engine intake, efficiency improvement (i.e. pressure recovery), increase of secondary mass flow and of engine exhaust will be addressed numerically in wind tunnel and/or in flight.

**GRC3:**

The electric tail rotor drive project will be concluded with ground test in an relevant environment and subsequently documented.

As many prototypes as possible of the various innovative electrical systems (electrical brake, power converters, HEMAS, energy storage) will be integrated and tested in the Copper bird (activities to be confirmed within the EcoDesign ITD for 2016).

**GRC4:**

All activities will have been concluded in 2015, no further activities are planned for 2016.

**GRC5**

The activities in the frame of the IFR and VFR ECO flight procedures and real time guidance area will be continued and concluded.

**GRC6:**

The tail cone parts manufactured in the frame of GRC6 will be tested and the data for the life cycle assessment will be gathered including the relevant recycling activities.

**GRC7:**

The main work within GRC7 has already been concluded. TE will be assisted in 2016 to prepare the final reporting.

**Major milestones planned for 2016:**

- Final Review
- Conclusion of the AGF test campaign
- Performance of whirl tower test with the optimised passive blade set
- Conclusion of the Copper Bird tests
- Completion of the ECO flight procedures
- Final testing of structural TP tail cone parts

No technical activities are planned in year 2017.

### **3.4. SAGE – Sustainable and Green Engines**

2014 will be a key year for SAGE ITD. Most of the remaining design activities will be completed transforming the last concepts into frozen definitions. New engine tests will be launched and the ones started in 2013 will be finalized. These efforts will raise the Technology Readiness Level (TRL) of sub-systems towards the overall whole engine system reaching TRL level 6. During this period another ramp-up in the spend will happen due to the costly detailed design activities, the manufacturing and the ground and flight tests of the demonstrators. This is reflected in the budgets for this period which demonstrates the high levels of budgets planned in 2014. In 2013, the Turboshift engine demonstrator has been delivered and during 2014 – 2016, 4 more engine demonstrators will be delivered representing new technologies such as Open Rotor, Large 3 Shaft Turbofan, Geared Turbofan and Lean Burn.

#### **Work plan for year 2015**

##### *Overview*

2015 will be another key year for delivering engine demonstrators for the success of SAGE ITD. Additionally, SAGE 3 and SAGE 5 will be finalising their analysis of demonstrators performed during 2014. For SAGE 2, 4 and 6 there will be their first engine runs. These efforts will raise the Technology Readiness Level of sub-systems towards the overall whole engine system reaching TRL level 6. During this period the spend level will remain high during this intense period of demonstrator testing. This is reflected in the budgets for this period which demonstrates the high levels of budgets planned in 2015. In 2014, the large 3-shaft engine demonstrator, SAGE 3, will have been delivered with 3 more engine demonstrators being delivered in 2015 representing TRL increases in Open Rotor, Geared Turbofan and Lean Burn.

SAGE 1 will continue to focus on 4 themes: Open Rotor (OR) Design Fast CFD; Component Integrity; Forced Response and Noise. These activities will cover developing the code to provide a fast capability to analyse and understand the steady and unsteady aerodynamics of installed open rotors, also leading to an enhanced understanding of the resultant aerodynamics, the project will develop the capability for impact engineering with composite materials for open rotor designs feature variable blade pitch angles in conjunction with an overhung rotor and the continuation of Aero and Noise Methodology Development.

SAGE 2 - The Geared Open Rotor Demonstrator project objectives are to demonstrate technologies that contribute to assess open rotor architecture feasibility and environmental benefits, to adapt an existing gas generator and a rig for technology validation and integration demonstration, to develop enabling manufacturing technologies and materials where these are necessary to deliver the engine technologies for demonstration, to deliver and install a demonstrator at the ground test facility in Q4 2015 and, on the basis of prediction and test

data obtained from the engine, to assess the improvements in gaseous and noise emissions that may result from a production open rotor propulsion system. After the Critical Design Review in 2014, 2015 will be the year of the receipt of the parts, the assembly and instrumentation and the delivery of the SAGE2 demonstrator to the ground test facility.

SAGE 3 - The Large 3 Shaft Engine project will have been delivered in 2014 demonstrating technologies applicable to large 3-shaft turbofan engines in the 60-95,000 lb thrust class, as concerns low pressure system. The project aim will have delivered the TRL6 for these sub-systems through appropriate testing delivering engine conditions representative of potential future engine applications. Demonstration by rig testing will continue for the Low Pressure Turbine development.

SAGE 4 - The purpose of the advanced Geared Turbofan (GTF) Engine Demonstrator as an important part of SAGE platform is to further improve engine technologies in support of the everlasting reduction of fuel burn / CO<sub>2</sub> by addressing efficiency and weight and to continue efforts to further decrease already low noise emission levels as well as to enhance reliability and cost. After completing engine assembly and test preparation main focus in 2015 will be on full-scale engine demonstration of the Geared Turbofan in order to validate the selected technologies. After testing, the demonstrator engine will be taken off the test stand, disassembled and inspections will take place on module and component levels, followed by test analysis and reporting including the results of assessments of inserted technologies.

SAGE 5 - The Turboshift engine Demonstrator shall provide with the necessary technologies for the development of a new engine family equipping helicopter classes with a take-off weight from 3 tons (single-engine) to 6 tons (twin-engine), delivering TRL6 for the sub-systems studied and design in SAGE 5 through appropriate testing, delivering engine conditions representative of potential future engine applications. The technologies to be demonstrated will deliver improved specific fuel consumptions, noise and emissions in-line with the goals of the Clean Sky programme. The main activity in 2015 for SAGE 5 will be the finalisation of the analysis of demonstrator test performed during 2014.

SAGE 6 - The Lean Burn Project, started in 2011, consists of two major work streams. The first will define sub-system designs and associated verification strategies for concepts identified as most suitable for introduction into future gas turbine products. The second will focus on design and make activity to create a set of functionally representative experimental subsystems that can be integrated into a demonstration platform. After a rig testing phase planned mainly during 2013-2014, an engine test campaign is foreseen in 2015-2016, which includes not only ground tests, but also flight tests supported by CSJU.

#### **Major milestones planned for 2015:**

##### **SAGE1**

- Open Rotor Component Integrity (Composite damage model available);
- Open Rotor Forced Response (Technical Report);
- Open Rotor Component Integrity;

- Open Rotor Forced Response;

## **SAGE2**

- Start of the assembly of the demonstrator;
- Installation of the GTD on the ground test facility;

## **SAGE3**

- Composite Fan System Pass to Test of the ALPS CFS2 composite fan system (including composite fan case) demonstrator.
- Low Pressure Turbine Demonstrator Pass to Test. Pass to Test of ALPS LPT1 build for ground demonstration of low pressure turbine technologies

## **SAGE4**

- GTF Demonstrator on test stand. *Final test preparation at test cell to allow full-scale GTF engine demonstration;*
- GTF Demonstrators DR6. *Verifying demonstrator test results with objectives;*

## **SAGE5**

- Finalisation of results analysis of demonstrators performed during 2014;

## **SAGE6**

- First Engine Run.

## **Major deliverables planned for 2015:**

### **SAGE1**

- Open Rotor Design Fast CFD Solver (Update Report);
- Open Rotor Component Integrity (Update Report);
- Open Rotor Forced Response (Update Report);
- Noise (Update Report) ;

### **SAGE2**

- Mounts test report;
- Demonstrator ready for test;

### **SAGE3**

- Final Parts to Stores for Composite Fancase demonstration. Delivery of final parts for build of the ALPS CFS2 engine
- Final Parts to Stores for Low Pressure Turbine demonstration. Delivery of final parts for build of the ALPS LPT1 engine

### **SAGE4**

- GTF demonstrator ground test report. *Delivery of post-test reports;*

## **SAGE5**

- Finalisation of results analysis of demonstrators performed during 2014;

## **SAGE6**

- Engine ready to test.

## ***Year 2016 Overview***

2016 will be the completion year for all activities of the SAGE programme. The last engine demonstrators will be delivered and tested either on the ground or in flight leading to TRL increases for the Open Rotor, Geared Turbofan and Lean Burn.

SAGE 1 has reduced its focus to 2 themes: Open Rotor (OR) Design by Fast CFD (Computational Fluid Dynamics) and simulation of Forced Response. These activities will cover the finalisation of the report for generation and evaluation of new open rotor designs and the development of new guidelines for installed open rotors. The final report will provide enhanced understanding / new design rules for Forced response.

SAGE 2 – After the reception of the parts, the assembly and the instrumentation of the SAGE2 demonstrator in 2015, the year 2016 will be the year for the Ground Test Demonstration of the Geared Open Rotor Demonstrator. The objectives are to assess open rotor architecture feasibility through validating the developed technologies and materials and the integration of such breakthrough architecture. After the Ground Test, on the basis of prediction and test data obtained from the engine, the assessment will be conducted of the improvements of gaseous and noise emissions that may result from an open rotor propulsion system and thus confirm the environmental benefits.

SAGE 3 – The Large 3-shaft Turbofan engine project will complete all SAGE3 test activities towards the end of 2015 and activities in 2016 will be limited to supporting Call for Proposal Partners in the final stages of their projects and completing project close out reviews and reports.

SAGE 4 Geared Turbofan - After a successful test campaign of the Geared Turbofan (GTF) Engine Demonstrator SAGE4 as an essential element of SAGE platform in which numerous state of the art engine technologies have matured to TRL5/6, the activities in 2016 are focussed to complete the specific technology developments, especially rig testing of High Speed Low Pressure Turbine technologies not dependent on engine environment and the Integral Drive System validation on the GeT FuTuRe test rig. This also includes finalisation of remaining related CfP topics.

SAGE 5 - Finalisation of results analysis of demonstrators performed during 2015 if not completed end 2015.



SAGE 6 – The Lean Burn engine demonstrator ALECSys (Advanced Low Emissions Combustion System) will continue ground testing beginning 2016 in one of the Rolls-Royce Civil Large test beds. Especially water ingestion and some of the more complex operability experiments are planned in a second test block during Q1. Based on the results from these tests potential software modifications will be provisioned and validated through an extended pass-off test on ground before the 2nd ALECSys engine will be mounted onto the wing of the Rolls-Royce flying test bed B747 by mid-2016. Flight testing will take place in Tucson USA for validation of the system across the full flight envelope. Further ground testing will be accomplished in parallel at the outdoor noise test bed in Stennis by Q3 2016. Icing tests at Manitoba/Canada during the seasonal icing slot are planned in Q4 to complete the route to TRL6.

### **Major milestones planned for 2016:**

#### **SAGE1**

- Open Rotor Forced Response (CFD and Technical Report);

#### **SAGE2**

- Start of the Ground Test

#### **SAGE3**

- Final Review

#### **SAGE4**

- Final validation of Impulse Mistuning
- Finalization of IDS validation on the GeT FuTuRe Rig and post-test analyses

#### **SAGE5**

/

#### **SAGE6**

- Flight Test Readiness Review
- Flight testing on the B747 Flying Test bed
- Outdoor noise test
- Icing tests
- Capability Readiness Review to claim TRL6

### **Major deliverables planned for 2016:**

#### **SAGE1**

- Open Rotor Design Fast CFD Solver (Final Report);
- Open Rotor Forced Response (Final Report);

## **SAGE2**

- Ground Test report

## **SAGE3**

- Final engine demonstration test reports

## **SAGE4**

- Completion of Impulse mistuning rig testing and analytical assessment for final validation (report)
- IDS test report

## **SAGE5**

/

## **SAGE6**

- Test report of the 2nd block of functional testing on ground with the 1st ALECSYS engine
- Delivery of an advanced fuel control system
- Flight Test Readiness Review report
- 2nd ALECSYS engine ready to test
- Outdoor noise test report
- Capability Readiness Review report

No technical activities are planned in year 2017.

### 3.5. SGO – Systems for Green Operations

The “Systems for Green Operations” ITD is focused on the development and demonstration of innovative technologies for *Management of Aircraft Energy*, dealing with electrical systems for fixed and rotary wing aircraft, and *Management of Trajectory and Mission*, addressing the optimisation of all flight phases from an environmental point of view.

#### Year 2015

##### Overview

In early 2015 the large scale integration test of electrical systems will be completed on Airbus test bench. In addition to the completion of electrical system testing, in 2015 a thermal test rig will host thermal management hardware i.e. the VCS hardware and the thermal load management function.

Other major milestones will be reached in 2015:

- An innovative Ice detection system will reach TRL5 in 2015 and the flight test hardware will be delivered for flight test aircraft integration. The test campaign itself will take place in 2016.
- The same test campaign as for ice detection will include the wing ice protection systems which will reach the TRL5 gate early 2015, hardware for the flight tests being delivered end 2015.
- The maturity demonstration of the electrical environmental control system will be completed beginning of 2015. The e-ECS flight tests (reduced pack size of 50kW) will be performed in 2016.
- The electrical ECS demonstrator for the Regional Aircraft application will be developed throughout 2014 reaching TRL4 end of 2014. The flight test for this system is planned mid of 2015.
- Mid 2015, SGO will deliver the HEMAS hardware for the helicopter architecture, to be tested in cooperation with the GRC ITD on the COPPER Bird in the second half of 2015.
- In the field of FMS Optimised trajectories, the cruise function providing optimised steps in cruise, will achieve TRL5, with tests in simulated environment. In parallel, function targeting the take-off and final approach phase will be assessed with the involvement of an airline. Finally, the 3 functions will be integrated in an FMS prototype to confirm industrial feasibility with final tests preparation in 2015 and finalization of the TRL6 activities in 2016.
- The Flight Management and guidance function will be finalised in 2015, with flight tests on board a Cessna Citation aircraft.
- The final tests of integrated new weather radar algorithms and trajectory optimisation functions on GRA regional aircraft simulator will be completed in 2015, providing technical results to achieve TRL5.
- Technologies for electrical taxi via an on-board wheel actuator system will tested in a full scale dynamometer bench early 2015

Main results – validated during TRL gates - and expected gains will be passed to vehicle ITDs for further tests and/or integration in Concept Aircraft models, to be transferred to the Technology Evaluator for consolidation and full assessment of environmental gains obtained by Clean Sky research.

In the field of mission optimisation functions, further coordination with SESAR will be pursued, in order to ensure consistency of the Clean Sky functions with the future evolutions of the Air Traffic Management system.

#### **Major milestones planned for 2015:**

- TRL5 E-ECS for Regional A/C
- TRL4 ECS mid-size pack (large aircraft)
- TRL5 50KW Power electronics for E- ECS (large aircraft)
- TRL4 Helicopter electro-mechanical actuation system HEMAS
- TRL5 WIPS System - Electromechanical Deicing System
- TRL5 Vapour Cycle System
- TRL5 Primary in Flight Ice Detection System
- TRL5 On-board Optimisation (Q-AI)
- TRL5 Multi step Cruise function

#### **Major deliverables planned for 2015:**

- PFIDS Delivery for flight tests
- Vapour cycle system for thermal bench tests
- Scoop intake, process air channel and RAM channel incl. protection systems to large aircraft
- Mid-Size pack, pack controller, power electronics and associated cooling system to large aircraft
- ECS Release of Equipment for Flight Test Demonstrator in GRA
- Report on HEMAS final tests results
- Methods and Tools : Test and Verification final report
- Flight Test results for Time and Energy Management function (MPG-TEMO: Final report cycle 2)
- Final Test results of A-WxR and Q-AI ground test in Regional simulator
- Multi step cruise function FMS implementation report
- Smart Operation on ground System Ground test report

#### ***Activities in 2016***

In the frame of MAE the main focus will be the maturation and validation and of technologies and sub-architectures up to TRL 6. This encompasses the need to show that the technologies developed work in the relevant environmental conditions (altitude, temperature, vibration and pressure). The SGO has the ambition to demonstrate:

- Proven large-scale ground-based architectural integration of electrical generation, distribution and loads, together with their management
- Proven large-scale ground-based architectural integration of thermal management technologies. Where maturity is shown, these will be integrated with the electrical equipment systems
- Flight proven electrical equipment systems, including environmental conditioning, and ice detection
- Flight proven technologies, architectures and concepts for distribution and recycling of electrical energy through power electronics
- Flight proven technologies and sub-systems for thermal exchange and management, including liquid loops and large heat exchangers

In particular, the flight test campaign of an innovative Ice detection system will take place in 2016. The current plan is to test the technology on a A320 MSN1. However, the ambition is to have the technology ready for flight test in case another test AC is made available, possibly already in 2015.

The maturity demonstration of the electrical environmental control system will be completed through the e-ECS flight tests on the Airbus A320 MSN1 (reduced pack size of 50kW) in the first semester of 2016. In this respect, it is worth noticing that the decision to develop a reduced pack size (50KW EECS pack instead of 70KW) allowed solving integration issues and secured adherence to the demonstration schedule. While the flight test will allow evaluating the system behaviour in representative A/C environment (taking into account external conditions, different flight phases and altitudes, scoop operation and the agreed envelope limitation), the performance aspects on the full 70KW pack will be covered in the frame of tests in altitude chamber at Liebherr facility. The development time sequence is to deliver the pack in Q1 2016 and start the flight test campaign in Q2 2016.

In 2015 relevant milestones are to be reached on the Robust Channel (including the PMG) and the Power Electronic Modules (PEM). These activities will pave the way to the finalization of (EPDC) ground test campaign G3 on PROVEN

In the field of FMS Optimised trajectories, the departure and cruise functions (Multi Criteria Departure and Multi Step Cruise) will achieve TRL6, with final tests of the FMS on a representative bench. In parallel, the function targeting the final approach phase will be assessed for TRL5, taking into account results from associated SESAR projects.

In the field of Smart Operations on Ground, technologies for electrical taxi via an on-board wheel actuator system will reach their final stage of maturity.

In the field of mission optimization functions, final coordination with SESAR will be pursued, in order to ensure consistency of the Clean Sky functions with the future evolutions of the Air Traffic Management system.

As transversal activity, a closer collaboration will be sought with the SESAR JU with a view to identify possible synergies and exchange of best practices: a number of technical Working Groups will be scheduled over the year which should lead to a more coordinated action on

research filed of common interest such as e.g. trajectory optimization, environmental impact, interface between aircraft and ground operations.

**Major milestones planned for 2016:**

- TRL6 Primary in Flight Ice Detection System
- TRL5 Integrated Power Electronic Module for EPDC
- TRL5 On-board Optimisation (Q-AI)
- TRL6 Multi step Cruise function
- TRL6 for Multi Criteria Departure function

**Major deliverables planned for 2016:**

- E-ECS pack, pack controller, power electronics and associated cooling system to large aircraft
- E-ECS Final assessment report
- Report on HEMAS tests results
- Thermal management function as rapid prototype hardware for integration into test rig – Pre-TRL4
- Ground test report for G3
- Virtual test results for G3
- Mission Large Demonstration report
- Validated Flight Test results for F.0/F1
- Final test results for FMS functions on Multi step cruise and multi-criteria Departure
- Smart Operation on ground System Ground final report

No technical activities are planned in year 2017.

### 3.6. ECO – Eco Design

Eco-Design ITD is organized in the two major areas of EDA (Eco-Design for Airframe) and EDS [Eco-Design for Systems (small aircraft)].

The **EDA** part of the Eco-Design ITD is meant to tackle the environmental issues by focusing on the following challenges:

1. To identify and mature environmentally sound (“green”) materials and processes for a/c production.
2. To identify and mature environmentally sound (“green”) materials and processes for a/c maintenance and use processes.
3. To improve the field of end-of-life a/c operations after several decades of operation, including reuse, recyclability and disposal (“elimination”) issues.
4. To provide means for an eco-design process in order to minimize the overall environmental impact of a/c production, use/maintenance and disposal.

#### Year 2015

##### *Overview*

In 2015, the work to be performed in the frame of **EDA** will continue on the following Work Packages:

- WP A.3 Application Studies,
- WP A.6 Lifecycle Ground Demonstration.

In WP A.3, WP A.3.1.1 (Evaluation Tools), A.3.1.3 (Final Eco-Statement) will be active and the final synthesis will be produced.

- In WP A.3.1.1 the activity will focus on the finalisation of the database for the new technologies by using results from the ground demonstrations.
- In WP A.3.1.3, the work in 2015 will be devoted to the finalisation of eco-statement of new technologies.

Ground demonstration activities will be carried out and finalised for the equipment (A.6.2) as well as for the equipped airframe demonstrators (A.6.1).

The EDA part will be finalised by the end of 2015 to produce conclusion on new technologies (feasibility, interest and final TRL). Data will be provided to the TE for aircraft/mission level final assessment.

The work to be performed in 2015 in the frame of EDS part of the Eco-Design ITD will consist in pursuing and finalising the characterization of the business jet sub-systems architectures (WP S.2).

The work within WP S.2 will continue throughout 2015 essentially at the level of the bizjet architecture trade-off (S.2.6) supported by modelling activities (S.2.5) and ground tests

results. In fact, in 2015, the ground electrical tests (WP S.3) and thermal tests (WP S.4) activities will be also finalised including results analysis and validation.

**Major milestones planned for 2015:**

- Final results of demonstrations to TRL 6 - Equipped airframe
- Final results of demonstrations to TRL 6 - Equipment
- General synthesis of WP S.2
- General synthesis of WP S.3
- General synthesis of WP S.4

**Major deliverables planned for 2015:**

- Dissemination & Communication Plan (update)
- Eco-Statement Final Report
- Equipped Airframe demonstration: Synthesis Report
- Airframe demonstrators: final results
- Equipment demonstrators Synthesis Report
- Application studies Final Synthesis Report
- Thermal bench conclusions and recommendations
- Final Review
- General synthesis of WP S.4
- General synthesis of WP S.2
- General synthesis of WP S.3

The closing phase and final review of Eco Design ITD will take place in the first quarter of 2016.

No activity is planned for 2017.



### **3.7. TE – Technology Evaluator**

The TE will perform in 2015 a global environmental Clean Sky Assessment, based on its set of dedicated tools, in order to monitor the environmental progress brought by ITDs' technology outputs, and in order to ensure a consistent technical assessment approach with respect to the environmental objectives. This 2015 Assessment will consider all segments of commercial aviation, ranging from large and regional aircraft to helicopters and business jets. This environmental impact assessment will be done, as in the previous TE assessments, at three complementary levels:

- Mission level, considering one single aircraft flying a set of typical missions. For fixed-wing aircraft, missions are defined in terms of a set of representative ranges. In case of helicopters, typical missions will be specifically defined;
- Airport (operations) level, for instance around an airport, considering all departing and arriving flights on a single (representative) day
- Global air transport system level, considering the global aircraft and rotorcraft fleet.

The TE completed its third assessments end 2014. During the period 2015-2016, the TE will continue its Clean Sky technology evaluation task based on environmental metrics, in order to reach the contractual CS final assessment in 2016.

These global environmental assessments reflect the global status of the Clean Sky programme with respect to its environmental objectives. From the 2014 assessment, contrary to the previous ones which were performed on a yearly basis, they are now aligned with ITDs models updates planning.

These updates of the ITD a/c models result from the integration in these models of new and higher TRL level technologies. Also, from one assessment to another, more complex scenario will be considered (more airports, taking into account SESAR, updating forecasts). They will also aim at improving the TE processes and tools in order to create a user friendly toolset.

Yet, beside these global assessments, the TE will go on performing every year partial assessments and trade-off studies upon request of such or such ITDs.

All these global or partial assessments aim to help secure the final TE Assessment which is planned for the end of 2016, after the completion of the various ITDs' work programmes and demonstrations.

#### ***Global assessments planning***

The TE completed its first, second and third assessments in 2012, 2013 and 2014 respectively. A further assessment is underway for mid-2015. During the period 2015-2016, the TE will continue its Clean Sky technology evaluation task based on environmental metrics, in order to reach the contractual CS final assessment in 2016.

All these global or partial assessments aim to help secure the final TE Assessment which is planned for the end of 2016.

#### **Detailed Scope of Work of Technology Evaluator**

This work plan is based on results reached by the first, second and third global assessments, and is organized on the following basis:

- In 2015, another global TE assessment will be achieved, in June 2015
- Beginning 2016, partial assessment results will be produced, then the final assessment will be produced at the end of the year..

This incremental way of working reduces the risk of both content and delay for the final 2016 assessment. It also allows the TE to benefit from the achievements of the partial assessments of the year before to improve the results of the year after.

Each year, the main outputs are:

- The issue of the global assessment report, in case such an assessment has been planned for the year (in June 2015 and final in 2016);
- The issue of the results of partial assessments of the year.

These outputs are strongly dependant on the inputs expected from the ITDs. These inputs are the updated ITDs a/c models and LCA data to be used in the TE global or partial assessments of the year. To avoid any delay in the issue of the assessment report by the TE, they must be received early enough before the issue by the TE of the global or partial assessment results (6 or 3 month, respectively).

In addition to these TE global or partial assessments, trade-off studies can be performed for the ITDs, on the basis of a compromise between their needs, and the available TE budget dedicated to this activity, knowing that the assessment task is a priority.

It is anticipated that these trade-off requests should increase with the time, when on the one hand, the TE system will be more complete, and on the other hand when the ITDs demonstrators will have reached a higher TRL level.

To support both assessments and trade-off studies, the TE system will be upgraded every year, following the same incremental procedure, on the basis of user's feedback, in order to get it both more powerful and easy to use.

## **Year 2015 Overview**

### **Objective**

To perform the 2015 global assessment which will include improved ITDs a/c models, updated airport, ATS scenario, and LCA scenario; trade-off studies and an updated TE system.

This objective is detailed by WP in the following:

### **WP1: Planning**

- 2015 planning updates of the global and partial TE assessments as well as trade-off studies until 2016, taking into account the major ITDs demonstration and TRL achievements

### **WP2: Models**

- 2015 PANEM update (bizjet/mainliners): integration of new or updated functionalities as required
- 2015 GRASM update: integration of new or updated functionalities as required
- 2015 Phoenix update or release of: SEL/TEM/DEL/TEH models.

### **WP3: TE system**

- Update TE computer system: TE-IS and 3 platforms simulation framework

### **WP4: TE assessments**

- TE global assessment in June 2015, including PANEM, GRASM and PHOENIX models updates

- Mission level: Mission assessments defined begin 2015 including development/updates of ITD models
- Airport level: Airport assessments according to specification defined end of 2014 including updates of and new airports and updated ITD models
- ATS level: ATS assessments according to specification defined end of 2014 including updates of forecasts / traffic scenarios and updated ITD models
- LCA: Perform LCA analysis for production phase for CleanSky reference and concept aircraft/rotorcraft

#### **Major milestone planned for 2015**

- End June 2015 : TE assessment report

#### **Major deliverables planned for 2015**

- Mid Feb 2015: 2014 Annual report
- End June 2015 : TE assessment report

#### **Year 2016 Overview**

##### **Objective:**

To perform the 2016 assessments which will include: improved ITDs a/c models, updated airport, ATS scenario, and LCA scenario; trade-off studies and an updated TE system.

This objective is detailed by WP in the following:

##### **WP1: Planning**

2016 planning updates of the global and partial TE assessments as well as trade-off studies, taking into account the major ITDs demonstration and TRL achievements.

##### **WP2: Models**

2016 Phoenix update or release of: TLR -SELU2-TELU2-TEH (with MEMs), DEL

##### **WP3: TE system**

Integration of final assessment results at 3 levels into the TEIS

##### **WP4: TE assessments**

TE partial then final global assessment according to the availabilities of the PANEM, GRASM and PHOENIX models updates.

- Mission level: Mission assessments defined begin 2016 including development/updates of ITD models.
- Airport level: Airport assessments according to specification defined end 2015 including updates of and new airports and updated ITD models.
- ATS level: ATS assessments according to specification defined end 2015 including updates of forecasts / traffic scenarios and updated ITD models
- LCA: Perform demonstration of LCA environmental improvement by comparing LCA for CleanSky reference and conceptual aircraft/rotorcraft.

#### **Major milestones planned for 2016:**

- 2016 assessment Synthesis report V1 March 2016
- 2016 assessment Synthesis report V2 July 2016

- 2016 assessment Synthesis report final October 2016

**Major deliverables planned for 2016:**

- Mid-March 2016: 2015 annual report
- 2016 assessment Synthesis report final October 2016

## 4. PARTNERS ACTIVITIES IN 2015-2017

As described in several chapters above, most ITDs have active projects performed by Partners selected via the Calls for Proposals, last ones being launched in 2013. The active GAPs (Grant agreement for Partners) at end of 2014 are just less than 300. Of this number, at least 90 are in completion of technical activities by early 2015. Therefore, about 200 are finishing in 2015-2016.

The GAPs still running in 2016 and specifically linked to completion of demonstration activities are split in the different ITDs as follows:

- EcoDesign: only partners participation where applicable to the final review taking place in Q1-16
- GRA: 6 GAPs active, as linked to the wind tunnel testing planned in Q4-15 or Q1-16, as described in the GRA chapter.
- GRC: only 3 GAPs active in 2016, for supporting and closing activities in the reporting phase.
- SAGE: 23 GAPs still active in 2016, across all SAGE projects (except SAGE 5) for the completion of technology maturation studies and demonstration, in some case not directly linked to the large scale demonstrators, but within the work plan of the SAGE leaders and associates.
- SFWA: at least 20 GAPs will remain active in 2016, some of them associated with the finalization of the demonstrators planned in this ITD and critical for the completion and integration of the related technologies or components to be tested. Specific attention will be given to these projects.
- SGO: more than 20 GAPs will be running in 2016; this is mainly due to the late start of activities (launch of topics in last calls). Also for SGO GAPs, a specific monitoring is planned already in 2015, to make sure they will be performed and completed as necessary within the timeframe of 2016. (Targeting Q3-16 for closure).

It is not considered at this stage to have any GAP continuation in 2017. Very extraordinary cases, if linked to the ITD demonstrators, will be analysed in due time.

## 5. OBJECTIVES AND INDICATORS

As the Clean Sky programme approaches its final phase, the objectives covering the remaining period are shown below.

### Objectives for 2015 to 2017

The overall objectives for this period are:

- To run all the demonstrators (ground or flight demonstrators)
- To achieve the environmental targets.

The two tables below give respectively the list of the demonstrators and the environmental forecasts:

### DEMONSTRATORS

<b>SFWA</b>	High Speed Smart Wing Flight Demonstrator <ul style="list-style-type: none"> <li>Airbus A340-300 flight test</li> </ul>
	Advanced load control for Smart Wing <ul style="list-style-type: none"> <li>Ground test bed for large transport aircraft</li> <li>Flight test for vibration control for bizjet</li> </ul>
	Smart Wing High Lift Trailing Edge Device <ul style="list-style-type: none"> <li>Full scale demonstrator, ground test only</li> </ul>
	Innovative afterbody <ul style="list-style-type: none"> <li>Full scale demonstrator, ground test only</li> </ul>
	Innovative Empennage Demonstrator <ul style="list-style-type: none"> <li>Full scale demonstrator, ground test only</li> </ul>
<b>GRA</b>	Static & Fatigue Test <ul style="list-style-type: none"> <li>Full Scale Ground Demonstration</li> </ul>
	Large scale Wind Tunnel Test Demonstration <ul style="list-style-type: none"> <li>Acoustic &amp; Aerodynamic WT Test - Turbo Prop 90 pax</li> <li>NLF wing aerodynamic &amp; aeroelastic design WT Tests - 130</li> <li>Geared Turbo Fan configuration</li> </ul>
	Ground Laboratory Test (COPPER BIRD and other)
	Flight Simulator on ground <ul style="list-style-type: none"> <li>Green FMS Final Demonstration on GRA Flight Simulator</li> </ul>
	Integrated In-Flight DEMO <ul style="list-style-type: none"> <li>ATR Integrated In-Flight Test - ATR 72 FTB</li> </ul>
<b>GRC</b>	Innovative Rotor blades, passive and active (AGF), on Ground and in Flight
	Drag reduction on Ground / in Flight
	Medium helicopter electrical system demonstrator
	Lightweight helicopter electromechanical actuation
	Electric Tail Rotor Prototype
	Diesel powered flight worthy helicopter Demonstrator
	Flightpath operational Demonstrations
	Thermoplastic composite faring demonstrator

	Thermoplastic composite tailcone demonstrator
	Surface treatments for tail gearbox and rotor mast
	Surface treatments and welding technology for intermediate gearbox
	Thermoplastic composite drive shaft for intermediate gearbox
<b>SGO</b>	VIRTUAL IRON BIRD
	COPPER BIRD <ul style="list-style-type: none"> <li>• Ground Test (Nacelle Actuation System, Power Generation and Conversion, Generators, Power Rectifiers, Electrical ECS Demonstrator, HEMAS )</li> </ul>
	PROVEN (Ground test rig at Airbus Toulouse) <ul style="list-style-type: none"> <li>• Flight Test (Environemental Control System Large Aircraft - Ice Protection and Ice Detection Systems)</li> <li>• Ground Tests (Power Generation and Conversion S/Gs, PEM - Eletrical Power Distribution System/Power Center)</li> </ul>
	<ul style="list-style-type: none"> <li>• Flight Tests (Thermal Management Skin Haet Exchanger)</li> <li>• Ground Tests (Thermal Management Vapour Cycle System inclucing Compressor)</li> </ul>
	AIR LAB, MOSAR & GRACE simulations
	Electric systems integration <ul style="list-style-type: none"> <li>• Ground Tests (Power Generation and Conversion EDS ITD)</li> </ul>
<b>SAGE</b>	Geared Open Rotor <ul style="list-style-type: none"> <li>• CROR Ground Test Demonstrator</li> </ul>
	Advanced Low Pressure System (ALPS) Demonstrator
	Geared Turbofan Demonstrator <ul style="list-style-type: none"> <li>• Ground Test - Engine demonstrator based on a GTF donor engine</li> </ul>
	Large 3-shaft Turbofan <ul style="list-style-type: none"> <li>• Ground tests Demonstrator (to study aero-performance, flutter, blade integrity and bird impact capability for the composite fan system and low pressure turbine).</li> <li>• Flight test Demonstrator (in-flight operability of the composite fan blades).</li> <li>• Outdoor ground testing (to determine composite fan system flutter behaviour under cross-wind conditions and noise performance.</li> <li>• Icing tests (to determine ice shedding behaviour of blades and impact damage tolerances of new liners).</li> </ul>
	Lean Burn Demonstrator <ul style="list-style-type: none"> <li>• Ground Test - Lean Burn Combustion System demonstrator engine</li> </ul>
<b>ECO</b>	Electrical Ground Test (Copper Bird®) <ul style="list-style-type: none"> <li>• High power, High Voltage Large electrical network for validation of the All Electrical Concept for small aircraft. It includes power generation, power distribution and consumers (actuators, ECS simulation, etc)</li> </ul>
	Thermal Ground Test <ul style="list-style-type: none"> <li>• Simulation of thermal exchanges of 3 sections of an aircraft in a representative environment. Main objective is the validation of the thermal modeling process of an overall aircraft.</li> </ul>
	Clustered technologies airframe and equipment demonstrators <ul style="list-style-type: none"> <li>• 12 demonstrators related to Airframe (e.g. Fuselage panel, Cabin furniture)</li> <li>• 6 Equipment demonstrators (e.g. Cables, connectors, part of air cooling unit)</li> </ul>

## Environmental forecasts

The following figures, summarized here for a limited number of air transport segments, are based on the initial estimates and have been refined during 2011-2012. For a clarification of the Concept Aircraft please refer to Appendix 2 of the Clean Sky Development Plan. The ranges of potential improvements result from the groupings of technologies which are expected to reach the maturity of a successful demonstration within the Programme timeframe. All environmental benefits are related to a Year 2000 reference.

<b>Aircraft</b>	<b>CO<sub>2</sub> [%]</b>	<b>NO<sub>x</sub> [%]</b>	<b>Noise area difference ratio at take-off (%)</b>
<b>Low Speed Bizjet</b>	<b>-30 to -40</b>	<b>-30 to -40</b>	<b>-60 to -70</b>
<b>Regional turboprop</b>	<b>-25 to -30</b>	<b>-25 to -30</b>	<b>-40 to -50</b>
<b>Short/ Medium Range / CROR</b>	<b>-25 to -35</b>	<b>-25 to -35</b>	<b>-30 to -40</b>
<b>Light twin engine rotorcraft</b>	<b>-15 to -30</b>	<b>-55 to -70</b>	<b>-40 to -50</b>



## Objectives for 2015/ 2017

Clean Sky annual objectives are linked to the completion of the planned operational tasks, the progress towards the technologies readiness, the environmental benefits assessment, the control of expenditures, the satisfactory scheduling and outcome of calls for proposals and the further improvement of the JU's quality management and internal control system.

The following objectives are set for 2015/2017. They are divided below as administrative objectives and operational objectives.

### **Operational Objectives:**

- Smart Fixed Wing Aircraft Natural Laminar Flow “BLADE” wing demonstrator Critical Design Review performed
- Low Sweep Bizjet Vibration Control Ground Test, Critical Design Review performed
- Green Regional Aircraft Fuselage Barrel and Wing Box demonstrators finalized
- ATR72 Flying Test Bed, Flight Test Readiness Review performed
- Rotorcraft Active blades tested on ground (wind tunnel and whirl tower preparation)
- Rotorcraft Diesel engine tested on ground
- Open Rotor Ground Demonstrator Critical Design Review held
- Large 3-shaft engine Composite Fan Blade Ground test campaign performed
- Engine Build 2 Turboshift Performance tests performed
- Power generation and electrical distribution systems tested on ground
- Green Flight Management System tested in simulator
- Thermal Test Bench tests for Eco Design performed
- Fully-fledged Technology Evaluator assessment available at mid-year.

### **Administrative Objectives:**

- A reliable financial management and reporting to the JU's individual stakeholders is ensured, in order to maintain the confidence of the financing parties, i.e. the European Union and the industrial members and partners of CS;
- 90% of GAM cost claims received are formally dealt with (validated, put on hold or refused) before end of May each year;
- 40% of GAPs are formally closed by June 2015;
- The ex-post audits on FP7 projects are performed according to the plan and show a materiality of errors lower than 2 % for the total programme period. The ex-post audit strategy for H2020 projects is developed and responsibilities are allocated to the CAS and the JU.

The JU has implemented various tools to monitor the execution of the programme in terms of productivity, achievements, planning and risks of the operations.

## Clean Sky Programme (FP7) Indicators

The following list of indicators was set up in 2011 and has been applicable since the beginning of 2012. These indicators allow the monitoring of the operational activities. The most important of these indicators are summarized below, in relation to the JU process concerned. They are assessed on an annual basis. These objectives will also apply for 2015.

<b>Indicator ID</b>	<b>Indicator short name</b>	<b>Description of the indicator</b>	<b>Target for 2015/2016 % or nr.</b>
Ind 1.9.2 A	Risk mitigation JU	Number of very important or critical risks on JU level without mitigation action (including also action defined but not implemented and unsuccessful actions)	0
Ind 1.9.2 B	Risk mitigation ITDs	Number of very important or critical risks on ITD level without mitigation action (including also actions defined but not implemented and unsuccessful actions)	0
Ind 2.5.6 A	Finalising of GAPs	Percentage of contracts signed in less than 8 months after the call closure	50%
Ind. 2.6 A	Deliverables of GAPs	Percentage of final reports due from partners on the schedule	80%
Ind. 2.7.1 A	AIP execution by members - resources	Percentage of resources consumption versus plan (members only)	90%
Ind 2.7.1 B	AIP execution by members - deliverables	Percentage of deliverables available versus plan (members only)	90%
Ind 2.9 C	Budget execution - payments operational	Percentage of payments made within the deadlines	85%
Ind 2.11 A	Dissemination of results	Number of publications from ITDs registered at JU level	3*ITD / 21
Ind 5.3 A	Ex-post audits - coverage	Percentage of operational expenses (incurred for FP7 projects) covered by ex-post audits	20%
Ind 5.3 D	Ex-post audits - error rates	Residual error rates resulting from audits at the beneficiaries per year and accumulated for the programme (FP7).	2%

Concerning the monitoring of the activity of the Members within the ITDs, which is the major part of the operations, the following tools are maintained:

- Internal rules to set the Grant Agreements Annex 1B, including technical risks associated to the Work Packages (CS Management Manual)
- Quarterly Reports of the ITDs, which inform on the resources consumption, the achievements and the resulting forecasts for level of project implementation
- Steering Committees at ITD level with involvement of the CS project officers
- Annual Reviews of the ITDs' performance organised by the JU with the involvement of independent experts.

This monitoring information is summarized and reported regularly to the Governing Board.

## 6. RISK ASSESSMENT

The following table presents the *Risk assessment for the year 2015*.

Risk Description	CS-process	Action Plan Summary
A late availability of ITD aircraft models for the Technology Evaluator (lack of prioritization or lack of technical inputs) could prevent the environmental benefits assessment to be efficiently performed.	<i>Manage the Programme</i>	Tightly monitor the work progress on this item through the Project Officers and the GAMs.  Have preliminary models implemented where needed.
Conflicts of priorities may happen within industrial companies, or change of strategy, resulting in a lack of resources available for Clean Sky and delays in the completion of the activities.	<i>Manage the Programme</i>	Have an early warning capability through quarterly reports and alert at Governing Board level.  Propose re-orientations when needed and possible.
The “share of the pie” logic could result in a lack of focus on the major, critical activities.	<i>Manage the Programme</i>	Challenge the ITDs in order that they focus on optimising the global output.
Technical setbacks in one or several ITDs may result in a significant under-spending of annual budget.	<i>Manage the Programme</i>	Re-balance the budget across ITDs and with Partners if necessary at mid-year, according to the 2 <sup>nd</sup> quarterly reports.
There is a risk that lack of pro-activity in dissemination of result may result in vague information to the end-user/interested party and therefore compromise the JU reputation	<i>Communicate</i>	Harmonize the dissemination plans of ITDs  Monitor the dissemination actions

Risk Description	CS-process	Action Plan Summary
The lack of experience in European Research Programmes from many Partners (SMEs) could result in a difficult and late closure process of their projects.	<i>Run the Executive Team</i>	Reinforce the information, mainly through relevant Information Days and Web conferences; reinforce the role and the awareness of Topic Managers
The potential introduction of Clean Sky 2 in parallel to Clean Sky could result in a scattering of beneficiaries' resources and a delay in Clean Sky demonstrator's finalisation.	<i>Run the Executive Team</i>	Condition the CS2 funding by SPD/TAs and by beneficiary to the actual execution of CS budgets and technical progress
The potential introduction of Clean Sky 2 in parallel to Clean Sky could result in an unbearable overload for the JU team, if not preceded by a staff increase as requested.	<i>Run the Executive Team</i>	Proceed as quickly as possible to the recruitment of the right level of staff.

The definition of the risk assessment for the year 2015 will be made at the end of 2014 when the situation will have evolved.

## 7. JUSTIFICATION OF THE FINANCIAL RESOURCES

### Introduction

The Framework Programme 7 under which Clean Sky is funded ended in 2013. The AB 2015-2017 therefore does not show any Commitment appropriations (CA) for 2015-2017 coming from the EU budget. It only shows the payment appropriations (PA). The sources of revenue are the carried over appropriations from previous years, the interest gained on the bank account of Clean Sky and the revenue from members for the JU running costs.

### Running costs

The running costs have been estimated based on previous years' implementation. The CA will be matched by industry each year until the end of the CS programme. The AB sets out the annual needs for running costs while keeping within the ceiling of 3% of the overall cash and in kind contributions of Members of CS.

*The main features of the 2015- 2017 expenditure in the budget are set out below.*

Budget Clean Sky Expenditure	CA 2015	PA 2015	CA 2016	PA 2016	CA 2017	PA 2017
Title 1	1.900.000	2.011.008	1.042.704	1.042.704	491.400	491.400
Title 2	1.067.616	1.548.578	602.674	602.674	262.212	262.212
Title 3	75.550.380	135.485.596	27.018.281	48.640.389	0	24.398.021
Title 5	0	0	1.693.635	2.633.197	1.416.829	2.583.629
<b>Total Budget</b>	<b>78.517.996</b>	<b>139.045.182</b>	<b>30.357.294</b>	<b>52.918.964</b>	<b>2.170.441</b>	<b>27.735.262</b>

### *Overall allocation of running costs between CS and CS2*

The Joint Undertaking's common costs such as electricity, services, postal costs, stationary etc. will be divided across the 2 programmes.

***Title 1 (Staff and associated costs):***

The JU has experienced the foreseen growth of its workload and consequently the need for qualified support has grown significantly. This need is particularly important to cope with the number of reports due and arriving at the JU from its GAPs and GAMs.

***Title 2 (Buildings, IT, Equipment, Communication, Management of Calls and Miscellaneous expenditure for running activities):***

***Premises***

The JU will continue to be housed in the White Atrium as with the other JUs and a marginal increase in cost could be expected due to indexation on the rental contract and associated charges for the building maintenance among others.

***Grant Management Tool – next steps***

In 2012 the JU started using the Grant management tool for the beneficiary information of members of the JU, i.e. the ‘programme’ grant information. A new contract for maintenance and further developments has been awarded at the end of 2013 for a period of 4 years (2013-2016) for a maximum of 500,000 €.

***Communication***

The Communication budget foresees the costs for the JU to participate to the air shows: Paris Air Show in 2015 and Farnborough in July 2016. Other communication costs are related to organising stakeholders’ and demonstration events. The costs for these events have been included in the final AB among other communication activities foreseen.

### ***Title 3 (Operational Expenditure):***

The JU has received the detailed scope of work from all ITDs and TE for the remaining lifetime of the programme.

### ***Grant agreements for Members (GAMs)***

The model Grant Agreements for Members has been revised to cater for both annual and multi-annual grant agreements. The figures per ITD are based on the estimates received 'bottom-up' from the beneficiaries of the ITDs and TE. For information, ITDs estimated allocations are:

OPERATIO NAL EXPENDIT URE	CA 2015	PA 2015	CA 2016	PA 2016	CA 2017	PA 2017
SFWA	14.600.000	20.530.621	5.381.000	5.883.816	0	2.101.363
GRA	1.035.096	9.952.534	0	5.626.215	0	500.000
GRC	12.044.092	9.813.731	2.020.708	4.142.917		1.010.354
SAGE	26.000.000	34.235.715	12.351.323	13.989.599	0	6.175.662
SGO	11.131.953	15.244.290	5.244.053	5.904.163		2.564.577
ECO	0	4.875.204	0	1.120.430	0	
TE	2.121.166	2.382.321	2.021.197	1.646.948		1.010.599
CfP	8.618.073	38.451.180	0	10.326.302	0	11.035.468
<b>TITLE 3 - TOTAL</b>	<b>78.517.996</b>	<b>139.045.182</b>	<b>27.018.281</b>	<b>48.640.389</b>	<b>0</b>	<b>24.398.021</b>



## **PART B – *CLEAN SKY 2 PROGRAMME***

## 8. OVERVIEW OF THE CLEAN SKY 2 PROGRAMME

### 8.1. Clean Sky 2 – Introduction to the Programme Structure and Set-up

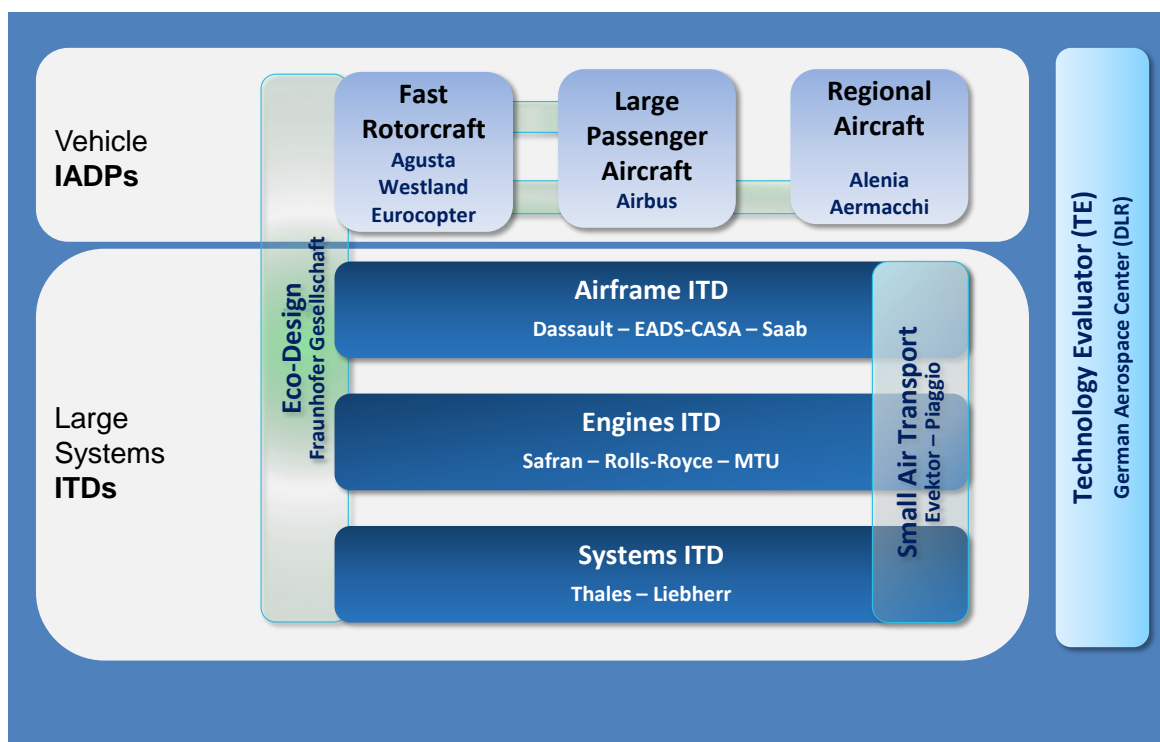
The *Clean Sky 2* Programme consists of four different elements:

- 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;

An overview of the distribution of the requested funding is given for the different IADPs, ITDs, TE and the Transverse Activities. The funding distribution is based on the €1.755 bn of EU funding as set out in the Clean Sky 2 regulation. Activities of the programme will go up to, and not beyond, TRL 6. They are considered to fall into the ‘Innovation actions’ category according to H2020 rules. Accordingly, they shall be funded at 70% of the eligible costs.

The overall estimated budget is €4 bn. In addition to the EU contribution (from the Horizon 2020 programme budget), the private members will contribute €2.2 bn. This includes some additional activities which are not formally part of the *Clean Sky 2* Programme as described here, but which are contributing to the objectives – enablers for the demonstrators or parallel research work necessary to develop an operational product in due time.

The structure of the *Clean Sky 2* Programme can be summarized as set out below.



The 16 *Leaders* are Members of Clean Sky 2 that will commit to deliver the full Clean Sky 2 Programme throughout its duration.

The *Core Partners* will make substantial long-term commitments towards the Programme and bring key competences and technical contributions aligned to the high-level objectives. They will contribute to the global management of the demonstrators and contribute financially with significant in-kind contributions. Core Partners will be selected on the basis of Topics for Core Partners which will be launched through the Calls for Core Partners. Applicants wishing to become Core Partners in the Clean Sky 2 Programme shall submit proposals against one or more Topics. The proposals will be evaluated and the highest ranked proposals will be selected for funding by the JU (see chapter 11).

The selected Core Partners will negotiate with the JU their accession to the Grant Agreement for Members (by signing an accession form) which will be already signed, where appropriate, between the JU and the Leaders of the relevant IADP/ITD/TA. The negotiation and accession stage will include the integration of the proposal, the work packages and technical activities of the Core Partner into the Annex I (Description of work and estimated budget) of the relevant IADP/ITD/TA Grant Agreement for Members. The Annex I will be subject to updates and revisions based on the multi-annual grant agreements framework in line with the multi-annual commitments and the programme management decision-making rules and governance framework under the CS2 Regulation.

The technical activities of the Core Partners will have to be aligned with the Programme objectives and strategic direction laid down in the Development Plan of the Clean Sky 2 Programme which will derive from the “Clean Sky 2 Joint Technical Programme” and will be referred to in the Grant Agreement for Members.

Based on the above and in the light of the specific role of the Core Partner in the implementation of the Programme and JU governance structure, other activities in addition to the technical proposal of the topic may be performed by the Core Partners and be funded by the JU. In the course of the implementation and updates of the multi-annual Programme when the implementation of other areas of the Programme require the specific key capabilities of the Core Partners and its level of technical involvement in the implementation of the ITD/IADP/TA objectives.

The JU will define on one hand, when the capabilities required and other areas of activities to be performed in an IADP/ITD/TA may be covered/absorbed by the existing level of capabilities at IADP/ITD/TA Members level, subject to a technical assessment of the JU and based on the Members multi-annual grant management process, and on the other hand when the capabilities required necessitate a call to be launched by the JU.

The *partners* will carry out objective driven research activities aiming at developing new knowledge, new technologies and solutions that will bring a contribution to one of the actions as defined in the Programme and developed in one of the IADP/ITDs/TAs.

The Partners' activities will be defined through topics proposed by the private Members of the JU to complement their research activities where appropriate. The list of topics will be defined in the Work Plan with information such as the related IADP/ITD/ TA, the title of the topic, its duration and an estimate of the topic budget value without setting a maximum threshold. The nature and value of the Topics for Partners will be smaller in terms of magnitude and duration from the Topics for Core Partners.

The private Members of the JU will propose the scope, the objectives, the duration and the estimated budget associated to the Partners' activities that will be launched through Calls for Proposals (CfP) organised by the JU. The Partners' activities will consist of tasks limited in time and scope and they will be performed under the technical monitoring of the private Member acting in the call for proposal process as topic manager (the person representing the private Member in charge of the topic).

The Calls for Proposals will be subject to independent evaluation and will follow the H2020 rules on calls for proposals. Upon selection, the Partners will sign a Grant Agreement for Partners with the JU and its contribution will be made to either the final demonstrator or the set of activities which are performed by one or several CS2 Members in the frame of the Grant Agreement for Members. Partners will not become members of the JU and will not be expected to contribute to the running costs of the JU. Similarly, they will not participate in the steering committees of the IADP/ITDs.

## **8.2. The multi-annual approach for the CS2 programme**

The CS2 regulation and the JU's financial regulation specifically outline the possibility to split multi-annual commitments covering large scale actions into annual instalments. This specific measure is introduced to reduce the uncertainty which may exist if the annual budget does not allow the JU to financially commit the entire funds covering the full action in the first year of the action. In Clean Sky 2, the activities are spread over several years and this flexibility will be used on a regular basis in order to accommodate the needs of the programme while taking into account the annual budget constraints.

### **2014-2015 implementation of multi-annual approach**

The leaders' activities are described in the following chapters which will later be complimented by the core partners who will join the programme in 2015. The commitment appropriations of the year 2014 will be sufficient to entirely cover the grant agreements with the leaders for 2014 and 2015. Depending on the outcome of the first call for core partners, the first core partners will join the grant agreements during 2015. A further financial commitment will be placed to add the funding of these activities to the original legal and financial commitment of leaders until the end of 2015.

## 9. CLEAN SKY 2 PROGRAMME IMPLEMENTATION 2015 - 2017

The following chapter presents the Clean Sky 2 Programme scope of work and the main activities to be performed in the period 2015-2017<sup>3</sup>.

### 9.1. IADP LARGE PASSENGER AIRCRAFT

The Large Passenger Aircraft IADP approach builds on the positive experience in Smart Fixed Wing Aircraft (SFWA) in *Clean Sky*. The BLADE laminar wing flight test demonstrator, the CROR demo engine flying test-bed and two different low speed and load control flight tests under preparation will provide unique contributions towards maturing technologies for application in the next generations of aircraft. For *Clean Sky 2*, the Large Passenger Aircraft goal is a high-TRL demonstration of the best candidates to accomplish the combined key ACARE goals with respect to the environment, fulfilling future market needs and improving the competitiveness of future products. The encompassed environmental goals are to achieve substantial double digit fuel burn efficiency at aircraft level, an end to end product life cycle that requires a greatly reduced amount of energy and resources and a significant reduction of the community noise. Reaching a significant reduction of community noise at the best level of economic efficiency is one of the biggest challenges, as the optimisation towards both targets typically leads to divergent solutions. Facing this challenge shall be part of the technology development and demonstration in LPA platform 1.

The setup of the main programme objectives is to further push the value of technologies tackled in *Clean Sky*. The focus is on large-scale demonstration of technologies integrated at aircraft level in 3 distinct ‘Platforms’:

- Platform 1: “Advanced Engine and Aircraft Configurations” will provide the development environment for the integration of the most fuel efficient propulsion concepts into the airframe targeting next generation short and medium range aircraft, the CROR engine and the Ultra-High Bypass Ratio (UHBR) turbofan;
- Platform 2: “Innovative Physical Integration Cabin – System – Structure” is aiming to develop, mature, and demonstrate an entirely new, advanced fuselage structural concept developed in full alignment towards a next generation of cabin-cargo architecture, including all relevant principle aircraft systems;
- Platform 3: “Next Generation Aircraft Systems, Cockpit and Avionics” ultimate objective is to build a highly representative ground demonstrator to validate a Disruptive Cockpit concept to be ready for a possible launch of a future European LPA aircraft. Although a Disruptive Cockpit is the main target of Platform 3, some of the technologies that will be worked out may find an earlier application. These technologies spin-offs would be candidate for an incremental development of the existing family of commercial airplanes. Advanced systems maintenance activities are also part of Platform 3.

---

<sup>3</sup> The list of deliverables and milestones presented in this chapter is a provisional and may be updated at the stage of the preparation and signature of the Grant Agreement for the Members.

## **Major milestones planned for 2015:**

### *Platform 1*

- Engagement of Core-Partners, first wave update of associate sections of the work plan
- Identification of Call for proposal Partners, first call
- Identification of Core-Partners, second wave
- Endorsement of updated Project Development Plan for CROR FTD, including economic viability gates
- Compilation of the Project Development Plan for the rear-end demonstrator
- Confirmation of the target design and manufacturing process for the HLFC nose applied on vertical tailplane based on results of AFLoNext, HIGHER-LE and incorporated requirements from CS2 (long-term testing, operational readiness).
- Definition of certification rules and procedures for flight test with full scale HLFC fin.
- Freeze of wind tunnel model configuration for WP153
- Value-for-money analysis for the definition of the best “Validation and Verification” strategy for UHBR engine integration on long-range-aircraft type FTD

### *Platform 2*

- Engagement of Core-Partners from the first wave and update of the work plan
- Engagement of Call for proposal Partners, first call
- Identification of Core-Partners, second wave

### *Platform 3*

- Initiation of the generic technologies and avionic functions development
- Start of service oriented architecture definition and prognostic activities
- Engagement of Call for proposal Partners, first call
- Identification of Core partners and Call for proposal Partners, second wave

## **Major deliverables planned for 2015:**

### *Platform 1*

- Project Development Plan for the rear-end demonstrator
- Project Development Plan for CROR FTD
- Dossier prepared about the initial technical definition of rear-end demonstrator.
- Dossier prepared about the technical content of CROR FTD
- Testing approach for scaled flight testing available and preparation of test platform software and flight control laws
- Dossier prepared about the target design and manufacturing process for the operational HLFC fin
- Set up of development plan and definition of technical interfaces for WP1.5 “Applied Technologies for enhanced aircraft performance”
- Dossier about the preliminary architectural work for engine integration (UHBR engine on FTD, long range aircraft type)

### *Platform 2*

- Detailed project development plan including all demonstrators and work shares for wave 1 and 2 Core Partners
- Next generation fuselage requirements and functionalities compilation dossier

- Recommendations on requirements, challenges and prioritization
- Next generation integrated fuselage candidate concepts /architectures (1st issue)

### *Platform 3*

- Provide high level specifications on the functions and technologies to be developed within Platform 3
- Maintenance operations dossier

*Note: The list of deliverables and milestones presented here is a provisional list and may be updated at the moment of the signature of the Grant Agreement for the Members.*

## **Implementation**

The activities in the Large Passenger Aircraft IADP will be performed following the general principles of the Clean Sky 2 membership and participation.

Airbus, as the IADP Leader, will perform the main activities related to the technology development and demonstration in the IADP. Significant part of the work will be performed by Core Partners, supporting the IADP leader in its activities. Finally, another part of the activities will be performed by Partners through Calls for Proposals for dedicated tasks.

Airbus, as the IADP Leader, will sign the one Grant Agreement for Members (GAM) in order to perform the work. This GAM will cover all the work of the Members in this IADP. The Core Partners are selected through open Calls for Core Partners and the retained applicants will accede to the existing Grant Agreement for Members. Partners will be beneficiaries selected at a later stage on the basis of open Calls for Proposals and will be signing the Grant Agreement for Partners. They will be linked to the IADP activities through the Coordination Agreement.

## **Years 2016 and 2017**

### **Platform 1**

In general, in 2016 and 2017 all activities in Platform 1 will be seamless continued which were already active in the previous period (2014 and 2015) and for which the need for continuation was validated according to the long-term development plan and associated technology reviews. With exception of activities in work package WP1.2 Rear end demonstrator and WP1.6 demonstration of radical aircraft configuration all other main parts of the Platform 1 programme have been started in 2014 and 2015. The implementation and launch of core partner activities related to 2<sup>nd</sup> wave are scheduled to take place in 2016 of core which were planned to start not before in 2016 will be launched in this reporting period. The key activities in years 2016 and 2017 are the following:

### **Activities 2016**

- Start to design aircraft components for the Flight Test Demonstrator such as pylon and installation equipment based on the chosen CROR FTD concept (WP1.1)



- Preliminary design of flight-worthy CROR demo engine (WP1.1)
- Development of Project Plan for the rear-end demonstrator (WP1.2)
- Define test procedures, prepare test aircraft, software and ground station (WP1.3)
- Assessment of final HLFC structure concept for fin application in terms of weight, costs and drag, certification requirements (WP1.4)
- Definition of the baseline configuration including engine specifications & positioning (WP1.5)
- Identification & selection of UHBR related technologies being part of the UltraFan FTD (WP1.5)
- Monitoring and analysis of numerical predictions of aerodynamics at engine wing pylon with/without active flow control (WP1.5)
- Preparation of wind tunnel entry to support TRL3 gate including setup of test matrix (WP1.5)
- Continuation of system integration and structural design and analysis actuator hardware design and development (WP1.5)
- Define alternative aircraft architectures / components (WP1.6)
- Select advanced technology bricks, develop & build hybrid-power bench (WP1.6)

#### **Activities 2017**

- Preliminary design of Flight Test Demonstrator components (WP1.1)
- Detailed design of flight-worthy CROR demo engine (WP1.1)
- Start of rear-end component and assembly design (WP1.2)
- Continuation of 2016 activities regarding flight testing, update of test aircraft for sensitivity study (WP1.3)
- Development and manufacturing of a HLFC full scale fin industrial concept (WP1.4)
- Aircraft level integration & Evaluation of the UHBR related technologies (WP1.5)
- Maturation & small scale demonstration of the selected technologies for UltraFan FTD (WP1.5)
- Profound analysis of wind tunnel test and know-how transfer to L2 project AFloNext (WP1.5)
- Continuation of flow control hardware design in the perspective of planned future flight-tests (WP1.5)
- Set-up of first real-scale flow control system mock-up (WP1.5)
- Development and test of components of hybrid-power chain (WP1.6)

The demonstrator activities in Platform 1 have various links to the ITDs. The links are planned to persist throughout most of the project lifetime, with a synchronization of R&T along the readiness level of the relevant technologies in the ITD respectively the IADP.

#### **Platform 2**

During the years 2016 and 2017 the work in Platform 2 will mainly focus on the detailed design and architecture definition of the 3 demonstrators.

For the Next Generation Fuselage, Cabin and Systems Integrated Demonstrator (Multifunctional demonstrator), it is planned to achieve the architecture definition at the end of 2016. This activity will be mainly supported by the Core-partner engaged for the multifunctional concept phase (research institute), who will deliver an architecture definition dossier in Q4 2016. Following this, it is planned to continue in 2017 with the detailed design of the demonstrator and the specifications of the demonstrator test bed.

For the Cabin & Cargo demonstrator, a requirements dossier should be available at the end of 2015. Hence during 2016 it is expected to continue to evaluate and select the technologies to be part of the demonstrator, and to have a well-defined concept by the end of 2016. The Cabin & Cargo demonstrator can then enter the preliminary design phase which should be achieved at the end of 2017. It is also expected from the Cabin&Cargo Core-Partner to deliver a selection list of enabler technologies (including assessment), a definition of Experimental process and trials, and a test infrastructure definition during the 2016-2017 timeframe.

In 2016-2017, the activities regarding the Lower Centre Fuselage demonstrator will mainly focus on the architecture down selection, the estimation of the benefits for the overall aircraft design, the definition of specifications and interfaces, and the business case refinement (for instance regarding cost, weight and risks & opportunities). A first milestone is the end of the concept phase EoY 2016, materialized by a Go/No Go decision (architecture benefits). In 2017 the definition of the manufacturing process will also be part of the objectives, as well as the specific design of the components and the definition of the component assembly process. At the end of 2017 it is also planned to have a full scale test concept definition.

### **Platform 3**

In 2016 and 2017, the IADP LPA platform 3 activities will focus upon launching the Phase 1 of the development of the Innovative functions and technologies towards a TRL4 by early 2018, and to prepare the corresponding enhanced cockpit tests and flight tests to be performed from 2018 onwards.

These activities will be performed with three main objectives:

- First, to feed the enhanced cockpit demonstrators and in flight demonstrations planned from 2018 onwards with Enhanced Flight Operations functions and enabling innovative technologies (WP 3.1 and WP 3.2);
- Second, to prepare the Enhanced cockpit demonstrator configuration (WP3.4) and innovative function and technologies flight tests (WP 3.3);
- Third, to gain in maturity for the technologies to be part of the Disruptive Cockpit demonstrator, and start specifying the platform to be used for this ultimate purpose (WP3.5).

These activities will be performed in collaboration with several key systems suppliers as well as with other aircraft manufacturers (“airframer-industries”, here business jet and regional aircraft).

In parallel, the activities started in 2014 for the Maintenance Work Package will ramp up with the introduction of selected Partners from wave 1 call.

## Main Activities in 2016:

During this first phase, the role of the airframer – industries will be to provide high level specifications for cockpit functions and avionic technologies for the sake of defining the targeted cockpit demonstrators perimeter and functionalities. The development of these functions and technologies to be performed by the Systems suppliers Core Partners will therefore represent the major workload in this early phase.

This Phase will thus see the introduction of two Core Partners, playing a major role in the technologies development.

## Main activities in 2017:

After the needs capture and definition activities, 2017 will see the continuation of the specification and design of the functions, components and models and associated compliance assessment.

The compliance to the requirements as defined by the airframer-industries will be evaluated and the selection of the functions and components to be integrated in the cockpit demonstrators will be performed.

## **LPA major milestones planned for 2016:**

### *Platform 1*

- Identification of Core-Partners, third wave
- Concept Review for CROR FTD (coherent with the route to economic viability review in ITD Airframe for the integrated technologies).
- Freeze of principle flight test procedures for scaled flight test demonstration
- Scaled Flight Test A/C ready, first flight of basic vehicle
- Preliminary Design Review (PDR) of the structural concept for HLFC VTP.
- PDR of the UltraFan concept
- Technical Review of a wind tunnel model and modifications for applied technologies for enhanced aircraft performance and wind tunnel test (intended 2016)

### *Platform 2*

- Identification of Core-Partners, third wave
- Identification and engagement of Call for proposals
- End of the concept phase EoY 2016, materialized by a Go/No Go decision (architecture benefits)

### *Platform 3*

- Engagement of Core-Partners and partner from the second wave and update of the work plan, initiation and project kick-off of activities
- Identification of Call for proposal Partners Wave 3

- Concept Review of advanced cockpit concepts for regional jets, concept definition, selection of the best concept solution for each technology
- Launch Design Review of Business Jet Cockpit Demonstrator (with core partner)
- Large passenger aircraft Cockpit demonstrator Avionics Platform Requirements (with partners)
- Common methodology and approach for the integration of IMA2G+ platform resources to create and IMA VIRTUAL PLATFORM to demonstrate the new Cockpit functions available
- Requirements update of the large passenger aircraft advanced cockpit concept
- Requirements compliance dossier established (Core Partner)
- E2E (end to end) business and operational scenario for maintenance (WP1.5)
- E2E architecture Development Review (WP1.5)
- IHMM TRL4 Review passed

## **LPA major deliverables planned for 2016**

### *Platform 1*

- Dossier of the Concept Review for CROR FTD.
- Wind tunnel test matrix for active flow control technologies for enhanced performance
- Multi-disciplinary work and qualification plan, synthesis plan of test perimeters for scaled flight test demonstrator
- Verification and Validation (V&V) plan and test requirements
- Overall assessment report of selected structure concept in terms of weight, costs and drag benefit for industrial HLFC concept.
- Concept analysis of alternative propulsion aircraft configuration
- Preliminary concept for distributed propulsion

### *Platform 2*

- Next generation Multifunctional Fuselage architecture definition dossier
- Concept definition document for new Cabin & Cargo architecture
- Detailed design of the Lower Centre Fuselage demonstrator

### *Platform 3*

- High level requirements document (final version) on the functions and technologies developed within WP 3.1 & WP 3.2 for regional aircraft (CASA)
- Analysis of applicable regulations framework (CASA + CP)
- Validation Test Plan (CASA + CP)
- Requirements document for functions for "always easier flight" with focus on bizjets
- Requirements document for multimodal HMI
- Specifications of bizjet cockpit utility management system
- Requirements Document for large passenger aircraft Cockpit Platform and cockpit demonstration needs

- IMA Virtual platform Common Methodology and architecture Dossier
- Updated enhanced cockpit components requirements
- Enhanced cockpit test plan
- E2E Evaluation Plan
- Use case definition and specification for collaborative environment, data analytics maintenance planning and mobile tool platform and applications
- E2E Maintenance Platform specification based on airline business and operational needs (report and model)
- IHMM specification and Demonstrator for Iteration Step 1 and Step 1 Evaluation
- Final Architecture definition for SHM and Prognostic solutions (report and model)

## **LPA major milestones planned for 2017**

### *Platform 1*

- Preliminary Design Review for CROR Flight Test Demonstrator components (aligned with the route to economic viability review in ITD Airframe for the integrated technologies).
- Preliminary Design Review for CROR engine mounts and interfaces to aircraft
- Project Development Plan for rear end demonstrator finalized
- Critical Design Review of structural concept for HLFC VTP held
- Qualification plan for flight test with HLFC fin available
- Critical Design Review of UltraFan concept
- Recommendations of AFloNext on active flow control technologies to LPA finished
- Tests with real-scale flow control mock-up accomplished.
- Alternate Propulsion Concept Power-Test Bench available.

### *Platform 2*

- Engagement of Core-Partners from the third wave and update of the work plan
- Identification and engagement of Call for proposals

### *Platform 3*

- Implementation and ramp up of Call for proposal Partners activities
- Preliminary Design Reviews for regional aircraft advanced cockpit concept
- Design phase completed, Critical Design Review for Regional Aircraft Cockpit
- Definition of requirements for system validation in the regional aircraft Cockpit Simulator
- Preliminary Design Review of Business Jet Cockpit Demonstrator
- Demonstration of advanced cockpit concept compliance to large passenger aircraft requirements
- Decision gate for enhanced cockpit functions demonstration architecture and contents
- Specification of “IMAPDEMO” test bench adaptation, launch of adaptation of the IMAPDEMO test bench
- Avionics platform emulator definition, integration and validation

- IHMM TRL5 review
- E2E architecture TRL4 review

## **LPA major deliverables planned for 2017**

### *Platform 1*

- Dossier about the Preliminary Design Review for CROR Flight Test Demonstrator components.
- Dossier about the Preliminary Design Review for CROR engine mounts and interfaces to aircraft.
- Project development Plan for rear end demonstrator
- Major components for HLFC fin for flight test (hardware)
- NACRE IEP capabilities in terms of scaled demonstrator flying-test bed defined.
- Delivery of first set of actuators for mock-up installation (WP1.5)
- Definition of bleed air interfaces in cooperation of airframer and engine manufacturer (WP1.5)

### *Platform 2*

- Specifications for Multifunctional Demonstrator's test bed
- Preliminary Design phase report for the Cabin & Cargo demonstrator
- Lower Centre Fuselage: delivery of first jigs & tools

### *Platform 3*

- Cockpit systems and equipment prototype technical specification- System architecture definition for regional aircraft
- Technical documentation supporting Preliminary Design Review and Critical Design Review for regional aircraft cockpit concepts
- Simulator requirements document for advanced regional aircraft cockpit
- Evaluation report of prototype navigation functions for bizjets cockpits
- Evaluation report of prototype HMI systems for bizjets cockpits
- Remote Data Power Concentrator Demonstrator specification for bizjet cockpits
- Software Defined Radio Architecture Dossier + High level Specifications
- IP Router, Avionics components High level Specification
- Avionics component requirements dossier for a large passenger aircraft advanced cockpit enabling technologies
- Large Passenger Aircraft Cockpit Platform Demonstration model
- IMAPDEMO CS2 Test Bench Definition Dossier
- IMA Virtual Platform - Component Design Guidelines, mock up and interfaces specifications
- Enhanced cockpit test bench adaptation specification
- Enhanced cockpit demonstrator components
- Enhanced cockpit demonstrator test plan

- For maintenance: mobile tool prototype for Augmented Reality, contextualized documentation
- IHMM specification and Demonstrator for Iteration Step 2 and Step 2 Evaluation
- E2E Evaluation means (framework & simulation integration) development (iteration1)

## **Implementation**

The activities in the Large Passenger Aircraft IADP will be performed following the general principles of the Clean Sky 2 membership and participation.

Airbus, as the IADP Leader, will perform the main activities related to the technology development and demonstration in the IADP. Significant part of the work will be performed by Core Partners, supporting the IADP leader in its activities. Finally, another part of the activities will be performed by Partners through Calls for Proposals for dedicated tasks.

In 2016, the core partners emerging from the second wave of CleanSky 2 Open Calls are planned to join the project through accession to the GAM which is expected to be updated at the end of the negotiation phase of the individual contributions to the project. When issuing this version of the Work Plan 2016-2017, the exact titles of the expected engagement of wave 2 core partners are not defined. The same applies for the titles respectively the content of topics for Call for Partner calls to be published at the end of 2015, in 2016 and 2017.

### List of Leaders and participating affiliates

Nr	Leaders	Description of activities 2015-2017
1	Airbus SAS	Airbus SAS has a main share of responsibility to coordinate the LPA project. This includes the coordination of the strategic planning, technical coordination, planning and execution, including the technical lead of main work packages.
8	Dassault Aviation SA	<p>The main activities are related to the physical integration of advanced turbofan engines to innovative aircraft configuration, using synergies of research and development to prepare the integration of a CROR engine to a large passenger aircraft in LPA Platform 1 for advanced engine integration to future business jets. Further focus of activities is laid on research and development of a laminar flow HTP and the definition and development of a future End-to-end maintenance operation concept in LPA Platform 3.</p> <p>As from 2015, Dassault Aviation SA is also contributing to the specifications of cockpit and avionics technologies in LPA Platform 3.</p>
9	Airbus Defense & Space - SA (CASA)	<p>In the first contractual period, CASA is contributing to definition of radical aircraft configurations aiming to integrate future propulsion concepts which may require severe modifications in the airframe geometry aero dynamical and structural layout. The contribution in the first contractual term is very moderate.</p> <p>As from 2015, CASA is also contributing to the specifications of cockpit and avionics technologies in LPA Platform 3.</p>
10	Fraunhofer	<p>FHG activities are related to contribute to develop engine-mounting architectures to optimize the loads transfer and introduction to the aircraft main frame and fuselage skin structure.</p> <p>A second area of contribution is in the research and development of advanced automated manufacturing and assembly processes associated to a new integrated fuselage cabin-cargo architecture</p>
11	Rolls-Royce plc	Activities are related to integrate advanced and radical engine concepts to a future aircraft configurations which require significant changes in the aircraft architecture
12	Thales Avionics	Focus of the activities is in LPA Platform 3 to take strong contributing share in the definition and development of a future End-to-end maintenance operation concept, the business and operational analysis.



Nr	Participating Affiliates	Description of activities
2	Airbus Operations SAS	Airbus Operations SAS will take a key contributing role research and technology activities in all three platforms respectively all main technical areas of the program, advanced engine and aircraft configuration, innovative physical integration cabin-system-structure, next generation aircraft systems and maintenance.
3	Airbus Operations GmbH	Airbus Operations GmbH will take a key contributing role research and technology activities in all three platforms respectively all main technical areas of the program, advanced engine and aircraft configuration, innovative physical integration cabin-system-structure and maintenance.
	GmbH	Airbus DS GmbH will provide support to the LPA program management by providing a comprehensive, dedicated tool for the full life cycle of the program. This includes the development, upgrading and services and support for all parties contributing to LPA.
4	Airbus Operations Ltd	Activities will be associated to the definition and preparation of the test pyramid and to provide key contributions to the specification of component and heavily integrated demonstrators in LPA platform 2 innovative physical integration cabin-system-structure.
5	Airbus Operations SL	Airbus Operations SL will take a coordinating role and key contributions in Platform 1 in work packages advanced engine integration driven fuselage and hybrid laminar flow control large scale demonstration. Activities are also associated in platform 2 to develop technologies for elementary parts, sub components and modules.
6	Airbus Group SAS	Activities in LPA are associated to the demonstration of radical aircraft configuration with focus on hybrid power bench development and testing.
7	Airbus Defense & Space - Germany	Activities in LPA are associated to the demonstration of radical aircraft configuration with focus on hybrid power bench development and testing. Airbus Defense and Space Germany will take a coordinating role.
13	SNECMA (Safran-Group)	Snecma has a main share of responsibility in the LPA Platform 1 to coordinate the FTD CROR Demo Engine project and the Non-Propulsive Energy project .This includes the coordination of the strategic planning, technical coordination, planning and execution, including the technical lead of main work packages.

Nr	Participating Affiliates	Description of activities
14	Microturbo (Safran-Group)	Activities related to advanced concepts of Non Propulsive Energy generation in LPA Platform 1. In the first contractual period, Microturbo will contribute to proposals, down selection and engine-aircraft-systems optimizations.
15	Aircelle (Safran-Group)	Aircelle activities are related to develop advanced concepts of nacelle and plug for the FTD CROR Demo Engine project fitting with the pylon configuration of the FTD Aircraft.
16	SAFRAN S.A. (Safran Group)	SAFRAN S.A. activities are related to develop advanced concepts of composite blades for the FTD CROR Demo Engine project fitting with the pylon configuration of the FTD Aircraft (Note: SAFRAN SA is not signatory of the first LPA GAM)

## 9.2. IADP REGIONAL AIRCRAFT

The R-IADP objective is to bring the technologies for Regional Aircraft to a further level of integration and maturity, and mastering the accompanying complexity compared to the progress made in Clean Sky GRA. Retaining GRA outcomes as well as results of other FP7 projects, advanced technologies for regional aircraft will be further developed, integrated and validated at aircraft level, so as to drastically de-risk their integration on the following future products:

- 90 Pax class Regional Aircraft with underwing mounted turboprop engines (near/midterm);
- Long term (enter in service beyond 2035): Breakthrough Regional Aircraft Configurations, e.g. a/c with rear fuselage mounted turboprop engines.

Full scale demonstrations, with acceptable risk and complexity but still providing the requested integration, are essential to allow the insertion of validated technologies on future regional aircraft. The R-IADP Demonstration Programme comprises:

- A Flight Demonstration Programme, by using two Flying Test Beds: existing regional aircraft properly modified to enable a meaningful demonstration of selected technologies;
- A Ground Demonstration Programme, including: i) a full scale innovative fuselage and passenger cabin; ii) a Flight Simulator demonstrating new cockpit interaction concepts as well as advanced avionics functions; iii) virtual and Physical “Iron Birds”

During 2015, both R-IADP and GRA will be managed through an unique Integrated Risk Management Plan since the former follows on from and partly builds up on the results obtained by the latter, as per Council Regulation on the Clean Sky 2 Joint Undertaking dictate, allowing and contributing to the finalisation of research activities initiated under Regulation (EC) No 71/2008.

So as to ensure GRA mitigation actions plan becoming R-IADP recovery actions plan, without a smooth transition from CS to CS2 obligations.

### Year 2015

#### *Overview*

During 2015, the detailed definition of the technical activities, WBS (Work Packages Breakdown Structure) covering the complete R-IADP project, will be consolidated with the contribution of selected Core Partners. The technical activities will continue in the: WP0 – Management; WP1 – High Efficiency Regional A/C (sub-WPs 1.1, 1.2, 1.3); WP2 – Technologies Development (sub-WPs 2.1, 2.2, 2.3, 2.4) and WP3 – Demonstrations (sub-WPs 3.1, 3.2, 3.3, 3.4, 3.5). Within these Work Packages:

- Alenia will: continue the studies on the innovative turboprop aircraft configuration; scale to reference configuration wing technologies from current CS and SARISTU, assess the performance of concepts to gain information for first step of technology down selection; assess NLF wing aerodynamic design and in flight certification requirements

investigation; define the wing structure conceptual design; consolidate the regional aircraft requirements for Systems; start the development of peculiar Regional avionic function: start the Flight Simulator update; consolidate system technologies roadmap and sharing of activities; define Systems technologies design requirement and architectures; preliminarily down select the functionalities/subsystems to be verified in FTB#1; preliminarily scale the FCS architecture and actuation concepts defined in 2014 on the target FTB#1; preliminarily define the Iron Bird considering the target FTB#1; start activities on Affordability/Preliminary Cost Analysis; define the external noise evaluation strategy and criteria for developed technologies assessment in terms of noise impact.

- Airbus Aerospace and Defence (EADS-CASA) will: i) perform the necessary trade-offs to define the concept for the new wing, based on MDO approach; ii) define WTT activities and wing model; iii) start the definition of A/C controls including MLA/GLA; iii) Complement the detailed technical specifications for the systems and structural elements identified in ITD with potential extension into IADP.

Furthermore, the following technical transversal activities will continue in 2015:

- Contribution to the strategic topics descriptions for the Core-Partners selection (2<sup>nd</sup> wave) and CfPs (1<sup>st</sup> batch)
- Negotiations with Core-Partner Winners (2<sup>nd</sup> Wave) and Partners (1<sup>st</sup> batch)
- Definition of Waves technological roadmaps
- Activities on Systems Engineering Technical Management in terms of SE Processes, Methods and Tools definition and set-up.

### **Major milestones planned for 2015:**

- M1 - Selection of Core Partners (2<sup>nd</sup> wave)
- M2 - Mid-Year Review Technology Assessments and Development progress
- M3 - 2015 Annual Review

### **Major deliverables planned for 2015:**

#### WP0 – Management

- Contribution to the strategic topic descriptions for Core Partners Selection (2<sup>nd</sup> Wave) (Alenia):
  - FTB#1 Demonstration Aircraft (Alenia)
  - D&M of items for innovative fuselage/cabin demonstrator (Alenia)
  - Technological contributions to conceptual design of innovative regional aircraft configurations featuring advanced integration of powerplant (Alenia)
- R-IADP System Engineering and IT tools and methods – 2nd issue (Alenia):
  - System Engineering Management Plan (SEMP) with Quality and Configuration/Convention Rules for Definition and Detailed Design Phases. (Alenia)

- IT Tools and Methods Implementation Plan (Set up of Operative Model) for Definition and Detailed Design Phases (Alenia)
- Consolidated Roadmaps for each Technological Wave (Alenia)

#### WP1 – High Efficiency Regional A/C

- Top Level Aircraft Requirements update (Alenia)
- High Efficiency Aircraft - First design loop (Alenia)

#### WP2 – Technologies

- Assessment preliminary results for Morphing Structures concepts for first step of technology down selection (Alenia)
- Qualification System Plan for Morphing Structures concepts (Alenia)
- Assessment of results for HLD concepts for first step of technology down selection (Alenia)
- Assessment of preliminary results for Loads Control and Alleviation concepts for first step of technology down selection (Alenia)
- Qualification System Plan for LC&A concepts (Alenia)
- Assessment of results for NLF design criteria (Alenia)
- Assessment of results for drag reduction concepts for first step of technology down selection (Alenia)
- Wing structure conceptual design (Alenia)
- Pilot fabrication facilities preliminary requirements for wing components manufacturing (Alenia)
- Requirements specifications of methodologies for Rational Engineering A/C Life Cycle (Alenia)
- Regional A/C customization requirements update for Display, FMS and avionic functions (Alenia)
- Systems Technologies Verification and Validation Plans (Alenia)
- Systems Technologies preliminary Integration Requirements (Alenia)
- Preliminary FCS architecture and actuation concepts on the target FTB#1 (Alenia)

#### WP3 – Demonstrations

- Progress report on CS2 Regional Flight Simulator update (Alenia)
- Iron Bird preliminary definition considering the target FTB#1 (Alenia)
- MLA/GLA preliminary architecture (Airbus Aerospace and Defence (EADS-CASA))
- Wing conceptual design and Wing WTT models. (Airbus Aerospace and Defence (EADS-CASA))

*Note: The list of deliverables and milestones presented here is a provisional list and may be updated at the moment of the signature of the Grant Agreement for the Members.*

### **Implementation**

The activities in the Regional Aircraft IADP will be performed following the general principles of the Clean Sky 2 membership and participation.

Alenia Aermacchi, as the IADP Leader, will perform the main activities related to the technology development and demonstration in the IADP. Significant part of the work will be performed by Core Partners, supporting the IADP leader in its activities. Finally, another part of the activities will be performed by Partners through Calls for Proposals for dedicated tasks.

Alenia Aermacchi, as the IADP Leader, will sign the one Grant Agreement for Members (GAM) in order to perform the work. This GAM will cover all the work of the Members in this IADP. The Core Partners are selected through open Calls for Core Partners and the retained applicants will accede to the existing Grant Agreement for Members. Partners will be selected at a later stage through Calls for Proposals and will be signing the Grant Agreement for Partners. They will be linked to the IADP activities through the Coordination Agreement.

During 2016 - 2017, technical activities will continue so as to achieve important TRL progress for technologies development as well as a detailed definition of each demonstrator. In particular, the overall main objectives for this timeframe are as follows:

- during 2016 : to complete the transition from Clean Sky GRA; to complete the selection of all the R-IADP Core Partners; to complete the collaboration agreement with other SPDs; to define the detailed interfaces/interactions with TE as well as with ECO TA;
- to down-select the technologies to be integrated into the demonstrators;
- to perform feasibility activities for demonstrators;
- to achieve the Demonstrators' PDRs;
- to provide the TE with first ASM [aircraft simulation model];
- to provide ECO TA with data for LCA evaluations.

## **Description of activities in 2016 and 2017**

### *Overview*

During 2016 - 2017, the transition from Clean Sky GRA will be finalized and the Core Partners selection will be completed. So, the R-IADP will be fully operative and activities will progress within all the technical Work packages / Sub-Work packages:

- WP1 – High Efficiency Regional A/C (sub-WPs 1.1, 1.2, 1.3)
- WP2 – Technologies Development (sub-WPs 2.1, 2.2, 2.3, 2.4)
- WP3 – Demonstrations (sub-WPs 3.1, 3.2, 3.3, 3.4, 3.5)
- WP4 – Technologies Development & Demonstration Results (sub-WPs 4.1, 4.2)

### **WP0 – Management**

Coordination, administration and management of technical activities assuring proper interactions and interfaces with the JU and other IAs. In particular, the following main activities will be performed:

- organization of CMCs, SCs and Annual Reviews;
- preparation and issue of inputs for work plans and for contractual documentation;
- preparation and issue of periodic reporting documentation;
- coordination activities related to Core Partners and Partners selection;
- risk management;
- updating of Systems Engineering Management Plan and related documentation;
- updating of IT Tools and Methods Implementation Plan (Set up of Operative Model);
- deployment/Training on SE Activities, Methods and Tools

### **WP1 – High Efficiency Regional A/C**

Preparation of first design loop for both the Conventional (near/mid term) and Innovative (long term) Regional Aircraft Configurations.

- Assessment of the Powerplant requirements and preparation of a first engine sizing for both configurations.
- Preliminary Aerodynamic dataset (high speed efficiency and low speed features).  
Definition of cost reduction targets.
- Start of safety assessment for the Innovative A/C configuration.
- Development of Aircraft Simulation Model tool, including also life cycle cost determination module and other socio-economics parameters to be agreed with TE.
- Generation of a second loop of top level aircraft requirements and updating of engine requirements for both configurations.

### **WP2 – Technologies Development**

#### **WP2.1 “Adaptive electrical Wing”**

- Definition of structural requirements for the design of innovative Wing structures as well as for SHM and consolidation of pilot fabrication facilities requirements for low cost-automated wing components manufacturing.
- Selection of suitable technologies for stiffened panels, ribs, spars, miscellaneous parts.

- Identification of SHM/NDI system architecture, design of coupons, elements and sub-components, Technology simulation of LRI process.
- Structural design and manufacturing of full scale concepts prototypes and execution of ground test for morphing devices structural and mechanical designed solutions verification.
- Aero-mechanical assessment at A/C level of High Lift Devices (HLD)/Load Control & Alleviation (LC&A).
- Architectural design of relevant control and actuation systems.
- Completion of computational optimization for either A/C Conventional and Innovative configuration for the Wing Natural Laminar Flow and Drag Reduction (DR) concept.
- Finalization of wing external shape.
- First down selection of morphing/HLD/LC&A/NLF/DR concepts.
- High lift Device (HLD)/Load Control & Alleviation (LC&A)/Wing Natural Laminar Flow (NLF)/ Drag Reduction (DR) optimization process validation by mean of proper large scale Wind Tunnel Test campaign to be organized and performed in order to verify the full feasibility and TRL level of the devices.
- Second down selection of morphing/HLD/LC&A/NLF/DR concepts.

#### **WP 2.2 – “Advanced Avionics”**

Consolidation of Regional aircraft customization requirements for Display, FMS and avionic functions.

- Consolidation of functional and software requirements for Regional a/c Performance/Health Monitoring function, with the assumption that requirements will drive regional specific development that will start in Systems ITD.

#### **WP2.3 – “Energy Optimized Regional A/C**

- Completion of the definition of integration requirements and architectures with preparation of technical specifications for the selected advanced technologies in the areas of
  - Wing Ice Protection System (WIPS),
  - Electrical Landing Gear System (E-LGS),
  - Thermal management (ThM),
  - Advanced Electrical Power Generation and Distribution (A-EPGDS),
  - Electrical Environmental Control System (E-ECS),
  - Innovative Propeller,
  - Enhanced Fuel/Inerting System.

#### **WP2.4 “Innovative FCS”**

- Definition of Architecture for Basic Design Configuration (implementing of LA/LC capability by movable Winglets and Wingtips) and Ailerons.
- Installation studies and definition of the Interface Control Requirements.
- Definition of Architecture for Innovative FCS advanced configuration (implementing of LA/LC capability, other than by movable Winglets and Wingtips) with definition of Interface Control Requirements.



- Preparation of System/Subsystem Requirement Specification for Basic Configuration and Ailerons.

### **WP3 – Demonstrations**

#### **WP 3.1**

- Definition of FTB#1 Aircraft Level requirements for the development and design of the airframe/system modifications.
- Feasibility activities related to modifications to be implemented for the flight demonstration.
- FTB#1 Modifications detailed definition, assessment of requirements for the flight test instrumentation (FTI) and test. Preparation of in-flight demonstration pre-PDR.

#### **WP 3.2**

- Definition of the Fuselage/Pax Cabin Ground Demonstrator with consolidation of structural requirements considering Airframe ITD relevant outcomes.
- Start with the design of the Fuselage/Cabin Ground Demonstrator and of the respective manufacturing and assembling tools considering technologies and methodologies developed in the Airframe ITD.
- Preparation of Fuselage/Cabin demonstrator Preliminary Design Review.

#### **WP 3.3**

- Definition of Flight Simulator configuration and preparation of Critical Design Review

#### **WP 3.4**

Activities for the definition of Iron Bird will proceed with updating of its preliminary specification, architecture and definition of initial configuration in collaboration with selected Core Partner.

- Preparation of Iron Bird Preliminary Design Review.
- Start of Iron Bird skeleton assembly.

#### **WP 3.5**

Activities of Airbus DS SAU will be related to the support to the specific Wing Overall Design, that will be manufactured in different Airframe ITD work Packages. The activity in the Regional A/C IADP will support the technologies to be tested in FTB#2 and are related to the continuation of this OAD activity in the phases of preliminary and detailed design. Detailed aerodynamic information will be obtained through WTT campaigns, based on the WTT model to be produced. Design loads (static and dynamics) will be produced for five specific devices actuated by EMA's and/or with morphing characteristics: aileron, spoiler, adaptive winglet, multifunctional flap and morphing leading edge.

The architecture of the FTB#2 Loads Control system as well as flap actuation will be specified in detail considering a large number of aircraft surfaces controlled by actuators (OAD/OSD MLA and control loads).

### **WP4 – Technologies Development & Demonstration Results**

- Detailed identification and planning of the interfaces with the technological WPs of R-IADP and with the TE, including inputs for the evaluation of environmental impacts and socio-economic benefits.
- Detailed identification and planning of the interfaces with the technological WPs of R-IADP and with the ECO TA for LCA evaluations.
- Delivery of first inputs (ASM) for TE evaluations as well as inputs for Eco Design transversal activities and LCA evaluations.

### **Major milestones planned for 2016:**

- M1 – Completion of Selection of Core Partners
- M2 – Annual Review Meeting
- M3 – Aircraft Configuration (Conventional) Design Loop#1
- M4 – Aircraft Configuration (Innovative) Design Loop#1
- M5 – Wing Technologies for FTB#1 First Down-Selection
- M6 – FTB#1 A/C Level Requirements for Modification Review (RR)
- M7 – Aircraft Flight Simulator Preliminary Design Review (PDR)
- M8 – Cabin/Fuselage Requirement Review (RR)
- M9 – FTB#2 Preliminary Flight controls aerodynamic data
- M10 – FTB#2 Preliminary Wing Loads
- M11 – FTB2# WTT model manufactured
- M12 – FTB#2 Low Reynolds Wind tunnel test
- M13 – FTB#2 Final wing aerodynamics configuration

### **Major deliverables planned for 2016:**

#### WP0 – Management

- Work Plan 2017 – 2018
- Grant Agreement 2016 - 2017
- Activity Report 2015
- R-IADP System Engineering and IT tools and methods – 2<sup>nd</sup> Issue (Alenia)

#### WP1 – High Efficiency Regional A/C

- Engine dataset loop1 (conventional a/c configuration)
- Engine dataset loop1 (innovative a/c configuration)
- Aircraft Simulation Model Tool (Life Cycle Cost Module)
- Preliminary aerodynamic dataset

#### WP2 – Technologies

- Wing Structure - Manufacturing Test Trials realized and Technologies for Wing stiffened panels, ribs, spars, miscellaneous parts firstly selected.
- Wing Structure - Test plan according the building block approach.

- New adaptive wing devices aerodynamic, aeromechanical and structural design assessment.
- Wing Technologies First Down Selection results
- Consolidation of regional avionics requirements
- Systems Technologies Integration Requirements
- Innovative FCS Basic Architecture and Aileron Definition

### WP3 – Demonstrations

- FTB#1 Aircraft Level requirements for modifications.
- Structural requirements for the Fuselage Ground Demonstrator.
- Iron Bird preliminary architecture
- First delivery of Iron Bird Description and Compliance Matrix
- FTB#2 WTT model
- FTB#2 Preliminary loads reports

### WP4 – Technologies Development & Demonstration Results

- Technologies progress first data inputs to TE

### **Major milestones planned for 2017:**

- M1 – Annual Review Meeting
- M2 – WP1 Aerodynamic Requirements Review for both configurations
- M3 – WP2 Final down-selection of technologies for demonstrators
- M4 – FTB1#1 In-Flight Demonstrator Pre-PDR
- M5 – Fuselage/Cabin Ground Demonstrator PDR (Alenia)
- M6 – Flight Simulator CDR
- M7 – Iron Bird PDR
- M8 – FTB#2 Detailed Wing loads
- M9 – FTB#2 High Reynolds Wind tunnel test
- M10 – FTB#2 Final aerodynamic datasets transposed to flight scale

### **Major deliverables planned for 2017:**

#### WP0 – Management

- Work Plan 2018 – 2019
- Grant Agreement 2017 - 2018
- Activity Report 2016

#### WP1 – High Efficiency Regional A/C

- Engine dataset loop2 (Conventional configuration)
- Engine dataset loop2 (Innovative configuration)

#### WP2 – Technologies

- New adaptive wing structure: Drawings and CAD Models of coupons, elements and sub-components including sensors locations
- New adaptive wing devices aerodynamic and aeromechanical assessment validation- Wind Tunnel models, Wind Tunnel test results
- New adaptive wing devices structural-mechanical assessment validation - Full scale structural – mechanical demos test results
- New adaptive wing devices actuation system design assessment
- Systems Technologies Specifications
- FCS System/Subsystem Requirement Specification for Basic Configuration and Ailerons.

#### WP 3 – Demonstration

- FTB#1 Modifications assessment
- Fuselage/Cabin Demonstrator Design description
- Iron Bird specification
- Iron Bird description and Compliance Matrix
- Low Reynolds WTT results

#### WP4 – Technologies Development & Demonstration Results

- Aircraft Simulation Model to TE
- Data for LCA evaluations to ECO TA

#### **List of Leaders and participating affiliates<sup>4</sup>**

<b>Nr</b>	<b>Leaders</b>	<b>Description of activities</b>
1	Alenia Aermacchi SpA	See detailed description in core text
2	Airbus Aerospace and Defence (EADS-CASA)	See detailed description in core text

<sup>4</sup> The two leaders of Regional IADP have no affiliated companies.

### 9.3. IADP FAST ROTORCRAFT

The Fast Rotorcraft IADP of *Clean Sky 2* consists of two separate demonstrators, the *NextGenCTR tiltrotor* (leader: Agusta Westland) and the *LifeRCraft 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.

NextGenCTR will be dedicated to design, build and fly an innovative next generation civil tiltrotor technology demonstrator, the configuration of which will go beyond current architectures of this type of aircraft. This tiltrotor concept will involve tilting proprotors mounted in fixed nacelles at the tips of relatively short wings. These wings will have a fixed inboard portion and a tilting outboard portion next to the nacelle. The tilting portion will move in coordination with the proprotors, to minimize rotor downwash impingement in hover and increase efficiency. Demonstration activities will aim at validating its architecture, technologies/systems and operational concepts. They will show significant improvement with respect to current Tiltrotors. NextGenCTR will continue to develop what has been initiated in Green Rotorcraft ITD in Clean Sky. New specific activities will also be launched in *Clean Sky 2* in particular concerning drag reduction of the proprotor, airframe fuselage and wing. The new proprotor will require substantial research to reduce noise emissions. In *Clean Sky*, noise reduction is mainly addressed through the optimisation of flight trajectories. In *Clean Sky 2* transversal subjects will cover new research areas, validating them at full scale and in real operational conditions.

The LifeRCraft project aims at demonstrating the compound rotorcraft configuration, implementing and combining cutting-edge technologies from the current *Clean Sky* programme, and opening up new mobility roles that neither conventional helicopters nor fixed wing aircraft can currently cover. The compound concept will involve the use of forward propulsion through turbo-shaft driven propellers on short wings, complementing the main rotor providing vertical lift and hover capability. A large scale flightworthy demonstrator, embodying the new European compound rotorcraft architecture, will be designed, integrated and flight tested. This demonstrator will allow reaching the TRL 6 at full-aircraft level in 2020. The individual technologies of the *Clean Sky* Programme (Green Rotorcraft, Systems for Green Operations and Eco-Design ITDs) aiming at reducing gas emission, noise impact and promoting a greener life cycle will be further matured and integrated in this LifeRCraft demonstration.

## **Year 2015**

### **WP0 – Management and transversal activities**

**WP 0.0: Consortium Management.** Planning and reporting activities will be implemented in 2015 as required for the regular monitoring of IADP activities, in liaison with the JU Officers.

**WP 0.1: Technology Evaluator methodology for fast rotorcraft.** In 2015, the tools used in GRC1-GRC7 will be adapted and further developed in order to enable the assessment of conceptual rotorcraft models corresponding to the new configurations to be demonstrated.

**WP 0.2: Eco-Design concept implementation to fast rotorcraft.** In 2015, the leaders will coordinate their activity plans concerning the greening of rotorcraft production processes ensuring complementarity of case studies. The general Life Cycle Assessment approach will be coordinated with the participants of the Eco-Design TA.

#### **WP0 Main Milestones planned for 2015:**

- Dry run of augmented rotorcraft software platform (PHOENIX2)
- LCA methodology agreed with newly involved Core Partners and Partners

#### **WP0 Main Deliverables planned for 2015:**

- First TE assessment results for FRC
- First issue of bills of materials for fast rotorcraft configurations.

### **WP1.0 - Management**

This task remains related to CS2 implementation, administration and management of technical activities and participation and preparation work to Clean Sky 2 committees (i.e. Management Committee, Steering Committee).

#### **WP1.1 / Task 1.1.1 – Concept & Integrated Systems Design**

In 2015 the conceptual and preliminary design, analysis and studies still open will be completed, and the relevant deliverables will be issued.

A Preliminary Design Review (late-2015) to freeze the design and the general architecture will lead to Task 1.1.1b - Integrated System Design. In the meanwhile, the dedicated design of selected aircraft systems shall start.

#### **WP1.2 / T1.2.1 – Proprotor design**

Dedicated proprotor design will start beginning of 2015 and cover proprotor components (blades, hub, fixed/rotating controls, etc.) as well as proprotor assembly and installation, based on the preliminary design performed in WP1.1.

### **WP1.3 / T1.3.2 – Drive System detailed design**

The preliminary design activity performed in T1.3.1 completed in 2014 will feed T1.3.2, where further dedicated design of components will be performed.

### **WP1.4 / T1.4.1.1, 1.4.2.1, 1.4.3.1, 1.4.4.1 - Fuselage and Tilting Wing design**

Dedicated modelling, analysis and design of all fuselage sections shall start beginning of 2015, in liaison with the outcomes of WP1.1 / T1.1.1a. Activities will be co-ordinated with respect to the Call for Core Partners in the Airframe ITD relevant to the 3 fuselage sections (T1.4.1, T1.4.2, T1.4.3) for integration of Core Partner activities as soon as possible in 2015.

T1.4.4 (wing dedicated design) will also start in 2015 and the launch of the Call for Core Partners planned in CPW2 in early 2015 for integration of Core Partner activities as soon as possible.

CPW2 – Core Partner Topic FRC-TR (WP1.4 / T1.4.4) – Design, manufacturing and testing of wing system components

### **WP1.5 / T1.5.1.1, 1.5.2.1, 1.5.3.1 – Nacelle, Fuel System and Engine Control System design**

Dedicated design activity for the systems related to engine installation shall be launched in early 2015, including definition and design of engine installation, as well as of the engine control and fuel systems. The Core Partners for engine nacelle to be integrated into activities in 2015 whilst the fuel system partners possibly in 2016.

CPW2 – Core Partner Topic FRC-TR (WP1.5 / T1.5.1) – Design, manufacturing and testing of engine nacelle

PW2 – Partner Topic FRC-TR (WP1.5 / T1.5.2) – Design, manufacturing and testing of components of fuel system

### **WP1.6 / T1.6.1, 1.6.2, 1.6.3– Electric Power Generation and Distribution System (EPGDS), Flight control System (FCS) and Pressurization and Environmental Control System (ECS) design**

These tasks will commence in beginning of 2015 and cover the design and development testing of Electrical power generation and distribution system (EPGDS), Flight control system (FCS) and Pressurization and environmental control system (ECS). Core Partners and Partners to be integrated as soon as possible in 2015.

CPW2 – Core Partner Topic FRC-TR (WP1.6 / T1.6.2) – Design, manufacturing and testing of components for flight control system

PW1 – Partner Topic FRC-TR (WP1.6 / T1.6.1) – Design, manufacturing and testing of components of EPGDS

PW2 – Partner Topic FRC-TR (WP1.6 / T1.6.3) – Design, manufacturing and testing of components of air management system

### **WP1.7 / T1.7.2 – Technology Evaluator Interface**

The Work Package 1.7 – Technology Evaluator Interface shall complete the definition of metrics and Key Performance Parameters (KPP's) which will be used to assess the achievement of Clean Sky 2 environmental goals (i.e. CO<sub>2</sub> and noise emissions), and the selection of related tools and software. Furthermore, for the non-environmental goals outlined in Task 1.7.1.4 metrics and KPIs will be defined.

Task 1.7.2 shall start in 2015 with the following tasks:

- T1.7.2.1: definition of civil tiltrotor missions and operations;
- T1.7.2.2: synthesis of the civil tiltrotor baseline model;
- T1.7.2.3: synthesis of the Next Generation Civil TiltRotor model; this task will continue for the whole duration of *Clean Sky 2*

### **WP2 – LifeRCraft - Compound Rotorcraft Demonstrator**

**WP 2.0: Project Administration.** In 2015, the Core Partners will implement a similar management organization in their own companies and start implementing it in coordination with the Leader.

**WP 2.1: Project Management & Integration Activities.** In 2015, the preliminary design will be completed with participation of the selected Core Partners and the PDR passed. Topic descriptions for CFP will be prepared and negotiation will be completed for contributions in the aerodynamic design including noise optimization studies (WP2.1.7) and vibration control (WP2.1.8). The development of compound rotorcraft conceptual model for TE will be initiated.

- W1 Partner Topic FRC2.1-1 - (WP2.1.7) Aerodynamic optimization for LifeRCraft
- W2 Partner Topic FRC2.1-2 - (WP2.1.8) Cabin active resonators for vibration control for LifeRCraft

### **WP2.2 through 2.12 – General description**

In 2015, all WP2 through 12 will be active and ramp-up substantially in order for the preliminary design studies of critical subsystems to be completed and the Preliminary Design Review to be passed end of 2015. Topic descriptions for the 2<sup>nd</sup> Call for Partners will be prepared either by the LifeRCraft leader or by the Core Partners in order to support further the design and realization process of other components and systems. Further topics will be prepared for WPs proposed in the 2<sup>nd</sup> Call for Partners planned to open mid-2015.

The paragraphs below only mention the distinctive activities of each WP, without repeating the generic aspects already explained above.



**WP 2.2: Airframe Structure.** The WP2.2.6 (stress analysis, optimization) and 2.2.7 (fast prototyping) to be proposed for Partners in 2015. This WP will also coordinate activities performed in the Airframe ITD, WPs B1.1 and B4.1 in charge to design and deliver respectively the wing and tail section for the LifeRCraft demonstrator.

- CPW1 Strategic Topic FRC2.2-1 - (WP2.2.5) LifeRCraft airframe  
The optimized main airframe supports the wing, the main gearboxes, and the engines. It includes the cabin, the cockpit and integrates the main system of the aircraft. The activities cover the structural design according to Airbus Helicopters specification and architecture, the stress analysis, the manufacturing of the demonstrator airframe.
- W1 Partner Topic FRC2.2-2 - (WP2.2.6) Fuselage stress analysis and optimization
- W1 Partner Topic FRC2.2-3 - (WP2.2.7) Fuselage fast prototyping techniques

**WP 2.3: Landing System.** In 2015, the landing gear study will start with the selected Partner.

- W1 Partner Topic FRC2.3-1 - (WP2.3.6) Landing gear for LifeRCraft airframe

**WP 2.4: Lifting Rotor.** In 2015, the design option(s) will be selected at the PDR based on further studies.

**WP 2.5: Propellers.** Descriptions of WPs 2.5.8 (aeroacoustic design & tailoring) and 2.5.9 (mechanical design, realization) will be proposed for Partners in 2015. In 2015, the propeller design process will start with the Partners.

- W1 Partner Topic FRC2.5-1 - (WP2.5.8) Propeller aero-acoustic optimization (noise, performance)
- W1 Partner Topic FRC2.5-2 - (WP2.5.9) Propeller mechanical design and manufacturing

**WP 2.6: Mechanical Drive System.** WP2.6.10 (Propeller coupling shafts) for a Partner in 2015. In 2015, the LifeRCraft leader will proceed with design studies for the Main Gear Box.

- CPW1 Strategic Topic FRC2.6-1 - (WP2.6.9) - LifeRCraft drive system - Two propeller gearboxes (LH & RH) and specific MGB modules have to be developed for the compound MGB (MGB derived from an existing MGB). The activities cover the design according to Airbus Helicopters specification and architecture, the stress analysis, the manufacturing of the gearboxes for ground tests and flight tests, and the analysis of the tests results.
- W2 Partner Topic FRC2.6-2 - (WP2.6.10) Propeller coupling shafts

**WP 2.7: Power Plant.** The engine specifications and installation requirements established based on the preliminary estimation of LifeRCraft performance (altitude envelope, power rating, fuel consumption, power turbine speed range) will evolve with the refinement of

preliminary design, the description of WPs 2.7.2.2 (turboshaft engine) by mid-2015 and proposed in the 2<sup>nd</sup> Call for Partners.

- W2 Partner Topic FRC2.7-1 - (WP2.7.2.2) Turboshaft engine adaptation and installation

**WP 2.8: Electrical System.** The electrical system based on technologies selected in the GRC ITD, it will allow proposing an electrical architecture consistent with the LifeRCraft specific configuration and producing several topic descriptions corresponding to WP2.8.7 (generation, storage, conversion), intended to engage Partners after selection in the 1<sup>st</sup> or 2<sup>nd</sup> Call for Partners.

- W1 Partner Topic FRC2.8-1 - (WP2.8.7) Electrical generation
- W1 Partner Topic FRC2.8-2 - (WP2.8.8) Electrical storage
- W1 Partner Topic FRC2.8-3 - (WP2.8.6) Electrical converters

**WP 2.9: Actuators.** The activity will start only in 2015, after sufficient progress in the design of the flight control system. Several topics corresponding to specific actuator requirements (e.g. WP 2.9.4.2, 2.9.5.2) are expected to be ready for the 2<sup>nd</sup> Call for Partners due to open mid-2015.

- W2 Partner Topic FRC2.9-1 - ((WP2.9.8) Flight control actuators

**WP 2.10: Avionics & Sensors.** The activity aims at pre-selecting the avionic suite and equipment from existing hardware as best suited for the LifeRCraft demonstration. The selection may subsequently evolve as desired functionalities or performance could change according to the progress in WP2.12. No call topics expected to be launched in 2015.

**WP 2.11: Cabin & Mission Equipment.** The activity will start only in 2015, after sufficient progress in the design of airframe and cabin. Several topics corresponding to specific cabin/mission systems (e.g. WP 2.11.2.2 for noise control; or 2.11.4.2 for cabin access) are expected to be ready for the 2nd Call for Partners.

- W2 Partner Topic FRC2.11-1 - (WP2.11.2.2) Interior noise control
- W2 Partner Topic FRC2.11-2 - (WP2.11.4.2) Equipment for cabin access

**WP 2.12: Flight Control, Guidance, Navigation.** The different Flight Control System options will be compared, in terms of work load reduction, safety, complexity and cost. In parallel, studies for compound rotorcraft specific flight operations for environmental protection will start based on results obtained in CS-GRC5 for conventional helicopters.

#### **Major milestones planned for 2015:**

- LifeRCraft Preliminary Design Review passed

## **Major deliverables planned for 2015:**

- Topics defined for the first Call for Partners
- LifeRCraft wind tunnel model (WP2.1.4)

## **Implementation**

The activities in the Fast Rotorcraft IADP will be performed following the general principles of the Clean Sky 2 membership and participation.

Airbus Helicopters and Augusta Westland, as the IADP Leaders, will perform the main activities related to the technology development and demonstration in the IADP. Significant part of the work will be performed by Core Partners, supporting the IADP leader in its activities. Finally, another part of the activities will be performed by Partners through Calls for Proposals for dedicated tasks.

Airbus Helicopters and Augusta Westland, as the IADP Leaders, will sign the one Grant Agreement for Members (GAM) in order to perform the work. This GAM will cover all the work of the Members in this IADP. The Core Partners are selected through open Calls for Core Partners and the retained applicants will accede to the existing Grant Agreement for Members. Partners will be selected at a later stage through Calls for Proposals and will be signing the Grant Agreement for Partners. They will be linked to the IADP activities through the Coordination Agreement.

## ***Description of activities 2016-2017***

### **WP 0 – Consortium Management**

The Coordinator will perform the interfacing role between FRC Members (Leaders and Core Partners) and the JU Officers in order to secure timely planning and reporting in compliance with GAM provisions and with the CS Management Manual.

According to the Consortium Agreement, the FRC Coordination role may be shifted from Airbus Helicopters (AH) to AgustaWestland (AW) in 2016.

### **WP 1 – NextGenCTR - Next Generation Civil Tiltrotor Demonstrator**

#### **▪ Year 2016**

In 2016 AW shall complete the requirements definition for the major sub-systems as described by the work package breakdown in WP 1 including cooperation with an engine OEM to cover integration aspects. This activity will lead to the system requirement reviews of the individual sub-systems to take place in 2016. An aircraft level SRR shall follow shortly afterwards to freeze the requirements environment prior to starting the preliminary design activity. The aircraft level SRR in Q3 of 2016 shall include the outcome of the pressurized fuselage SRR performed within the Airframe ITD to ensure a consistent requirement set across the design of the demonstrator. During this period system and aircraft modelling tools shall be developed by AW and possible partners previously selected through Call for

Proposals launched in 2015. Following the aircraft level SRR, AW and Partners shall perform technology trade-studies of the aforementioned major systems in preparation of the preliminary design review (PDR) in 2017. Other activities to be initiated include, manufacturing planning, tooling definition, test and simulation environment infrastructure planning. A strong interface with the Airframe ITD will be maintained to coordinate the activities that impact on the fuselage and vice-versa.

▪ Year 2017

The culmination of the activities initiated in 2016 will lead to a preliminary design review (PDR) first at system level and finally at complete aircraft level to be performed by Q1 of 2017. Following a successful PDR the detail design phase shall begin for both major system and component level activities. This effort will be performed in close collaboration with the partners selected during Calls for Proposals (CfP) launched in 2015 and 2016, as well as the 3<sup>rd</sup> Core Partner Wave (CPW3) launched in 2016. The detail design activities shall continue into the 2018 period. The design and construction of the testing and simulation environment infrastructure shall be developed in 2017. Other activities shall include generation of models in support of the TE efforts in CS2.

**WP 1 Major milestones:**

- System Requirement Review (SRR) for key sub-systems: Q2 2016
- System Requirement Review (SRR) for NextGenCTR demonstrator: Q3 2016
- Preliminary Design Review (PDR) for NextGenCTR demonstrator: Q1 2017

**WP 1 Major deliverables:**

- System Requirement Review (SRR) report for Demonstrator: Q4 2016
- Preliminary Design Review (PDR) report: Q2 2017

**WP 2 – LifeRCraft - Compound Rotorcraft Demonstrator**

▪ Year 2016

AH and the involved Core Partners and Partners will complete the detailed design of all demonstrator subsystems.

A final wind tunnel test campaign will be performed in order to identify the complete aerodynamic characteristics of the vehicle and create a reliable data package for the flight simulation.

The demonstrator fuselage will be designed by the selected Core-Partner in close connection with Airbus Helicopters and the detailed stress analysis will be performed in order to secure flightworthiness with the regular safety margins. Similar design activities performed in the Airframe ITD for the demonstrator wing and tail unit will be closely coordinated. Dedicated tasks covering the airframe doors and frontal transparencies fulfilled by partners selected within ITD airframe will be monitored, coordinated and harmonised between IADP FRC and ITD Airframe. The Critical Design Review (CDR) for the airframe is planned by end 2016 before the general demonstrator CDR.

Further to the design of the main landing gear by the partner to be selected, a functional mock-up will be assembled and some critical sample parts will be realized and tested in laboratory, if needed.

The modifications required to adapt the main rotor to the LifeRCraft demonstrator, including air-tight rotating fairings, will be designed and sample development tests performed, if needed. Lateral rotors<sup>5</sup> will be designed and ground test articles will be manufactured with the hub featuring an innovative pitch control system and blade sets corresponding to the demonstrator requirements.

The detailed design will be performed by Airbus Helicopters and the selected Core-partner for the Main Gear Box (MGB) modifications and for the new Lateral Gear Boxes (LGBs). A mechanical rig will be adapted in preparation of back-to-back MGB tests. After contract signature with them, the engine manufacturer will design the necessary engine adaptations. The detail design of the air intake system, the fuel system and the equipped engine compartment will be performed.

The new/adapted components of the Electrical Generation and Distribution System will be developed by the involved partners. The electrical system installation and harnesses architecture will be defined, selecting the wiring and connection technologies suited for the demonstrator system needs. The preparation of a topic description to do the detailed design and the manufacturing of the electrical harnesses will be done.

The new/adapted actuators will be developed by the involved partners. The hydraulic system will be designed.

The modular avionic system will be configured for the demonstration. The detailed design of the demonstrator cockpit and MMI will be performed. The sensing system and VEMS software will be adapted to the LifeRCraft specificities.

The cabin interior layout will be defined and the equipment, including Air Control System components and noise insulation/control, special mission equipment will be specified and procured.

The specific Flight Control System including AFCS will be designed and tested in a flight simulator. Neighbour-friendly flight procedures taking advantages of the specific control capabilities of the LifeRCraft configuration will be developed in liaison with partners.

The last Call Topics for partners needed to build the LifeRCraft demo will be published before end 2016.

#### ▪ Year 2017

The general demonstrator Critical Design Review (CDR) is planned in February. The flightworthy fuselage segments and the wing and tail unit (Airframe ITD) will be manufactured and delivered by end 2017 to the prototype shop for assembly.

---

<sup>5</sup> Lateral rotors are ensuring two functions: 1/ anti-torque and yaw control ; 2/ propellers

The landing gear system will be manufactured and a ground test article will undergo a drop test.

The modified lifting rotor system will be manufactured, including a ground test article needed for the Rotor System Rig. Lateral rotors will also be produced, including a set to be installed on the Rotor System Rig.

Components for the MGB will be manufactured and assembled and the back-to-back test campaign will be performed. LGBs will also be manufactured and undergo specific development tests.

The engine modifications will be realized on prototype engines which will be tested on ground, as far as necessary. The air intakes, fuel system and engine compartment components will be manufactured.

All electrical components will be delivered after component unit tests. A dedicated integration rig for the electrical generation will be assembled and integration tests will be performed. The CDR of the electrical harnesses definition will be done with the partner to be selected and the manufacturing of harnesses launched.

The actuators will be delivered and the hydraulic system components procured.

All cabin systems and equipment will be delivered for installation on the demonstrator fuselage.

The Flight Control System will be integrated and tested on a specific bench. The navigation equipment will be configured to display guidance information to the pilot for performing neighbor-friendly flight procedures and/or to perform them in an automatic mode.

#### **WP 2 Major milestones:**

- Airframe-specific Critical Design Review passed successfully: Dec 2016
- LifeRCraft Critical Design Review passed successfully: Feb 2017

#### **WP 2 Major deliverables:**

- Fuselage components and airframe-mounted equipment delivered: Dec 2017.
- The list is still incomplete because current planning and progress in core-partners acquisition does not allow for details regarding deliverables in 2016-2017 (FRC is not a continuation of GRC/CS); it will be completed for the final version.

#### **WP 3 – Eco-Design Implementation for Fast RotorCraft**

The materials and industrial processes selected for NextGenCTR and LifeRCraft demonstrators will be evaluated according to economic criteria in comparison with other materials and processes already documented in the Clean Sky 1 programme. This activity will require specific collaboration between Leaders, Core Partners, Partners and suppliers. The work plan will be coordinated with similar activities performed in other IADPs and ITDs through the Eco Design TA interface.

**WP 3 Major milestones:**

- TBD in 2015, in liaison with Eco-Design TA

**WP 3 Major deliverables:**

- TBD in 2015, in liaison with Eco-Design TA

**WP 4 – Technology Evaluator Methodology for Fast RotorCraft**

It is expected that, after the definition phase taking place in 2015, the joint activities between AW and AH will transition to an execution phase in accordance with CS2 TE requirements for Fast RotorCraft. The activities in 2016 and 2017 will cover the tools development and verification, and initial modelling.

**WP 4 Major milestones:**

- TBD in 2015, in liaison with the Technology Evaluator

**WP 4 Major deliverables:**

- TBD in 2015, in liaison with the Technology Evaluator

**List of Leaders and participating affiliates**

Nr	Leaders	Description of activities
1	Airbus Helicopters S.A.S.	Consolidation of operational requirements and general technical specification. Preliminary architecture and sizing studies of the compound rotorcraft demonstrator. Preliminary investigation of flight physics, preliminary design of dynamic components, on-board energy systems, avionics and flight control system. Preparation of call topics in the corresponding work areas and first collaborative activities with selected Core Partners & Partners.
2	AgustaWestland S.p.A.	Development of complementary conceptual design and architectures for a next generation of civil tilt-rotor in coordination with AW Ltd. Further definition of technical, operational and environmental requirements as well as general vehicle technical specifications with a view to engage core partners and partners.
3	AgustaWestland Ltd.	Development of complementary conceptual design and architectures for a next generation of civil tilt-rotor in coordination with AW SpA. Further definition of technical, operational and environmental requirements as well as general vehicle technical specifications with a view to engage core partners and partners.

Nr	Participating Affiliates	Description of activities
1a	Airbus Helicopters Deutschland GmbH	Contribution to general technical specification and preliminary architecture and sizing studies of the compound rotorcraft demonstrator, in collaboration with AH-SAS. Preliminary design of airframe (architecture, design and sizing), contribution to studies of aerodynamics, on-board energy systems, fuel system, cabin layout, avionics and flight control system. Preparation of call topics in the corresponding work areas and first collaborative activities with selected Core Partners & Partners.
1b	Airbus Helicopters Polska (AH-P)	Contribution to FRC Consortium Management (WP0) and to the design of Drive System (WP2.6)
2a	PZL-Swidnik S.A.	Supporting activities foreseen to AW SpA and AW Ltd on airframe and structures topics, following general architecture requirements.



## 9.4. ITD AIRFRAME

In the Smart Fixed Wing project in *Clean Sky*, a more efficient wing with natural laminar flow, optimised control surfaces and control systems will be demonstrated. Also, novel engine integration strategies will have been derived and tested, and innovative fuselage structures investigated. Progress towards the 2020 targets will be significant, but efforts remain necessary - in particular for the most complex and challenging requirement on new vehicle integration – to reach these objectives and start towards the 2050 SRIA goals. The Airframe ITD will target significant gains in the following areas:

- Introducing innovative/disruptive configurations enabling a step-change in terms of efficiency
- Developing more efficient wings: Further important gains can be obtained combining:
  - Weight-optimized use of composites on very high aspect ratio wings,
  - Cost effective production of laminar wings and use of hybrid laminar flow technology,
  - Full scale demonstration of the aero efficiency of low cost wings and of high-lift wing concepts
- Developing fuselages with optimized usage of volume and minimized weight, cost and environmental impact. Step changes in efficiency and environmental impact are expected from:
  - Optimized shapes of fuselage and cockpit,
  - Optimized use of metallic and composite materials,
  - New integration of components and systems, as well as advanced integrated structures
- Developing an enhanced technology base in a transverse approach towards airframe efficiency to feed the demonstrators on synergetic domains such as:
  - Efficient wing technologies,
  - Hybrid laminar flow technologies,
  - New production and recycling techniques,
  - Progress on certification processes and associated modelling capacities which will be key to facilitate the market access of future step changes.

All those streams have shown feasibility to be developed into a more complex and demanded structural components to be used into Clean Sky 2 platforms.

Until mid-2015, Technical requirements for key contributions from Core Partners will be scoped and described, then discussed with the selected core partners in order to infer the technical description of planned developments from Core Partners.

Based on a successful selection of the first batch of core partners, those activities will be continued in 2015 with inserting analysis from engaged Core Partners, with the target to achieve the preliminary definition of first scheduled demonstrators. Trade-offs analysis will consolidate the definition of selected concepts, behavior analysis will support the study of

advanced integration of system in structure and MDO approach will support the demonstration specification phase to be initiated in 2015.

Due to the large scope of technologies undertaken by the Airframe ITD, addressing the full range of aeronautical portfolio (Large passenger Aircraft, Regional Aircraft, Rotorcraft, Business Jet and Small transport Aircraft) and the diversity of technology paths and application objectives, the technological developments and demonstrations are structured around 2 major Activity Lines, allowing to better focus the integrated demonstrations on a consistent core set of user requirements, and, when appropriate, better serve the respective IADPs:

- Activity Line 1: Demonstration of airframe technologies focused toward High Performance & Energy Efficiency; Related Technology Streams are noted “A” hereafter.
- Activity Line 2: Demonstration of airframe technologies focused toward High Versatility and Cost Efficiency. Related Technology Streams are noted “B” hereafter.

### **Technology Stream A-1: Innovative Aircraft Architecture**

The activities will first focus on the selection of routes for the advanced optimization of engine integration on rear fuselage and on advanced power-plant solutions (UHBR and CROR) to achieve a significant gain in aircraft performance (aerodynamics, acoustics, weight). All enabling simulation and testing technologies to achieve this goal will be developed or if already existing adopted to the given needs. From pure technology perspective all necessary investigations will be performed which support a complete characterization of the advanced power-plant solutions, such as wind tunnel tests, acoustic test or dedicated component tests. Preliminary definition of requirements for advanced efficient certification process will be elaborated.

### **Technology Stream A-2: Advanced Laminarity**

The activities will first focus on the selection of a representative configuration for demonstration of laminar nacelle and initial investigation of manufacturing technologies / potential partners in order to identify the most suitable for reliable production of high quality/low tolerance external surface. Initial specification of a representative demonstration will be developed in 2015, in parallel to the investigation on operational aspects (e.g. ventilation and accessibility) linked to repositioning of operational hatches in the non-laminar zone. For the Natural Laminar Flow (NLF) smart integrated wing, definition and preparation of work for ground tests with respect to structure and systems verification and validation will be performed. Based on a preparation phase in 2014 performed in German funding project scheme, the plan is to perform in this work package in 2015 a flight test with a NLF Horizontal Tail Plan mounted on A320 to validate the chosen structural concept.

### **Technology Stream A-3: High Speed Aircraft**

The initiation works will first focus on fuselage structures with new materials. First material characterization and analysis on structure's design will start in 2015. Initial work on new

concepts for Design for Manufacturing will be started focusing on door structures and integration. Preliminary concepts of optimization of complex shape structure of rear fuselage will be identified in 2015. With respect to wing, initial investigation will address high aspect ratio wing for large civil aircraft with structure efficient, stringer dominated design. Innovative architectures for tail plane stabilizers and ailerons for large passenger aircrafts will also start to be assessed. In 2015, wing planform, structure concepts and system/moveable integration for a high aspect ratio wing will be matured. Based on the most promising tails architectures elaborated in 2014 the initial shape design will take in place in 2015. In terms of ECO Design two main activities will be carried out:

- Elaboration of a list of new technologies not considered on Clean Sky / Eco-Design ITD and promising in terms of environmental benefits. Selection of the most promising for a development after 2015.
- Studies on the viability of re-using recycled Carbon Fibres in aeronautical or aerospace products will be started.

#### **Technology Stream A-4: Novel Control**

The activities will first focus on strategies selection for load alleviation and concept identification for integrated movable surfaces. Analysis of control techniques and system architecture for load alleviation will start in 2015. Initial design work of an integrated slat will start in 2015. In 2014 activities will concentrate on the definition of wing concepts featuring an active winglet for load and span control. Based on this preliminary concept phase, the work in 2015 will focus on initial wing/winglet aero shape design and the definition of folding kinematics and movables concepts.

#### **Technology Stream A-5: Novel Travel Experience**

The activities will first focus on the identification of the key enablers and technology drivers that will support the flexible, ergonomic and attractive cabin. Passenger behavioral analysis and specification of innovative equipment will start in 2015. Human factors related with cabin, systems and structure integration will be studied.

#### **Technology Stream B-1: Next generation optimized wing**

The activities will first focus on the consolidation of the activity plan and the integrated approach with the R-IADP for the new outer wing concept including wing, winglet, aileron and spoiler. In addition, the capabilities required for a call for core partners to support Out of Autoclave (OoA) composite manufacturing and multifunctional design applicable to the mentioned components will be described (based on previous experience in CS and national projects), in conjunction with the starting of the OoA SAT activities as describe in the SAT dedicated chapter of the present Work Plan. These activities will concurrently address the integrated approach with the FRC-IADP for the specific concept of a wing providing additional lift as suited for the compound rotorcraft demonstrator. A Core Partner able to design and manufacture and deliver this full scale flightworthy wing for the compound rotorcraft will be called and engaged.

Based on the state-of-the-art of applied flow control technologies, developed so far in European and National research projects, the activities in 2015 will concentrate clearly on the robust design of the most promising flow control technologies, capable of being integrated and tailored to the objectives set in the IADP-LPA, Platform 1.

### **Technology Stream B-2: Optimized high lift configurations**

The activities will first focus on the consolidation of the activity plan and the integrated approach with the R-IADP for a new morphing flap and multifunctional nacelle cowlings. SAT High Lift Wing activities will start (refer to the SAT dedicated chapter of the present Work Plan). In addition, the capabilities required for a core partners to support the definition and manufacturing of this flap will be described. One call for core partner will be launched covering the needs of B-1 and B-2.

In 2015, for B-1 and B-2, the structural preliminary design of the mentioned components will be launched, in parallel with the work at the RA IADP, that will perform the necessary trade-offs to define flap/winglet/etc, concepts. Based on MDO approach, the wing/ flap structural preliminary design will start during 2015.

### **Technology Stream B-3: Advanced integrated structures**

The activities will first focus on the technical description of activities as well as capabilities required for Core partners in more electrical wing. Secondly, they will cover in wing system installation, electrical distribution, actuation systems, structure embedded SATCOM, and anti-ice systems.

Capitalizing on the CS activities in the cockpit, in 2015 will be performed the analysis of the electrical behavior of the composite cockpit and development of the electrical structural network and the definition of the detailed technical specifications for the systems included in the cockpit as well as the more electrical wing (actuation, morphing devices, electrical distribution, cockpit system installation and SHM) and nacelles. Cockpit noise attenuation means will be investigated.

SAT activities related to advanced integration of System and affordable manufacturing will start (refer to the SAT dedicated chapter of the present Work Plan).

Activities concerning the Integration of Systems in Nacelle (WP B-3.3), in 2015 will consist of the technical specifications for the systems (e.g. Anti-Ice, Acoustic liner) to be included in the Nacelle together with the definition (preliminary) of the testing campaigns (Full Scale Demonstrators) and Test Plans.

### **Technology Stream B-4: Advanced fuselage**

**B-4.1.** In 2014, the general specification of the rotor-less tail for the compound rotorcraft demonstrator will be derived as part of the coordinated activity with the FRC-IADP. The Core Partner joining the Consortium to support OoA composite manufacturing and

multifunctional design (see WP B1.1) will also be engaged for and tasked with the design and manufacturing of this flightworthy tail unit.

In 2015, the preliminary design and optimization studies of the tail unit structure will be completed. The PDR to be passed at the end of the year will validate the selected structural architecture and design. Two CFP Topics may be opened in 2015 in order for expert labs to further support the detailed design and optimization process and manufacturing activities in the subsequent steps of this WP.

**B-4.2.** Along with the activities associated to the definition of NextGenCTR's general architecture and technical requirements at major system level in Fast Rotorcraft IADP, trade-off studies and elaboration of configuration and requirements for pressurized fuselage will be done at a first stage. This work will be used to develop and issue technical specification to provide clear requirements to start design activities in the following period (2015). Down selection of key technologies will be part of this activity, together with the definition of major testing and validation activities planned for the following years. It is expected that one Call for Core Partners for the development of a large structural elements will be issued in 2015, complemented by CfP to address specific needs on design activities.

**B-4.3.** The technical description of overall activities as well as capabilities required for Core partners to be firstly involved within the More Affordable composite fuselage will be provided. The following activities will be performed: i) architectural trade-offs for fuselage preliminary definition considering the relevant technologies; ii) preliminary requirements for manufacturing tools in order to develop and set up the processes to be used for fuselage components; iii) preliminary requirements specification of methodologies for design, manufacturing, assembling, maintenance, repair for SHM technologies integration.

In 2015, the activities will focus on: i) fuselage conceptual design; ii) preliminary requirements for pilot fabrication facilities; iii) identification of methodologies for design, manufacturing, assembling, maintenance, repair of SHM integrated technologies on fuselage barrel.

**B-4.4.** The activities will first focus on the identification of the comfort key factors and technology drivers that will support in 2015 the innovative and integrated design approach for Multidisciplinary human centred Cabin as well as the Core Partners capabilities to be firstly involved.

**Major milestones planned for 2015:**

- Engagement of Core Partners
- Start of first demonstrator concept design (wing concept, laminar nacelle concept, NFL smart integrated wing & HTP, aileron concept, design for manufacturing concept, complex rear fuselage structure, high aspect ratio flexible wing, integrated system concept, integrated nacelle, composite fuselage concept, human centered cabin concepts) on the basis of Clean Sky OAD results

- Start of technology developments for airframe, components, composite structures and automated assembling in line with the SAT RA and Rotorcraft focused demonstration roadmap
- Initialization of technology developments
- AIRFRAME Annual Review
- Completion of preliminary design phase for structural components of the compound rotorcraft demonstrator, in coordination with the FRC-IADP

### **Major Deliverables planned for 2015:**

- Requirement specifications for Core Partner technical activities for the anticipated call batches in 2015. Foreseen topics are listed on table at end of this AIRFRAME section
- Concept guidelines for each of initial demonstrators
- High level description of initial technology developments
- Initial manufacturing requirements for key pilot items for more affordable composite fuselage
- Technical specifications for the systems to be included in the integrated Nacelle and definition (preliminary) of the testing campaigns (Full Scale Demonstrators) and Test Plans
- Topic descriptions for CFP n°1 and 2
- Manufacturability analysis and trials of highly integrated structural concepts for control surfaces tail plane stabilizers and wingbox upper covers, (based on the previous technology development performed in national research projects)
- Preliminary paper analysis of the effects of a highly integrated cabin on flight operators, passengers and users.
- Technical description and specification of pressurized fuselage for fast rotorcraft demonstrator
- Eco-Design: list of technologies/process selected for development after 2015

### **Implementation**

The activities in the Airframe ITD will be performed following the general principles of the Clean Sky 2 membership and participation.

Dassault Aviation, Airbus Aerospace and Defence (EADS-CASA) and Saab, as the ITD Leaders, will perform the main activities related to the technology development and demonstration in the ITD. Significant part of the work will be performed by Core Partners, supporting the ITD leader in its activities. Finally, another part of the activities will be performed by Partners through Calls for Proposals for dedicated tasks.

Dassault Aviation, Airbus Aerospace and Defence (EADS-CASA) and Saab, as the ITD Leaders, will sign the one Grant Agreement for Members (GAM) in order to perform the work. This GAM will cover all the work of the Members in this ITD. The Core Partners are selected through open Calls for Core Partners and the retained applicants will accede to the

existing Grant Agreement for Members. Partners will be selected at a later stage through Calls for Proposals and will be signing the Grant Agreement for Partners. They will be linked to the ITD activities through the Coordination Agreement.

### **Description of activities 2016-2017**

#### **▪ Management and interface A-0**

On **WP A-0.2** (BJ OAD and configuration management), following the reference aircraft design on 2015, a first aircraft project with use of innovative technologies will be designed as an overall aircraft evaluator and as an input for some of the other WP. (DAv)

On **WP A-0.4** (Eco-Design TA Link), this Management WP aims at coordinating and ensuring data provision for Eco Design Assessment within the ITD Airframe and to the TA Eco-design, following technology scoping, mapping and definition from the ITD into ED-TA technology streams. This WP defines also the link between Airframe and ECO TA Coordination Committee. (FhG)

#### **▪ Technology Stream A-1: Innovative Aircraft Architecture**

The activities link to **WP A-1.1** will mainly address the conceptual aspect of an optimised engine integration on rear fuselage for a BJ application. During 2016, tasks will be to establish a first list of concept candidates. For these tasks, the pros and cons will be estimated also the risks link to each concept. Based on this list, the first milestone will be a short list of concept candidates for the following. For 2017, studies will mainly focus on the structural aspect. Feasibility of the structural integration will be studied. (DAv)

On **WP A-1.2** (UHBR and CROR configuration) the evolution of UHBR integration technologies will take place targeting to achieve TRL3 and pre-TRL4 in the reporting period. The evolution of technologies takes place which will enable to achieve the economic viability for the integrated CROR engine. The maturity level for the respecting technologies and the according rear-end will be assessed at a pre-TRL3 (2016) and a TRL3 (2017) at technology level as well as on aircraft level (technologies integrated into rear-end). (AIB)

On **WP A-1.3** (Novel High Speed Configuration), studies in 2016 will establish of a list of aircraft architectures to study through high level trade-off. The main goal of 2016 is to define which kind of studies, tests and demos are needed to increase the TRL of the innovative aircraft architecture. 2017 tasks will be about designing a first BJ aircraft configuration at an OAD level. (DAv)

On **WP A-1.4** (Novel certification processes) after the initial studies on the concepts of operation performed in 2015 for the five sub work packages WP1 to WP5, the 2016-2017 work will move to active prototyping of the retained concepts. (DAv, Airbus)

In addition, after collection of requirements and set-up of models, the activities will also focus on advanced simulation techniques for supporting certification issues considering concrete scenarios defined with the project partners. (FhG)

## ▪ **Technology Stream A-2: Advanced Laminarity**

In the frame of **WP A-2.1** (Laminar nacelle), the design and validation of a structural concept of laminar nacelle for BJ will be carried out with the partner selected through CfP W1. In complement a flight test demonstration will be conducted on 2017 for aerodynamic validation. (DAv)

In the frame of **WP A-2.2** (NLF smart integrated wing) and **WP A-2.3**, the activity will be detailed with the CP selected through the CPW1 (CP). The activity will then be launched on 2016. (AIB)

On **WP A-2.2** in addition, the on-going NLF concept will develop with a more comprehensive design. Development and verification trials will be conducted to validate the long term airworthiness. Small scale manufacturing trials will be conducted using existing BLADE tools. (SAAB)

Major activities in this WP are related to plan, prepare and perform a ground test, thermal test and a wing bending test. Also the tooling plan & the supply chain support plan will be prepared. For refurbishment of the aircraft the preparation of the post laminar wing plan will take place. (AIB)

On **WP A-2.3** the activities will further develop technologies aiming at improving aerodynamic efficiency of lifting surfaces. (AIB, FhG)

In addition, after the successful flight test in 2015, validating the structural concept of the NLF HTP, including the filler concept and its application (between leading edge and box), the next step is to study in the reporting period surface quality effects on laminarity (roughness, filler shape, 3D disturbances) by flight testing. Another activity will focus on the component design and test set-up for a Krueger leading edge device under icing conditions. (AIB)

## ▪ **Technology Stream A-3: High Speed Aircraft**

In the frame of **WP A-3.1** (Multidisciplinary wing), preliminary design of the BJ Wing root box demonstrator will be continued on 2016 with a PDR mid-2016. The detailed design will start with a CDR mid-2017. (DAv)

In addition, demonstration of benefits, drawbacks and showstoppers of a LPA wing with high aspect ratio and flexibility will start. This includes integrated overall design & analysis, structural design and manufacturing concepts to evidence the feasibility of a highly efficient adaptive wing with a realistic industrial business case. This is a follow-up to CS1 activities in order to push the TRL level from 3 to 6. The activities for the second topic, the functional driven movables layout for future aircraft concepts, will be coherent to the design concepts of the high-aspect ratio wing. (AIB)



In addition, design concept for an innovative large Aileron structure, evolved from the multispar A320 Aileron concept will be done. Out of plane strength for a large aileron structure will be demonstrated through analysis and supporting stress/coupon tests (SAAB)

In the frame of **WP A-3.2** (Tailored front fuselage), BJ innovative front fuselage architecture and technology candidates will be defined and evaluated. (DAv)

In the frame of **WP A-3.3** (Innovative shape & structure), preliminary design of the BJ fuselage wing box demonstrator will be continued on 2016 with a PDR mid-2016. The detailed design will start with a CDR mid-2017. In parallel the manufacturing of some parts will start on 2016 and will continue over 2017. (DAv)

The work on the design concept for an innovative aircraft door structure and its integration will continue (SAAB).

In the frame of **WP A-3.4** (Eco-Design for airframe), after finalisation of *Clean Sky* / EDA planned in 2015, a new cycle of technology development for environmental purposes will be launched. New technology candidates will be highlighted, evaluated and the trade-off will be concluded by the selection of the most promising candidates. In parallel improvement of the *Clean Sky* / EDA LCA tools and database will be continued. The activity will be conducted with the CP selected through the CPW02. (DAv)

In the context of Eco-Design for Airframe – “Re-use of Thermoplastics”, main activities will be oriented on developing new processes, methods, manufacturing & recycling technologies that enable “Green” manufacturing, maintenance and disposal. (AIB)

In addition, data for Eco balance and assessment will be gathered from possibly all technologies of Airframe A+B and delivered to Eco TA. (FhG)

#### ▪ **Technology Stream A-4: Novel Control**

In the frame of **WP A-4.1** (Smart Mobile Control Surfaces) activity of the ST CPW01-AIR-01-02 (Optimised Ice Protection Systems Integration in Innovative Control Surfaces) will be carried out on the validation at TRL6 of an inner wing leading edge running wet mixed energy thermal ice protection system through WTT on a representative demonstrator. Work on a business jet S-duct ice protection system will be initiated. (DAv, AIB)

For business aircraft, vibration control has been studied in *Clean Sky* / SFWA and efficiency will be partially demonstrated within this project. Further demonstration will be performed in order to fully validate the vibration control technology efficiency during flight tests on scale 1 aircraft in the frame of **WP A-4.2** (Active Load Control). Enhanced gust load alleviation and flutter control functions will be studied in order to obtain significant gains on the A/C structural weight as initiation of development of control laws. (DAv)

Regarding load control, the work will also focus on the implementation of data acquisition and processing, considering reduction of required bandwidth/storage but still reliable enough reliable for determination of fatigue behaviour of CFRP. (FhG)

In addition, advanced design for gust load alleviation by means of active winglet will be studied for LPA application. (AIB)

#### ▪ **Technology Stream A-5: Novel Travel Experience**

In **WP A-5.1** (Ergonomic Flexible Cabin) personalised thermal comfort and occupational well-being will be analysed. New ergonomic concepts for maximum flexible cabins require the adequate consideration of physiological and perceptual aspects of the human being in aircraft cabins. Therefore models for the evaluation of comfort and well-being with respect to the thermal cabin environment will be developed and evaluated. (FhG)

In addition, in the frame of WP 5.1.1 (Human Centred Cabin), the activity will focus on: (AIB)

- Crew fatigue Investigations, which summarizes crew stressors, their effects on fatigue and stress, as well as resulting errors and health problems
- Generation of a culture specific cabin catalogue that goes beyond the current design for western 5%-95% percentile passengers
- Pre-integration of 37" PRM lavatory and multifunctional seat bench
- In the frame of WP 5.1.2 (Cabin Infotainment and Operations (former "Immersive Cabin Services")), activity will focus on (AIB):
- Cabin System Integration of a unique set of technology applications for integrating a new class of passenger owned devices in a relevant, real-like environment (demonstrator).
- Perform V&V tests to demonstrate that the connection between the user, the interface device, the interface layer, the aircraft server platform and the connectivity solutions are working in a relevant environment and may be adapted for commercial purposes.

For **WP A-5.2** (Office Centred Cabin) technology concepts defined along 2015 activity will be studied. Examples of areas are: high modularity equipment for multi-functionality, organization of the sound in the cabin for comfort purpose.

The development of a cabin evaluation bench for innovative systems evaluation will be started. (DAv)

In the frame of *Clean Sky* / Eco-Design a thermal modelling platform has been developed allowing evaluation of temperature over the a/c. An extension of the modelling tool to the passenger cabin including a human thermal model will be started. (FhG)

Further, considering the cabin as "multifunctional comfort cocoon" for the passengers, the system for wireless energy and data transmission will be further developed. (FhG)

#### **Management and interface B-0**

Within the Different sub-packages general Management activities and coordination in this ITD and for the transversal activity e.g. to support focused work on partner projects will be performed.

▪ **Technology Stream B-1: Next generation optimized wing**

For the **WP B-1.1** (Wing for increm. lift & transmission shaft integration) supporting activities in the fields of design and stress, manufacturing- and material technologies to the CP activities are taking place. The important Critical Design Review has to be performed end of 2016 to allow start of the manufacturing phase in 2017. Activities in the frame of certification have to be monitored and supported (e.g. setting up of test-pyramid) and the start of the manufacturing phase has to be accompanied. (AH-D)

For the **WP B-1.2** (More affordable composite structures) during 2016 the material and process selection will be completed including some manufacturing trials. In parallel, a preliminary sizing of the wing box will be developed. For usage thermoplastics in secondary structures, activities in 2016 will be focused on testing and verification. For 2017, activities are related to a design and manufacturing of precise thermoplastic parts and development of effective joining and mounting methods (SAT).

For the **WP B-1.3** (More efficient Wing technologies) the selected concept for morphing winglets will be developed to achieve a final design during 2017 and start the manufacturing. The highly integrated actuation system to control surface tabs with EMAs will start its development, with the target to start testing and integration phase at the end of 2017. This will be closely linked with the activities started by the two CPs (CASA).

The smart repair patch will be further developed, considering an integrated and synergetic SHM approach. The component will be designed and manufactured (FhG).

For the **WP B-1.4** (Flow & shape control) development of the Loads Alleviation and morphing leading edge will spread all along the 2016/17 period, with the aim to start testing and integration phase at the end of 2017 (CASA).

Regarding morphing several models will be further developed, investigated and down-selected. The final result will be frozen with all necessary drawings ready for manufacturing. Fluidic actuators for AFC will be further developed and a first prototype will be manufactured and tested. Morphing activities will be supported by partners through CfP. (FhG)

▪ **Technology Stream B-2: Optimized high lift configurations**

For the **WP B-2.1** (High wing / large Tprop nacelle configuration) during this period the development of the engine mounting and cowling will be performed considering interface requirements from the selected Nacelle. In addition, integration of ice protection based on heat transport devices (Loop Heat pipes) into the engine air intake will be concluded (CASA).

For the **WP B-2.2** (High lift wing) the selected concept for wing box will continue its development with the aim to achieve a final design during 2017 and start the manufacturing of

its components. The highly integrated actuation system to control Flaps with EMAs will start its development, with the target to start testing and integration phase at the end of 2017. This will be closely linked with the continuation of activities started by the Core Partners (CASA).

For SAT, activities in 2016/ 2017 will be mainly provided by Core partner. During 2016 the material and process selection will be completed. The activity will also include some manufacturing trials to support the selection. In parallel in 2016/2017 a preliminary sizing of the wing box will be developed. For usage thermoplastics in secondary structures of small aircraft, activities in 2016 will focus on testing and verification of thermo-mechanical properties of selected thermoplastic materials. The activities planned for 2017 are related to a design and manufacturing of precise thermoplastic parts and development of effective joining and mounting methods.

#### ▪ **Technology Stream B-3: Advanced integrated structures**

For the **WP B-3.1** (Advanced integration of system in nacelle) consolidation of the Nacelle Integrated systems requirements for the design, manufacturing, assembling, maintenance and repair has been done. Design of Test articles for composite materials and acoustic treatment technologies with start of demonstrator manufacturing will be carried out. (ALA)

For the **WP B-3.2** (All electrical wing) the highly integrated actuation system based on EMAs to control aileron and spoiler will continue the development phase, with the target to start testing and integration phase at the end of 2017. The integrated electrical distribution, HVDC (High Voltage Direct Current), selected will continue its development to achieve a final design during 2017. In addition, for SATCOM and Ice protection both embedded in the structure, the design will be concluded (CASA).

The smart hybrid ice-protection system will be further enhanced and electro-thermal simulation will be further optimized. A CDR will be performed for a frozen design of the ice-protection system ready for manufacturing and integration. Also, for the network for power supply and information system for AFC a preliminary design (PDR) will be performed. (FhG)

For the **WP B-3.3** (Advanced integrated cockpit) the target for this period is to have a design frozen to start manufacturing at the end of 2017. In addition, a Structural Health Monitoring System (SHMS) will start the development phase. The aim of this phase is to reach a level of maturity that allows starting test and integration phase at the end of 2017. All this will be closely linked with the continuation of activities started by the Core Partners (CASA).

In the frame of this WP, four projects are launched with the aim to define new innovative process such as: New Structural bonded repair of monolithic composite airframe, On line NDT, New Enhanced composite material and Netshape composite structure. (AIB)

Also first numerical results of simulation of different materials subjected to extreme conditions will be delivered (including bird-strike and hail / debris impact and lightning strike) (FhG)

For the **WP B-3.4** (More affordable small A/C manufacturing) the main mission will be cooperation with CfP partner selected on development, implication and testing of the orientation system and simplified programming system for robotic hand. At the end of 2017, works on platform –hand –accessories integration and first programming and testing will start. In 2017, the activities related to development of the joining methods will continue. Simultaneously, development of the sizing methodology for analytical prediction of the connection behavior will be initiated. At the beginning of 2016 suitable shapes of sheet metal flange embossment from shape variants will be selected.

In addition, at the end of 2017, work on design of the advanced experimental assembly will start. (SAT)

For the **WP B-3.6** (New materials and manufacturing) the activities dealing with technologies related to eco-efficient factories, assisted composite manufacturing, future leakage identification systems, integration of testing systems on iDMU and automated testing technologies will spread with the aim to achieve a sufficient TRL to be applied for the different demonstrators (CASA).

Specimen of laser sintered material will be manufactured and tested. Methodologies for local composite reinforcement via innovative fibre placement technology will be also investigated. Choice and evaluation of specific CrVI-free anodizing processes depending on designated industrial use will be performed. (FhG)

#### ▪ **Technology Stream B-4: Advanced fuselage**

For the **WP B-4.1** (Rotor-less Tail for Fast Rotorcraft), during 2016 the Detailed Design phase will be carried out by AHE and its CP and will finish with a CDR. In parallel to the detailed design activities, it will be performed the development and delivery of Prototype manufacturing moulds for every single part and the assembly tooling. During 2017 the Assembly activities will be developed also.

For the **WP B-4.2** (Pressurized Fuselage for Fast Rotorcraft), in 2016 AW shall complete the requirements definition for the pressurized fuselage for the front, centre and aft sections. This activity will lead to the systems requirement review (SRR) to take place in 2016. Subsequently AW and Partners shall perform preliminary design of the aforementioned segments to include technology trade-studies, manufacturing planning, tooling definition, test planning and infrastructure planning. The culmination of these activities will lead to a preliminary design review (PDR).

For the **WP B-4.3** (More affordable composite fuselage), the “Design Against Distortion” will be studied. In the context of part distortion prediction, the activities will be focused on topology optimisation accounting for distortion and shape and lay-up optimisation accounting for distortion (AIB).

In addition, election of methodologies and technologies for NDI/SHM, repair, maintenance, reducing of environmental impact, low cost manufacturing and assembling; consolidation of

pilot fabrication facilities requirements for fuselage components manufacturing; design and manufacturing of coupons and element, then design of sub-components (ALA).

Cabin acoustic performances will be further improved after preliminary analysis of vibration and noise source/paths and acoustic characteristics (FhG).

For the **WP B-4.4** (Affordable low weight, human centered cabin), activities regarding composite material and cabin comfort and environment will further conducted. Local (seat environment) air-quality analysis (temperature and humidity) and conditioning will be performed. Associated technologies and controls for integration in new cabin layouts will be developed. Cabin acoustic performances will be further improved. Active methodologies will be employed. Structural integrity will be investigated by means of SHM methodologies: Optical fibres and PZT sensors will be integrated after sensor network design and signal characterisation. (FhG)

In addition, definition of main cabin items requirements; definition and development of materials/process for cabin interiors; preliminary definition of small scale test for the mechanical/physical/chemical characterization. Definition of main a/c interfaces; optimization of N&V treatments; manufacturing of materials coupon elements and the small-medium test campaign for green materials characterization; definition of virtual platform for cabin interiors (ALA).

### ***Main AIRFRAME Milestones***

#### **High Performance & Energy Efficiency (HPE) activity line**

- WP A-1.1: Choice of concepts for more detailed studies (December 2016) - DAv
- WP A-1.2.1 TRL3 summary on identified UHBR integration technologies (November 2016) - AIB
- WP A1.2.1 Pre-TRL4 summary on identified UHBR integration technologies (November 2017) - AIB
- WP A-1.2.2 Pre-TRL3 summary on route to economic viability technologies (November 2016) - AIB
- WP A-1.2.2 TRL3 summary on route to economic viability technologies (November 2017) - AIB
- WP A1.2.2 Pre-TRL3 summary on route to economic viability integrated rear end (November 2016) - AIB
- WP A1.2.2 TRL3 summary on route to economic viability integrated rear end (November 2017) - AIB
- WP A-1.3: Definition of the a/c architecture 2017 studies (Dec. 2016) - DAv
- WP A-2.1: CDR of the BJ laminar nacelle demonstrator – DAv/CP
- WP A-2.1: Flight test for the BJ laminar nacelle – DAv/CP
- WP A-2.2: Wind tunnel test object manufactured (mid 2016) - SAAB
- WP A-2.2: Freeze design and materials for anti- and deicing system (mid 2017) - SAAB
- WP A-2.2: Aircraft ready for flight test (November 2016) – AIB
- WP A-2.3: Flight test performed with NLF HTP, investigating operational limits (mid 2016) - AIB

- WP A-3.1: PDR, CDR of the BJ wing root box demonstrator
- WP A-3.3: PDR, CDR of the BJ fuselage wing box demonstrator
- WP A-3.1: Aileron tooling concept demonstrated on a technology demonstrator level (late 2016) - SAAB
- WP A-3.1: PDR Aileron concept (late 2017) – SAAB
- WP A-3.1: TRL Reviews (TRL4-6) - AIB
- WP A-3.3: Freeze design and material for AM demonstrator (late 2016) - SAAB
- WP A-3.3: Small level demonstrations of methods/technologies to be used on door demonstrator (2017) - SAAB
- WP A-3.3: PDR Door concept (late 2017)- SAAB
- WP A-3.4: End of technology trade-off for green technologies - DAv
- WP A-4.1: CDR, TRR for WTT of wing leading edge with mixed energy thermal ice protection system - DAv
- WP A-4.2: Flight tests for vibration control for business jet application – DAv
- WP A-4.2 Gust load alleviation means for single aisle aircraft, TRL5 (December 2016) - AIB
- WP A-5.2: PDR, CDR of the cabin systems evaluation bench - DAv

### **High Versatility and Cost Efficiency (HVC)**

- WP B-1.1: PDR/CDR for Wing Structure and ailerons - AH
- WP B-1.2: Wing design concept and preliminary sizing - SAT
- WP B-1.3: PDR/CDR for EMA actuation and winglet morphing - CASA
- WP B-1.4: PDR/CDR Loads alleviation and morphing leading edge - CASA
- WP B-1.4: First actuator prototype (Q3 2017) - FhG
- WP B-2.1: PDR/CDR Engine mount and cowling and LHP ice protection - CASA
- WP B-2.2: PDR/CDR Flap actuation and wing box - CASA
- WP B-2.2: Preliminary design of the demonstration and high lift design - SAT
- WP B-3.1 Test articles for Nacelle composite materials and acoustic treatment PDR/CDR - ALA
- WP B-3.2 Design of the IPS (Q4 2017) - FhG
- WP B-3.3 Lightning strike simulation concept (Q2 2017) - FhG
- WP B-3.4 Production of first part with embossed flange - SAT
- WP B-3.6 Prototypes manufacturing (Q4 2017) - FhG
- WP B-4.1: PDR/CDR for LifeRCraft Rotorless Tail - AH-E
- WP B-4.2: SRR/PDR for Pressurized Fuselage - AW-SpA
- WP B-4.3: Design & Development of SHM and LM (Q4 2017) - FhG
- WP B-4.3: Defined HPC based NDI/SHM platform architecture for fuselage design - ALA)
- WP B-4.4: Definition of cabin interiors HCDA (Human Centred Design Approach) with relevant Innovative Technologies (Acoustic and green material) for regional aircraft - ALA
- Main AIRFRAME Deliverables
- High Performance & Energy Efficiency (HPE) activity line
- WP A-0.2: Document with aircraft definition. This aircraft is defined by integration of innovative technologies from other WP as laminar nacelle or optimal engine integration on rear fuselage (December 2016) - DAv

- WP A-1.1: Document with definition of conceptual designs for optimal engine integration on rear fuselage (December 2016) - DAv
- WP A-1.3: Document with one aircraft definition (novel high-efficiency configurations) (December 2017) - DAv
- WP A-2.1: Synthesis report on the BJ laminar nacelle - DAv
- WP A-2.2: Wind tunnel test results from testing of reference wing profile object (late 2016) - SAAB
- WP A-2.2: Ice wind tunnel test results (late 2017) - SAAB
- WP A-2.2: Tooling plan & supply chain support plan (Nov. 2016) - AIB
- WP A-2.2: Post laminar wing plan (May 2017) - AIB
- WP A-2.3: Flight-test validation results for structural concept of leading edge for NLF HTP - AIB
- WP A-3.1: PDR, CDR reports of the BJ wing root box demonstrator - DAv
- WP A-3.1: PDR Aileron concept late 2017 – SAAB
- WP A-3.1: Feasibility assessment of ultra-efficient integrated adaptive wing – Annual Progress reports - AIB
- WP A-3.3: PDR, CDR reports of the BJ fuselage wing box demonstrator - DAv
- WP A-3.3: Manufacture of AM demonstrator late 2017 - SAAB
- WP A-3.3: PDR Door concept late 2017 - SAAB
- WP A-3.4: Green technologies trade-off report - DAv
- WP A-4.1: TRL 6 validation of wing leading edge with mixed energy thermal ice protection system - DAv
- WP A-4.2: TRL 6 validation of vibration control for business jet application - DAv
- WP A-5.2: PDR, CDR reports of the cabin systems evaluation bench - DAv

### **High Versatility and Cost Efficiency (HVC)**

- WP B-1.1: PDR/CDR for Wing Structure and ailerons report - AH
- WP B-1.2: Wing design concept and preliminary sizing - SAT
- WP B-1.2: Production process design and simulation - SAT
- WP B-1.3: PDR/CDR EMA actuation and winglet morphing reports - CASA
- WP B-1.4: PDR/CDR Loads alleviation and morphing leading edge reports - CASA
- WP B-1.4: Final design and CFD/CAA results (Q4 2017) - FhG
- WP B-2.1: PDR/CDR Engine mount and cowling and LHP ice reports - CASA
- WP B-2.2: PDR/CDR Flap actuation and wing box reports - CASA
- WP B-2.2: Preliminary design of the demonstration and high lift design - SAT
- WP B-3.1: Nacelle composite materials and acoustic treatment specification requirements - ALA
- WP B-3.2 Report of detailed design of the IPS (Q3 2017) - FhG
- WP B-3.4 Simplified programming system for robotic hand - SAT
- WP B-3.4 Progress report detailing the results of numerical and experimental investigations (Q2 2017) - FhG
- WP B-3.6 Progress report on design process and numerical analysis for a generic component under dynamic load (Q4 2017) - FhG
- WP B-4.1 PDR/CDR of the Rotorless Tail reports - AH-E
- WP B-4.2 SRR Pressurized Fuselage reports - AW-SpA
- WP B-4.3: Development of Actuator (Q4 2017) - FhG



- WP B-4.3: Design and development of SHM and LM (Q4 2017) - FhG
- WP B-4.3: Drawings and CAD Models of sub-components including sensors locations - ALA
- WP B-4.4: Multifunctional regional Interior Cabin systems innovative technologies and Cabin System Specification - ALA

### List of Leaders and participating affiliates

Nr	Leaders	Description of activities
1	Dassault Aviation	The main Dassault Aviation activity is focused on the design of the composite wing root box demonstrator with definition of manufacturing tools and of partial tests. For the fuselage wing box demonstrator a trade-off will be carried out between the composite and aluminium alloy concepts. Other activity will consist in preparation and initiation of activity related to novel certification process, advanced laminarity and novel control. A functional analysis of the business jet cabin will be carried out to prepare the future activity on the office centered cabin.
2	Saab	Saabs activities in ITD Airframe will focus on three important WPs in TS2 and TS3. The activities will mainly be devoted to definition of the demonstrators and technology development needed to meet the technology readiness level. Technology development to be started will focus on further development of the novel NLF panel tools and fixtures for advanced manufacturing of high quality surfaces, definition of a test section for a multifunctional leading edge structure, definition of a highly integrated composite aileron demonstrator and definition of a large door structure to demonstrate design for manufacturing technologies, assembly and additive manufacturing.
3	Fraunhofer	The start will focus on the definition of requirements and specifications, along with the industrial partners, for the technology development foreseen. Further, activities like Structural Health Monitoring, enhanced high lift surfaces (morphing concepts for leading edge and specific material application, actuators for active flow control, CFD and CAA, ), ice-protection, active acoustics for cabin applications, composite enhancement considering fatigue properties and impact/lightning simulation, laser sintering and eco friendly anodising process will be developed considering current and future TRL. All this with the objective of improving their economic impact by a tight cooperation with Eco-design TA.
5	Airbus SAS	Identification of candidate technologies enabling UHBR Engine efficient integration into the Aircraft. Mature technology candidates enabling a viable CROR Aircraft up to TRL2.
9	Airbus Defence and	The activities in HVCE Airframe will be devoted to the

Nr	Leaders	Description of activities
	Space S.A.U. (EADS CASA)	conceptual and preliminary phases of the different technologies to be developed in CS2, using conceptual design information from RA IADP. Technologies to be started will be OOA external wing box, adaptative winglet, multifunctional flap, more electrical wing and more efficient/ green manufacturing techniques. In addition management of Airframe HVCE part.
11	Alenia Aermacchi	Activities will be devoted to the definition of preliminary requirements of advanced methodologies and technologies addressed to fuselage structures, to the integration of systems in nacelle and to the definition of key cabin drivers for passenger/crew and wellbeing in the cabin of regional aircraft. A preliminary concept design for fuselage and nacelle will be developed. For cabin, small-scale test activities on samples will be executed. Preliminary requirements of pilot fabrication facilities will be also defined.
12	Piaggio Aero	Management of SAT activities incl. CfP. Configuration of ref. SAT A/C. Material & Process Selection Low Cost Composite. Innovative high lift device for SAT trade-off and selection.
13	Evektor	Management of SAT activities incl. CfP. Configuration of ref. SAT A/C. Material & Process Selection Low Cost Composite. Innovative high lift device for SAT trade-off and selection. Definition of requirements and trade off studies in Cabin comfort topic.
14	AgustaWestland S.p.A.	Development of complementary airframe and structural concepts and architectures for a next generation of civil tiltrotor, in coordination with AW Ltd and in liaison with FRC IADP requirements, with a view to engage core partners and partners.
15	AgustaWestland Ltd.	Development of complementary airframe and structural concepts and architectures for a next generation of civil tiltrotor, in coordination with AW SpA and in liaison with FRC IADP requirements, with a view to engage core partners and partners.

Nr	Participating affiliates	Description of activities
4	Airbus Operations SAS	<p>Identification of candidates technologies enabling UHBR Engine efficient integration into the Aircraft.</p> <p>Mature technology candidates enabling a viable CROR Aircraft up to TRL2.</p> <p>Plan, prepare and perform for laminar outer wing, the removal of existing wing, the laminar outer wing join up and wing systems and flight test instrumentation equipping.</p> <p>Demonstration of benefits, drawbacks and showstoppers of a wing with high aspect ratio and flexibility. This includes integrated overall design &amp; analysis, structural design and manufacturing concepts to evidence the feasibility of an highly</p>

Nr	Participating affiliates	Description of activities
		efficient adaptive wing with a realistic industrial business case. Studies of active winglet for load control purposes. Transfer of SARISTU AS03 outcome from regional A/C reference towards large passenger A/C solution in terms of future industrialisation.
4a	Airbus Group SAS	Contribution to the identification of candidate technologies enabling UHBR Engine efficient integration into the Aircraft. Contribution to mature technology candidates enabling a viable CROR Aircraft up to TRL2. Definition of business case (reference aircraft, list of requirements), first system layouts for integrated solutions and analysis for multifunctional fluidic trailing edge and multifunctional morphing trailing edge.
6	Airbus Operations Ltd	Mature technology candidates enabling a viable CROR Aircraft up to TRL2. Plan, prepare and perform for laminar outer wing, the removal of existing wing, the laminar outer wing join up and wing systems and flight test instrumentation equipping.
7	Airbus Operations SL	Mature technology candidates enabling a viable CROR Aircraft up to TRL2. Ground testing of modified natural laminar leading edge (LE) on horizontal tail plane (HTP), assembly and filler application. This ground test is a pre-test for the subsequent flight test. Furthermore studies on new HTP LE structure concepts.
8	Airbus Operations GmbH	Identification of candidate technologies enabling UHBR Engine efficient integration into the Aircraft. Mature technology candidates enabling a viable CROR Aircraft up to TRL2. Participation to execution of project multifunctional fluidic trailing edge and multifunctional morphing trailing edge, supporting the consortium with specification of industrial aspects. Plan, prepare and perform for laminar outer wing, the removal of existing wing, the laminar outer wing join up and wing systems and flight test instrumentation equipping. Ground testing of modified natural laminar leading edge (LE) on horizontal tail plane (HTP), assembly and filler application. This ground test is a pre-test for the subsequent flight test. Start of requirements definition for the Human Centred Cabin such as user groups, human factors, use cases, potential restrictions, safety and security analysis. Start of scope and objectives definition of the project "Immersive Cabin Services" together with batch of core partners.
10	Airbus Helicopters España	AH-E will concentrate in HCVE Airframe on the conceptual and preliminary design of the rotor-less tail for a compound rotorcraft based on and closely linked to the conceptual design stemming from IADP FRC. AHE will as well manage

Nr	Participating affiliates	Description of activities
		thelaunching of a couple of CfP for the second or third wave.
13a	Evektor Aeroteknik	Production of coupons, subassemblies and prototypes.
14a	PZL-Swidnik SA	Supporting activities foreseen to AW SpA and AW Ltd on airframe and structures topics, following general architecture requirements.
16	Airbus Helicopters Deutschland GmbH	AH-D will concentrate in HCVE Airframe on the conceptual and preliminary design of the wing for a compound rotorcraft based on and closely linked to the conceptual design stemming from IADP FRC. AHD will as well manage several topics for CfP like windcreens and doors for the compound rotorcraft and possibly further topics.

## 9.5. ITD ENGINES

As defined in Clean Sky, the objective of the Sustainable and Green Engines (SAGE) is to build and test five engine ground demonstrators covering all the civil market. The goals aim at validating to TRL 6 a 15% reduction in CO<sub>2</sub> compared to 2000 baseline, a 60% reduction in NO<sub>x</sub> 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 remain on track.

*Clean Sky 2 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:*

- Open Rotor Flight Test, 2014-2021: a second version of a Geared Open Rotor demonstrator carrying on *Clean Sky* SAGE 2 achievements and aimed at validating TRL 6;
- Ultra High Propulsive Efficiency (UHPE) demonstrator addressing Short / Medium Range aircraft market, 2014-2021: 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, 2014-2019: design, development and ground testing of a new turboprop engine demonstrator in the 1800-2000 shaft horse power class;
- Advanced Geared Engine Configuration, 2015-2020: design, development and ground testing of a new demonstrator to validate key enablers to reduce CO<sub>2</sub> emissions and noise as well as engine mass;
- Very High Bypass Ratio (VHBR) Middle of Market Turbofan technology, 2014-2021: development and demonstration of technologies in each area to deliver validated powerplant systems matured for implementation in full engine systems;
- VHBR Large Turbofan demonstrator, 2014-2019: design, development, ground and flight test of an engine to demonstrate key technologies at a scale suitable 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.

## ***Description of activities 2015***

### **Work Package 1 – Open Rotor flight Test (Snecma)**

During 2015 only WP 1.1 (Propulsion System Integration), WP 1.2 (Modules Adaptation or Modifications) and WP 1.3 (Systems and Controls Development) will be active.

The analysis of gap between Ground Test Demonstrator (GTD) status and Flight Test Demonstrator (FTD) specifications will be performed, including control system requirements (control laws, engine and fire protections, etc). After airworthiness analysis and taking into account previous studies, it will be decided what non flight-able parts from SAGE 2 GTD propeller module will have to be re-designed. It is foreseen some nacelle components will be new or adapted to the FTD (air intake, gas generator dressing, engine mounts...) as well as some systems components (accessories gearbox, starter, oil modules...). The Preliminary Design Phase for the modified modules, including the impact on overall engine behaviour (integration, installation...) will start mid-2015 and will be completed in 1<sup>st</sup> quarter of 2017.

### **Work Package 2 – Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range aircraft (Snecma)**

In 2015 a preferred candidate to power the Short / Medium Range aeronautic transport will be selected to give rise to the choice of the UHBR demonstrator concept/architecture in 2016. The selection process will include the check of sufficient technology readiness level to allow ground test at the scheduled date in Clean Sky 2 and then to enter in service within 2025-2030.

### **Work Package 3 – Business Aviation / Short Range Regional TP Demonstrator (Turbomeca)**

WP03 is split into 6 subprojects: Integration of the propulsion system, Core engine adaptation for turboprop usage, Gear box module, Propeller, Air intake & Nacelle, Innovative accessories and equipments.

2015 will be dedicated to the preliminary design of the whole Integrated Power Plant System (IPPS). At the end of 2015, the architecture of the IPPS will have been selected and the specifications of each subsystem will be available. Management activities will consist in participating to Steering Committees, interfacing with the IADP (Rotorcraft, RA) and SAT. The first Calls for Proposals will be issued.

### **Work Package 4 – Adv. Geared Engine Configuration (HPC-LPT) (MTU)**

Key objectives of the activities in 2015 are the definition and preparation of the entire programme.

The conceptual design studies will be continued for Engine Demo and Rigs under the assumptions of the preselected technologies. Main focus are on the materials and manufacturing technologies and further design features as the main contributors to meet the

overall Clean Sky 2 objectives and achievements. A concept review will be performed end of 2015.

Further activities will be launched to support the core partner selection process in the first 2 waves as well as the first call of call for proposals

#### **Work Package 5 – VHBR – Middle of Market Technology (Rolls-Royce)**

Throughout the course of the programme, work package 5 will demonstrate a range of underlying technologies necessary for very high bypass ratio (VHBR) engines in all markets, although focusing on Middle of Market short range aircraft. A series of design studies and rig tests will deliver TRL4-5 for each technology in 2018, feeding full system demonstration in other programmes.

The programme will continue to accelerate through 2015, where all required technologies will achieve Concept design review, bench and rig verification will start, and preparations begin for the manufacture of long lead-time hardware to support delivery to WP6 in 2018.

#### **Work Package 6 – VHBR – Large Turbofan Demonstrator (Rolls-Royce)**

Work package 6 targets the extension of Very High Bypass Ratio technologies to large engines for the long range airliner market. Building on the technology validation delivered by WP5, the project will develop these for higher power engines and ultimately demonstrate the technology at full system level in ground and flight test in order to achieve TRL 6 in 2019 in preparation for the next generation of wide body airliners.

In 2015, an initial study into modifications required to test facilities and flight test aircraft to support the demonstrator will be undertaken.

Progress will accelerate significantly through 2015, when the preliminary design will continue, and provisions are made to begin manufacture and procurement of long-lead time items which will be required to be delivered to stores for engine test in 2018. Tools, instrumentation, and methods to support the verification programme will be reviewed alongside functional modelling of the engine to support the technical evaluation program.

#### **Work Package 7 – Small Aircraft Engine Demonstrator**

Work Package 7 relates to Small Air Transport (SAT) and 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. This area in the Engines ITD will focus on light weight and fuel efficient diesel engines and on turbine activities with power range suitable for general aviation.

Please refer to SAT chapter for more details.

## **Key Engine ITD Deliverables**

### **WP1 – Open Rotor Flight Test**

- Gaps between GTD status and FTD specifications
- List of SAGE 2 GTD parts to re-designed / adapted incl. objectives

### **WP2 – Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range Aircraft (Snecma)**

- Report on UHPE concept studies to feed ground test demo concept study in 2016

### **WP3 – Business aviation / short range Regional TP Demonstrator**

- Call for Core Partners available: PGB/AGB,
- Call for Core Partners available: Propeller and pitch control system
- IPPS Architecture & Specification
- Minutes of Design Review

### **WP4 – Adv. Geared Engine Configuration (HPC-LPT)**

- Minutes of Interims Concept Review
- Preliminary Module Descriptions
- Minutes of Concept Review

### **WP5 – VHBR – Middle of Market Technology**

- Technical requirements documentation for VHBR technologies issued
- Scope of work defined: Low speed fan system & Structural Technology
- Scope of work defined: High speed LP Turbine

### **WP6 – VHBR – Large Turbofan Demonstrator**

- Technical requirements documentation for VHBR demonstrator issued

### **WP7 – Small Aircraft Engine Demonstrator**

- Turbine engine – content to be defined following CP selection
- Engine architectures Analysis
- Engine Final design
- Endurances analysis



## **Key Engine ITD Milestones**

### **WP1 – Open Rotor Flight Test**

- First conclusion of airworthiness and FTD specifications studies

### **WP2 – Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range Aircraft**

- UHPE concept selection to give rise to UHBR ground demo

### **WP3 – Business aviation / short range Regional TP Demonstrator**

- PDR

### **WP4 – Adv. Geared Engine Configuration (HPC-LPT)**

- Interims Conceptual Design Review
- Conceptual Design Review

### **WP5 – VHBR – Middle of Market Technology**

- Concept Reviews for VHBR technologies complete

### **WP6 – VHBR – Large Turbofan Demonstrator**

- Concept Reviews for VHBR technologies complete

### **WP7 – Small Aircraft Engine Demonstrator**

- Diesel Engine road map with partners
- Prototype Test Cell First Run
- Engine Installed First Run (Ground)
- First Flight

## **Implementation**

The activities in the Engines ITD will be performed following the general principles of the Clean Sky 2 membership and participation.

Safran, Rolls-Royce and MTU, as the ITD Leaders, will perform the main activities related to the technology development and demonstration in the ITD. Significant part of the work will be performed by Core Partners, supporting the ITD leader in its activities. Finally, another part of the activities will be performed by Partners through Calls for Proposals for dedicated tasks.

Safran, Rolls-Royce and MTU, as the ITD Leaders, will sign the one Grant Agreement for Members (GAM) in order to perform the work. This GAM will cover all the work of the Members in this ITD. The Core Partners are selected through open Calls for Core Partners and the retained applicants will accede to the existing Grant Agreement for Members.

Partners will be selected at a later stage through Calls for Proposals and will be signing the Grant Agreement for Partners. They will be linked to the ITD activities through the Coordination Agreement.

### ***Description of activities 2016-2017***

#### **▪ Work Package 1 – Open Rotor flight Test (Snecma)**

Included in Platform 1 of LPA IAPD.

#### **▪ Work Package 2 – Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range aircraft (Snecma)**

In 2016 and 2017, Snecma will continue to manage WP2 Programme and Project, extending the organization set in 2014 and 2015 in order to integrate the new core partners and CfP Partners and to optimize overall progress rate of the UHPE demo project.

### **Demo Architecture and Integration**

#### **Preliminary Studies of UHPE Demo**

Preliminary studies will be performed in 2016 in order to choose a demo concept adequate to mature UHPE concept, using an existing HP core and including nacelle aspects, taking into account the whole perimeter of the Integrated Power Plant System. This study will lead to the issuance of UHPE Demo specifications expected on Q4 2016. Then preliminary design of the UHPE demo will be performed allowing to hold Preliminary Design Review by the end of 2017. This activity will include integration studies such as performance, preliminary layout, thermal and dynamic evaluations.

### **Demo Modules**

#### **Preliminary Design of UHPE Demo Modules**

On the basis of UHPE Demo specifications, preliminary design of UHPE Demo Modules will be performed in 2017 allowing to hold Preliminary Design Review of the modules by the end of 2017.

### **Core Partner activities**

In 2016 and 2017, several Modules of the UHPE Demo will be preliminary designed by Core Partners.

The following core partner packages are expected to be fully incorporated into the Snecma UHPE programme in 2016 and 2017 as a result of Core Partner Call Wave 1 submitted in 2014:

- *JTI-CS2-CPW-ENG-01-01*: Low Pressure Turbine Rear Frame and Low Pressure Spool Shaft for Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range aircraft

- *JTI-CS2-CPW-ENG-01-02*: Power GearBox (PGB) for Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range aircraft

Two other core partner topics have been proposed by Snecma in Q4 2014 in the frame of Core Partner Call Wave 2: Turbine Vane Frame and Intermediate Centre Frame for Ultra High Propulsive Efficiency (UHPE) Demonstrator. They are expected to result in an accession of selected core partners beginning of 2016, allowing the implementation of the associated tasks in 2016 and 2017.

### ▪ **Work Package 3 – Business Aviation / Short Range Regional TP Demonstrator (Turbomeca)**

Development of the Integrated Power Plant System demonstrator

#### **Finalization of the subsystems specifications**

The Integrated Power Plant System specification will be made available in 2015. Based on this document, each subsystem will be analysed and specification will be issued. It is expected to close the specification activities by 2016 in order to start detailed design of IPPS components.

#### **Detailed design of each subsystem**

The various components of the IPPS will be designed. As far as the core engine is concerned, the activities will concentrate on the exhaust, the combustor and the turbine. The controls for both engine and propellers will be developed as well. A new propeller is expected to be studied during the programme, to be tested on the TP engine ground test facility. The power gear box and accessory gear box detailed design will be addressed during this phase.

#### **Start of manufacturing of parts for the demonstration**

The detailed design phase is expected to be completed by end of 2016 in order to launch the phase for components manufacturing.

#### **Start of the test preparation activities**

In parallel to the component manufacturing phase, the activity dedicated to the test preparation will start. In particular, an upgrade of the Turboprop ground test facility is necessary. The test programme will be prepared in accordance to the technological objectives of the demonstration.

#### **Core Partner activities**

The core partner activities are expected to start as early as possible in 2016 in order not to compromise the demonstration time schedule.

One core partner will focus on the Power & Accessory Gear Box detailed design, manufacturing and partial testing.

The second core partner will develop state-of-the art propeller hardware & controls.

## ▪ **Work Package 4 – Adv. Geared Engine Configuration (HPC-LPT) (MTU)**

WP4 effort in 2016 and 2017 is threefold.

### **Maintenance and update of the WP4 notional engine concept:**

- Review of assumptions like engine installation, weight and SFC requirements, etc, that have been made with respect to aircraft and engine market needs
- Review of assumptions like TRL maturation, schedule, budgets, that have been made for required advanced component technology level, especially with respect to the feedback coming from the technology development projects
- Update of the notional engine concept and the derived requirements for the technology roadmaps and the technology demonstration vehicles

### **Development, procurement and test execution of the build 1 of the modular compressor rig**

- Execution of the technology projects connected to the integrated compression system design
- Completion of the detailed design phase (production release)
- Procurement of the test hardware
- Test preparation and execution

### **Development of the engine demonstrator**

- Execution of the technology projects connected to the integrated expansion and exhaust system design
- Start of the detailed design phase for the engine demo
- Start of the test preparation activities

### **Core partner packages**

Based on a reference engine concept representing the next generation of geared fan engines, MTU intends to develop and validate together with its core partners technologies for an engine compression system and an engine exhaust system with significantly improved operational performance parameters.

After successful integration of the Core Partner in 2015 the following CP work packages are expected to be fully incorporated into the Engine ITD WP4 programme and support the defined milestones and deliverables in 2016 and 2017:

#### **JTI-CS2-2014-CPW01-ENG-02-01**

Aerodynamic Design and Testing of advanced Geared Fan Engine Modules

The core Partner is expected to:

- develop multidisciplinary tools
- design of sub modules using multidisciplinary tools
- design and procure, or adapt a test-bed and perform testing
- provide data Reduction and Analysis

## **JTI-CS2-2014-CPW01-ENG-02-02**

LPC, ICD and TEC development for next generation geared fan engine

The Core Partner is expected to:

- develop and provide LPC Backend and ICD H/W
- develop and provide a Turbine Exit Casing and Mixer

### **▪ Work Package 5 – VHBR – Middle of Market Technology (Rolls-Royce)**

Throughout the course of the programme, work package 5 will demonstrate a range of underlying technologies necessary for very high bypass ratio (VHBR) engines in all markets, although focusing on Middle of Market short range aircraft. A series of design studies and rig tests will deliver TRL4-5 for each technology in 2018, feeding full system demonstration in other programmes.

With regards to the Power GearBox, 2016 and 2017 will see the integration of the PGB system funded under LuFO into the whole engine design (RR UK).

On the Nacelle side, the development of Noise amplitude assessment and aerodynamic methods for variable area nozzle (VAN) concepts will take place in 2015-2017 (RR UK). The development of aerodynamic methods for VAN concepts to TRL 4, as well as the development of Thrust Reverser Unit aerodynamic assessment method towards TRL 4 will both be managed by RR Deutschland during the same period. The VAN concept progression up the TRL scale towards TRL 3 will also be ensured and will be managed by both RR UK and RR DE.

The 2<sup>nd</sup> Generation TiAl material technology development will continue to TRL3, from MatCap1 towards MatCap2, and MCRL 3 in 2016, and TRL4, MatCap2 and MCRL4 in 2017<sup>6</sup>. This will be through alloy development, materials testing and casting / manufacturing trials, managed by RR UK.

### **Core partner packages**

The following core partner packages are expected to be fully incorporated into the work plan in 2016 and 2017:

---

<sup>6</sup> MatCap = Materials Capability Acquisition Panel; MatCap1 – Concepts proposed with evidence from literature, supplier data/information

MatCap2 – Formal Requirements Definition Statement defined, agreed property targets, cost and timescales.

MCRL = Manufacturing Capability Readiness Level; MCRL3 – Experimental proof of concept. MCRL4 – Process validated in lab using representative development equipment

## **JTI-CS2-2014-CPW01-ENG-03-01 VHBR Engine - IP Turbine Technology**

### **IP Turbine Technology for UltraFan**

The Core Partner would be expected to be on contract within 2015 and as such would be expected to be participating fully in the UltraFan programme.

The Core Partner will be expected to support the milestones and deliverables that were defined in the original call and also provide strategic input to the UltraFan programme. There are some key activities around the IPT rig in addition to the definition of the turbine sufficient for the key design reviews that will occur in 2016 and 2017.

## **JTI-CS2-2014-CPW01-ENG-03-02 VHBR Engine - Structural Technology**

### **Structural technology, ICC for UltraFan**

The Core Partner would be expected to be on contract within 2015 and as such would be expected to be participating fully in the UltraFan programme.

The Core Partner will be expected to support the milestones and deliverables that were defined in the original call and also provide strategic input to the UltraFan programme. There are some key activities around the technology concept review for the ICC in addition to the definition of the ICC sufficient for the key design reviews that will occur in 2016 and 2017.

### **▪ Work Package 6 – VHBR – Large Turbofan Demonstrator (Rolls-Royce)**

Work package 6 targets the extension of Very High Bypass Ratio technologies to large engines for the long range airliner market. Building on the technology validation delivered by WP5, the project will develop these for higher power engines and ultimately demonstrate the technology at full system level in ground and flight test in order to achieve TRL 6 in 2019 in preparation for the next generation of wide body airliners.

Throughout 2016, the objective will be to capture and generate formal documentation of demonstrator requirements, which should be completed by mid-year with the expectations of updates for the rest of the year. As clarity over the technical requirements for the demonstrator become clear, resource for support of sub-system integration is expected to ramp up. Hence it is anticipated the core project team will start to develop, e.g. recruitment of demo Chief Design Engineer.

The capture and generation of formal documentation of demonstrator requirements will continue in 2017, but now focused at the more detailed technical level, e.g. Subsystem requirements level. There are expectations of updates for the rest of the year on previously issued requirements. Dedicated integrated technical project teams will start to be built up and hence their plans will need to be incorporated into the Integrated Master Schedule (IMS).

On the Architecture and Demo System Integration side, the technologies required within each of the product systems and sub-systems sizing point trades will be captured from work which has been carried out in 2015. The down-selected demonstrator sizing point concept will be

further developed in 2016. The system level trades will be completed to enable the product definition document to be sufficiently mature to allow flow down to the sub-systems and lower level product systems. Design Reviews (stage 0) will be performed against each sub-system in the same year. 2016 will also see the start of the formal sub-system definition, ramping up resource to enable sufficient design definition to be developed for stage 1 exit. In November an internal gap analysis will be performed to determine technical gaps which require closure prior to stage 1 exit. [RR UK]

Further development of the down-selected demonstrator sizing point concept will take place.. The Thrust Producing System/Nacelle trades will be completed to enable the product definition document to be sufficiently mature to allow flow down to the sub-systems.

The formal nacelle component definition will also be initiated, ramping up resource to enable sufficient design definition to be developed for stage 1 exit. In November 2016, an internal gap analysis will be performed to determine the technical gaps on the Nacelle which require closure prior to stage 1 exit.

The following year (2017) the sub-system definition of the UltraFan™ will be continued, allowing sufficient detail prior to a stage 1 exit review in July. Each Sub-System and lower level product system will perform a Design Review, stage 1 in March to ensure a down-selected concept will have been chosen prior to the July stage 1 exit. [RR UK]

The Nacelle component definition of the UltraFan™ will be continued, allowing sufficient detail prior to a stage 1 exit review in July, with a Design Review (stage 1) in March to ensure a down-selected concept has been chosen prior to the July stage 1 exit. [RR DE]

The Validation will take place through EDP= Engine Development Plan (EDP) iteration in 2016, to be in line with selected technical requirements on the demonstrator. A flight clearance strategy will also be agreed. The flight clearance strategy will involve and include buy-off from the airframer and, at this stage, will be part of WP6(not LPA). The validation plans will be developed in 2017 to meet agreed demonstration in support of stage 1 exit.

In addition to the work plan defined above, the addition into WP6 of a full engine demonstration of the new core for the UltraFan engine is proposed. The core, called Advance 3, will provide the heart for the UltraFan engine and is therefore critical to its success.

The Advance 3 core includes a significant change in the work split between the compressors and turbines and introduces a two stage high pressure turbine, compared to the single stage turbine in current Trent engine architectures.

The activity proposed under Clean Sky would take the Advance 3 core (built into a donor Trent XWB engine) and complete the ground test demonstration phase. The core and donor engine would be managed outside of the Clean Sky programme but the key demonstration testing would be actioned through Work Package 6.

It is expected that the Advance3 ground testing would be completed in 2016 and early 2017 and would represent a significant milestone for the UltraFan programme providing the

confidence to take the new core architecture and build the new LP and IP systems around it, including the new power gearbox.

## ▪ **Work Package 7 – Small Aircraft Engine Demonstrator**

### **WP7.1 Lightweight and fuel efficient compression ignition power unit**

Considering Partners activities start by the end of September 2015, exception of the WP7.1.3 (propeller) which should be included in the second wave CfP with a start date in 2016 (To be confirmed).

These activities and deliverables described in CfP will be confirmed or adapted during discussions between SMA and partners after CfP selection. The sharing of these activities will be confirmed as well. The SMA main planned role is the management of these activities.

#### **WP7.1.1 Higher power density**

The initial work will be dedicated to establish the specification (end 2015), then to design according these specifications (2016). Prototype parts will be made, for a prototype demonstration planned in 2016.

#### **WP7.1.2 Turbocharger**

The initial work will be dedicated to establish the specification and the development plan (end 2015), then to design according these specifications (2016). Prototype parts will be made, for a prototype demonstration planned in 2016.

#### **WP7.1.3 Propeller**

The activity should be initiated in 2016 and should include a technical proposal (CfP wave 2). 2017 should be dedicated to the elaboration of a prototype with factory tests, ended by a propeller-engine test.

#### **WP7.1.4 Research activities on High density new architectures**

The Mono-cylinder research activities oriented to combustion in 2015, will be followed in 2016 by different tests of technologies for piston, cylinder, and cylinder head, till mid-2017.

In parallel, from Q2 2016, multi-cylinder and integration studies will be performed in order to reach the high density and capacity. These activities are planned till mid-2018.

#### **WP7.1.5 Installation optimisation**

The initial work will be dedicated to establish the specification and the development plan (end 2015). The year 2016 will be dedicated to perform studies (aerodynamic, thermal, weight, compactness). Demonstration will take place in 2017.



## **WP 7.2 Reliable and more efficient operation of small turbine engines (19 seats)**

In the period 2016-2017, in cooperation with selected core partners, the baseline engine and technology improvement roadmap will be traded in the way to assess the technology maturation to achieve the high level objective.

This phase will be completed by trade off analysis on engine concept and the technology improvement of each single component of the engine, which is gas generator, power turbine and exhaust, reduction gear box and propeller.

### **WP7.2.1 Engine Integration & Coordination**

The Core Partner, in cooperation with leaders SAT, is expected to identify the engine baseline, to set technology roadmaps to achieve the Topic High Level objectives providing consistent assessment of the technical results and environmental benefits that the Topic brings.

The Core Partner and leaders SAT will also define metrics and will assess the technology maturation against main targets during the activity development.

Concerning the demonstration strategy, the Core-Partner(s) and leaders are expected to provide evidence on the availability and background of experimental facilities and testing engineering capability.

### **WP 7.2.2 Gas Generator**

The Core Partner and leaders are expected to develop and validate advanced Gas Generator technologies aiming at increasing engine thermal efficiency and delivering low weight solutions contributing to the fuel efficiency improvement target.

The Core Partner and leaders at the 2016 will complete the PDR, during 2017 the development of the component with CDR.

### **WP 7.2.3 Power Turbine & Exhaust**

The Core Partner and leaders are expected to develop and validate technologies for ultra-high efficient power turbine and exhaust system contributing to the overall fuel efficiency improvement.

Advanced aerodynamics features for efficient flow path and airfoil concepts along with optimized solutions for clearance control and secondary losses reduction are expected to be validated.

The leaders and the core partners at the 2016 will complete the PDR during 2017 the development of the component with CDR.

### **WP 7.2.4 Reduction Gearbox and Low Noise Propeller**

The Core Partner and leaders SAT are expected to develop low noise propulsive system, including reduction gearbox & integrated control system for optimal propeller speed and low noise propeller design technologies.

In addition, the Core Partner and leaders SAT are expected to evaluate optimal trade-offs of the whole system in order to maximise propulsive efficiency as well as reduce noise emission and weight.

Affordable manufacturing technologies for key components (gears, bearings) are expected to be developed and validated to reduce acquisition costs as well as reliable and durable design solutions aiming at extending maintenance intervals and reducing operational costs.

The leaders and the core partners at the 2016 will complete the PDR during 2017 the development of the component with CDR.

### ***Key Engine ITD Deliverables***

#### **WP1 – Open Rotor Flight Test**

- Included in Platform 1 of IADP\_LPA.

#### **WP2 – Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range Aircraft (Snecma)**

- Summary presentation of UHPE Demonstrator Concept Review [15/Nov/16]
- Summary presentation of Demonstrator Requirements Documentation [30/Nov/16]
- Summary presentation of UHPE Demonstrator PDR [15/Dec/17]
- Summary presentation of UHPE modules PDR from Core Partners :
  - Low Pressure Turbine Rear Frame and Low Pressure Spool Shaft [30/Nov/17]
  - Power GearBox [30/Nov/17]

#### **WP3 – Business aviation / short range Regional TP Demonstrator**

- 3.1 Project Management
  - Summary presentation of TP Demonstrator PDR [30/Jul/16]
  - Summary presentation of TP Demonstrator CDR [30/March/17]
- 3.2 Architecture and Demo System Integration
  - Technology report showing main architecture choices & TRL progress [2016]
  - Technology report showing subsystems definition choices & TRL progress [2017]
- 3.3 Validation
  - Overview of Development test programme [2016]

#### **WP4 – Adv. Geared Engine Configuration (HPC-LPT)**

- 4.1 Update report on notional engine concept
- 4.2 Completion of the detailed design report (build 1 – compressor rig)

- 4.3 Test preparation and execution report (build 1 – compressor rig)

#### **WP5 – VHBR – Middle of Market Technology**

- 5.1 Power GearBox (PGB) – N/A
- 5.2 Nacelle – N/A
- 5.3 IP T & Second Generation TiAl - N/A

#### **WP6 – VHBR – Large Turbofan Demonstrator**

- 6.1 Project Management [RR UK]
  - Summary presentation of Technical Demonstrator Requirements Documentation [30/Jul/16]
  - Summary presentation of Demonstrator Project Requirements Document (PRD) [30/Oct/16]
  - Summary presentation on Demonstrator Product Definition Document (PDD) [30/Apr/17]
  - Summary presentation on UF Engine Demo stage 1 exit (Concept) [30/Jun/17]
  - Summary presentation on UF Engine Demo Stage 2 exit (PDR) [17/Dec/17]
- 6.2 Architecture and Demo System Integration
  - Technology report issued capturing product system/sub-system technologies requiring further development for UltraFan™ [RR UK, 2016]
  - Product Definition Document issued following completion of system level trades [RR UK, 2016]
  - Non Advocate audit review held - (stage 1 exit gap review) [RR UK, 2016]
  - Product Definition Document issued following completion of system level trades [RR DE, 2016]
  - Non Advocate audit review held - (stage 1 exit gap review) [RR DE, 2016]
  - Design Review Stage 1 (DR1, at component and sub-system level) held and passed for all sub-systems and chosen product systems [RR UK, 2017]
  - Stage 1 Audit Review [RR UK, 2017]
  - DR1 reviews held and passed for Nacelle component [RR DE, 2017]
  - Stage 1 Audit Review [RR DE, 2017]
- 6.3 Validation
  - Issued Engine Development Plan (EDP) [RR UK, end of 2016]
  - Overview on flight clearance strategy [RR UK, 2016]
  - Summary presentation of stage 1 exit [RR UK, 2017]

#### **WP7 – Small Aircraft Engine Demonstrator**

- Core engine demonstrator in 2016
- Turbocharger demonstrator in 2016
- Propeller demonstration in 2017
- Mono-cylinder conclusion in 2016
- Engine digital installation in 2016
- Engine installation demo in 2017

## ***Key Engine ITD Milestones***

### **WP1 – Open Rotor Flight Test**

- Included in Platform 1 of IADP LPA.

### **WP2 – Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range Aircraft**

- 2.1 Concept Review (CoR) of UHPE Demonstrator [15/Oct/16]
- 2.2 PDR of UHPE Demonstrator [15/Nov/17]
- 2.3 PDR of UHPE Demonstrator modules PDR from Core Partners :
  - Low Pressure Turbine Rear Frame and Low Pressure Spool Shaft [30/Oct/17]
  - Power GearBox [30/Oct/17]

### **WP3 – Business aviation / short range Regional TP Demonstrator**

- 3.1 PDR of TP Demonstrator [30/March/16]
- 3.2 CDR of TP Demonstrator [30/January/17]

### **WP4 – Adv. Geared Engine Configuration (HPC-LPT)**

- 4.1 Update notional engine concept
- 4.2 Completion of the detailed design
- 4.3 Test preparation and execution

### **WP5 – VHBR – Middle of Market Technology**

- 5.1 PGB
  - Support of PGB team completed<sup>7</sup> [RR UK, 2016]
  - Support of PGB team completed [RR UK, 2017]
- 5.2 Nacelle
  - Noise rig design complete [RR UK, November 2016]
  - VAN rig design complete [RR DE, September 2016]
  - TRU rig design complete [RR DE, September 2016]
  - Noise test results analysed providing TRL 4 amplitudes [RR UK, August 2017]
  - VAN aeromethod TRL 4 gate pass [RR DE, July 2017]
  - TRU aeromethod TRL 4 gate pass [RR DE, July 2017]
- 5.3 IP T & Second Generation TiAl
  - "2nd Gen TiAl MCRL3" [RR UK, Feb 2016]
  - "Go / No-Go Decision on 2nd Gen TiAl" [RR UK, Jan 2017]
- 5.4 Core partner - IP T

---

<sup>7</sup> The first design iteration of the gearbox was/is done by the UK team under CS2. The knowledge and tools learned from this stage need to be transferred across to Germany to support the design and make of the next gearbox standards

- Review of Aerodynamic Rig Plan [RR UK, March 2016]
- CS2 Core Partner to have produced an integrated TRL4 (Stage 1 Exit) solution by mid-2017
- Sub-System PDR [RR UK, Dec 2017]

## **WP6 – VHBR – Large Turbofan Demonstrator**

- 6.1 Project Management [RR UK]
  - Technical Demonstrator Requirements Documentation [30/Jul/16]
  - Demonstrator PRD [30/Oct/16]
  - Demonstrator PDD [30/Apr/17]
  - UF Engine Demo stage 1 exit (Concept) [30/Jun/17]
  - High Impact Part sources selected [30/Jun/17]
  - UF Engine Demo Stage 2 exit (PDR) [17/Dec/17]
- 6.2 Architecture and Demo System Integration
  - 'Demonstrator Technologies - recommendations (76klb and 40klb) [RR UK, 27/Feb/16]
  - System Level Definition Studies complete [RR UK, 30/June/16]
  - Stage 1 Exit Gap Review [RR UK, 30/Nov/16]
  - Thrust Producing System Definition Studies complete [RR DE, 30/June/16]
  - Stage 1 Exit Gap Review [RR DE, 30/Nov/16]
  - Sub System DR1 review [RR UK, 30/Feb/17]
  - Stage 1 Exit Review [RR UK, 30/Jun/17]
  - Nacelle Component DR1 review [RR DE, 30/Mar/17]
  - Stage 1 Exit Review [RR DE, 30/Jun/17]
- 6.3 Validation
  - Issued EDP [RR UK, end of 2016]
  - Issued flight clearance strategy with FTB provider [RR UK, July 16]
  - Successful stage 1 exit [RR UK, 17]

## **WP7 – Small Aircraft Engine Demonstrator**

- Core engine demonstrator in 2016
- Turbocharger demonstrator in 2016
- Propeller demonstration in 2017
- Mono-cylinder conclusion in 2016
- Engine digital installation in 2016
- Engine installation demo in 2017

### List of Leaders and participating affiliates

Nr	Leaders	Description of activities
1/6	Rolls-Royce plc	As the leader of work packages 5 and 6, Rolls-Royce will technically lead and manage the R&T programmes for the long range VHBR engine (Ultrafan <sup>TM</sup> ). Rolls-Royce will also play a key role in management of the Engines-ITD.
5	MTU Aero Engines AG	MTU takes technical and management ownership for work package 4. The R&T programmes in this work package focuses on the Advanced Geared Engine Configuration. MTU will also play a key role in management of the Engines-ITD.
6/1	SNECMA	As Affiliate of Safran S.A., SNECMA will lead Engines ITD with Rolls-Royce and MTU Aero Engines. SNECMA will also technically lead and manage work package 2 “Ultra High Propulsive Efficiency (UHPE) Demonstrator for short / medium range aircraft”. SNECMA will play a key role in management of the Engines-ITD.

Note: SAFRAN S.A. (for information): Safran S.A. is not involved in 2015 for technical activities but should take part, through its “Safran Composite” and “Material and Processes” business units on the WP 2 “UHPE Demonstrators” at a later stage.

Nr	Participating Affiliates	Description of activities
2	Airbus Operations SAS	Airbus Operations SAS will participate in term of aircraft integration point of view for the WPs related to mid and large turbofans (i.e WP 2 / WP5 / WP 6).
3	Aircelle	As Affiliate of Safran S.A., Aircelle will play a major role in WP 2 “UHPE Demonstrator”, being responsible for Fan Nacelle and Variable Fan Nozzle. These are key modules for the UHPE demonstrator.
4	Turbomeca	As Affiliate of Safran S.A., Turbomeca will technically lead and manage work package 3 “Turboprop ground demo for SR regional aviation”. Turbomeca will play a key role in management of the Engines-ITD as WP 3 leader and manage the Core Partners and Partners involved in this TP demo.
7	Rolls-Royce Deutschland	Rolls-Royce Deutschland are providing key systems for the long range VHBR (Ultrafan <sup>TM</sup> ) engine. Specifically they will be providing the power gearbox and whilst this is outside of the Clean Sky 2 programme, interface management will leave Rolls-Royce Deutschland with a critical role in WP 6.

Nr	Participating Affiliates	Description of activities
		Additionally as a key whole engine systems provider in Germany, Rolls-Royce Deutschland are set to lead key work packages in WP 5 (MoM) during the CS2 programme.
8	SMA (SAFRAN)	As Affiliate of Safran S.A., SMA will technically lead and manage work package 7.1 “Light weight and efficient jet-fuel reciprocating engine” for SAT applications. SMA will be responsible for the demo and manage the Partners involved in WP 7.1.
1a/6a	Rolls Royce Corporation	Rolls-Royce Corporation will play a very important role during the early phases of the Rolls-Royce Plc programmes defined in WP5 and WP6 as they have critical knowledge and capability surrounding gearbox and structural technology. This knowledge is held within Rolls-Royce Corporation and therefore represents the most cost and time effective way to bring this capability to the European business (UK and Germany).

## 9.7. ITD SYSTEMS

Systems and equipment play a central role in aircraft operation, flight optimisation and air transport safety:

- Direct contributions to environmental objectives: for example optimized green trajectories or electrical taxiing have a direct impact on CO<sub>2</sub> emissions, fuel consumption and perceived noise;
- Enablers for other innovations: in particular for innovative engines or new aircraft configurations;
- Enablers for air transport system optimization: improving greening aviation, mobility or ATS efficiency can only be reached through the development and the integration of on-board systems;
- Smart answers to market demands: systems and equipment have to increase their intrinsic performance to meet new aircraft needs without a corresponding increase in weight and volume.

Starting from the *Clean Sky* developments through Systems for Green Operations (SGO), further maturation, demonstration and new developments are needed to accommodate the needs of the next generation aircraft. In addition, the systemic improvements initiated by SESAR and NextGen will call for new functions and capabilities geared towards environmental or performance objectives, and for flight optimisation in all conditions, flight safety, crew awareness and efficiency, better maintenance, reduced cost of operations and higher efficiency. The Systems ITD in *Clean Sky 2* will address this through the following actions:

- Work on specific topics and technologies to design and develop individual equipment and systems and demonstrate them in local test benches and integrated demonstrators (up to TRL5). The main domains to be addressed are cockpit environment and mission management, computing platform and networks, innovative wing systems, landing gears and electrical systems.
- Customization, integration and maturation of these individual systems and equipment in IADP demonstrators. This will enable full integrated demonstrations and assessment of benefits in representative conditions.
- Transverse actions will also be defined to mature processes and technologies with potential impact on all systems, either during development or operational use.

### *Description of activities 2015*

#### ▪ **Work Package 0**

The management activities will set the frame and control the running activities and manage in parallel the launch of the first CP call and definition of CfPs for 2015.



## ▪ **Work Package 1**

2015 work for WP1 “Avionics Extended Cockpit” will mostly address definition activities, mostly of preparatory and organizational nature:

- Definition of main functions and flight management features to be featured in the ITD-level demonstration of extended cockpit. Identification of additional / alternative candidate functions, probably via open calls for partners/core partners.
- Definition of the overall functional architecture to host planned activities and accommodate additional contributions to be integrated in the main demo: target platform, format and high-level principles, down-selection and insertion process.
- Early work with airframers (Large, Regional, Bizjet, Rotorcraft, Small regional)
  - Work on aircraft-level requirements from airframers
  - Mapping of expectations and selection of minimum functional content for demo platform.
  - Identification of functionalities not selected in the mailine demonstration, possibly to be accommodated alternatively, via CP, CfP.
  - Identification of synergies, common systems/subsystems addressing the needs of two or more airframers.
  - Work on high-level constraints/requirements for future IADP integration and high-level specification of future customization.
- High-level specification of the common, ITD-level physical demonstrator of the extended cockpit: number of screens, head-up philosophy, main IHS means.
- Definition of needed environment, support, tools for the extended cockpit demo: simulators, minimum operational environment.
- High-level specification of additional demos to address specific needs for functions or stringent cockpit constraints.
- Identification of existing / planned building blocks in the field of Integrated Modular Architecture and networks.. Down-selection of best candidates, definition of a very high-level target architecture for extended cockpit demo platform & networks.
- Early work with airframers (Large, Regional, Bizjet, Rotorcraft, Small regional)
  - Work on aircraft-level requirements from airframers
  - Mapping of expectations and selection of minimum functional content for demo platform.
  - Evaluation of transverse, synergetical issues: scalability, re-use.
  - Identification of technologies not selected in the mainline demonstrator, possibly to be accommodated alternatively, via CP, CfP.

- Work on high-level constraints/requirements for future IADP integration and high-level specification of future customization.
- Definition of needed environment, support, tools for the extended cockpit demo: simulators, minimum operational environment.
- High-level specification of additional demos to address specific needs for technologies or stringent cockpit constraints.

In 2015, an inventory of existing work in related collaborative R&D projects will be established, and added value through synergies and synchronization will be sought. This should lead either to integration and maturation of other projects' results (typically L1 or L2) in the larger CS2 demonstrations, or to a high-level alignment of CS2 developments and demonstrations with system-level policies (SESAR results).

While most of the activity in the period should be performed by Systems leaders, some early assessment and definition Core Partner work will start as well (2015). Partner's activities may also take place for advanced identification of innovative concepts.

#### ▪ **Work Package 2**

2015 work for WP2 "Cabin & Cargo Systems" will lead to the publication of one or two strategic topics for Core Partner's contributions in the fields of power systems for cabin (self-sufficient cabin, energy storage ...), cargo systems, and transverse redefinition of cabin electronics in an IMA-like approach. Specifications and early developments will be led by the Core Partners selected, and should start by the end of 2015.

#### ▪ **Work Package 3**

The smart integrated wing systems architecture design will be further elaborated and matured in 2015 and 2016, integrating Partners contribution and expertise.

In the meantime, the first development step will replace all engine driven pumps (EDPs) by generators but keep the hydraulic actuators as a well proven technology for flight control.

The architecture is based on new control technologies and cooling concepts which represents the next step of such Hydraulic Power Packages (HPPs). The design activities, conducted in collaboration with IADP LPA Leader have started in the second half of 2014, with a TRL5 target in 2016.

In Parallel, sensors and power electronics technology bricks will be matured internally, and continue with the technical contribution out of the calls for proposal.

Concerning the demonstration focusing on regional aircraft Flight Control Systems (FCS) application, the activities will start with systems and real time architecture studies, as well as preliminary activity on electrical network for energy and data distribution. The activities regarding the technology bricks (sensors, actuators, etc.) will start in 2015.

▪ **Work Package 4 (depending on re-evaluation outcome)**

The Landing Gear systems activities are organized around different technologies pillars which are the actuation, the green taxiing and the short TAT brake cooling.

In 2015, generation of specifications for second generation of Green Taxiing System at integration level and at components level based on first generation performance level and targeted improvements will be performed; it would help to decrease the noise and improve local air quality (LAQ) on ground by taxiing the aircraft while having the main engines shut down. Similar activity for short Turn Around Time (TAT) braking system will be done, based on current research activities at low TRL levels.

The following Preliminary Design Review (PDR) is planned for January 2015, followed by the detailed design phase.

During the detailed design phase the final configuration of system design and equipment design will target a TRL3 review in May 2015 and a Detailed Design Review (DDR) in September 2015. The successful execution of the DDR will then start the prototype manufacturing.

▪ **Work Package 5 (depending on re-evaluation outcome)**

Within power generation demonstrators, technologies bricks for AC and DC network generators and also generator control unit (GCU) are going to be evaluated to expect a TRL 4 level at the beginning of 2015, followed by the organization of TRL5 prototypes development. In parallel, collaboration with IADP Airframers will be initiated to establish A/C conditions and specifically requirements and also tests plan.

Concerning to conversion demonstrators, TRL4 level milestone is planned in the year of 2015 and in parallel, collaborations with IADP Airframers to define System specifications are planned to occur frozen A/C specification in the middle of the year 2015. A selection of dedicated technologies is also planned in regard to these specifications and the performances of the TRL4 demonstrators. Technology and maturity road maps on energy storage with core partner collaboration are also planned in the year 2015.

For the Innovative Electrical Network (IEN) decentralized architecture concept, the scenario definition, dealing with the usage scenarios based on end users' needs (number of loads, location, nominal power, redundancy needed, etc.) activities will be launched in 2015 for functional need / topology selection and technological block developments.

Further designs for regional, business jet and large aircraft will leverage on these results and will begin in the year of 2015 with the definition of next generation of power management center, these tasks will be made with collaboration of the IADP Airframers and core partner.

The new electrical network HVDC performances have to be consolidated and validated through tests with representative hardware coming from Members and Partners. An electrical network simulation is necessary to set-up the equipment specification and then to extrapolate the test results to full aircraft architecture. In the 2 first years, the task consists in defining the

key equipment demonstrators and associated verification and validation plans in relation with the partners:

- Enhanced architecture : the task consists in relation with the other work packages to select the right new technology
- Validation plan: the task consists in elaborating the road map for the project

#### ▪ **Work Package 6**

The major loads work package regroups the main electrical loads on the aircraft, which is a wide set of activities. In 2015, a trade-off on new electrical ECS architectures for a single-aisle application, extended to thermal management and with Trans ATA consideration, will be carried out based on experience gained on Clean Sky studies and demonstrations.

This study will enable to define an E-ECS architecture optimized with respect to system impact on weight and power consumption, reliability, drag reduction and enhanced engine power efficiency.

Moreover, Liebherr will pursue in 2015 the maturity improvement of the major components like turbomachines, power electronics and centrifugal VCS compressor.

These developments will pave the way for the development of an airworthy full-scale E-ECS demonstrator (from 2016).

For Wing ice Protection System, the initial developments planned in 2015 will focus on the design of an optimized architecture for large aircraft based on preliminary work performed in JTI Clean-Sky and with focus on performance, weight, reliability and maintainability. The Ice protection strategy will be refined according to optimize the power consumption.

In the year of 2015, activities are planned to reach TRL3 level for weight-optimized reliable motor control strategies at hardware and software levels. In parallel, technologies road map is planned to perform electrical motor and to specify the next generation of electrical motor and control motor.

In 2015 COPPER BIRD® will support the design of demonstrators, providing experience, lessons learnt based on Clean Sky programme, and constraints in test possibility. After demonstrator's PDR the design of test means adaptation, choice of partners or subcontractors will begin.

#### ▪ **Work Package 7**

The activities of the Small Air Transport (SAT) group are detailed in the SAT Work Plan.

### ***Milestones and Deliverables 2015***

#### **Milestones**

##### **WP0 – ITD Management**

- ITD Systems Kick-Off
- ITD Systems Annual review

#### WP1 – Extended cockpit preparation

- Launch of Extended Cockpit Demonstrator specification
- Validation of Extended cockpit architecture

#### WP3 – Smart integrated wing for large aircraft

- Roadmap of technologies and integration
- Preliminary wing systems architecture available

#### WP4 – Full Electrical Actuation System for Main Landing Gears

- Launch of MLG Electrical LGERS demonstrator design
- Launch of MLG Braking EMA components design

#### WP4 – Green Taxiing

- Launch of specification phase for second generation of Green Taxiing Systems

#### WP4 – Short TAT braking system

- Launch of specification phase for future short TAT braking system

#### WP4 – Tiltrotor Landing Gear System

- Partner selection
- Prel. System Spec. release
- IDR

#### WP5 – Power Generation

- DGCU requirements for RA and LA IADP

#### WP6 – Electrical ECS

- Selection of E-ECS architecture

### **Deliverables**

#### WP0 – ITD Management

- Topics definition for CP
- Topics definition for CfPs to be launched in 2015
- Work plan 2015-2016

#### WP1 – Extended cockpit preparation

- Initial list of functions for down-selection
- Airframers requirements
- List of ad hoc demonstrators planned in WP1
- Overall definition of extended cockpit (Displays)
- Overall definition of extended cockpit (functions & FMS)
- Initial list of architectures for down-selection
- Airframers requirements
- List of ad hoc demonstrators planned in WP2
- List of target building blocks
- Work plan 2015-2016

- Overall definition of extended cockpit (Architecture)
- Overall definition of extended cockpit (Hardware)

#### WP2 – Cabin & cargo systems

- Statement of work and demonstrator description

#### WP3 – Smart integrated wing for large aircraft

- Wing system architecture for large aircraft
- Wing systems definition to fit architecture
- Joint system/structure architecture
- Business case analysis of structure integrated system
- Design criteria for autonomous Electro-Hydrostatic Actuation
- Topics descriptions for other wing systems
- Smart integrated wing test rig specifications
- Smart integrated wing test rig preliminary design

#### WP3 – Innovative electrical wing for regional aircraft

- Preliminary architectures specification
- Preliminary components specification
- Test means specification

#### WP4 – Full Electrical Actuation System for Main Landing Gears

- Selection of MLG Electrical LGERS architecture to be evaluated
- Definition of MLG Electrical LGERS prototype
- Specification of MLG Braking EMA components

#### WP4 – Green Taxiing

- Specification for second generation Green Taxiing systems

#### WP4 – Short TAT braking system

- Specification of future short TAT braking system

#### WP4 – Nose Landing Gear

- Trade Study Results for NLG Actuation
- Trade Study Results for NLG Installation
- System Description Document 01/2015
- System V&V Plan

#### WP4 – Tiltrotor Landing Gear System

- RFP's
- System Design Description
- Requirements List MLG/ NLG structure
- Design Description MLG/ NLG structure
- Requirements List actuation
- Design Description actuation
- RFP for BWT/BC
- Design Description for BWT/BC

- Trade Study Report
- System Design Description

#### WP5 – Power Generation

- System requirements defined with IADP Airframers for the needs of power conversion
- DGPU requirements for RA and LPA IADP

#### WP5 – Innovative electrical network & Power management center

- Next step toward MEA technologies for the electrical network (draft)

#### WP5 – Innovative electrical network

- Use case scenario definition (1<sup>st</sup> step)

#### WP5 – Power management center

- Specification for the next generation of power management center for RA, business jet and LA aircraft

#### WP6 – Electrical ECS

- Specification of E-ECS components
- V&V plan

#### WP6 – Electrothermal WIPS

- Optimized architecture for Large aircraft
- Design and development of a ground demonstrator for performance tests in icing Wind Tunnel
- Performance test report (IWT)

### *Description of activities 2016-2017*

#### ▪ **WP0**

The management activities will set the frame and control the running activities and manage in parallel the launch of the CP Wave 3 call and the integration of the CfP Partners from wave 2 and wave 3.

#### ▪ **WP1**

2016-17 work for WP1 “Cockpit, Avionics & Mission Management” will mostly provide the first elements of solutions for answering to the need and specifications issued in 2015:

- Interface specifications for cockpits and avionics systems: flow down of the solution specification defined in 2015 to the interfaces between various component of the system.
- Internal specification of solution for each component.
- Definition of the V&V strategy (including parts to be developed in mock-up for risk mitigation, and parts that can be simulated).
- Mock-up and prototypes development at various maturity level.
- Integration and Test plans for local demonstrations when needed on generic environments
- Preparation of the transfer to IADP for customization when relevant, depending on internal gates.

- Initial implementation of the common, ITD-level physical demonstrator of the extended cockpit: screens, first functions, IHS means;
- Update of operational scenarios and initial implementation of the most simple ones.
- Iterative work with airframers (Large, Regional, Bizjet, Rotorcraft) during the specification and development of mock-ups in order to feedback potential difficulties in the design into the requirement and needs, in order to optimize the overall solution.
- Initiation of development for the business jet innovative communication architecture and of the associated technology for the Software Design Radio.

In particular, Airbus activities for WP1 “Cockpit, Avionics & Mission Management” will mostly address:

- Follow-up of definition and development of main functions of CDS and flight management candidate for further integration in the IADP LPA Platform 3 demonstrators.
- Follow-up of Technical activities with the objective to feed the selection of avionics platform components for enhanced cockpit demonstrator within IADP LPA Platform 3

## ▪ **WP2**

2016-17 work for WP2 “Cabin & Cargo Systems” will kick off, with the involvement of Core partners in the GAM in S1 2016. The main objectives will be:

- Identification of existing / planned building blocks in the field of Cabin System power, Cargo and Cabin systems, and supporting sensors and network.
- Down-selection of best candidates,
- Definition of high-level specifications.
- Start the development of solutions
- Definition of simulation and demonstration environment to for cabin and cargo systems
- Contribution to the harmonization of work with other ITDs/IADPs, in particular to prepare the customization of WP2 solution for target vehicles.

This work plan will be reviewed with the core partners selected in this WP.

## ▪ **WP3**

### - **Large AC**

The activities on large passenger aircraft demonstrators will mostly be preparation to final demonstration. These activities will run in parallel with multiple national funded projects and the integration of the outcomes will start by 2018.

Once the results of the tests, studies and analysis on state-of-the art actuation technology has been performed and the preliminary system architecture has been defined, the future actuators have to be designed and matched with technological capabilities of the stakeholders.

Therefore, the output of Actuation 2015 (FP7) is expected on standardization aspects of the actuators and on sub-system architecture, mainly in the electrical matter.

The demonstration preliminary design will start and the concept is planned to hold its TRL3 in the first half of 2017.



## - **Regional AC**

The activities on Regional Aircraft will be driven by the two functional specifications from Alenia on R-IDAP for two systems architectures; one Basic and one Advanced Configuration. The trade-off begins in mid-2015, will continue between Alenia and Sagem for the first part of 2016.

Two architectures are considered:

- System Basic configuration : FCC and EMAs for Winglets control
- System Advanced Configuration: FCC, EMAs for Winglets and High Lift function

In 2016, the trade-off will be achieved to select the Items of the FCS architecture with assistance of models and virtualization. The Items specification shall be done at the end of 2016.

These Items will be developed by Sagem in 2017, derived from internal developments. The beginning of prototypes conception is planned for the end of 2017. In parallel, test Benches will be developed for EMAs, FCC, and for the FCS in the middle of 2016. The development of these benches will be completed in 2017.

The FCS system will be interfaced to WP 3.1.1 Electrical Network and WP 3.2.2 Sensors Concept and Health Monitoring.

## ▪ **WP4**

### - **Main LG**

The Landing Gear systems activities are organized around different technologies pillars which are the actuation, the green taxiing and the short TAT brake cooling.

For the Main Landing Gears (MLG), following selection of the best extension/retraction system architecture in 2015, the activities will be focussed on the definition of the prototype in 2016, and manufacture in 2017. As for the Smart Braking EMA activities, the components specifications will be defined in 2015, before a selection of a smart braking EMA architecture for design and manufacture (2016) and tests (2017) of an optimized prototype.

Modular approach will be applied in green taxiing system design activities in order to be adaptable to several aeronautical platforms (single aisle, bizjet, regional, helicopter) and based on CS1 achievement technological improvements will be deepen at components levels.

The Short TAT braking system activities will start with a selection of a wheel and brake architecture for design (2015), manufacture (2016) and tests (2017) of an optimized prototype, aiming at improving the passive and active cooling reducing the Turn Around Time.

Elaboration of requirements for a business jet MLG on the basis of electrical actuation will be carried out.

### - **Nose LG**

The Nose Landing Gear (NLG) Electro-Hydrostatic Actuation (EHA) will reach TRL3 in 2015. Based on specific design choice made at that time, the advanced detail of the components and the integration at system level will be performed.

The TRL4 is planned for the end of 2016, presenting a detailed design and proposals on system integration together with studies on impacts.

By the end of 2017, the TRL5 will be held and present a physical system demonstration integrated into a representative environment. The demonstration will take place in test facilities in Lindenberg, but may be extended to external test means.

- **RC LG**

- The Rotorcraft Landing Gear System covers electrical actuation (extension / retraction, steering), as well as braking and kinematics design. The development path is linked to the Next Generation Tiltrotor development plan.

It is planned to design first the kinematics of the landing gear system and in parallel to trade off the different electrical technologies.

- Once the technology has been selected, the system design will start and we envisage reaching TRL4 in the first half of 2017. The system components will then be demonstrated as hardware, targeting a flight demonstration in 2021 on the Next Generation Tiltrotor prototype.

▪ **WP5**

- **Electrical architecture**

For the Electrical architecture, Airbus activities in 2016 and 2017 will mainly focus upon:

- High power electrical network simulation
- Energy management modelling and simulation for new concept network
- Specification of power electronics components
- Specify power management centers air cooling architectures

- **Generation**

During this 2016-2017 work plan period, activities will be planned to pursue tasks around the power generation (WP5.1.1 and WP5.1.2) and also to start studies for the power conversion work package (WP5.1.3) and for the storage energy work package (WP5.1.4).

Concerning power generation (WP5.1.1 and WP5.1.2), workshops with airframers will enable gathering of requirements on standalone and dedicated power generation architectures and finalize the specification of the next generation of equipment (Starter generator and generator control unit (GCU)). During this 2016-2017 work plan period, the launch of digital GCU development is foreseen in order to reach TRL4 for a demonstrator at the end of 2017. In parallel, as contributions to maturity enhancement of next generation starter generators, technology bricks for these electrical machines will be identified through CfP and CP topics and evaluated to meet aeronautic environment conditions.

Concerning to conversion work package (WP5.1.3), studies are planned on AC and also DC voltage networks. Ground demonstrators for both power networks will be launched with technical objectives to reach power density requirements of these demonstrators. TRL4 milestone is planned at the end of 2017 and in parallel a selection of dedicated technologies is also planned in line with these specifications and performance of the TRL4 demonstrators.

Concerning energy storage, the core partner for this activity will be selected through the wave 3 selection of Core Partners. Technology and maturity road maps on energy storage with core partner collaboration are also planned and will be shared with airframers. Workshops should allow the definition of relevant energy storage architectures meeting security and safety requirements. The specification is planned at the end of 2016.

#### - **Energy Management**

For Energy management, activities in 2016 and 2017 will mainly focus on specification of power management center for energy distribution based on Clean-Sky 1 results and by considering:

- power management center architecture optimization;
- cooling technologies to reduce power consumption, reliability, and to ease integration. A focus on air cooling technologies will be addressed;
- Specification of power electronics components.

For the Innovative Electrical Network (IEN) decentralized architecture concept, after the preliminary study, the scenario defined and chosen as the most promising topologies in 2015 will be worked, modelled and simulated to assess trade off, including more criteria (weight, cost, safety etc). It will lead to detailed design specification (system, components, interface specification etc) end 2017.

In parallel, distribution components are worked separately to anticipate the future needs.

- Classical one (common to any topologies) are worked: protection, converters, EWIS components for new constraints (higher voltage, harsh environment) as cable, bus bar, racking solution and new materials.
- Some mandatory for new topologies (health monitoring, communication, network management) will be worked on a case by case basis, depending on first results.

#### ▪ **WP6**

##### - **Aircraft Loads Architecture**

In 2016 and 2017, Airbus will provide the aircraft level electrical system architecture for the large passenger aircraft (A320 type). Additional investigations related to certifiability as well as the verification and validation (V&V) strategy will be documented.

##### - **E-ECS**

The major loads work package regroups the main electrical loads on the aircraft, which is a wide set of activities. In 2016, the resources will be mainly charged on design activities for

the E-ECS for large passenger aircraft, on electro thermal wing ice protection system and on electrical motors.

In 2016, the trade-off on new electrical ECS architectures for a single-aisle application, extended to thermal management and with Trans ATA consideration, will be pursued based on the specification provided by Airbus. A focus on installation aspect of the flight test demonstrator will be considered

This study will enable to define an E-ECS architecture optimized with respect to system impact on weight and power consumption, reliability, drag increase and enhanced engine power efficiency.

The development of an ozon converter optimized for bleedless application and including monitoring functions will be initiated with the support of a CFP partner.

The development of an airworthy full-scale E-ECS demonstrator will be initiated from 2017 based on the selected architecture. This demonstrator will enable to validate the performance objectives and integration aspects with air intake) in full scale configuration.

In 2016 Airbus will provide the specification for minimum qualification of the electrical ECS pack integration for experimental flight test. During 2016 and 2017, the integration for such an electrical ECS into a flight test aircraft will be analysed.

A call for Proposal (CfP) to develop a flightworthy fresh air intake for the eECS system will be launched in 2016.

The technology development of ozone and oil vapor filtration for business jet application will be initiated.

#### **- Cooling/Thermal Management**

In 2016, Liebherr will perform a trade-off study for new generation of supplemental cooling system based on the specification provided by Airbus. A ground demonstrator will be developed from 2017 to perform performance tests in a thermal test bench.

In 2016 Airbus will provide the specifications for thermal systems comprising vapor cycle system and thermal management function (TMF).

#### **- Adaptive ECS**

These activities are intended to be published in a Call for Proposal (CfP) in 2015 (Wave 2).

For 2016, the baseline cabin air quality will be established based on a cabin air quality sampling campaign.

For 2017 the Adaptive ECS control system demonstrator development will start.

#### **- WIPS**

For Wing ice Protection System, the definition of an optimized architecture for Large aircraft based on preliminary work performed in JTI Clean-Sky and with focus on performance,

weight, reliability and maintainability will be achieved in 2016. The Ice protection strategy will be refined as well to optimize the power consumption.

A TRL 3 review with new architecture will be planned in end 2016. The development of a full scale demonstrator for performance tests in icing Wind Tunnel test will be initiated in 2017. A decision gate to confirm the relevance of flight test demonstration is planned within the TRL3 review.

For Ice detection, the activities in 2016 and 2017 will be focused on the development on new generation of PFIDS (ice accretion rate characterization) addressing Appendix 0 and D with the support of a CFP partner CFP partner.

For Wing ice Protection System, the Airbus activities will be split between e-WIPS and PFIDS in 2016 and 2017 as follows:

- eWIPS

In 2016, Follow-up of LTS/SONACA activities & TRL3 demonstration for an ETIPS/anti-icing & de-icing

In 2017, PFIDS/eWIPS IWT/T preparation

- PFIDS

In 2016, Follow-up of CfP activities on PFIDS (ice accretion rate characterization) and decide upon need for PFIDS flight tests in icing conditions

In 2017 PFIDS/eWIPS IWT/T preparation

## **Integrated Demonstration and Validation**

Airbus will lead the WP for demonstration activities on ground facilities and flight test aircraft in 2016 and 2017.

In 2016 ground test will be specified for the Airbus test rig AVANT in order to carry out integration tests for the thermal and ECS systems. First testing will start with a cooling loop and thermal load simulation in 2016, followed by vapor cycle system integration in 2017. First results will be reported in 2017 from thermal loop testing.

In 2016 and 2017 Airbus will define the requirements for flight test installation of an electrical ECS system including fresh air intake and power supply.

### **- Test facilities**

Tests of integration of specific equipments for business jet application will be carried out (e.g. WIPCU, Li HVDC batteries).

## ▪ WP7

The WP7 objective within this ITD is to research and develop the application of new and cost effective technologies in the area of systems for a future new generation small transport aircraft.

The main target is to achieve the high level objectives:

- Reduction in the Operational Costs;
- Improved Cabin (noise, Thermal , entertainment) & Flight comfort;
- Safety and Security.

### **WP 7.1 Efficient operation of small aircraft with affordable health monitoring systems (PAI)**

With selected partner a demonstrator prototype of an innovative electromechanical actuator, with real time health monitoring, will be designed and developed. This actuator type will be taken as reference for primary control surface application on small aircraft. The development of health monitoring system is based on available actuator with high level specification defined by Piaggio.

### **WP7.2 More electric/electronic technologies for small a/c**

#### *WP 7.2.1 electrical power generation and distribution architecture for more electric SAT*

Electrical Power Generation. A demonstrator prototype for electrical generator will be designed and developed during 2016 and 2017, comprising the electrical machine and power electronic converter, associated cooling system and control enabling the system to operate safely and reliably as a started generation system for small aircraft. An integrated design and modeling approach will be performed to develop an optimized solution with components reduction. The design and development of Electrical Power Generation is based on high level specification defined by Piaggio.

Electrical Power Distribution. With selected partner a Solid Stated Power distribution will be designed and developed during 2016-2017 based on two voltages level, depending in the application of alternate or direct current, instead of typical low power DC electrical distribution of small aircraft. Virtual and laboratory test bench will be used to identify problems and risk related to the selected architectures.

#### *WP 7.2.2 electrical landing gear architecture for SAT*

With selected partner a demonstrator prototype of an innovative electromechanical actuator for landing gear will be designed and developed. The landing gear type taken as reference for demonstration will be P180 aircraft. The development of electrical landing gear is based on available specification with high level specification defined by Piaggio.

### **WP 7.3 Fly by wire for small aircraft**

Demonstration of a representative FBW configuration for small aircraft will be based on existing iron bird and dynamic model of P180. During 2016 design and development of the

main modules will be performed to be used for the next test phase. In 2017 the iron bird will be updated with selected modules for test campaign.

#### **WP 7.4- Affordable SESAR operation modern cockpit and avionic solutions for small aircrafts**

Topics will be held and organized by selected CP. Is expected, that Core partner will be selected in CPW2. Detail planning and technical content will be discussed with CP, but areas of work are as follows:

- Affordable SESAR functions in cockpit
- Low-cost navigation and communication systems
- Low-cost computing platforms
- High-integrity electronics

#### **WP 7.5 – Comfortable and safe cabin for small aircraft**

##### *WP 7.5.1 Multifunction Thermo-Acoustics insulation of cabin for small aircraft*

In year 2016, laboratory testing of different materials for noise and thermal insulation will be initiated. Synergy composite materials will be designed and both passive and active insulation technologies will be investigated.

##### *WP 7.5.2 Advanced structural design of crashworthy configurable seats*

In the 2nd Q of 2016, Basic design and calculation manual for seat development will be finished.

In the beginning of 2016, CfP for dynamic material properties will be launched. The main objective of this CfP is to create a database of dynamic material properties for common materials used in aerospace industry. The end of this CfP is planned to the 1st Q of 2017.

In 2017, both design and calculation of the first seat demonstrator intended for manufacturing will be finished. First manufactured seat prototype for testing will be ready by the end of 2017.

##### *WP 7.5.3 Thermal comfort in cabin for small aircraft*

In year 2016, computational model for assessment of thermal comfort will be prepared and validated.

The main efforts for year 2017 will be directed towards multidimensional analysis of thermal comfort factors.

#### **▪ WP 100**

##### **WP 100.1**

The transversal work package 100.1 will develop low TRL technology bricks to de-risk breaking through items and get a common basic understanding on power electronics.

Also these bricks will be customized and further developed in the work packages linked to demonstrations.

## **WP 100.2**

In the coming decade, the aerospace industry will have to focus more and more on its production processes. Aircraft manufacturers are expected to increase their production cadence, which will lead suppliers to make their own production more efficient (and less wasteful). In order to master our resources and our environment, weight reduction and economical production is also targeted and will drive to the development of innovative designs and production processes.

To this end Liebherr plans to keep developing new ecological coating systems. Production processes such as additive manufacturing will keep being investigated in order to develop lighter components.

This will happen thanks to multiples calls for Proposals enabling strong collaboration with universities, research centers and small and medium enterprises (SMEs)

## **WP 100.3 Aircraft Level Simulation:**

In 2016 and 2017 Airbus will work with the leaders on aircraft level use cases to define the basis for the simulation tool for electrical aircraft system architectures.



### **ITD Systems Milestones**

Work Package	Demonstrator	Milestone	Target date
WP0	ITD Management	ITD Systems Annual review	2016
		ITD Systems Annual review	2017
WP1	Extended Cockpit	WP 1.1 Requirements architecture: Requirements review	2016
		First instance of extended cockpit demonstration	2017-Q4
WP2	Cabin and Cargo	Roadmap of technologies and integration plan	2017-Q1
		High level specification for each component	2017-Q3
WP3	Smart Integrated Wing	System architecture review	2016
		Smart Integrated Wing TRL3	2017
	Integrated Electrical Wing for Regional Aircraft	End of System Architecture Trade Off / Specification at System Level	2016
		End of Components Trade Off / Specification at Component Level	2016
		Components Preliminary Design Review	2017
WP4	Full Electrical Actuation System for Main Landing Gears	MLG Electrical LGERS TRL4	2017
		End of smart braking EMA prototype design	2016-Q3
		End of smart braking EMA prototype manufacture	2017-Q2
		End of smart braking EMA prototype tests	2017-Q4
	Green Taxiing	Optimized second generation of Green Taxiing Systems TRL3	2016
	Short TAT braking system	End of short TAT braking system architecture trade off phase	2015-Q2
		End of short TAT braking system prototype design	2015-Q4
		End of short TAT braking system prototype	2016-Q4

Work Package	Demonstrator	Milestone	Target date
		manufacture	
		End of short TAT braking system prototype tests	2017-Q2
	Nose Landing Gear	System TRL4	2016
		System TRL4	2017
	Rotorcraft Landing Gear System	Technology roadmap for integration frozen with AW	2016
		System TRL4	2017
WP5	Electrical Architecture	Partner wave 2 selection for Electrical simulation tool	2016
		Partner Wave 2 selection for Power electronics	2016
		CP wave 3 kick-off on energy distribution	2017
	Power Generation	Technology bricks selection for AC and DC starter generators	2017-Q1
		Design review for digital GCU demonstrator	2016-Q4
	Conversion	Design review for AC network converter	2017-Q1
		Design review for active power conversion	2017-Q1
	Innovative Electrical Network	IEN Design review	2017-Q3
WP6	e-WIPS	TRL3 demonstration for an Electrothermal wing ice protection system in optimized configuration	2016
		CfP Partner Wave 3 partner kick off	2016
		eWIPS/PFIDS/IWT tests preparation	2017
	PFIDS	CfP Partner Wave 2 kick off	2016
		Decision gate for flight tests in natural icing conditions	2016
		eWIPS/PFIDS/IWT tests preparation	2017

Work Package	Demonstrator	Milestone	Target date
	AVANT ground test bench	Delivery of the vapor cycle system	2016
	eECS Flight Test Aircraft	CfP Fresh air intake PDR	2017
		Selection of EECS optimized architecture	2017
		Preliminary definition of installation constrains for EEC flight test demonstration	2017
WP 7.1	electromechanical actuator with HM design	Preliminary Design review	2016-Q3
		Critical Design review	2017-Q4
WP 7.2.1	electrical power generation and distribution	Preliminary Design review	2016-Q3
		Critical Design review	2017-Q4
WP 7.2.2	electrical landing gear	Preliminary Design review	2016-Q3
		Critical Design review	2017-Q4
WP 7.3	Fly by wire	Preliminary Design review	2016-Q3
		Critical Design review	2017-Q3
WP 7.4	Cockpit and avionics solutions	Affordable SESAR Cockpit Architecture for SAT	2016-Q4
		Technology Element & System Design and Gate Reviews (Batch 1)	2017-Q4
WP 7.5	Multifunction thermo acoustic insulation	Initiation of material testing for active and passive insulation	2017-Q2
	Crashworthy Configurable Seats	Dynamic material properties database	2017-Q1
	Thermal comfort	Thermal comfort computational model preparation	2016-Q4

## **Deliverables**

WBS	Demonstrator	Deliverable	Target
WP0	ITD Management	Topics definition for CfPs to be launched in 2017	2016
WP1	Preparation of extended cockpit	Demonstration strategy for extended cockpit	2016-Q3
		Work plan 2015-2016	2015-Q1
		Overall definition of extended cockpit (Displays)	2015-Q1
		Overall definition of extended cockpit (functions & FMS)	2015-Q1
		List of target building blocks	2015-Q1
		Work plan 2015-2016	2015-Q1
		Overall definition of extended cockpit (Architecture)	2015-Q1
		Overall definition of extended cockpit (Hardware)	2015-Q2
WP3	Smart Integrated Wing for large aircraft	Wing system architecture	2016
		Systems requirements and specifications	2016
		Systems development plan	2017
		Test facility preliminary design	2017
	Integrated Electrical Wing for Regional Aircraft	Technical Specification for Components	2016
		Components preliminary Design	2017
WP4	Full Electrical Actuation System for Main Landing Gears	MLG Electrical LGERS integration report	2016
		MLG Electrical LGERS prototype	2017
		Specification of smart braking EMA components	2015-Q2
		Smart braking EMA prototype drawings	2016-Q3
		Smart braking EMA prototype components	2017-Q2
		Smart braking EMA prototype tests report	2017-Q4
	Green Taxiing	Second generation Green Taxiing system definition	2017
	Short TAT braking	Short TAT braking system architecture trade off	2015-Q2

WBS	Demonstrator	Deliverable	Target
	system	justification document	
		Short TAT braking system drawings	2015-Q4
		Short TAT braking system prototype components	2016-Q4
		Short TAT braking system tests report	2017-Q2
	Nose Landing Gear	System integration report	2016
		Test campaign definition	2016
		Prototype for hardware demonstration	2017
	Rotorcraft Landing Gear System	System definition	2016
		Sub-system requirements and specifications	2016
		System preliminary design	2017
WP5	Electrical architecture	Electrical Simulation automatic parameter tuning tool:  - Use case scenarios definition  - Tuning tool delivery from Partner	2016  2017
		High power architecture Electrical simulation (MEA):  - Reports on validation  - Report on optimization potential	2017
		Energetic simulation:  - Validation report for Implementation of reference architecture  - reports with alternate architectures	2016  2017
		Standard parts: test report on applicability to HVDC	2017
		SSPC: Trade off dossier	2017
		Air cooling architecture specification in pressurized and unpressurized zones	2017

WBS	Demonstrator	Deliverable	Target
		Power Electronics:	
		- Modular integration software Specification	2017
		- Specification of Power Electronic components	2016
		- Modules definition dossier from Partner	2017
	Power generation	Report on the selection of technologies bricks for AC and HVDC network	2017-Q1
		Design and development of a DGCU demonstrator for performances	2017-Q4
	Conversion	Report on optimization result for AC network converter	2017-Q1
		Evaluation report on an active converter for HVDC network	2017-Q4
	Energy storage	Energy storage specification	2016-Q4
	Innovative Electrical Network	System detailed design	2017-Q4
		Distribution components	2017-Q4
	Power Management Center	Partner definition dossier for Air cooled Rectifier Unit	2017
	e-WIPS	e-WIPS SRD update	2016
		ETIPS TRL3 Assessment	2016
		IWT test programme and demonstrator specification	2017
	PFIDS	PFIDS SRD update	2016
		IWT test programme and demonstrator specification	2017
	eECS Flight Test Aircraft	Electrical architecture specification	2016
		Certifiability/V&V plan	2016
		Flight test Requirements	2016
		Selection of EECS optimized architecture	2017
		Installation Specification	2017

WBS	Demonstrator	Deliverable	Target
		CfP Fresh air intake Statement of Work	2017
		CfP Fresh air intake PDR document	2017
	AVANT – Cooling/ Thermal Management	Ground test specification thermal testing	2016
		Ground test specification vapor cycle system integration	2017
		Report on thermal loop testing	2017
	Applicant test facility – Adaptive ECS	Report Cabin air quality sampling campaign	2016
		Report Development of Adaptive ECS	2017
WP 7.1	electromechanical actuator with HM design	<p>Phase 1 Preliminary Design:</p> <ul style="list-style-type: none"> <li>Requirement specification and HM approach</li> <li>Definition of sensoring for EMA components</li> <li>Test campaign of each EMA component (damage and undamaged) with sensors</li> <li>Mathematical Modeling EMA with HM</li> </ul> <p>Phase 2 Design development</p> <ul style="list-style-type: none"> <li>Monitoring system design and integration in the actuator electronics</li> <li>Monitoring system design and integration in the mechanical part of the actuator</li> </ul>	<p>2016-Q3</p> <p>2017-Q4</p>
WP 7.2.1	electrical power generation and distribution	<p>Phase 1 Preliminary Design:</p> <ul style="list-style-type: none"> <li>Requirement and specification for start generator system</li> <li>Requirement and specification for electrical power distribution</li> <li>Trade off study of starter generator topology, power electronic converter including cooling.</li> <li>Trade off study of electrical power distribution architecture.</li> <li>Test specification and Test preparation on components (converter, inverter, power load management, etc)</li> <li>Modeling of starter generator for supporting trade off and functional and behavior</li> <li>Modeling electrical power distribution based</li> </ul>	2016-Q3





### List of Leaders and participating affiliates

Nr	Leaders	Description of activities
1	Liebherr Aerospace Lindenberg	ITD Coordination and management of call for Partners and Core Partners. Wing system architecture design and HVDC network investigation. Electro-Hydrostatic Actuators for flight control and landing gear design and optimization. System design, kinematics and electrical actuation requirements definition for Tiltrotor landing gear system.
4	Thales Avionics	ITD Coordination and management of call for Partners and Core Partners. Extended cockpit demonstrator coordination, development of building blocks for displays, functions, flight management, supporting environment. Test and assessment of demonstrator in simulated operational conditions. Supply of cockpit building blocks and systems to IADPs.
8	Safran SA	Stakeholder coordination and management of call for Partners and Core Partners.
13	Airbus SAS	Stakeholder coordination and management of call for Partners and Core Partners.
16	Evektor	Investigation on possible solutions to improve the thermal and acoustic comfort of the cabin on small aircraft.
17	Piaggio Aerospace	Feasibility studies on health monitoring for small aircraft systems. Trade off study for electrical system and fly-by-wire on small aircraft.
18	Dassault Aviation	Investigation on solution to improve air cabin comfort (air filtering and standardization). Maturation of 28 VDC Li-Ion battery and electronics. Initiation of activity on communication (network and SDR). Stakeholder coordination and management of call for Partners and Core Partners.

Nr	Participating affiliates	Description of activities
2	Liebherr Aerospace Toulouse	Electrical bay system and cooling design. Electrical Environmental Control next generation system architecture design. Electrothermal Wing Ice Protection System redesign according to new specifications provided by Aiframer. Definition of call for Partners and Core Partners.
3	Liebherr Elektronik GmbH	HVDC Network investigation and power electronics technological bricks development for electrical actuation, high speed bearing machines and power center cooling.
5	Thales electrical systems	Contribution to Partners and Core Partners topics definition. Specification of generation activities and capture of Airframers requirements.
6	Thales UK Ltd	Participation in WP meetings, contribution to CP and CfP topics, work on communication architecture and Integrated Modular

Nr	Participating affiliates	Description of activities
		Communication
7	Thales Training & Simulation SAS	Participation in WP meetings, and contribution to CP and CFP topics, work on cockpit environment and crew interface (IHS, monitoring, simulation)
9	Sagem	Top level specification of the flight control system and architecture level system modeling. Definition of overall system benched and subsystem analysis.
10	Messier-Bugatti-Dowty	Specification and system design for full electrical actuation system for main landing gear, second generation of green autonomous taxiing system and short Turn Around Time braking system
11	Safran Engineering Services	Innovative Electrical network preliminary topology studies and components design. System architecture definition.
12	Labinal Power Systems	Innovative Electrical network preliminary topology studies and components design. System architecture definition.
14	Airbus Operations SAS	Requirements for LPA enhanced cockpit components studied in ITD Systems
15	Airbus Operations GmbH	No activity foreseen before 2016.

## 9.8. SMALL AIR TRANSPORT TRANSVERSE ACTIVITY

The SAT Initiative proposed in *Clean Sky 2* represents the R&T interests of European manufacturers of small aircraft used for passenger transport (up to 19 passengers) and for cargo transport, belonging to EASA's CS-23 regulatory base. This will include dozens of industrial companies (many of which SMEs), research centers and universities. The New Member States industries feature strongly in this market sector. The community covers the full supply chain, i.e. aircraft integrators, engine and systems manufacturers and research organisations. The approach builds on accomplished or running FP6/FP7 projects. Key areas of societal benefit that will be addressed are:

- Multimodality and passenger choice;
- More safe and more efficient small aircraft operations;
- Lower environmental impact (noise, fuel, energy);
- Revitalization of the European small aircraft industry.

To date, most key technologies for the future small aircraft have reached an intermediate level of maturity (TRL3-4). They need further research and experimental demonstration to reach a maturity level of TRL5 or TRL6. The aircraft and systems manufacturers involved in SAT propose to develop, validate and integrate key technologies on dedicated ground demonstrators and flying aircraft demonstrators at an ITD level up to TRL6. The activity will be performed within the *Clean Sky 2* ITDs for Airframe, Engines and Systems with an aim to making the best use of synergies with the other segments of aeronautical design, with strong co-ordinating and transversally integrating leadership from within a major WP in Airframe ITD.

### *Description of activities 2015*

In 2015 the planning of CS2 programme technical activities will be matured. The interfacing of SAT activities within all three ITD's Airframe, Engines and Systems will be fleshed out. In parallel the definition of synergies between technical activities of SAT and different IADP's and TAs will be matured.

In 2015 in cooperation with selected Core Partners the definitions of selected concepts and technologies will be consolidated. The definition of reference aircraft will be defined.

#### ▪ **ITD Airframe**

##### WP 0.2B – Small Air Transport Overall A/C Design & Configuration Management

Transversal coordination activity within SAT group will start. The interaction and interfaces with Technological Evaluator TA and inputs/outputs will be agreed. In 2015 activity regarding "reference aircraft" definitions will start, with the focus on performance, transport capabilities and the most important actual costs of a recent aircraft type in the 19 seat commuter class. Reference aircraft should be an existing platform of "best in class" current service aircraft.

### WP B 1.2 - Optimized Composite Structures

The start of activities is strongly dependent on the timeframe for the Core Partner selection. It is assumed that WPs will be managed by selected CP and technical content will be elaborated by CPs. Expected activities will be focus on preparation of CP selection in 2<sup>nd</sup> wave.

Activities in 2015 will be focused on defining the strategies of selection, development and application of suitable Out of Autoclave (OOA) composite production methodologies for the target demonstrator of a small aircraft wing box. The focus for the selection will be on the cost efficient production methodologies with reduction of number of components, more automation and higher process stability compared to wet laminate production methodology. Specific zones of the wing box with different structural requirements will be defined and suitable raw materials (matrix, carbon/fiber glass layer) and/or prepregs will be selected in 2015.

Coupon testing will start in 2016. The first CfP are planned for 2016.

### WP B 2.3 – High Lift Wing (SAT)

The activities will focus on the definition of State of the Art of generally used high lift devices at the 19 seater commuter class. In 2015 will be initialized process of definition of requirements of HLW for 19 seater with focus on simple, light weight and cost effective system. Approaches of leading edge/trailing edge devices will be considered for targeted short take-off and landing operations. Set of demonstrators will be defined – wind tunnel models. Trade off study will be done, selected technology will be considered and initial design work started.

### WP B 3.4 – Advanced integration of systems in small a/c

The activities of this WP will focus on the definition of demonstrators, with close interaction with ITD Systems SAT Work packages. Technologies developed in Systems WP's will be integrated. Demonstration activities from Systems WPs are expected to be covered by leaders for S1 (health monitoring) S2 (more electric), and S5 (cabin) and selected Core partners S3 (fly by wire) and S4 (cockpit).

Selection of proper Core partners with ability to demonstrate selected technologies (fly-by-wire and cockpit) is a key element. During the 2015 the selection of core partner for fly by wire will take place in the second wave.

### WP B 3.5 - More Affordable Small a/c Manufacturing

Key factor will be preparation of Core partners' selection in 2<sup>nd</sup> wave for demonstration of automated assembling processes (longitudinal joints configuration) with multidisciplinary usage in low volume production.

In 2015 will continue works on the technology requirements and start design works on new concepts of automated assembling. Initial specification of demonstrators will be set in cooperation with selected Core Partners. The first CfP are planned for 2016.

## ▪ ITD Engines

### WP E.1 - Reliable and more efficient operation of small turbine engines

Based on a successful selection of Engine ITD core partner in Wave 1, those activities will be continued in 2015 with inserting analysis from engaged Core Partner, with the target to achieve the preliminary definition of first scheduled demonstrators. Trade-offs analysis will consolidate the definition of selected engine components material and concept. Behaviour analysis will support the study of advanced Engine components specification phase to be initiated in 2015. The preliminary design of engine components will be launched.

### WP E.3 - Light weight and fuel efficient diesel engines

The activities will mainly consist in initiating the definition works by Leaders of the first set of Engine ITD Diesel technology developments and demonstration for engine components leading to the high level description of objectives and requirements for those demonstrators.

In 2015 the target is to achieve the preliminary definition of first scheduled demonstrators. Trade-offs analysis will consolidate the definition of selected engine components material and concept; behaviour analysis will support the study of advanced Engine components specification phase to be initiated in 2015.

## ▪ ITD Systems

### WP S.1 - Efficient operation of small aircraft with affordable health monitoring systems

The activities will mainly consist in initiating the definition works of the first set of technology developments and demonstration for Health monitoring in the area of: Structure Health Monitoring (SHM), Actuators with Health Monitoring and Solid State Power Controller (SSPC) with CBM, leading to the high level description of objectives and requirements for those demonstrators.

Based on a successful selection of the System ITD core partner in Wave 2, the activities will be continued in 2015 with inserting analysis from engaged Core Partner, with the target to achieve the preliminary definition of first scheduled demonstrators. Trade-offs analysis will consolidate the definition of selected components for demonstration and concept; behaviour analysis will support the study of SHM components specification phase to be initiated in 2015.

### WP S.2 - More electric/electronic technologies for small aircraft

The activities will consist in initiating the definition works of the technology developments and demonstration for more electric systems. In 2015 these activities will continue with inserting analysis from systems leaders, airframes leaders and engaged airframe ITD System Core Partner selected in Wave 2 for:

- Consolidation of selected system and architecture definition.

- First CfP in this area with the target to achieve the systems preliminary definition and the hardware development for demonstration.

#### WP S.3 - Fly-by-wire architecture for small aircraft

The activities will consist in initiating the definition works of the technology developments and demonstration for fly-by-wire. Based on a successful selection of the Core partner in Wave 3, these activities will be continued in 2016 with inserting analysis from systems leaders, airframes leaders and engaged airframe Core Partner for:

- Consolidation of selected system and architecture definition.
- First CfP in this area with the target to achieve the systems preliminary definition and the hardware development for demonstration.

#### WP S.4 - Affordable SESAR operation, modern cockpit and avionic solutions for small a/c

The activities will consist in initiating the definition works of the technology developments and demonstration for modern cockpit with overview of relevant regulations and the formulation of recommendations to support the vision of SAT and with inserting analysis from systems leaders, airframes leaders and engaged airframe Core Partner for:

- Consolidation of selected system and architecture definition.
- First CfP in this area with the target to achieve the systems preliminary definition and the hardware development for demonstration.

#### WP S.5 - Comfortable and safe cabin for small aircraft

The activities will focus on defining the strategies of selection, development and application of new passive multifunctional materials and active insulation materials. The first CfP in this area are planned to 2015. The selection of suitable aerospace materials for their dynamic properties investigation will be done with the first CfP for coupon testing in 2015.

#### **Major milestones planned for 2015:**

- Selection of the next batch of Core Partners in airframe (composite WPB1.2 and metallic WP B3.5), System integration (WP B3.4 fly by wire), Systems (S1, S2 more electric) , System (S4 cockpit)
- Preparation of CfP
- Initialization of technology developments in airframe, , composite structures
- Consolidation of selected system and architecture definition with contribution of selected Core Partners
- Airframe, Engine and Systems ITD Annual Review

## **Major deliverables planned for 2015:**

- Concept guidelines of initial demonstrators in Airframe, Engines and Systems
  - First turbine engine concept, specification of systems and subsystems
- Updated work plan with inputs of selected Core partners  
Technical specifications for the systems to be included in demonstrators

## ***Description of activities 2016-2017***

### **▪ ITD Airframe**

#### WP 0.2B – Small Air Transport Overall A/C Design & Configuration Management

Transversal coordination activities of SAT will continue with the aim to prepare base for first set of demonstrators. Successfully selected Core Partners will be implemented in SAT CS2 management processes.

The technical description of the reference and green aircraft shall be updated at Loop 2 in 2016 with results coming the first assessment of technologies investigated.

#### WP B 1.2 - Optimized Composite Structures

Activities in 2016 – 2017 will be mainly provided by Core partner selected in CPW2. It is expected, that during 2015/early 2016 will be discussed and finalized technical content of work on the main wing box.

During 2016 the material and process selection will be completed starting from the preliminary activity performed during 2015. The activity will also include some manufacturing trials to support the selection. In parallel in 2016 and during 2017 a preliminary sizing of the wing box will be developed.

More details for 2016/2017 will be added after successful implementation of work content of selected CP, based on answer of CP call.

In the work package Optimized composite structures, focused for usage thermoplastics in secondary structures of small aircraft, will be activities in 2016 focused on testing and verification of thermo-mechanical properties of selected thermoplastic materials. There will be tested materials whose properties are not available and in order to verify available values.

The activities planned for 2017 are related to a design and manufacturing of precise thermoplastic parts and development of effective joining and mounting methods.

#### WP B 2.2 – High Lift Wing (SAT)

Activities in 2016 – 2017 will be mainly provided by partner selected in partner wave 3 at the end of 2015 beginning 2016.

During 2016 selection of technology for high lift will be completed and preliminary design of the demonstration will be performed.

During 2017 the high lift design will be performed with preliminary test specification.

#### WP B 3.4 – More affordable small a/c manufacturing

##### WP B 3.4.1 Automated assembling of SAT structures

The main mission for years 2016 and 2017 will be cooperation with CfP partner selected in 2015 on development, implication and testing of the orientation system and simplified programming system for robotic hand. At the same time, parallel development and design of accessories and mobile platform for the hand will run. At the end of the period, works on platform –hand –accessories integration and first programming and testing will start. First accessories will also be produced and delivered and production of first mobile platform will start.

##### WP B 3.4.2 - Effective Joining Methods of Metal-Composite Hybrid Structures

The activities in 2016 will be directed towards finding a Partner for cooperation on developing the joining method selected in the preceding stage of the project. The development itself will involve identification of relevant parameters of the joint, surface topology, possible joint components such as adhesives, assessment of the manufacturing methodology etc.

In 2017, the activities related to development of the joining methods will continue. Simultaneously, development of the sizing methodology for analytical prediction of the connection behaviour will be initiated.

##### WP B 3.4.3 - Non jig assembling

At the beginning of 2016 we will select and define in detail suitable shapes of sheet metal flange embossment from shape variants given from WP 3.4.3.3.1. This selection will be based on the FEM analysis. Strength and fatigue tests of the flanges with embossment will be done. Results of these analyses will be used for stress manual.

Next step will be development and testing of suitable technological process for production of these parts, including heat treatment.

At the end of the period, work on design of the advanced experimental assembly will start.

#### ▪ **ITD Engines**

##### WP7.1 Lightweight and fuel efficient compression ignition power unit

Post 2015, activities will be mainly dedicated to manage partners (CFP), already described in CFP documents.

SMA activities (in addition to management) may be performed. There will be defined with partners (CFP).

##### WP 7.2 Reliable and more efficient operation of small turbine engines (19 seats)



In the period 2016-2017 the activities will be focused to coordinate activity with Leader (Turbomeca) and Core Partners (to be selected) in developing the installation activity.

## ▪ ITD Systems

### WP7

The WP7 objective within this ITD is to research and develop the application of new and cost effective technologies in the area of systems for a future new generation small transport aircraft.

The main target is to achieve the high level objectives:

- Reduction in the Operational Costs;
- Improved Cabin (noise, Thermal , entertainment) & Flight comfort;
- Safety and Security.
- WP 7.1 Efficient operation of small aircraft with affordable health monitoring systems (PAI)

With selected partner a demonstrator prototype of an innovative electromechanical actuator, with real time health monitoring, will be designed and developed. This actuator type will be taken as reference for primary control surface application on small aircraft. The development of health monitoring system is based on available actuator with high level specification defined by Piaggio.

- WP7.2 More electric/electronic technologies for small a/c

#### *WP 7.2.1 electrical power generation and distribution architecture for more electric SAT*

- Electrical Power Generation. A demonstrator prototype for electrical generator will be designed and developed during 2016 and 2017, comprising the electrical machine and power electronic converter, associated cooling system and control enabling the system to operate safely and reliably as a started generation system for small aircraft. An integrated design and modeling approach will be performed to develop an optimized solution with components reduction. The design and development of Electrical Power Generation is based on high level specification defined by Piaggio.
- Electrical Power Distribution. With selected partner a Solid Stated Power distribution will be designed and developed during 2016-2017 based on two voltages level, depending in the application of alternate or direct current, instead of typical low power DC electrical distribution of small aircraft. Virtual and laboratory test bench will be used to identify problems and risk related to the selected architectures.

#### *WP 7.2.2 electrical landing gear architecture for SAT*

- With selected partner a demonstrator prototype of an innovative electromechanical actuator for landing gear will be designed and developed. The landing gear type taken as reference for demonstration will be P180 aircraft. The development of

electrical landing gear is based on available specification with high level specification defined by Piaggio.

- WP 7.3 Fly by wire for small aircraft

Demonstration of a representative FBW configuration for small aircraft will be based on existing iron bird and dynamic model of P180. During 2016 design and development of the main modules will be performed to be used for the next test phase. In 2017 the iron bird will be updated with selected modules for test campaign.

- WP 7.4- Affordable SESAR operation modern cockpit and avionic solutions for small aircrafts

Topics will be held and organized by selected CP. Is expected, that Core partner will be selected in CPW2. Detail planning and technical content will be discussed with CP, but areas of work are as follows:

- Affordable SESAR functions in cockpit
- Low-cost navigation and communication systems
- Low-cost computing platforms
- High-integrity electronics

#### WP 7.5 – Comfortable and safe cabin for small aircraft

##### *WP 7.5.1 Multifunction Thermo-Acoustics insulation of cabin for small aircraft*

In year 2016, laboratory testing of different materials for noise and thermal insulation will be initiated. Synergy composite materials will be designed and both passive and active insulation technologies will be investigated.

##### *WP 7.5.2 Advanced structural design of crashworthy configurable seats*

In the 2nd Q of 2016, Basic design and calculation manual for seat development will be finished.

In the beginning of 2016, CfP for dynamic material properties will be launched. The main objective of this CfP is to create a database of dynamic material properties for common materials used in aerospace industry. The end of this CfP is planned to the 1st Q of 2017.

In 2017, both design and calculation of the first seat demonstrator intended for manufacturing will be finished. First manufactured seat prototype for testing will be ready by the end of 2017.

##### *WP 7.5.3 Thermal comfort in cabin for small aircraft*

In year 2016, computational model for assessment of thermal comfort will be prepared and validated.

The main efforts for year 2017 will be directed towards multidimensional analysis of thermal comfort factors.

***Milestones and Deliverables for 2016-2017***

**ITD Airframe Milestones**

Work Package	Demonstrator	Milestone	Target date
WP 0.2		Airframe, engine, system ITD – Support Steering Committee for SAT transversal activities	Q4/2016 Q4/2017
		Risk Management	Q4/2016 Q4/2017
		Preparation of the annual reports	Q4/2016 Q4/2017
		Reference and green Aircraft L2	Q4/2016
WP 1.2	Optimized Composite Structures	Start of activities of partners selected in CfP calls	Q1/2016
		Selection of material and cost efficient production technologies	Q3/2016
		Wing design concept and preliminary sizing.	Q3/2017
WP 2.2	High Lift Wing	Selection of technology	Q2/2016
		Preliminary design of the demonstration	Q4/2016
		Preliminary test specification	Q3/2017
		High lift design	Q4/2017
WP 3.4	More affordable small a/c manufacturing	Start of activities of partners selected in CfP calls	Q1/2016
		Decision on the amount of properties and parameters to be tested and analysed for effective joining methods	Q4/2016
		Production of first part with embossed flange by using non-jig technology	Q2/2017
		Integration of the robotic hand - assemblage of platform –hand –accessories system	Q4/2017

**ITD Airframe Deliverables**

WBS	Demonstrator	Deliverable	Target
WP 1.2	Optimized Composite	Definition of mechanical test matrix and technological trials	Q2/2016

	Structures		
		Selection of material and cost efficient production technologies	Q3/2016
		Material allowable assessment	Q2/2017
		Wing design concept and preliminary sizing.	Q4/2017
		Production process design and simulation	Q4/2017
WP 2.2	High Lift Wing	Selection of technology	Q2/2016
		Preliminary design of the demonstration	Q4/2016
		Preliminary test specification	Q3/2017
		High lift design	Q4/2017
WP 3.4	More affordable small a/c manufacturing	Report on thermo-mechanical properties of selected thermoplastic materials	Q4/2016
		Report on design and production of precise thermoplastic parts	Q3/2017
		Simplified programming system for robotic hand	Q2/2017
		Report on all the relevant aspects of the selected manufacturing methodology	Q4/2017
		Stress manual for embossed flanges	Q2/2017

### **ITD Systems Milestones**

Work Package	Demonstrator	Milestone	Target date
WP 7.1	Electromechanical actuator with HM design	Preliminary Design review Critical Design review	2016-Q3 2017-Q4
WP 7.2.1	Electrical power generation and distribution	Preliminary Design review Critical Design review	2016-Q3 2017-Q4
WP 7.2.2	Electrical landing gear	Preliminary Design review Critical Design review	2016-Q3 2017-Q4
WP 7.3	Fly by wire	Preliminary Design review Critical Design review	2016-Q3 2017-Q3
WP 7.4	Cockpit and avionics solutions	Affordable SESAR Cockpit Architecture for SAT	2016-Q4
		Technology Element & System Design and Gate Reviews (Batch 1)	2017-Q4
WP 7.5	Multifunction thermo acoustic insulation	Initiation of material testing for active and passive insulation	2017-Q2
	Crashworthy Configurable Seats	Dynamic material properties database	2017-Q1
	Thermal comfort	Thermal comfort computational model preparation	2016-Q4

### **ITD Systems Deliverables**

WBS	Demonstrator	Deliverable	Target
WP 7.1	Electromechanical actuator with HM design	<p>Phase 1 Preliminary Design:</p> <ul style="list-style-type: none"> <li>Requirement specification and HM approach</li> <li>Definition of sensing for EMA components</li> <li>Test campaign of each EMA component (damage and undamaged) with sensors</li> <li>Mathematical Modeling EMA with HM</li> </ul> <p>Phase 2 Design development</p> <ul style="list-style-type: none"> <li>Monitoring system design and integration in the actuator electronics</li> <li>Monitoring system design and integration in</li> </ul>	<p>2016-Q3</p> <p>2017-Q4</p>

WBS	Demonstrator	Deliverable	Target
		the mechanical part of the actuator	
WP 7.2.1	Electrical power generation and distribution	<p>Phase 1 Preliminary Design:</p> <ul style="list-style-type: none"> <li>• Requirement and specification for start generator system</li> <li>• Requirement and specification for electrical power distribution</li> <li>• Trade off study of starter generator topology, power electronic converter including cooling.</li> <li>• Trade off study of electrical power distribution architecture.</li> <li>• Test specification and Test preparation on components (converter, inverter, power load management, etc)</li> <li>• Modeling of starter generator for supporting trade off and functional and behavior</li> <li>• Modeling electrical power distribution based on solid state power control</li> </ul> <p>Phase 2 Design development</p> <ul style="list-style-type: none"> <li>• Design and integration of electrical power generation and distribution systems</li> </ul>	<p>2016-Q3</p> <p>2017-Q4</p>
WP 7.2.2	Electrical landing gear	<p>Phase 1 Preliminary Design:</p> <ul style="list-style-type: none"> <li>• Requirement and specification for electromechanical on P180 LG</li> <li>• Tradeoff study on architecture for: extension and retraction actuation, steering and braking</li> </ul> <p>Phase 2 Design development</p> <ul style="list-style-type: none"> <li>• Design and integration on electrical LG</li> </ul>	<p>2016-Q3</p> <p>2017-Q4</p>
WP 7.3	Fly by wire	<p>Phase 1 Preliminary Design:</p> <ul style="list-style-type: none"> <li>• Requirement and specification for affordable fly-by-wire</li> <li>• Modeling of FBW system architecture</li> <li>• Design and development of main modules</li> <li>• Preliminary test on iron bird of FBW modules</li> </ul>	<p>2016</p> <p>2017 Q4</p>
WP 7.4	Cockpit and avionics	Affordable SESAR Cockpit Architecture for SAT	2016-Q4

WBS	Demonstrator	Deliverable	Target
	solutions	Technology Element Prototypes & Lab Validation (Batch 1)	2017-Q4
WP 7.5.1	Multifunction thermo acoustic insulation	Initiation of material testing for active and passive insulation	2017-Q2
WP 7.5.2	Crashworthy Configurable Seats	Dynamic material properties database	2017-Q1
WP 7.5.3	Thermal comfort	Thermal comfort computational model preparation	2016-Q4

## Implementation

The activities in the Small Air Transport Transverse Activity (TA) will be performed following the general principles of the Clean Sky 2 membership and participation.

Piaggio and Evktor, as the TA Leaders, will perform the main activities related to the technology development and demonstration as transversal activities in the different ITD. Significant part of the work will be performed by Core Partners, supporting the leaders in its activities. Finally, another part of the activities will be performed by Partners through Calls for Proposals for dedicated tasks.

Piaggio and Evktor, as Leaders, signed Grant Agreement for Members (GAM) for Airframe and Systems in order to perform the work. These GAMs will cover all the work 2016-2017 of the Members in this TA. The Core Partners are selected through open Calls for Core Partners (two in the ITD Airframe, one in the ITD Engine and one in the ITD System) and the retained applicants will accede to the existing Grant Agreement for Members. Partners will be selected at a later stage through Calls for Proposals and will be signing the Grant Agreement for Partners. They will be linked to the TA activities through the Coordination Agreement.

## 9.9. ECO DESIGN TRANSVERSE ACTIVITY

Eco design transverse activity in *Clean Sky 2* will be developed based on the objectives and action plan implemented in previous period.

The activity leader (Fraunhofer Gesellschaft) will continue its effort in guiding the ITD/IADPs toward the implementation of the eco design theme, aimed to support future aeronautical products technologies with a lower environmental footprint, profiting from a common and synergetic approach for areas of interest, requirements, Life Cycle Assessment (LCA) and guidelines.

The action implementation, due to its novelty, requires a step and consistent approach with ITD/IADPs to maximize its benefits.

In 2016-17 Eco design transverse activity major area of activity are therefore as follows:

- Continuing to support ITD/IADPs platforms and technology streams through a continued and structured cooperation in the frame of eco-committees and disciplinary teams, proper advising in quantifying the benefits and accelerating the selection of new solutions considering environmental, sustainability and socio-economics aspects.
- Cooperating with ITD/IADPs in the VEES (Vehicle Ecological Economic Synergy) theme to consolidate a technology mapping, verify interests and opportunities and select the most interesting areas for eco-technology subsequent development (i.e. Material, processes, manufacturing, Re-use, End of life,...).
- Continuing in the definition in the frame of EDAS (Eco design analysis) theme of an expanded and enhanced LCA data base as a 'Hybrid platform' together with proper improved and innovative analytical tools and processes able to simulate a wider possible range of potential solutions.
- Encourage the proposition of new Eco themes through open calls and workshops to highlight new ideas, methodologies and reinforce eco-data collection and supply chain integration.
- Open possibly the view on other sectors to import new promising solutions for aeronautics.

### *Description of activities 2015*

The Eco-Design activity has a *baseline*, *mainline* and *top level delivery* basis. This characterises the interactions with the SPDs and through them the output to the TE.

Work units represents the core of the activity through a proper and defined collaboration to be established with Eco-Design Life and REcycle disciplines (MPR, production, end of life) and SPDs.

- Baseline delivery



The *baseline* annotates the take-up of technologies from an eco-innovation angle for the benefit of improving SPD activities either by specific or general value issues. The main duty for this stands out through the **Eco-Design Life and REcycle** theme reference which is an orientation for current and forward looking technology pools.

It is important to note that the SPDs have addressed strong *technology streams*. These have a component / parts / system and specific vehicle orientation. Eco-Design unifies the effort aimed to specific clean technology and *process improvement* through the following main disciplines:

- Next Generation Life Scoping and Identification Strategy
- Materials, Processes and Resources (MPR)
- Manufacture/ Production
- Service to component and System (MRO, financing, accounting, storage, inside-outside gate processes, alt. parts/ COTS material flow, logistics)
- Re-Use Phase
- End of Life
- Integration/ Field Assembly-Disassembly- Separation
- Alternative Sectoral Applications
- Use Phase (complimentary reference access between TE and Eco Design: flight physics and operations of block time versus ground phase impact of eco design)

To pursue the effort in Clean Sky, new *life technology value* approaches are envisaged to ensure fresh technology alternatives are made available. This baseline can grow and develop continued improvement also through competitive calls to be defined in scope.

▪ Mainline delivery

The ‘*mainline*’ *delivery*’ is addressed by the coordinated impact orientation agreed with the SPD and to be developed in the early phases of the programme; obviously different vehicles, systems will have a different weighted approach depending on current developments. This is mostly accomplished by selected allocation of identified *Eco-Design work units into the SPD-WP-plot*, supported by *Eco-Design analysis*.

Eco-Design needs real life technology ensembles, and is dependent on a concept to track complete processes, complete vehicles and complete architectures. This can be formed on building blocks (as accessible *modules*) from the perimeter of Eco-Design in the respective SPD. Eco-Design Analysis then validates the vehicle-level life cycle impact.

These concepts will not be able to contain, since the beginning, all the virtues of life cycle variables and working towards an optimum; this has to be grown in realistically without any technology lock-in on any side. A *coordinated forward looking approach* has to be found, combining best synergies to get the respective full air-vehicle picture, working with high performance issues.

Eco-Design will define an **Eco Hybrid Platform (EHP)**, in view of a **Design for Environment (DfE)** vision, which is totally *life cycle plus* (LCA+) driven in its design to ensure transversal purpose. This would be a major advance from the present Eco-Design delivery.

▪ Top level delivery

The *top level delivery* pertains to the hand-in-hand delivery through-put of Eco-Design with the ITD/ IADP benefit analysis to the needs of the Technology Evaluator, to complement its global socio-economic demand analysis.

Generally, but not exclusively, this will be based on results in a *big impact technology pathway (BITP)* format which will be served also to the examination of industrialisation scoping of the ITD/ IADPs.

In conjunction with that scoping, Eco-Design will also deliver the respective socio-economic derivatives, including work effort improvements (e.g. through human interface assisted automation in production).

***Milestones and Deliverables 2015***

In **2015** the program will develop, extending to the other main tasks to define the team work, interactions, technology scoping and LCA tools new requirements, including economics, financing processes. Top level activity on the socio-economic derivative along with the economic harmonisation concept (link with TE and ITD/ IADP respectively) will be then activated as well. A second batch of CFP partners will be selected to support the activities.

LCA & MPR-workshops are organized during these years, in view of dissemination and public feedback. Complementarity and excellence issues for the topics' proposals will be supported through the Eco Design TA coordination committee.

**Major milestones planned for 2015:**

- First Eco Design CFP topics definition and launch
- 1<sup>st</sup> Coordination Steering Committee launched on the remit of the GB and CS Programme Office; Importantly, sub working groups for Eco-Design Analysis and Vehicle Ecological Economic Synergy are set up
- Description of Work reference for the first major period 2015 to 2017 is completed with consensus through the coordination steering committee
- Selection of the first batch of Partners
- Selection of the second batch of Partners
- Integration of the future CS GMM requirements for the TA
- Work-units set-up in the project data management system
- Clean Sky Materials, Processes & Resources Data Base in secured augmented functionality
- Eco (compliance) matrix for EH proposal completed as input to ITD/ IADP
- Eco Statement, now in hands of TA

- ES 2015 in the advanced scope of Clean Sky 2 – see global targets.

### **Major deliverables planned for 2015:**

- High level description of each SPD objectives and requirements prioritisation as input
- Arbitration of economic targets and expected LCA/flow logic methodologies
- Tech/Work-units definition and collocation of interactions: Work units-Work correspondence table maturation c.f. JTP
- Clean Sky Major Workshop “MPR and LCA” State of the Art and New Frontiers Participant socio-economic “check-in check out” tableau definition
- Consolidation of objectives and requirements
- Progress on LCA/flow logic methodologies needs
- Clean Sky Major Workshop “MPR and LCA” State of the Art and New Frontiers
- Second Eco Design CFP topics definition and launch
- Eco tasks scope definition per SPD
- LIFT Technology description and new frontiers
- Effects on CS Materials, Processes and Resources(MPR) Data Base functionality
- LIFT-interfaces definition
- TA detailed plan and master technical GANTT
- First deliveries of the selected CfP projects (state of the art plus socio-economic check-in)
- First down selection reports of conceptually validated technologies on selected components
- LIFT-LCA tools interfaces, tracing results by technology examples
- Eco Hybrid platforms scoping and definition
- ECOTech scoping and definition
- First deliveries of the complimentary member contributions
- Concept of key performance Indices maps, foot prints, system eco categories, Regulation hotspots wrt. REACH etc.
- First analysis of ITD / IADP configurations proposed
- Conception of new architectures beyond the current technologies
- Eco architecture scoping
- Strategy paper eco design and systems
- Strategy paper eco design and airframe
- Review of Eco Design ITD high TRL population for application of the new didactic Eco Design eco-compliance population
- validation of new process impacts with first available configuration(s) from the ITD/ IADP
- First SOA tools and substances in metal versus composites major reference manufactory process chain ensemble measured for LCA inputs
- Eco statements planning and global output for CS 2
- Definition and first traced values for the RRQ, GPP and SES key Performance Indicators socio-economic charter
- Input of SPD economic analysis approach, giving at least the SLCA (Simplified LCA) reference

- Provision of Supplier LCA module
- SWOT analysis of Eco ITD LCA contributing to LCA+ assets
- Tools requirements LCA and economic harmonisation with respect to the respective user benefit analysis of each major integrator

### **Major Milestones planned for 2016-2017**

- Eco technology mapping and down-selection consolidation (ITD/IADPs priorities)
- Work-units set-up in Eco TA and ITD/IADPs
- LCA data base initial concept in new functionality
- First preliminary Eco statements released
- Call topics definition and launch

### **Major deliverables for 2016-2017**

- Update of Eco design content, requirements in ITD/IADPs
- Consolidation of economic targets, LCA/flow logic
- Eco technologies maturation updated road-map (including partners)
- Eco workscope definition for 2018-2019 GAM (SPDs, Eco TA).

### **Implementation**

The activities in the Eco Design Transverse Activity (TA) will be performed following the general principles of the Clean Sky 2 membership and participation.

Fraunhofer, as the TA Leader, will perform the main activities related to the technology development and demonstration in the TA. Significant part of the work will be performed by Core Partners, supporting the TA leader in its activities. Finally, another part of the activities will be performed by Partners through Calls for Proposals for dedicated tasks.

Fraunhofer, as the TA Leader, will sign the one Grant Agreement for Members (GAM) in order to perform the work. This GAM will cover all the work of the Members in this TA. The Core Partners are selected through open Calls for Core Partners and the retained applicants will accede to the existing Grant Agreement for Members. Partners will be selected at a later stage through Calls for Proposals and will be signing the Grant Agreement for Partners. They will be linked to the TA activities through the Coordination Agreement.

There are no topics opened for the first call for Core Partners for this TA.

## **9.10. TECHNOLOGY EVALUATOR**

A Technology and Impact Evaluation infrastructure is and remains an essential element within the Clean Sky JTI. Impact assessments evaluating the performance potential of the Clean Sky 2 technologies both at vehicle level and at relevant aggregate levels such as at Airport and ATS level, and currently focused on noise and emissions, will be retained. Where appropriate they will be expanded to other relevant environmental or societal impacts (e.g. mobility benefits or increased productivity).

For vehicle concepts arising from the IADPs, the core aircraft performance characteristics (at the so-called ‘mission level’) will be reported by the IADP and TE impact assessment will focus on aggregate levels. For those Clean Sky 2 ITDs technologies not feeding into an IADP aircraft model, the TE will build up its own Mission Level assessment capability, also to assess innovative long term aircraft configurations. Thus, an aircraft-level synthesis of these results via ‘concept aircraft’ is possible and the respective ITD results can be shown at aircraft level and evaluated within the Airport and Air Transport System alongside the IADP results. In summary, the Technology Evaluator consists of three major tasks:

- Monitoring of *Clean Sky 2* achievements vs. defined environmental and societal objectives;
- Evaluation at Mission Level by integrating selected ITD outputs into concept aircraft / rotorcraft;
- Impact Assessments at Airport and ATS Level using IADPs and TEs concept aircraft / rotorcraft.

### **Description of activities 2015**

The 1<sup>st</sup> Clean Sky 2 TE assessment is foreseen for 2017. CS2 TE activity will start in July 2015. The 2015 activities will be preparatory work for the 1<sup>st</sup> assessment models input and output specifications. CS2 TE integrated planning will be started including the definition of the 2015 CS2 reference aircraft. It is assumed that SPDs will contribute to this definition. The existing Clean 1 TE tool suite will be reused, while the need for additional tools and an extension of the evaluation framework will be identified in order to address the extended scope of the CS2 TE. CFP/CFT/CSA definition will be done as appropriate.

### **WP0 TE management**

Further CFP topic descriptions will be prepared.

### **WP1 TE scope and set up**

The overall scope and set-up of CS2 TE is covered through WP1. WP1.1. will define the TE assessment metrics to be applied based on the SPDs objectives in terms of environment, mobility and socio-economic aspects. Additionally the CS2 TE reference points will be defined for 2015 state of the art aircrafts.

The TE inputs and outputs will be defined through WP1.2. This encompasses the inputs from SPDs and the outputs of the TE. TE timing and integrated planning with the SPDs for the whole Clean Sky 2 project will be discussed.

### **WP2 TE Interfacing with SPDs and transversal activities**

WP2 covers the interfacing between the TE and the SPDs, i.e. Airframe, Engine and Systems, Large Passenger Aircraft, Regional Aircraft and Fast Rotorcraft. In 2015 two to three meetings with all SPDs will be held for to discuss TE requirements and work plan as well as WP1 issues and deliverables.

### **Main milestones / deliverables 2015**

Milestones will be those done through the WP2 “interfacing with SPDs and transversal activities” and the definition of the CFP/CFT/CSAs.

Milestones planned for 2015:

- Coordination and interaction with SPDs to define Clean Sky 2 TEs integrated planning and inputs / outputs
- Definition of the Call mechanisms to be used for the TE and the launch of further Calls

Deliverables planned for 2015:

- Definition of CS2 TE set-up, methodology, metrics, 2015 reference aircrafts
- 1<sup>st</sup> Definition of CS2 TE integrated planning

### **Description of activities 2016-2017**

The 1<sup>st</sup> Clean Sky 2 TE assessment is foreseen for 2017. In 2016 definition and modelling of the 2015 reference aircraft will be finished and an update of the CS2 TE integrated planning performed. Preparatory activities for airport and ATS levels will be performed for the 2017 assessment. Definition of advanced TE concept aircraft modelling will be started.

### **Description of activities 2016**

#### **WP0 TE management**

Further CFP topic descriptions will be prepared.

#### **WP1 TE scope and set up**

The overall scope and set-up of CS2 TE is covered through WP1. WP1.1. will define the TE assessment metrics to be applied based on the SPDs objectives in terms of environment, mobility and socio-economic aspects. Additionally the CS2 TE 2015 state of the art reference aircraft will be defined.

The TE inputs and outputs will be defined through WP1.2. This encompasses the inputs from SPDs and the outputs of the TE. TE timing and integrated planning with the SPDs for the whole Clean Sky 2 project will be discussed.

The results of the 2015 deliverable will be updated for WP 1.1 and WP 1.2. Definition and modelling of the 2015 reference aircraft will be finished. The modelling of the 2015 reference aircraft will be performed by the SPDs in close interaction with CS2 TE.

In WP1.3 Consistency with SESAR and other projects like environmental CSAs in Horizon 2020 will be checked and discussed.

WP1.4 will specify the 2017 planned CS2 TE 1<sup>st</sup> assessment and update the TE overall integrated planning.

## **WP2 TE Interfacing with SPDs and transversal activities**

WP2 covers the interfacing between the TE and the SPDs, i.e. Airframe, Engine, Systems, Large Passenger Aircraft, Regional Aircraft and Fast Rotorcraft. In 2016 regular three months meetings will be held to discuss WP1 issues and deliverables.

## **WP3 TE independent integration on Mission level**

As recommended by external reviewers, a reinforced TE Mission Level modeling capability for aircraft will be developed in WP3. The goal is to allow the generation of TE aircraft models at a conceptual design level. This environment would be capable to take into account specific aspects of Airframe, Engine and Systems technologies. In coordination with SPDs a set of technologies will be defined as preparation for future TE concept aircraft modelling for 2035 and 2050 concept aircraft.

## **WP4 TE airport impact assessment**

Airport scenarios will be prepared for the 2017 assessment.

## **WP5 TE ATS impact assessment**

ATS fleet and traffic scenarios will be defined for the 2017 assessment. Definition of other long term scenarios will be started.

## **Main milestones / deliverables 2016**

Milestones in 2016 will be:

- Coordination and interaction with SPDs to define Clean Sky 2 TEs integrated planning and inputs / outputs
- Delivery of CS2 reference aircraft models from SPDs to the TE

Deliverables in 2016 will be:

- Update of CS2 TE integrated planning

- Specification of 2017 assessment
- Definition of airport and ATS fleet and traffic scenarios
- Preparation and specification of CS2 TE concept aircraft modelling

### **Description of activities in 2017**

A 1<sup>st</sup> assessment will be performed at mission level comparing the CS2 reference aircraft with the CS1 reference aircraft. At global fleet level the assessment will compare CS1 reference fleet with a CS2 reference fleet. The same will be done for airport fleet assessments.

### **Main milestones / deliverables 2017**

- Performance of 2017 assessment

### **Implementation**

The activities in the Technology evaluator Transverse Activity (TA) will be performed following the general principles of the Clean Sky 2 membership and participation.

DLR, as the TA Leader, will perform the main activities related to the technology development and demonstration in the TA. Significant part of the work will be performed by Core Partners, supporting the TA leader in its activities. Finally, another part of the activities will be performed by Partners through Calls for Proposals for dedicated tasks.

DLR, as the TA Leader, will sign the one Grant Agreement for Members (GAM) in order to perform the work. This GAM will cover all the work of the Members in this TA. The Core Partners are selected through open Calls for Core Partners and the retained applicants will accede to the existing Grant Agreement for Members. For the TE GAM, the Consortium Agreement will not be applicable, due to its nature of transverse activities.

Partners will be selected at a later stage through Calls for Proposals and will be signing the Grant Agreement for Partners. They will be linked to the TA activities through the Coordination Agreement.

There are no topics opened for the first call for Core Partners for this TA.



## **10. CALL ACTIVITIES IN 2015-2017**

### **10.1. CALLS FOR CORE-PARTNERS**

#### **10.1.1. Role of Core Partners and their accession as JU Members**

Core Partners will be Members of the JU. They will have a strategic and long-term commitment to the Programme, and will perform core tasks and bring key capabilities to implement the Programme through the research actions in which they are involved. Core Partners will bring a significant level of in-kind contribution that is consistent with the indicative total value of each Topic and further activities which may be performed, where applicable, in the relevant IADP/ITD

Core Partners' responsibilities will include:

- Performing technological research activities, reflecting the core activities of the programme, aimed at a significant advance beyond the established state-of-the-art, including scientific coordination;
- Contributing to the preparation and management of integrated demonstrators, proving the viability of new technologies with a potential economic advantage, up to TRL 6
- Sharing other key activities such as work package management, dissemination of research results and the preparation for their take-up and use, including knowledge management; and activities directly related to the protection of foreground. This will also include acting where appropriate as a Topic Manager in the Calls for Proposals within the relevant Work Package for which they are responsible, and consequently, monitoring the activities of the relevant Partner(s) selected by the JU by the Calls for Proposals;
- Participate to the relevant Steering Committees of the IADP/ITD and be represented in the Governing Board of the JU
- Co-determine the direction of the Programme through its governance entitlements.

Core Partners will be selected on the basis of topics launched through the Calls for Core Partners. Applicants wishing to become Core Partners in the Clean Sky 2 Programme shall submit applications against one or more topics describing their key capabilities and competences and a description of the work to be performed in response to the topics. The funding shall be allocated following evaluation of proposals by independent experts, the ranking list submitted to the Governing Board for acceptance and the highest ranked applicants subsequently invited to commence negotiations which, upon successful conclusion will lead to a formal application for membership of the JU to the Governing Board. On accession as member the applicant's agreed activity will be absorbed in the Grant Agreement for Members and will become eligible for funding by the JU.

The selected Core Partners will negotiate with the JU their accession to the Grant Agreement for Members (by signing an accession form) which will be already signed, where appropriate, between the JU and the Leaders of the relevant IADP/ITD/TA. The negotiation and accession stage will include the integration of the proposal, the work packages and technical activities of the Core Partner into the Annex I (Description of work and estimated budget) of the relevant IADP/ITD/TA Grant Agreement for Members. The Annex I will be subject to updates and revisions based on the multi-annual grant agreements framework in line with the multi-annual commitments and the programme management decision-making rules and governance framework under the CS2 Regulation.

The technical activities of the Core Partners will have to be aligned with the Programme objectives and strategic direction laid down in the Development Plan of the Clean Sky 2 Programme which will derive from the “Clean Sky 2 Joint Technical Programme” and will be referred to in the Grant Agreement for Members.

Based on the above and in the light of the specific role of the Core Partner in the implementation of the Programme and JU governance structure, other activities in addition to the technical proposal of the topic may be performed by the Core Partners and be funded by the JU. In the course of the implementation and updates of the multi-annual Programme when the implementation of other areas of the Programme require the specific key capabilities of the Core Partners and its level of technical involvement in the implementation of the ITD/IADP/TA objectives.

The JU will define on the one hand, when the capabilities required and other areas of activities to be performed in an IADP/ITD/TA may be covered/absorbed by the existing level of capabilities at IADP/ITD/TA Members level, subject to a technical assessment of the JU and based on the Members multi-annual grant management process, and on the other hand when the capabilities required necessitate a call to be launched by the JU.

### **10.1.2. Definition of Topics for the Calls for Core Partners**

The description of the Topic will define the key capabilities and capacity required to the applicants to implement the Programme in the relevant IADP/ITD area and the scope, goals and objectives of the activities to perform the topic. The indicative average total value of a Topic for the selection of Core Partners will be approximately 10 M€ throughout the Programme.<sup>8</sup>

---

<sup>8</sup> This indicative average total topic value of 10M € is set in a way to achieve at global and individual level a real strategic contribution and level of investments of the Core Partners to the Programme in the light of the total budget of the Programme (1,755 B€), the level of in-kind contribution to the Programme to be brought by the Core Partners as Members of the CSJU (Article 4 of the Statutes) and the 30% maximum share of funding envisaged for Core Partners as set out in the CSJU Regulation.

The description of the overall Clean Sky 2 Programme is the “Joint Technical Programme [first published by JU on the 27<sup>th</sup> of July 2014]<sup>9</sup> which may be regarded by the applicants to clarify the context of the topics within the overall strategic objectives of the Programme and the relevant IADP/ITD area.

Content of the Core Partner Topic description:

- IADP/ITD or TA containing the activity and of the CS2 Leader launching the topic;
- topic area and its relation to the strategic objectives of the IADP/ITD;
- indicative funding value of the topic over its foreseen full duration;
- expected scope of work and contributions of the core partner within the IADP/ITD;
- short/medium term objectives/milestones; required output; timeframe, major deliverables;
- key capabilities, operational capacity and competences required to implement the Programme and to adequately deal with the risks associated to the activity under the topic and the Programme area (both at IADP/ITD and applicant level);
- requirements related to the operational capacity (level of competences, level of technical capabilities, availability and capacities of specific resources, equipment, machineries track record etc.) and any specific requirement such as (e.g.) Design Organization Approval [DOA], Production Organization Approval [POA], etc.;
- any specific legal, intellectual property, confidentiality and liability aspects in line with the provisions under the JU Model Grant Agreement for Members<sup>10</sup> and with the IADP/ITD Consortium Agreement<sup>11</sup>;
- specificities related to Transversal Activities (TAs) where contributions stemming from the topic are relevant to one or more of the IADP/ITDs in addition to the TA itself.

Complementary Activities<sup>12</sup>

Applicants may propose complementary activities and innovative solutions within the general topic area related to the topic(s) for which they are applying and within the scope of the IADP/ITD where they can demonstrate that their capabilities and these activities as proposed:

- would be in line with the Programme’s key goals and objectives;
- would represent an enhancement or improvement of the content of an IADP/ITD;
- would lead to a demonstrable additional move beyond the state of the art in the general area of the topic as published.

---

<sup>9</sup> The Clean Sky 2 “Joint Technical Programme” is the high-level programme as published by the CSJU following the independent evaluation performed on the work packages, technology streams and demonstrator projects proposed by the Leaders via the “Joint Technical Proposal.” *The Joint Technical Programme” will be implemented and updated across the duration of the Programme and of the CSJU in the form of a “Development Plan » to be formally approved by the CSJU which will define and update the full roadmap of the Programme.*

<sup>10</sup> To be published by the CSJU at the launch of the call

<sup>11</sup> To be published by the CSJU at the launch of the call or in due time before the start of the negotiation

<sup>12</sup> Applicable to calls for Core Partners only. Complementary activities shall not be misunderstood with the additional activities defined in Article 4.2 of CSJU Regulation.

### **10.1.3. First Call for Core Partners JTI-CS2-2014-CPW01**

The first Call for Core Partners was launched on 9 July 2014 and closed in November of that year, with evaluations concluded in February 2015. The negotiations with top-ranked applicants in 26 topics are on-going at the moment of adoption of this Work Plan and accession as Members of the JU and the inclusion into the relevant Grant Agreements for Members is foreseen in the third and fourth quarters of 2015. The list and full description of topics are available in Annex I: 1<sup>st</sup> Call for Core-Partners: List and Full Description of Topics of the Work Plan 2014-2015.

*(see also separate document published on the [Participant Portal](#))*

### **10.1.4. Second Call for Core Partners JTI-CS2-2015-CPW02**

The second Call for Core Partners was launched on 16 April 2015 and will close on 30 July 2015. The evaluation of proposals will take place in the fourth quarter of the year with negotiations due to commence with the top-ranked applicants from December 2015. Technical activity of the selected new Members will begin from the second quarter of 2016. The list and full description of topics are available in Annex IV: 2<sup>nd</sup> Call for Core-Partners: List and Full Description of Topics of the Amendment nr. 2 of the Work Plan 2014-2015.

*(see also separate document published on the [Participant Portal](#))*

### **10.1.5. Third Call for Core Partners JTI-CS2-2015-CPW03**

The JU plans to launch a third call for core partners in October 2015. A first preliminary list of the topics foreseen for this call and their indicative value will be provided in this Work Plan. Further information on the topics to be opened for this call will be available at a further update of this work plan and in time before the call is launched according to the JU's process.

### **10.1.6. Fourth Call for Core Partners JTI-CS2-2016-CPW04**

The JU foresees a fourth call for core partners to be launched in the second quarter of 2016. Further information on the topics to be opened for this call will be available at a further update of this work plan and in time before the call is launched according to the JU's process.

## **10.2. CALLS FOR PROPOSALS**

A first Call for Proposals (for Partners or ‘complementary grants’) was launched in December 2014. Grant implementation for these beneficiaries will commence in the second quarter 2015 and technical activity is forecast to kick off from December 2015.

The second and third Calls for Proposals are foreseen in July 2015 and January 2016 respectively.

A fourth, fifth and sixth Calls for Proposals (for Partners or ‘complementary grants’) are foreseen to be launched in July 2016; January and July 2017 respectively.

### **Partners**

Partners will carry out objective driven and applied research activities aiming at developing new knowledge, new technologies and solutions that will bring a contribution to one of the actions as defined in the Programme and developed in one of the IADPs/ITDs/TAs. The Partners' activities will be performed under the technical monitoring of the private Member acting in the Call for Proposal process as Topic Manager [see general annexes].

The Partners' activities are defined through open topics proposed by the private Members of the JU for the Calls for Proposals. Upon the validation of these proposed topics by the JU in terms of innovation and/or new knowledge to result, they are launched by the JU in the Calls in order to support and complement the Programme's research and innovation activities where appropriate. Special consideration is given by the JU to the appropriate balance of lower TRL and longer-term research actions versus innovation-oriented efforts called for in the topics, and the leverage and supply chain access made available to SMEs.,

The lists of Call topics and their short summary and indicative budget form part of the JU Work Plan; their descriptions are defined in the Call Fiche. Topics for Partners will be smaller in terms of magnitude and duration than the Topics for Core Partners.

The Calls for Proposals will be subject to independent evaluation governed by the rules appended to this Work Plan and/or published with the topics on the participant portal. Upon selection, the Partners will sign a Grant Agreement for Partners with the JU and their contribution will be made to the research activities which are performed by one or several CS2 Members in the frame of their Grant Agreement for Members. Partners will not become members of the JU and will not be expected to contribute to the running costs of the JU. Similarly, they will not participate in the management of the IADP/ITDs/TAs concerned.

### **10.2.1. Definition of Topics**

Partners will be selected on the basis of Topics which will be launched through the Calls for Proposals (CfP). Applicants interested in becoming Partners in the Clean Sky 2 Programme must submit proposals against one or more Topics. The proposals will be evaluated and the highest ranked proposals will be selected for funding by the JU.

The description of Topics will define the scope, goals, objectives and estimated duration of the activities to be performed by the successful applicant upon being selected a Partner.

The Topic description will be described in the call text.

#### *Content of the Topic description:*

- The name of the IADP/ITD to which the activity is linked;
- the proposed scope of work and tasks outputs as required within the IADP/ITD;
- an indicative total action value, no maximum value will be set;
- the alignment with strategic objectives of the IADP/ITD;
- a clear description of the areas or fields where the applicant is requested to bring new knowledge, new technologies or solutions
- the expected overall contribution: output, timeframe, deliverables and milestones;
- the competences required to run the action (expertise and skills, capabilities and track record) and to deal with risks associated to the activity (both at project and applicant level);
- the requirements related to the operational capacity (level of competences, level of technical capabilities, availability and capacities of specific resources, track record etc);
- any specific legal, intellectual property and liability aspects in line with the provisions of the JU model Grant Agreement for Partner and with the IADP/ITD Consortium Agreement or Implementation Agreement;
- Any specific confidentiality and competitive issues and any specific requirement (e.g holding a valid Design Organization Approval [DOA]; Agreement, Production Organization Approval [POA], etc.);

### **10.2.2. Technical implementation of the Partner's actions within the IADP/ITD - Access rights between private Members and Partners**

The contribution of the Partner to the activities of the private Member and the objectives of the relevant IADP/ITD requires a close cooperation between the Topic Manager and the Partner selected by the JU to execute the work and implement the action under the Grant Agreement for Partner.

When assigned as Topic Manager in a Call for Proposals, the private Member shall monitor that the activities of the selected Partner are properly technically implemented and meet the objectives of the IADP/ITD and to provide a timely technical feedback/opinion to the JU which is in charge of the validation and approval of reports and deliverables.

In order to ensure an adequate framework for the cooperation between the private Member and the Partner, the latter is requested either to accede to the Consortium Agreement of the IADP/ITD, where applicable, or to negotiate and sign an implementation agreement with the private member which will define the framework of the cooperation.

In order to ensure the correct implementation of the action, a mutual access rights regime shall apply to the Topic Manager and the selected Partner. The access rights regime shall apply at action level. More specifically the Topic Manager and the selected Partner shall grant mutual access rights under the same conditions to the background for implementing their own tasks under the action and for exploiting their own results. Specific provisions will be laid down in the respective Model Grant Agreement for Members and Model Grant Agreement for Partners<sup>13</sup>.

#### **10.2.3. First Call for Proposals (for Partners) JTI-CS2-2014-CfP01**

The first Call for Proposals for Partners JTI-CS2-2014-CFP01 was launched in December 2014. The call closed on 31<sup>st</sup> March 2015 and evaluations were undertaken in May 2015. Grant implementation is foreseen in the 3<sup>rd</sup> quarter of 2015 with a start of research actions from December 2015. The list and full description of topics are available in Annex III: 1<sup>st</sup> Call for Proposals (for Partners): List and Full Description of Topics of the Amendment nr. 1 of the Work Plan 2014-2015.

*(see also separate document published on the [Participant Portal](#))*

#### **10.2.4. Second Call for Proposals (for Partners) JTI-CS2-2015-CfP02**

The second Call for Proposals for Partners JTI-CS2-2014-CFP01 will be launched in July 2015. The Call topics and their brief summaries and indicative values are reminded in Annex III: 2<sup>nd</sup> Call for Proposals (for Partners): List and Full Description of Topics of this Work Plan.

The list and full description of topics will be available via the Participant Portal in the *Call Text*: 2<sup>nd</sup> Call for Proposals (CFP02): List and Full Description of Topics.

#### **10.2.5. Third Call for Proposals (for Partners) JTI-CS2-2016-CfP03**

The third Call for Proposals for Partners is foreseen to be launched in January 2016. The Call topics and their brief summaries and indicative values will be appended to further updates to this Work Plan.

---

<sup>13</sup> Under the conditions set out in Articles 25.2 and 25.3 of the H2020 model grant agreement

#### **10.2.6. Fourth Call for Proposals (for Partners) JTI-CS2-2016-CfP04**

The fourth Call for Proposals for Partners is foreseen to be launched in July 2016. The Call topics and their brief summaries and indicative values will be appended to further updates to this Work Plan.

#### **10.2.7. Fifth Call for Proposals (for Partners) JTI-CS2-2017-CfP05**

The fifth Call for Proposals for Partners is foreseen to be launched in January 2017. The Call topics and their brief summaries and indicative values will be appended to further updates to this Work Plan.

#### **10.2.8. Sixth Call for Proposals (for Partners) JTI-CS2-2017-CfP06**

The sixth Call for Proposals for Partners is foreseen to be launched in July 2017. The Call topics and their brief summaries and indicative values will be appended to further updates to this Work Plan.

### **10.3. Submission of proposals from applicants**

The process related to the submission of proposals as Core Partner is explained in the JU *“Rules for the submission of proposals, evaluation, selection, award and review procedure of Core Partners”* available on the CSJU website: <http://www.cleansky.eu/>

The rules applicable to the Calls for Proposals (for Partners) are the *H2020 rules for participation*, the derogation on the application from single entities (so called mono-beneficiary) is a specific derogation applicable to CSJU under EC Delegated Regulation (EU) No 624/2014 of 14 February 2014.

The call for proposals process will be based substantially on the H2020 applicable guidance documents for calls for proposals, any specificity in the submission and selection process is set out and described in the *JU Rules for submission, evaluation, selection, award and review procedures for Calls for Proposals* which pursuant to CSJU Regulation n° 558/2014 of 6<sup>th</sup> May are to be approved by the Board and published on the JU website and on the Participant Portal.

On a practical level, both the Calls for proposals and Calls for Core Partners will make use of the European Commissions’ participant portal:

<http://ec.europa.eu/research/participants/portal/desktop/en/home.html>



## 11. OBJECTIVES AND INDICATORS

The overall objectives for the Clean Sky 2 Programme for the period 2015-2017 are:

- To refresh / refine the technical content of the overall programme in the course of the accession of the core partners, and ensure this is adequately incorporated in the *CS2 Joint Technical Programme, the Clean Sky 2 Development Plan* and the Grant Agreements [including any re-evaluation of elements where appropriate];
- To further define and refine the requirements for the Demonstration Programme – as the accession of the full complement of members through the core partner selection will involve adjustments in the schedule, scope and definition of demonstrators;
- To conduct Launch Reviews for 100% of technical activity commencing in the 2015-2017 period, enabling the JU to adequately test the level of definition, of preparation and resourcing geared towards each major activity. The state of play of the relevant CS projects will be a key consideration in these reviews, in order to ensure an effective and appropriate transition from CS to CS2;
- To refine the Technology Roadmaps as elaborated in each of the sections of the CS2 Joint Technical Proposal related to the IADPs, ITDs and TAs, including where necessary a review and revision of content and priorities (for instance as a consequence of the review of former “Level 2” projects);
- To implement solutions for leveraging Clean Sky 2 funding with Structural Funds;
- To implement an effective and efficient management and governance through the Clean Sky 2 Management Manual;
- To define and implement an appropriate model for each transverse area that allows for the transversal coordination to be executed and technical synergies to be extracted;
- To select the Programme’s Core Partners as planned in four Calls for Core Partners;
- To widely disseminate the information about the Calls for Proposals (for partners), in order to reach a participation from SMEs higher than 35%. To proceed with the selection of participants through these calls;
- To define the reference framework for the TE (including performance levels of reference aircraft against which the progress in CS2 will be monitored); and to elaborate the assessment criteria and evaluation schedule for the TE for each technical area. To launch the CS2 TE and complete the selection of its key participants; to conduct within the timeframe of the Work Plan the first TE assessment of CS2;
- To ensure a time-to-grant no greater than 8 months for the Calls for Proposal;
- To execute at least 90% of the budget and of the relevant milestones and deliverables;
- To ensure a high level of technical and process integrity in the execution of the Programme, including the Calls and their resulting selection of CS2 participants; and a maximum relevance of research actions performed towards the Programme’s goals: thus ensuring a strong positive perception of the Programme throughout the mid-term assessment.

## 11.1. Clean Sky 2 Demonstrators and Technology streams

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
Large Passenger Aircraft	Advanced Engine Design & Integration for Large Passenger Aircraft	CROR demo engine flight test demo
		Advanced engine integration driven fuselage ground demonstrator
		Validation of dynamically scaled integrated flight testing
Large Passenger Aircraft	Advanced Laminar Flow Rig Reduction for Large Passenger Aircraft	HLFC large-scale specimen demonstrator in flight operation
		High speed demonstrator with hybrid laminar flow control wing
Large Passenger Aircraft	Innovative Aircraft Configuration and Operation	Innovative Flight Operations Next generation cockpit and MTM functionalities
		Demonstration of advanced short-medium range aircraft configuration
Large Passenger Aircraft	Innovative Cabin & Cargo Systems and Fuselage Structure Integration for Large Passenger Aircraft	Full-scale advanced fully integrated fuselage cabin & cargo demonstrator
		Next generation lower centre-fuselage structural demonstrator
		Next generation large module fuselage structural demonstrator with fully integrated next generation cabin & cargo concepts and systems
Large Passenger Aircraft	Next Generation Cockpit & Avionic Concepts and Functions for Large Passenger Aircraft	Integrated systems and avionics demonstration Full 4D - flight capability; fully parameterized green trajectory capability
		Next Generation Cockpit ground demonstrator Development and validation suite for: <ul style="list-style-type: none"> <li>- New MMI functions</li> <li>- Advanced IMA's</li> <li>- Networked data link and functions</li> </ul> Fully integrated next generation

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
		avionics simulation & test lab
		Flight demonstration Next Generation Cockpit & flight operation features Coordinated with Systems and Equipment ITD
		"Pilot case" demonstration in flight Qualification and validation of next generation cockpit features sensible to a highly realistic environment
		Maintenance service operations enhancement demonstrator  Demonstration of the technical and economic maturity and performance of a value and service oriented architecture and its enablers
<b>Regional Aircraft</b>	<b>Highly Efficient Low Noise Wing Design for Regional Aircraft</b>	Air Vehicle Technologies – Flying Test Bed#1 (FTB1) Low noise and high efficient HLD, NLF, Active LC&A, Innovative wing structure and systems
<b>Regional Aircraft</b>	<b>Innovative Passenger Cabin Design &amp; Manufacturing for Regional Aircraft</b>	Full scale innovative Fuselage and passenger Cabin
<b>Regional Aircraft</b>	<b>Advanced for Regional Aircraft: 1 Power Plant 2. Flight Simulator 3. Iron Bird</b>	WTT for Configuration of Next Generation Hi-Efficient Regional A/C with Innovative configuration, advanced powerplant integration, efficient technologies insertion at A/C level
		Flight Simulator with New cockpit interaction concepts, advanced avionics functionalities (including pilot workload reduction) , MTM (green functions in a global environment)

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
		Iron Bird with Innovative systems integration, Next generation flight control systems (H/W and pilot in the loop)
<b>Regional Aircraft</b>	<b>Innovative Future Turboprop Technologies for Regional Aircraft</b>	High Lift Advanced Turboprop – Flying Test Bed#2 (FTB2)
<b>Fast Rotorcraft: Tiltrotor</b>	<b>Advanced Tilt Rotor Structural &amp; Aero-acoustic Design</b>	D1: Mock-up of major airframe sections and rotor D2: Tie-down helicopter (TDH) D3: NextGenCTR flight demonstrator (ground & flight)
		D4: Prop-rotor components and assembly
<b>Fast Rotorcraft: Tiltrotor</b>	<b>Advanced Tilt Rotor Aerodynamics and Flight Physics Design</b>	D6: NextGenCTR's fuselage assembly
		D7: NextGenCTR's wing assembly
		D8: Engine-airframe physical integration D9: Fuel system components
<b>Fast Rotorcraft: Tiltrotor</b>	<b>Advanced Tilt Rotor Energy Management System Architectures</b>	D5: NextGenCTR's drive system components and assembly
		D10: intelligent electrical power system and ancillary/ auxiliary components
		D11: Flight control & actuation systems and components
<b>Fast Rotorcraft: Tiltrotor</b>	<b>Tiltrotor Flight Demonstrator</b>	Tiltrotor Flight Demonstrator
<b>Fast Rotorcraft: Compound R/C</b>	<b>Innovative Compound Rotorcraft Airframe Design</b>	<p>Airframe structure &amp; landing system</p> <p><i>NB: Wing and tail addressed in Airframe ITD dedicated WPs (1.8, 1.11)</i></p> <p>To include:</p> <ul style="list-style-type: none"> <li>– advanced composite or hybrid metallic/composite structure using latest design and production techniques</li> <li>– Specific landing system architecture &amp; kinematics</li> </ul>

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
<b>Fast Rotorcraft: Compound R/C</b>	<b>Innovative Compound Rotorcraft Power Plant Design</b>	<p>Lifting Rotor &amp; Propellers</p> <p>Integrated design of hub cap, blades sleeves, pylon fairings, optimized for drag reduction; Rotor blade design for combined hover-high speed flight envelope and variable RPM; Propeller design optimized for best dual function trade-off (yaw control, propulsion);</p>
		<p>Drive train &amp; Power Plant</p> <p>Engine installation optimized for power loss reduction, low weight, low aerodynamic drag, all weather operation; New mechanical architecture for high speed shafts, Main Gear Box input gears, lateral shafts, Propeller Gear boxes, optimized for high torque capability, long life, low weight. REACh-compliant materials and surface treatments.</p>
<b>Fast Rotorcraft: Compound R/C</b>	<b>Innovative Compound Rotorcraft Avionics, Utilities &amp; Flight Control Systems</b>	<p>On board energy, cabin &amp; mission systems</p> <p>Implementation of innovative electrical generation &amp; conversion, high voltage network, optimized for efficiency &amp; low weight; advanced cabin insulation &amp; ECS for acoustic and thermal comfort.</p>
		<p>Flight Control, Guidance &amp; Navigation Systems</p> <p>Smart flight control exploiting additional control degrees of freedom for best vehicle aerodynamic efficiency and for noise impact reduction.</p>

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
<b>Fast Rotorcraft: Compound R/C</b>	<b>LifeRCraft Flight Demonstrator</b>	LifeRCraft Flight Demonstrator Integration of all technologies on a unique large scale flight demonstrator, success & compliance with objectives validated through extensive range of ground & flight tests
<b>Airframe</b>	<b>High Performance and Energy Efficiency</b>	Innovative Aircraft Architecture Noise shielding, noise reduction, Overall Aircraft Design (OAD) optimisation, efficient air inlet, CROR integration, new certification process, advanced modeling
		Advanced Laminarity Laminar nacelle, flow control for engine pylons, NLF, advanced CFD, aerodynamic flow control, manufacturing and assembly technologies, accurate transition modelling, optimum shape design, HLF
		High Speed Airframe Composites (D&M), steering, wing / fuselage integration, Gust Load Alleviation, flutter control, innovative shape and structure for fuselage and cockpit, eco-efficient materials and processes
		Novel Control Gust Load Alleviation, flutter control, morphing, smart mechanism, mechanical structure, actuation, control algorithm
		Novel Travel Experience Ergonomics, cabin noise reduction, seats & crash protection, eco-friendly materials, human centered design, light weight furniture, smart galley

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
<b>Airframe</b>	<b>High Versatility and Cost Efficiency</b>	<p>Next Generation Optimized Wing Box</p> <p>Composite (D&amp;M), out of autoclave process, modern thermoplastics, wing aero-shape optimisation, morphing, advanced coatings, flow and load control, low cost and high rate production</p>
		<p>Optimized High Lift Configurations</p> <p>Turboprop integration on high wing, optimised nacelle shape, high integration of Tprop nacelle (composite/metallic), high lift wing devices, active load protection</p>
		<p>Advanced Integrated Structures</p> <p>Highly integrated cockpit structure (composite metallic, multifunctional materials), all electrical wing, electrical anti-ice for nacelle, integration of systems in nacelle, materials and manufacturing process, affordable small aircraft manufacturing, small a/c systems integration</p>
		<p>Advanced Fuselage</p> <p>Rotor-less tail for fast r/c (CFD optimisation, flow control, structural design), pressurised fuselage for fast r/c, more affordable composite fuselage, affordable and low weight cabin</p>

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
<b>Engines</b>	<b>Innovative Open Rotor Engine Configurations</b>	<p>Open Rotor Flight Test</p> <p>Ground test and flight test of a Geared Open Rotor demonstrator:</p> <ul style="list-style-type: none"> <li>- Studies and design of engine and control system update and modifications for final flight test</li> <li>- Manufacturing, procurement and engine assembly for ground test checking before flight</li> </ul> <p>Following on flight test planned in LPA IADP and test results analysis</p>



<b>IADP / ITD</b>	<b>Technology Areas</b>	<b>Demonstrator / Technology Stream</b>
<b>Engines</b>	<b>Innovative High Bypass Ratio Engine Configurations I : UHPE Concept for Short/Medium Range aircraft (Safran)</b>	UHPE demonstrator Design, development and ground tests of a propulsion system demonstrator for an Ultra High Bypass Ratio engine: validation of the low pressure modules and nacelle technology
<b>Engines</b>	<b>Business Aviation/Short Range Regional Turboprop Demonstrator</b>	Business aviation/short range regional Turboprop Demonstrator Design, development and ground testing of a new turboprop engine demonstrator for business aviation and short range regional application
<b>Engines</b>	<b>Advanced Geared Engine Configuration</b>	Advanced Geared Engine Configuration (HPC and LPT technology demonstration) Design, development and ground testing of an advanced geared engine demonstrator: improvement of the thermodynamic cycle efficiency and noise reduction
<b>Engines</b>	<b>Innovative High Bypass Ratio Engine Configurations II: VHBR Middle of Market Turbofan Technology (Rolls-Royce)</b>	VHBR Middle of Market Turbofan Technology  Design, development and ground testing of a VHBR Middle of Market Turbofan
<b>Engines</b>	<b>Innovative High Bypass Ratio Engine Configurations III: VHBR engine demonstrator for the large engine market (Rolls-Royce)</b>	VHBR engine demonstrator for the large engine market Design, development and ground testing of a large VHBR engine demonstrator
<b>Engines</b>	<b>Small Aircraft Engine Demonstrator</b>	Small Aircraft Engine Demonstrators - reliable and more efficient operation of small turbine engines - light weight and fuel efficient diesel engines

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
<b>Systems</b>	<b>Integrated Cockpit Environment for New Functions &amp; Operations</b>	<p>Extended Cockpit Demonstrations for:</p> <ul style="list-style-type: none"> <li>- Flight Management evolutions : green technologies, SESAR, NextGen, interactive FM</li> <li>- Advanced functions : communications, surveillance, systems management, mission management</li> <li>- Cockpit Display Systems: new cockpit, HMI, EVO, etc.</li> <li>- IMA platform and networks</li> </ul>
<b>Systems</b>	<b>Innovative and Integrated Electrical Wing Architecture and Components</b>	<p>Innovative Electrical Wing Demonstrator (including ice protection) for:</p> <ul style="list-style-type: none"> <li>- New actuation architectures and concepts for new wing concepts</li> <li>- High integration of actuators into wing structure and EWIS constraints</li> <li>- Inertial sensors, drive &amp; control electronics</li> <li>- New sensors concepts</li> <li>- Health monitoring functions, DOP</li> <li>- WIPS concepts for new wing architectures</li> <li>- Shared Power electronics and electrical power management</li> </ul> <p>Optimization of ice protection technologies and control strategy</p>

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
Systems	<b>Innovative Technologies and Optimized Architecture for Landing Gears</b>	<p>Advanced systems for nose and main landing gears applications for:</p> <ul style="list-style-type: none"> <li>- Wing Gear and Body Gear configurations</li> <li>- Health Monitoring</li> <li>- Optimized cooling technologies for brakes</li> <li>- Green taxiing</li> <li>- Full electrical landing gear system for NLG and MLG applications</li> <li>- EHA and EMA technologies</li> <li>- Electro-Hydraulic Power Packs</li> <li>- Remote Electronics, shared PE modules</li> <li>- Innovative Drive &amp; Control Electronics</li> </ul>

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
Systems	High Power Electrical and Conversion Architectures	<p>Non propulsive energy generation for:</p> <ul style="list-style-type: none"> <li>- AC and DC electrical power generation</li> <li>- AC and DC electrical power conversion</li> <li>- SG design for high availability of electrical network</li> <li>- Integrated motor technologies, with high speed rotation and high temperature material</li> </ul>
		Equipment and Systems for new aircraft generations
Systems	Innovative Energy Management Systems Architectures	<p>Innovative power distribution systems, (including power management) for:</p> <ul style="list-style-type: none"> <li>- Electrical Power Centre for Large Aircraft – load management and trans-ATA optimization</li> <li>- High integrated power center for bizjet aircraft (multi ATA load management, power distribution and motor control)</li> <li>- Smart grid, develop &amp; integrate breakthrough components to create a decentralized smart grid, partly in non-pressurized zone.</li> <li>- Electrical Power Centre – load management optimization</li> <li>- Health Monitoring, DOP compliant</li> </ul>

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
<b>Systems</b>	<b>Innovative Technologies for Environmental Control System</b>	<p>Next Generation EECS, Thermal management and cabin comfort for:</p> <ul style="list-style-type: none"> <li>- New generation of EECS including a global trans ATA visionable to answer the needs for load management, Inerting systems, Thermal Management, Air quality &amp; cabin comfort</li> <li>- Development / optimisation of Regional A/C EECS components for full scale performance demonstration</li> <li>- New generation of cooling systems for additional needs of cooling</li> </ul>
<b>Systems</b>	<b>Advanced Demonstrations Platform Design &amp; Integration</b>	<p>Demonstration Platform – PROVEN, GETI &amp; COPPER Bird®</p> <ul style="list-style-type: none"> <li>- To mature technologies, concepts and architectures developed in <i>Clean Sky 2</i> or from other R&amp;T programs and integrated in <i>Clean Sky 2</i></li> <li>- For optimization and validation of the thermal and electrical management between the main electrical consumers</li> </ul>

IADP / ITD	Technology Areas	Demonstrator / Technology Stream
Systems	Small Air Transport (SAT) Innovative Systems Solutions	<p>Small Air Transport (SAT) Activities</p> <ul style="list-style-type: none"> <li>- Efficient operation of small aircraft with affordable health monitoring systems</li> <li>- More electric/electronic technologies for small aircraft</li> <li>- Fly-by-wire architecture for small aircraft</li> <li>- Affordable SESAR operation, modern cockpit and avionic solutions for small a/c</li> <li>- Comfortable and safe cabin for small aircraft</li> </ul> <p><i>Note: budget has been identified for specific SAT work inside Systems. However, synergies with main demonstrators and specific work still have to be worked upon</i></p>
Systems	ECO Design	<p>ECO Design activities</p> <p>Refers to ECO Design chapter</p>
Technology Evaluator (TE)	A systematic overall approach to the Technology Evaluation process and monitoring activity	<ul style="list-style-type: none"> <li>- Progress Monitoring of <i>Clean Sky 2</i> achievements</li> <li>- Evaluation at Mission Level of particular ITD outputs</li> <li>- Impact Assessments at Airport and ATS Level</li> </ul>

<b>IADP / ITD</b>	<b>Technology Areas</b>	<b>Demonstrator / Technology Stream</b>
<b>Eco-Design Transverse Activity</b>	<b>An overall innovative approach and "agenda" for Eco-Design activity in the CS2 Programme</b>	<p>Eco-Design activities are embedded in all IADPs and ITDs. They are detailed in Chapter 13. Thus, a dedicated funding for Eco-Design is reserved inside each IADP's and ITD's funding.</p> <p>The co-ordination of all Eco-Design activities will be established in the Airframe ITD.</p> <p>The list of technology areas and "story boards" and demonstrators will be established during the 2014-15 period.</p>
<b>Small Air Transport (SAT) Transverse Activity</b>	<b>An overall innovative approach and "agenda" for Small Air Transport activity in the CS2 Programme</b>	<p>Small Air Transport (SAT) activities are part of Airframe, Engines (WP7) and Systems ITDs and are detailed in Chapter 14. The co-ordination of all SAT activities will be established in the Airframe ITD.</p> <p>The planned demonstrators are included in the above descriptions of the Airframe, Engines and Systems ITDs.</p>
<b>LEGEND</b>		
<b>IADP/ITD/TA</b>	<b>Technology Area</b>	<b>Demonstrator / Technology Stream</b> <i>Text highlighted as indicated relates to demonstrators foreseen within the CS2 Programme for which an ex-ante Technical Evaluation by independent experts is still required. As such they are noted here as conditional - subject to a successful evaluation.</i>

## 11.2. Environmental forecast

The table below shows the environmental targets of the Clean Sky 2 Programme as defined in the Joint Technical Proposal.

	<i>Clean Sky 2 as proposed*</i>
CO <sub>2</sub> and Fuel Burn	-20% to -30% (2025 / 2035)
NO <sub>x</sub>	-20% to -40% (2025 / 2035)
Population exposed to noise / Noise footprint impact	Up to -75% (2035)

\* Baseline for these figures is best available performance in 2014

These figures represent the additionality of CS2 versus the 2014 Horizon 2020 Start Date and allow the full completion of the original ACARE 2020 goals (with a modest delay)



### 11.3. Indicators for Clean Sky 2 Programme

The following table presents the list of indicators (Key performance Indicators) set up for the CS2 programme.

Indicator ID	Indicator short name	Description of indicator	Target set
Ind 1.4 C	SME share in CfPs - numbers	number of SME participation in CfP versus total number of applicants	>40%
Ind 2.5.1 B	Core Partner Topics success rate	percentage of topics resulting in signature of the GAM	>90%
Ind 2.5.4 B	Core Partner Strategic Topics Redress procedures - all	Number of redress requests	<5%
Ind 2.5.1 B	CfP Topics success rate	percentage of topics resulting in signature of the GAP	>90%
Ind 2.5.4 B	CfP Topics Redress procedures - all	Number of redress requests	<5%
Ind. 2.7.1 A	WP execution by Members - resources	percentage of resources consumption versus plan (Members only)	>80%
Ind 2.7.1 B	WP execution by Members - deliverables	percentage of deliverables available versus plan (Members only)	>80%
Ind 2.7.3 C	Launch reviews – percentage held	percentage of total major demo activity where Launch Reviews held and resulting in agreed launch of major projects	30%
Ind 2.9 C	Budget execution - payments operational	percentage of payments made within the deadlines	>85%
Ind 3.7.3 A	Budget execution - payments running costs	percentage of payments made within the deadlines	>75%

## 12. RISK ASSESSMENT

The following table presents the risk assessment of the Clean Sky 2 programme as defined through the risk assessment exercise performed by the JU's management.

Risk Description	CS Process	Action Plan summary
Conflicts of priorities may happen within industrial companies, or change of strategy, resulting in a lack of resources available for Clean Sky 2 and delays in the completion of the activities.	<b>Manage the Programme</b>	Implement a Launch Review for each Project. Have an early warning capability through quarterly reports and alert at Governing Board level. Propose re-orientations when needed and possible.
Technical setbacks in one or several ITDs may result in a significant under-spending of annual budget.	<b>Manage the Programme</b>	Re-balance the budget across ITDs/IADPs and with Partners if necessary at mid-year, according to the 2nd quarterly reports.
The potential introduction of Clean Sky 2 in parallel to Clean Sky may result in a scattering of beneficiaries' resources, a delay in Clean Sky demonstrator's finalization and an overload for the CS team	<b>Manage the Programme</b>	Check resources and any critical dependencies in Launch Reviews. Condition the CS2 funding by ITD and by beneficiary to the actual execution of CS budgets and technical progress
Guidelines for Clean Sky 2 preparation documents may be not clear and/or stable enough, leading to late or incomplete ITD submissions to the JU	<b>Manage the Programme</b>	Have clear management plan and templates for required documentation, defined at the start of the programme.
Core Partner call may be not answered or quality of submissions results in non-selection	<b>Manage the Programme / Manage the Calls</b>	Continue to inform and engage as open a discussion as possible with potential CP Ensure well written description of CP technical activities / Ensure adequate involvement and attention of Industry leaders in the strategic topic definition process
Planning for cost and effort for complex, large ground and flight demonstrators (10 year programme) may lack accuracy	<b>Manage strategic planning risks</b> <b>Deploy lessons learned project</b>	Each IADP / ITD to deploy an individual, tailored risk management and to completion plan
Negotiation processes with Core Partners may be lengthy, leading to delayed start of technical activities	<b>Manage the Programme / Manage the Calls</b>	Ensure appropriate training to Winners and Topic Managers; have a close follow-up of all negotiations and early warning / escalating process for solving

Risk Description	CS Process	Action Plan summary
		issues.
Efforts for interfaces and cooperation of partners for flight worthy hardware and complex flight demonstrators may be initially underestimated	<b>Manage strategic planning risks</b> <b>Deploy lessons learned project Systematic Design Reviews</b>	Have clear descriptions of work in Call texts for such activities directly related to flight worthy hardware, including requested skills and agreements. Deploy an individual, tailored risk management for interfaces of members and partners for large demonstrator activities Prepare more conservative back-up solutions in advance to mitigate the risk
Competences and resource to successfully enable flight testing may be insufficient	<b>Manage the Programme / Manage the ITDs</b>	Clearly identify the required competences and resources and closely monitor thru PDR/CDR and milestone management. Enforce consistent and robust risk management; implement early-warning system to avoid late discovery of critical path related risks Check relevance of cost and schedule wrt airworthiness issues at Launch Reviews (and further reviews)
The lack of guidelines for inclusion of some Level 2 projects may lead to an unclear perspective and lack of commitment of Members	<b>Manage the Programme / Manage the Calls</b>	Agree strategic priorities with GB. Adapt the technical content. Revise JTP and relevant ITD (IADP), with a target of EoY 2014.
Some costs may be overrun, and some participants may be unable to carry on until completion.	<b>Manage the ITDs</b>	Manage priorities: abandon non crucial technology development and integrate only the crucial ones in the demonstration. Consider the implementation of a contingency margin.

### **13. PRIVATE CONTRIBUTION TO THE PROGRAMME AND TO THE JTI OBJECTIVES**

The JU proposes to present more information on the Clean Sky 2 Programme Private contribution to the programme and to the JTI objectives on the occasion of the finalisation of the work plan 2016- 2017 before the end of 2015.

Based on the current information at hand, the minimum estimated in-kind contributions from operational activity are the unfunded 30% of the total eligible costs for the members in 2016/2017. As the funding value (70% funding rate) for members is currently estimated at 91,156,375 € for 2016, the corresponding unfunded value (remaining 30%) is **39,067,018 €**. In 2017, the funding value (70% funding rate) for members is currently estimated at 92,428,571 €, and therefore the corresponding unfunded value (remaining 30%) is **39,612,245 €**. In addition to this, the JU expects some members to report further in-kind contributions for these periods and additional activities. These estimates will be further elaborated when finalising the Work plan 2016/17 before the end of 2015.

## 14. JUSTIFICATION OF THE FINANCIAL RESOURCES

### Introduction

As Horizon 2020 is the EU funding programme under which the Clean Sky 2 programme will be implemented, the basic funding of the running costs and operational activities is entirely separate to that of the Clean Sky programme. The sources of revenue for 2015 as currently set out does not foresee interest gained on the bank account of Clean Sky 2 Joint Undertaking. The sources of revenue are from the EU Subsidy, the private members (for half of the annual running costs) and the carry over appropriations from 2014. In total, the running costs will not surpass 78m € when both sources of revenue are combined and are shared 50/50. The available operational budget from the EU subsidy is therefore 1.716bn € (39m € for running costs in addition to this figure).

*The main features of the 2015- 2017 expenditure in the budget are set out below:*

Budget Clean Sky 2 Expenditure	CA 2015	PA 2015	CA 2016	PA 2016	CA 2017	PA 2017
Title 1	2.850.000	3.153.677	3.413.296	3.413.296	4.058.600	4.058.600
Title 2	2.009.906	2.509.130	1.981.642	1.981.642	2.182.636	2.182.636
Title 4	357.277.704	101.232.274	200.190.976	199.466.148	197.580.971	172.148.300
Title 5	0	0	0	0	0	0
<b>Total Budget</b>	<b>362.137.610</b>	<b>106.895.081</b>	<b>205.585.914</b>	<b>204.861.086</b>	<b>203.822.207</b>	<b>178.389.536</b>

### Running costs

The running costs have been estimated based on Clean Sky implementation while also taking into account the new elements which need to be covered by the CS2 budget only.

*Overall allocation of running costs between CS and CS2:* It can be noted that the Joint Undertaking's common costs such as electricity, services, postal costs, stationary etc. need to be divided across the 2 programmes. For 2015, it has been reduced to meet the reduced commitment and payment appropriations available from the EU subsidy.

***Title 1 (Staff and associated costs):***

The current figures reflect the available commitment and payment appropriations of 2015/2017 for CS2JU staff costs.

***Title 2 (Buildings, IT, Equipment, Communication, Management of Calls and Miscellaneous expenditure for running activities):******Premises***

The JU will continue to be housed in the White Atrium (on 3<sup>rd</sup> and 4<sup>th</sup> floor) as with the other JTIs.

**Title 3 (Operational Expenditure):**

In summary, the amounts allocated for Leaders, Core Partners and Partners for the years 2015 and 2017 are reflected here. These amounts are flexible between each other while the total envelope, in particular for PA, is not flexible.

OPERATIONAL EXPENDITURE	CA 2015	PA 2015	CA 2016	PA 2016	CA 2017	PA 2017
LPA	45.921.000	6.751.202	17.000.000	28.846.722	27.389.192	18.977.021
REG	13.716.000	2.037.610	11.241.000	6.627.581	5.477.838	4.360.002
FRC	25.214.000	5.631.532	18.100.000	22.478.590	10.003.009	14.787.700
AIR	47.775.000	9.413.008	19.100.000	37.899.820	16.671.682	24.932.666
ENG	74.984.000	11.222.604	27.740.000	41.155.563	14.290.013	27.074.480
SYS	41.987.000	8.325.198	7.950.000	28.645.722	11.908.345	18.844.792
TE	435.000	67.500	0	486.516	924.286	320.058
ECO TA	3.800.000	855.000	0	2.502.249	2.104.034	1.646.122
SAT TA	3.800.000	477.000	6.000.000	4.191.121	3.660.171	2.757.159
CfP /CfT	99.645.704	56.451.620	93.059.976	26.632.264	105.152.400	58.448.300
<b>TITLE 4</b>	<b>357.277.704</b>	<b>101.232.274</b>	<b>200.190.976</b>	<b>199.466.148</b>	<b>197.580.971</b>	<b>172.148.300</b>
<b>TITLE 5– UNUSED APPROPRIATIONS</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>TOTAL TILE 4 &amp; 5</b>	<b>357.277.704</b>	<b>101.232.274</b>	<b>200.190.976</b>	<b>199.466.148</b>	<b>197.580.971</b>	<b>172.148.300</b>

## **PART C – *CLEAN SKY 2 JU – PROGRAMME OFFICE***

## 15. COMMUNICATION AND EVENTS

### Strategy

Key communication activities will include increasing the visibility and reputation of the organisation by conveying JU's achievements, successes and the promotion of Clean Sky 2 Calls for proposals. We will sharpen our message, expand our networks and make our brand visible, consistent and reputed

Clean Sky 2 JU will rely on multipliers and ambassadors:

- Clean Sky 2 Members: industrial leaders and European Commission;
- Local multipliers in the Member States such as States Representative Group (SRG) reaching out to potential applicants;
- Clean Sky project coordinators and participants, who will communicate the successes of Clean Sky to various national and European audiences;
- Clean Sky management and staff and Clean Sky communications network;
- ACARE, reaching out to policy makers inside ACARE companies;

### Actions

- a) Attract the best technology in Europe to apply for Clean Sky 2 projects

<b>TARGET GROUPS:</b>	<b>Potential applicants:</b> IADP/ITD leaders, Large, Small and Medium Enterprises, academia
<b>MESSAGE:</b>	Benefits of participation in Clean Sky 2 projects
	<b>Promotion of Calls</b> <ul style="list-style-type: none"><li>• Brand new web site expanding on the Clean Sky 2 section;</li><li>• Info Days sessions around Call launch</li><li>• Open Webinar</li><li>• SRG promotion in each country</li><li>• Clean Sky management and staff active participation at events</li><li>• Partnership with SMEs European organisations</li></ul> <hr/> <b>Clean Sky visibility at key events:</b> <ul style="list-style-type: none"><li>• Paris-Le Bourget on 15-21 June 2015 and in 2017</li><li>• Clean Sky Forum in 2016 and 2017;</li><li>• ILA Berlin and Farnborough Air Shows in 2016;</li><li>• ASD Annual event</li><li>• Clean Sky 2 national events</li></ul>



b) Keep decision makers aware by demonstrating progress of Clean Sky 2

<b>TARGET GROUPS:</b>	<b>Policy makers</b> in the area of research, innovation, transport, and environment, and SMEs in industry and public institutions.
<b>MESSAGE:</b>	<b>Success</b> of demonstrators in on-going technical projects
	<ul style="list-style-type: none"> <li>• <b>High-level meetings</b> with national and European policy-makers;</li> <li>• <b>Targeted meetings/invitations to Demonstrator-related events</b> to representatives of the European Commission, the European Parliament, EU Permanent Representations, and the business community;</li> <li>• <b>High-level media coverage</b> through press work, press releases, and opinion articles in leading and specialised media.</li> </ul>

c) Internal enabler: Support IADP/ITD/TA coordinators and project officers

<b>TARGET GROUPS:</b>	<b>CS ITD coordinators, CS2 IADP/ITD/TA coordinators, project officers</b>
<b>MESSAGE:</b>	<b>Ex-ante and post-project interaction</b> with communications to optimise visibility, advocacy and influence of Clean Sky
	Provide <b>communications guidance</b> and support for their contributions to the web site, events, printed and digital publications as well as other communication tools available.

d) Maximise efficiency and effectiveness of Clean Sky communications efforts.

<b>TARGET GROUPS:</b>	<b>ITD leaders communications professionals, Clean Sky management and staff</b>
<b>MESSAGE:</b>	Maximise internal information and coordinate well external actions while aligning messages and timing
	<ul style="list-style-type: none"> <li>• <b>Align messages</b> to speak with a single voice at events, high-level meetings and when doing media relations. Improve narrative to reach out various audiences</li> <li>• <b>Coordinate communication activities</b> with Communications network group</li> <li>• Conclude <b>contracts</b> with external communication suppliers where more efficient and needed</li> </ul>

## 16. JU EXECUTIVE TEAM

The JU team of statutory staff consists of 31 positions currently. It is proposed that this team will be increased to 42 statutory positions to manage the two programmes. The establishment plan for 2015 shows the increased level. 5 additional posts are envisaged in 2015. Currently the JU manages 286<sup>14</sup> grant agreement in addition to the 7 grant agreements for members in Clean Sky programme (consisting of 210 beneficiaries financial reports and 7 annual technical reports) and 6 grant agreements for members of the Clean Sky 2 Programme (consisting of 69 financial reports and 6 annual technical reports). As foreseen, the ramp up of the number of grant agreements with partners in place brings a significant burden to the JU to monitor, control and finalise. As the JU moves closer to the demonstrators, many of these grant agreements need to be closed as they deliver the technical activities foreseen.

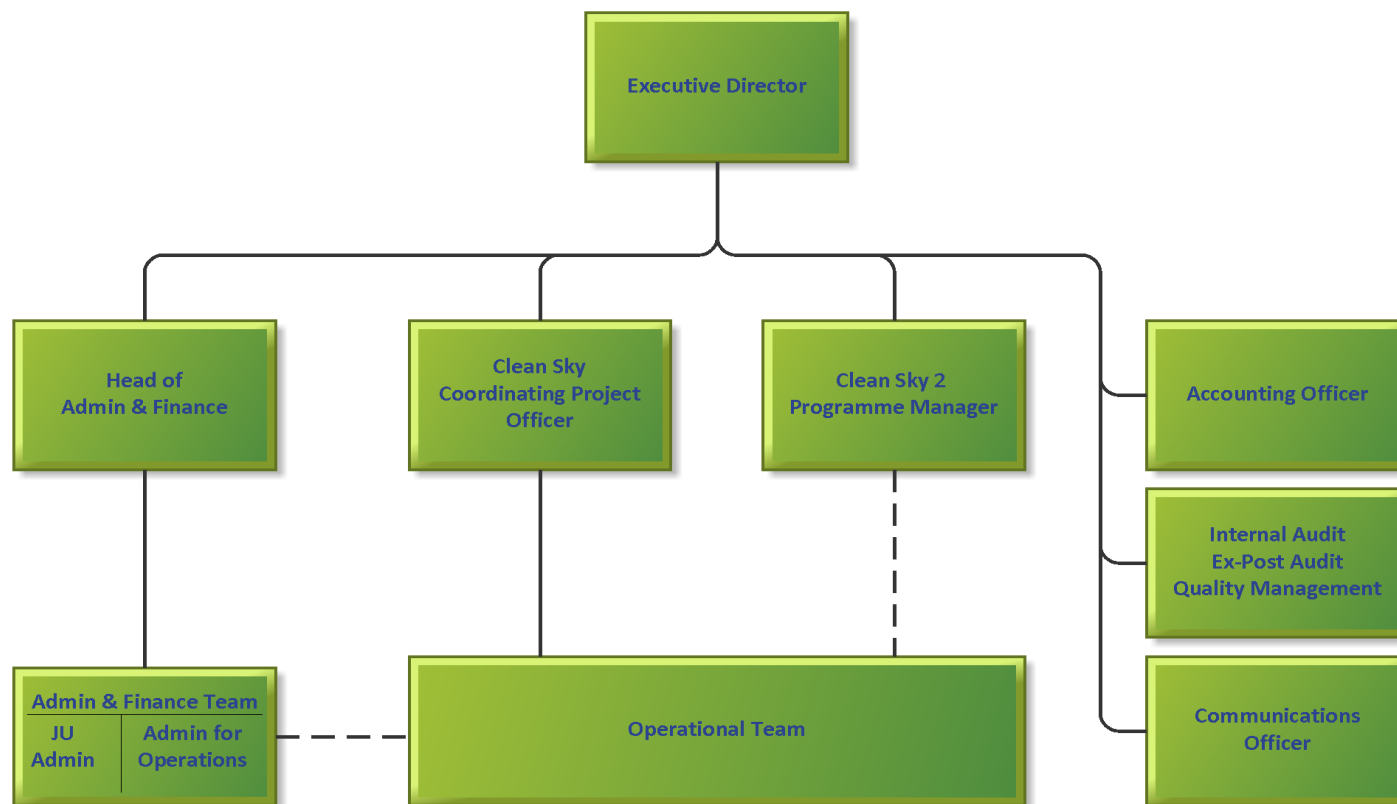
Of the 31 positions currently recruited, 24 positions are involved in the grant management area (excluding senior management tasks). The JU will be in a better position to manage, with its own internal resources both programmes. The operational team is composed of project officers supported by a pool of project support officers newly recruited. This additional element in the operational team will bring much needed support to the overall management of the Programme. In addition, the administrative team will be re-enforced with 2 further financial roles allowing to meet the targets set in H2020 for time to grant and time to pay.

The new organisational structure of the JU is shown below. The structure shows how the ‘administration and finance’ team works for the most part on the ‘operational’ files of the JU, i.e. with and for the grant agreements of beneficiaries. The administration of the running costs is a minor task for this team. The structure also shows the functional link from the operational team to the CS2 programme manager.

---

<sup>14</sup> 478 total signed GAPs minus 192 closed projects.

### Organisational chart of the JU



## 17. SUMMARY ANNUAL BUDGET

The Clean Sky 2 Joint Undertaking manages 2 programmes and therefore, having provided the individual programme budget in the previous chapters, the consolidated annual budget of the Joint Undertaking is set out below. These figures are the addition of the 2 programme elements above. The running costs are shared between the 2 programmes based on the available payment appropriations coming from the EU subsidy.

The detailed Annual Budget for the years 2015-2017 is summarized as follows:

Budget 2015 Clean Sky 2 JU	Commitment Appropriations	Payment Appropriations
Title 1 Expenditures	4.750.000	5.164.685
Title 2 Expenditures	3.077.522	4.057.708
Title 3 Expenditures	75.550.380	135.485.596
Title 4 Expenditures	357.277.704	101.232.274
Title 5 Unused Appropriations	0	0
<b>Total Budget</b>	<b>440.655.606</b>	<b>245.940.263</b>

Budget 2016 Clean Sky 2 JU	Commitment Appropriations	Payment Appropriations
Title 1 Expenditures	4.456.000	4.456.000
Title 2 Expenditures	2.584.316	2.584.316
Title 3 Expenditures	27.018.281	48.640.389
Title 4 Expenditures	200.190.976	199.466.148
Title 5 Unused Appropriations	1.693.635	2.633.197
<b>Total Budget</b>	<b>235.943.208</b>	<b>257.780.050</b>

Budget 2017 Clean Sky 2 JU	Commitment Appropriations	Payment Appropriations
Title 1 Expenditures	4.550.000	4.550.000
Title 2 Expenditures	2.444.848	2.444.848
Title 3 Expenditures	0	24.398.021
Title 4 Expenditures	197.580.971	172.148.300
Title 5 Unused Appropriations	1.416.829	2.583.629
<b>Total Budget</b>	<b>205.992.648</b>	<b>206.124.798</b>

## 18. EX-POST AUDITS

The Ex-post audit (EPA) process represents a significant element of the Internal Control System of the JU.

The main objectives of the audits are:

- 1) Through the achievement of a number of quantitative targets, ensure the legality and regularity of the validation of cost claims performed by the JU's management
- 2) Provide an adequate indication on the effectiveness of the related ex-ante controls
- 3) Provide the basis for corrective and recovery activities, if necessary

### FP7 programme

On the basis of the Clean Sky Ex-post audit Strategy for the FP7 programme, as adopted by the CS Governing Board, audits will be performed in the years 2015-2017 at the JU's beneficiaries covering mainly cost claims pertaining to the execution of FP7 GAMs of the years 2011 to 2015. The audit activities may also cover FP7 GAPs validated by the JU since the year 2012.

A sample of validated cost claims will be selected covering the following elements:

- Most significant cost claims
- Representative sample selected at random
- Risk based sample

The JU aims to achieve a coverage of 20 to 25% of the operational FP7 expenditure through the ex-post controls.

Audits will be assigned to external audit firms, on the basis of the existing framework contract between the 3 JUs IMI JU, FCH JU and JU. In addition the JUs may make use of a new framework contract, which has been established by the Commission for ex-post audits.

To ensure correct and consistent audit conclusions and results, the JU will closely monitor the execution of the agreed standard audit procedures through the external audit firms. The internal EPA processes of the JU, comprising of planning and monitoring of the audits and implementation of the audit results, will require the input of 3 FTE.

Reported audit results may be (1) qualitative - concerning the internal controls applied by the beneficiaries - and (2) quantitative - expressed in error rates. The ex-post control objective of the JU is expressed in the target of an overall residual error rate<sup>15</sup> for the entire programme period (FP7) of maximum 2% of total budgetary expenditure.

---

<sup>15</sup> The residual error rate represents the remaining level of errors in payments made after corrective measures.

In order to prevent errors in future cost claims of the JU's members the input of the ex-post audit team into the ex-ante validation process will be an important task.

For the final reports of projects under the FP7 programme, the ex-post audit team will develop appropriate audit procedures to cover the specific situation during the operational and financial termination of projects.

The accumulated results of the EPA process during the years 2015 and 2017 will be described in the Annual Activity Reports and will be considered for the assurance declarations of the Executive Director for the two years.

## **H2020 programme**

The first audits of H2020 grant agreements are not planned before 2016. Until then, the JU Ex-post Audit Strategy needs to be developed in reconciliation with the Commission. A specific monitoring and review process regarding the methodology applied for the evaluation of the in-kind contribution reported by the JU Members and Core Partners will be developed.

## **19. PROCUREMENT AND CONTRACTS**

### ***Procurement***

For the years 2015-2017 the JU will assign the necessary funds for the procurement of the required services and supplies in order to sufficiently support its administrative and operational infrastructures.

From its autonomy, the JU has efficiently simplified the procurement process by establishing multi-annual framework contracts and Service Level Agreements for the supply of goods and services and by joining inter-institutional tenders and joint tenders with the European Commission and other Joint Undertakings to reach optimization of resources.

In 2015-2017 only few new calls for tenders are expected to be launched due to the fact that some framework contracts will start running at end of 2013 for a 3 or 4 year duration. The tenders planned to be launched in 2015-2017 are expected to support some core activities mainly in the field of communication for specific events and activities and in the IT field.

A summary table is made available below listing the tenders planned for 2015-2017 and the procurement procedure expected on the basis of the information currently available which may be subject to modifications.

In addition to the administrative procurements, the JU may consider the launch in 2016-2017 of a limited number of “operational” calls for tenders in the meaning of Article 11.5 f) and 16.1 c) of the Statutes for the benefit of its technical Programme and in association under a joint procurement process with one or more private Members as envisaged under the JU Financial Rules. Upon definition of an internal process to regulate such a specific tendering procedure, the JU will update the Work Plan as appropriate indicating the specific operational needs (works, services, supplies) that will be identified in cooperation with the private Members in due time after having completed the JU internal set-up of the process.

*Contracts to be tendered in 2015-2017*<sup>16</sup>

<b>Title</b> <i>indicative</i>	<b>Expenditure</b> <b>(EUR)</b> <i>Indicative</i>	<b>Type of procedure</b>	<b>Schedule</b> <i>indicative</i>
<b>2015-2016</b>			
<b>HR related activities and events</b>			
Team building activities	max. 15.000	Negotiated procedure for low-value contracts	2016
<b>Programme management related</b>			
Dissemination of research results. Repository for CSJU website	< 134.000 EUR	Negotiated procedure	3 <sup>rd</sup> quarter 2015
<b>Communication related activities and events</b>			
Organisation of stand at Paris Le Bourget Air Show	< 60.000 EUR	Negotiated procedures with three tenderers	1 <sup>st</sup> quarter 2015
Organisation of stand at Farnborough Air Show	max.50.000	Negotiated procedure for low-value contracts	2 <sup>nd</sup> half of 2016
Clean Sky Forum	max. 20.000	Negotiated procedure for low-value contracts	1 <sup>st</sup> half of 2016
Demonstration Events	max. 30.000	Negotiated procedure for low-value contracts	1 <sup>st</sup> and 2 <sup>nd</sup> half of 2016
3AF/CEAS Greener Aviation 2016-Clean Sky breakthroughs	max. 144.000	Negotiated procedure for low-value contracts	2 <sup>nd</sup> half of 2016
Media partnerships	max 25.000	Negotiated procedure for low-value contracts	1 <sup>st</sup> half of 2016
New Clean Sky website	max 50.000	Negotiated procedure for low-value contracts	2 <sup>nd</sup> half of 2016
Clean Sky Book	max 50.000	Negotiated procedure for low-value contracts	1 <sup>st</sup> half of 2016
<b>Total: 510.000 EUR</b>			
<b>2017</b>			
<b>HR related activities and events</b>			
Team building activities	max. 15.000	Negotiated procedure for low-value contracts	2017
<b>Communication related activities and events</b>			
Organisation of stand at Paris Air Show	max.50.000	Negotiated procedure for low-value contracts	1 <sup>st</sup> half of 2017
Organisation of Conference at ILA Air Show	max.20.000	Negotiated procedure for low-value contracts	1 <sup>st</sup> half of 2017
Demonstration Events	max. 30.000	Negotiated procedure for	1 <sup>st</sup> and 2 <sup>nd</sup> half of

<sup>16</sup> Estimate



<b>Title</b> <i>indicative</i>	<b>Expenditure</b> <b>(EUR)</b> <i>Indicative</i>	<b>Type of procedure</b>	<b>Schedule</b> <i>indicative</i>
		low-value contracts	2017
Clean Sky Forum	max. 20.000	Negotiated procedure for low-value contracts	1 <sup>st</sup> half of 2017
Media partnerships	max 25.000	Negotiated procedure for low-value contracts	1 <sup>st</sup> half of 2017
<b>Total: 160.000 EUR</b>			

## 20. DATA PROTECTION

In 2015-2017, the JU will continue to ensure that personal data are protected and that Regulation (EC) No 45/2001 is complied with, by implementing the following actions:

- ✓ The JU Data Protection Officer will allocate time in advising and /training the staff in particular in relation to the implementation of the accountability principle and to the follow-up in specific fields of the thematic guidelines issued by the European Data Protection Supervisor;
- ✓ The JU will continue to implement the internal procedure for handling internal notifications under Article 25 of Regulation (EC) No 45/2001 related to administrative processing operations by the JU's staff and, where applicable, to the prior checking notifications to the EDPS under Article 27 of Regulation (EC) No 45/2001.
- ✓ The JU will implement the data protection aspects related to the launch and management of the calls for proposals in accordance with the rules and procedures of Horizon 2020.

In the light of the General Monitoring Report for the year 2014 carried out by the JU in a comprehensive way and duly notified to the EDPS, the JU will ensure adequate follow up to any pending notification or any complement of information requested by the EDPS in the light of the latest prior checking notifications submitted to EDPS by the end of 2014 such as the notifications on procurements, grants and experts, on the treatment of health data and on the conflicts of interest and the related declarations of interests.

- ✓ The JU will also take note of the EDPS Report expected in 2015 and of any recommendation addressed to the JU.
- ✓ Follow-up in EDPS meetings on the EU legal framework for data protection and potential impact on EU Institutions/Agencies/JUs of the data protection package proposal, along with any guidelines and training provided by EDPS on specific areas such as the impact of technological developments on personal data protection, IT, websites etc.

# **ANNEXES**

## **21. ANNEX I: Annual Budget 2015-2017 and Establishment Plan 2015**

*(Available in separate document, available on [www.cleansky.eu](http://www.cleansky.eu))*

## **22. ANNEX II: 2<sup>nd</sup> Call for Proposals: Summary List of Topics**

*(for full description of the topics see separate call document “Call Text” published on [Participant Portal](#))*

Indicative start date of activities: Q2 2016

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-LPA-01-04</b>	<b>Active technologies for acoustic and vibration comfort</b>	WP1.5	3	0,75	IA	To progress on airframe efficiency while supporting the high level of the customer comfort requested, new technologies of noise and vibration reduction have to be developed to face the new evolutions of business jet design. It is proposed to develop and evaluate active technologies for 2 different problems: active control systems for reducing cabin noise from engine vibration, and active control systems for reducing global fuselage vibration from aerodynamic excitations	Dassault Aviation
<b>JTI-CS2-2015-CFP02-LPA-01-05</b>	<b>Validation of aero-vibro-acoustic model on new aerodynamic configurations.</b>	WP1.5	3	0,9	RIA	Due to new fuselage shape and different cruise mach numbers, this project aims at improving knowledge on turbulent boundary layer noise and its propagation into the fuselage structure. The influence of pressure gradients and fuselage shapes will be investigated through both experimental measurements and numerical simulations. Wind tunnel test on a modular mock-up will provide data about aero-acoustics and structural dynamics under non homogeneous loading.	Dassault Aviation

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
JTI-CS2-2015-CFP02-LPA-01-06	Laminar Horizontal Tail Plane full scale ground demonstrator	WP1.4	1,92	1,5	IA	<ul style="list-style-type: none"> <li>• Participate to the design of a industrial structure of a laminar HTP taking account the laminar requirements in terms of surface quality;</li> <li>• Manufacture a 2 meter span piece of this main box HTP: the demonstrator;</li> <li>• Design and manufacture the HTP remote surface control</li> <li>• Design and manufacture the inner extension and of this HTP to install the demonstrator for large scale wind tunnel tests at flight Reynolds numbers;</li> <li>• Manufacture several partial demonstrators.</li> </ul> <p>Explanation: The overall model will have a span of approximately 5m and a mean aerodynamic chord of approximately 2 m. The model will be divided into an inner (the extension) and an outer section (the demonstrator). The outer section will be instrumented with pressure ports and need to be compatible with IR measurements.</p>	Dassault Aviation

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-LPA-01-07</b>	<b>Design, test and manufacturing of robust fluidic actuators</b>	WP1.5	3	0,35	RIA	Design, test and manufacturing of robust, energy-efficient, aerodynamically effective actuators without moving parts for TRL3 WTT	Airbus
<b>JTI-CS2-2015-CFP02-LPA-01-08</b>	<b>Drive and control system for piezoelectric AFC actuators</b>	WP1.5	3	0,35	IA	Drive and control system for piezoelectric AFC actuators. Ground Based Systems Demonstrator: Development, manufacturing and testing of a smart amplifier box for fluidic actuators with advanced monitoring capabilities	Fraunhofer
<b>JTI-CS2-2015-CFP02-LPA-01-09</b>	<b>Test aircraft preparation and qualification for Scaled Flight Testing ("PREP")</b>	WP1.3	4	2	IA	This task covers modifications to the test vehicle itself, based on results from the former NACRE project and from other similar activities. The task should include planning for the changes, execution of the modifications, in cooperation with partners, and qualification of the changes as well as the complete vehicle.	Airbus
<b>JTI-CS2-2015-CFP02-LPA-01-10</b>	<b>Hybrid Prop. Demonstrator Components – Electric Power Drives ("DRIVE")</b>	WP1.6.2	4	1,5	IA	Support for Hybrid Electric Propulsion component development work, for Electric Power Drive components. This task includes design, build and test of specific components.	Airbus



Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-LPA-01-11</b>	<b>Hybrid Propulsion Component Studies – Electrics</b>	WP1.6.2	5	1,5	RIA	This task supports the Hybrid Electric Propulsion demonstration with component and architecture simulations, modelisation of basic principles and break-through innovation. The focus is on electric generation, conversion and drive components.	Airbus
<b>JTI-CS2-2015-CFP02-LPA-02-07</b>	<b>Landing gear large die-forged fitting with improved mechanical performance</b>	WP2.3.1.1	2	0,4	IA	This study aims at developing a new generation of Lower Center Fuselage, with a Body Landing Gear, in order to reduce the drag and the overall weight. The objective of this study is to develop a landing gear fitting with high mechanical properties, thanks to new generation alloys. Forged blanks geometry will be close to the final shape, in order to reduce weight, distortions and impact on the environment.	Airbus
<b>JTI-CS2-2015-CFP02-LPA-02-08</b>	<b>High production rate composite Keel Beam feasibility</b>	WP2.3.1.2	2	0,4	IA	The keel beam is a highly loaded structural element located in the lower centre fuselage. The aim of this call for partner is to propose a compromise between performance and cost taking into account manufacturing needs and constraints (low cost & high volume technology).	Airbus

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-LPA-02-09</b>	<b>Integrated main landing gear bay</b>	WP2.3.1.3	2	0,6	IA	This topic aims at developing a new generation of Lower Center Fuselage, with a Body Landing Gear. This topic relates to the design of a main landing gear bay for a landing gear attached to the fuselage. The most promising solution has to be found disregarding the load compatibility, the best material utilization through a quantitative assessment, taking into account manufacturing requirement (recurring cost, high production rate, process stability...) at high level of integration for design to cost.	Airbus
<b>JTI-CS2-2015-CFP02-LPA-02-10</b>	<b>Development of pultrusion manufacturing applications</b>	WP2.3.1.4	2	0,6	IA	Pultrusion is a rapid and continuous out of autoclave process used to simultaneously extrude and polymerize profiles. Thus, this process offers high energy savings perspectives.	Airbus

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-LPA-03-04</b>	<b>Touchscreen control panel for critical system management functions</b>	WP3.1	7,75	2	IA	The purpose of this Call for Partner is to develop a touchscreen control panel that could replace standard overhead control panels as an incremental step on existing aircrafts and more globally on future cockpits. In order to address all overhead functions, the technology should be compliant with failure conditions up to CAT. Therefore, the whole control chain shall be secured from the touch sensor to the controlled system. The project should last 3 years at most and target TRL5 maturity by the end of the project thanks to a representative prototype that would be integrated on a large aircraft cockpit simulator. An extension may be decided to feed Airbus Disruptive Cockpit Demonstrator	Airbus
<b>JTI-CS2-2015-CFP02-LPA-03-05</b>	<b>New flight crew oxygen mask concept for prolonged use in civil aircraft</b>	WP3.1	8	0,55	IA	Current flight crew oxygen masks are not adapted to prolonged use as required for some aircraft operations. The objective of the project is to develop and validate mask solutions which would drastically increase the mask comfort for long duration while maintaining safety of the crew.	Airbus

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
JTI-CS2-2015-CFP02-LPA-03-06	Head Up System integration in next generation cockpits	WP 3.1	3	1	IA	The Head Up Display is now becoming more and more a standard equipment in aircraft, both for economical reasons (the cost has been reduced drastically) and because the demonstration of its benefits is now widely shared. This opens the possibility of new usages in next cockpit generation, or in the evolution of existing ones. The objective of the project is to analyze how the capacities of the Head Up Display could be used to provide new functionalities, in combination with other visualization means, and to demonstrate them on a fixed simulator. The bidder will be expected to contribute to the analysis of potential new functionalities, to prototype them in an existing Head Up System, to provide the airframer with two test equipment, including rapid prototyping capacities, and to participate to, and support, bench tests at the Airframer facilities.	Dassault Aviation
JTI-CS2-2015-CFP02-LPA				14,4			

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-REG-01-01</b>	<b>Smart-grid converter</b>	WP 2.3.4.2	3	0,8	RIA	Development and prototype manufacturing of innovative High/low voltage DC/DC "resonant cellular" converter with automatic inversion for innovative "smart-grid" based electrical network	Alenia
<b>JTI-CS2-2015-CFP02-REG-02-02</b>	<b>Powered WT model design and manufacturing of the FTB2 aircraft configuration for aerodynamic tests in wind tunnel at low and high Reynolds number</b>	WP 3.5	2	2,5	IA	The subject of this topic is the design and manufacturing of a wind tunnel aircraft model (both sides) representing the FTB2 configuration WTT. The complete model will include the A/C model and the powered propulsive system and must be compatible for testing at two different wind tunnels.	Airbus D&S
<b>JTI-CS2-2015-CFP02-REG</b>				<b>3,3</b>			

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-FRC-01-01</b>	<b>Development and demonstration of materials and manufacturing process for ultra high reliability electric Anti-ice/De-ice thermal layers for high strain civil rotor blades and airframe sections of tiltrotor</b>	WP 1.1 and 1.6	4	0,75	IA	The objective is to deliver flight cleared heater layers to be embedded in composite structures to provide anti-icing and de-icing capability where safety requirements dictate ultra-high reliability, while operating in high strain and vibration conditions. Representative test items will be used for structural and environmental testing and the flight cleared components will be embedded in the rotor blades and airframe sections of the tiltrotor.	AW
<b>JTI-CS2-2015-CFP02-FRC-01-02</b>	<b>Development and demonstration of materials and manufacturing process for high power density homokinetic drive joints for civil rotor applications</b>	WP 1.1 and 1.2	4	0,75	IA	The objective is to deliver flight cleared homokinetic drive units for tiltrotor proprotor units. Representative test items will be used for structural and environmental testing and the flight cleared components will be integrated in the tiltrotor rotor system.	AW

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-FRC-01-03</b>	<b>Development and validation of an optimised gearbox housing structural design and manufacturing process, based on additive layer manufacturing concept leading to a flight cleared demonstrator.</b>	WP 1.1 and 1.3	5	1,75	IA	Design of a novel TiltRotor Drive System housing, by means of additive manufacturing process, definition of the optimised manufacturing process and construction of an appropriate number of specimens and parts to support flight clearance on the TiltRotor Demonstrator. The development of Additive Layer Manufacturing (ALM) materials characterised by suitable mechanical and fatigue properties, as well as the development of optimisation tools for ALM component design and structural substantiation, will be part of the activities.	AW
<b>JTI-CS2-2015-CFP02-FRC-01-04</b>	<b>Design, development and flight qualification of a highspeed/high torque novel freewheeling clutch architecture for tiltrotor main drive system</b>	WP 1.1 and 1.3	3	0,75	IA	The objective is to design, develop, manufacture, test and flight qualify a novel type of freewheeling clutch system for high speed / high torque application to be integrated in the drivetrain of a tiltrotor. The main challenges are due to the need of obtaining extreme reliability and safety in a very compact format. The components will be integrated in the demonstrator drivetrain.	AW

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-FRC-01-05</b>	<b>Design, development and flight qualification of a novel, integrated high efficiency heat exchanger for tiltrotor transmission oil cooling</b>	WP 1.1 and 1.3	3	0,35	IA	The objective is to design, develop, manufacture, test and flight qualify a novel type of oil heat exchanger for integration in the drivetrain of a tiltrotor. The main challenges are due to the need of obtaining extreme reliability and safety in a very compact format.	AW
<b>JTI-CS2-2015-CFP02-FRC-01-06</b>	<b>Design, development, testing and qualification of a high-reliability integrated fuel gauging and distribution system providing active CG management in a civil tiltrotor</b>	WP 1.1 and 1.5	4	0,75	IA	The objective is to design, develop, manufacture, test and flight qualify a complete high reliability fuel gauging and transfer system capable of supplying fuel to the engines and additionally to provide active management of the aircraft center of gravity during all phases of flight to increase efficiency and optimize performance of the tiltrotor.	AW



Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-FRC-02-09</b>	<b>Light weight, impact resistant, canopy for fast compound rotorcraft</b>	WP2.2	2	1	IA	The primary structure to be designed and produced constitutes the fuselage front section from radar-transparent nose and cockpit section to junction with the central fuselage. It does not include the doors but include the transparent panel. This structure will be integrated in the LifeRCraft rotorcraft flight demonstrator. Main challenges are to demonstrate light weight and bird strike resistance compatible with airworthiness (TRL6).	AH Group
<b>JTI-CS2-2015-CFP02-FRC-02-10</b>	<b>Multipurpose test rig for transmission gear boxes</b>	WP2.6	4	0,8	IA	To adapt an existing rig, to enable simultaneous mechanical testing of main and side gear box modules as needed for Permit to Fly of the LifeRCraft demonstrator. This rig must accomodate the non-conventional mechanical architecture of this demonstrator and save energy, requiring low power input (back-to-back architecture).	AH Group
<b>JTI-CS2-2015-CFP02-FRC-02-11</b>	<b>Design and realization of equipped engine compartments for a fast compound rotorcraft</b>	WP2.7	3,5	1,25	IA	The scope of this WP includes firewalls, cowlings, engine air inlet systems, engine bay ventilation and halon-free fire extinguishing system	AH Group

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
JTI-CS2-2015-CFP02-FRC-02-12	Fuel bladder tanks for a fast compound rotorcraft	WP2.7	2,5	0,8	IA	The partner will develop the fuel system including specific full tanks and will define and conduct all system tests required to validate flightworthiness. The delivered system will be integrated in the LifeRCraft rotorcraft flight demonstrator (TRL6).	AH Group
JTI-CS2-2015-CFP02-FRC-02-13	HVDC Generator	WP2.8	4,5	1,2	IA	To design, develop, manufacture, test and qualify up to TRL6 a High Voltage Direct Current (HVDC) controlled Generator (HVGEN) intended to be installed on Heavy Class Rotorcraft (compound or conventional helicopter) for a Flight Demonstration.	AH Group
JTI-CS2-2015-CFP02-FRC-02-14	Bird strike- and erosion resistant and fast maintainable windshields	WP2.2	4	0,6	IA	A complete set of windshields for the Fast Rotorcraft has to be developed, manufactured and tested. This encompasses both sides of the front area as far as the upper pilot- and the lower- windshields. The requirements for a High Speed Helicopter (min. impact on drag & max. operational performance) and the requirements for bird strike resistance according to EASA CS29 have to be fulfilled.	AH Group
JTI-CS2-2015-CFP02-FRC				10,75			

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-AIR-01-08</b>	<b>CROR Engine debris Middle level Impact and mechanical test</b>	WP A-1.2.2	3	0,4	IA	These work package deals with the development and maturation of innovative shielding able to sustain high and low energy debris associated to the engine failure. The objective of the work is to perform impact and mechanical test on structural and non-structural shielding for aircraft, to sustain high and low energy debris impact.	Airbus
<b>JTI-CS2-2015-CFP02-AIR-01-09</b>	<b>Experimental characterization of turbulent pressure fluctuations on realistic Contra-Rotating Open Rotor (CROR) 2D airfoil in representative high subsonic Mach number.</b>	WP A-1.2.2	1	0,4	IA	The prediction of Open Rotor broadband noise requires boundary layer turbulence statistics that are not available today in the literature at the high subsonic relative Mach number encountered by the blades. High fidelity wind tunnel tests shall be performed to fill this lack.	Airbus

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-AIR-01-10</b>	<b>Erosion-resistant functional coatings</b>	WP A-2.2	3	0,2	RIA	The objective of this work is to define, demonstrate and apply hard erosion-resistant functional coatings on carbon fiber/epoxy test panels representing a multifunctional Natural Laminar Flow (NLF) wing skin. The applicant is responsible for testing of coating-to-panel adhesion and other basic characterization according to a test plan to be provided by the Topic Manager.	SAAB
<b>JTI-CS2-2015-CFP02-AIR-01-11</b>	<b>High accuracy and low intrusiveness in-flight wing shape and temperature measurements</b>	WP A-2.2	2	0,55	RIA	Detailed and high accuracy (approximately 20 µm) measurement of aerodynamic surface shapes is a key enabler for the future of laminar flow aerodynamics. The objective of this topic is to develop an integrated and unobtrusive measurement system providing local and global wing structural deformation and temperature data with high environmental constraints.	Airbus

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-AIR-01-12</b>	<b>Tool-Part-Interaction simulation process linked to laminate quality</b>	WP A-3.1	3	0,35	RIA	Highly integrated composite structures require complex tooling with increasing physical and geometrical complexity. Factors affecting laminate quality include thermal expansion, pressure distribution, frictional effects, and their influence on the consolidation of the part. The objective of this topic is to develop a FE based model, currently not available on the market that will make it possible to simulate the complex consolidation process during the cure phase and link the result to laminate quality.	SAAB
<b>JTI-CS2-2015-CFP02-AIR-01-13</b>	<b>Complex (composite) part Ultrasonic inspection facilitated by man-robot collaboration</b>	WP A-3.1	3	0,35	RIA	The objective of the work is to develop the next generation NDI robot cell for scanning complex integrated composite parts. The cell is preferably equipped with off the shelf robot solutions and state of the art ultrasonic end effectors. Moreover the robot cell shall allow close interaction with an operator without jeopardizing safety aspects.	SAAB

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-AIR-01-14</b>	<b>Technology evaluation of immersive technologies for in-flight applications</b>	WP A-5.1.2	2	0,35	IA	The activities shall evaluate the use of immersive technologies (Virtual Reality and Augmented Reality) for passengers and cabin crew during flight operation. Key areas are the impacts on the well-being of passengers and crew as well as evaluating potential technology solutions and applications for ancillary revenue generation and operational efficiency.	Airbus
<b>JTI-CS2-2015-CFP02-AIR-02-08</b>	<b>Ice protection system based on two-phase heat transport technologies integrated in representative engine intake structure</b>	WP B-2.1	3,7	0,5	IA	The Call for Proposal deals with developing an ice protection system based on two-phase heat transport technologies. The objective is to increase aircraft efficiency by integrating the system within the structure (i.e. representative engine intake structure) and by replacing the traditional ice-protection that require energy from the A/C powerplant with passive devices.	Airbus D&S

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-AIR-02-09</b>	<b>HVDC Electrical Power Conversion and Distribution System Development</b>	WP B-3.2	3,8	1	IA	A new electrical power conversion and distribution system more efficient and reliable is needed as the dependence on electric power increases and the necessity to supply systems more critical to the safe operation of the aircraft using HVDC voltages, as, in this case, the Flight Control System actuators.	Airbus D&S
<b>JTI-CS2-2015-CFP02-AIR-02-10</b>	<b>Integrated airborne antenna for satellite communications in wing – fuselage airframe fairing</b>	WP B-3.2	4,2	1,1	IA	This topic describes the design, prototyping, manufacturing and testing “on ground” and “in-flight” of an airborne antenna highly integrated into the wing – fuselage airframe fairing. Main deliverables of this topic are the Regional FTB#2 wing – fuselage fairings where the antenna is integrated and operative.	Airbus D&S
<b>JTI-CS2-2015-CFP02-AIR-02-11</b>	<b>Ice protection technology based on electromagnetic induction integrated in representative leading edge structure</b>	WP B-3.2	3	0,25	RIA	The topic scope is to develop, manufacture and test an ice protection system embedded in a composite structure based on electromagnetic induction technology. Modularity, minimum energy loss, minimum weight and adaptability to concave surfaces representative of wing leading edge are the design drivers of the topic.	Airbus D&S

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-AIR-02-12</b>	<b>System development for optical fiber sensing technology measurements for industrial aeronautical contexts: composite manufacturing plants, structural test platforms and airborne conditions</b>	WP B-3.3.2	2,5	0,35	IA	The project will be focussed on the development of equipment based on distributed optical fibre sensors technology to measure and evaluate the quality and structural health of the composite parts along their different life phases. The system will integrate different acquisition modules and their corresponding interface software adapted to the needs and functionalities of each industrial context.	Airbus



Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
JTI-CS2-2015-CFP02-AIR-02-13	Prototype Manufacturing Tooling for Single Parts Manufacturing of the Rotorless tail for LifeRCraft.	WP B-4.1	2,8 (34 months)	0,75	IA	<p>The aim of this Call for Partner is to develop, design, manufacture and deliver to the CoP of the CfCP AIR-02-02, the prototype manufacturing toolings for all single parts of the LifeRCraft Rotorless Tail that belong to the WP_B4.1 “Rotorless Tail for LifeRCraft”. The development of this tooling should be innovative in order to implement the best performances in the following fields:</p> <ul style="list-style-type: none"> <li>• Low Cost Materials</li> <li>• Eco-design</li> <li>• Energy savings</li> <li>• Manufacturing processes simplification-Production time savings.</li> </ul> <p>Always ensuring that each one of the single parts manufactured with the prototype tooling fit with the Aeronautical quality standards.</p>	AH Group

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-AIR-02-14</b>	<b>Prototype Tooling for Sub-Assembly, Final Assembly and Transport of the Rotorless tail for the Compound RC.</b>	WP B-4.1	2,7 (32 months)	0,35	IA	<p>The aim of this Call for Partner is to develop, design, manufacture and deliver to the Leader and/or the CoP of the CfCP AIR-02-02, all the prototype Assembly, Sub-Assembly and Transportation tooling needed to pre-assemble, assemble and transport the Compound RC Rotorless Tail.</p> <p>The development of this tooling should be innovative in order to implement the best performances in the following fields:</p> <ul style="list-style-type: none"> <li>• Low Cost/ Natural Materials</li> <li>• Eco-design</li> <li>• Energy savings</li> <li>• Assembly processes simplification- Assembly time savings.</li> <li>• Simplify Transportation processes.</li> </ul>	AH Group
<b>JTI-CS2-2015-CFP02-AIR-02-15</b>	<b>Design Against Distortion: Part distortion prediction, design for minimized distortion, carbon-epoxy aerospace parts</b>	WP B-4.3	2,5	0,35	RIA	<p>Develop rapid distortion prediction methods for curing of carbon-epoxy. Develop methods &amp; tools for shape- and layup optimisation accounting for distortion.</p>	Airbus

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-AIR-02-16</b>	<b>Process development for composite frames manufacturing with high production rate and low cost</b>	WP B-4.3	2	0,4	IA	The Topic shall contribute to the development and validation of an advanced process for manufacturing regional aircraft composite material fuselage frames, which will result in a significant reduction in overall production costs, component weight and manufacturing flow. The process shall be validated and costs assessed through the application of the building block approach from level 1 (coupons) to level 3 (sub-components) and to the realization of demonstrators.	Alenia
<b>JTI-CS2-2015-CFP02-AIR</b>				<b>7,65</b>			
<b>JTI-CS2-2015-CFP02-ENG-01-02</b>	<b>Conventional and Smart Bearings for Ground Test Demo</b>	WP2	5,5	2	IA	Supply all bearings of UHPE Ground Test Demo including current definition products and specific products that will be necessary due to the characteristics of UHPE Ground Test Demo. Innovative design is required in order to meet demo specification and to provide significant weight savings and room benefit versus existing standards.	SAFRAN Snecma

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-ENG-01-03</b>	<b>More electric, advanced hydromechanics propeller control components</b>	WP3	3	0,25	IA	The project aims at designing, manufacturing and testing more electric propeller control components, including propeller governor and oil pump, in order to optimize the overall propulsive efficiency.	SAFRAN Turbomec a
<b>JTI-CS2-2015-CFP02-ENG-01-04</b>	<b>Engine Mounting System (EMS) for Ground Test Turboprop Engine Demonstrator</b>	WP3	5	0,4	IA	Design, manufacture, assembly and instrumentation of an Engine Mounting System for Business Aviation / Short Regional TP ground demonstrator. EMS Set for characterization and validation during engine ground tests.	SAFRAN Turbomec a

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
JTI-CS2-2015-CFP02-ENG-02-02	Integration of Laser Beam Melting Simulation in the tool landscape for process preparation of Additive Manufacturing (AM) for Aero Engine applications	WP4	3	0,7	RIA	It is demonstrated that simulation of an additive manufactured engine part concerning residual stresses and distortions is possible. However the usually used models incorporate many simplifications and can therefore not model the complexity of real life parts and the AM-process. Results indicate that simulation of a number of equal or geometrically complex or big parts with supporting structures on the building platform may need several 100 hours of simulation time which is not applicable in terms of process optimization. The aim of this project is therefore to increase the fidelity of the predictions and decrease the calculation time dramatically by novel methods. Use of open software will ease user based extension/modification.	MTU

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
JTI-CS2-2015-CFP02-ENG-02-03	Integration of a property simulation tool for integrated virtual design & manufacturing of forged discs/rotors for aero engine applications	WP4	3	0,45	RIA	Simulation of microstructural and mechanical properties for forged DA718 parts - considering billet, final part forming and heat treatment process route has been demonstrated. To increase prediction fidelity the next step is to include the aspect of grain structure originated in the beginning of the overall manufacturing process and its modification during the process route for DA718 in the model. Additionally impact of grain structure, i.e. degree of recrystallization, on mechanical properties including yield strength variations in circumferential direction shall be evaluated. Further development of the modelling backed-up with experimental validation work is required, covering the complete manufacturing process for forgings.	MTU

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-ENG-03-01</b>	<b>Industry focused eco-design</b>	WP5	4	2,5	RIA	Develop an industry focused assessment tool to evaluate the environmental and sustainability impact of a product during its design. The tool will help aerospace efficiently manage the transition from low confidence early design data to more detailed assessments as part of existing design workflows.	Rolls-Royce
<b>JTI-CS2-2015-CFP02-ENG-03-02</b>	<b>Jet Noise Reduction Using Predictive Methods</b>	WP5	3	0,4	RIA	Reducing expensive experimental testing by using computational methods and achieving methods for low noise design, in order to remain in advance of ever tighter emissions targets. This will involve developing reliable Detached Eddy Simulation plus Ffowcs-Williams and Hawkings (DES/FWH) methods aiming to enhance jet noise predictions and consequently improving confidence in numerical methods and best practices. The research will be applied to 3D nozzle designs optimized for specific styles of integration, e.g. various under-wing configurations targeted to lower jet-flap interaction noise emissions.	Rolls-Royce

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-ENG-03-03</b>	<b>Catalytic control of fuel properties for large VHBR engines</b>	WP6	3	0,35	RIA	The current proposal is aimed at understanding & developing key technologies for increasing the heat sink potential of fuel (de-oxygenation, use of fuel additives, and fuel filtration via catalysts, sorbents and membranes). These key technologies are critical to the successful realisation of oil lubrication and heat management systems for future large geared engines in WP6 of Engine ITD.	Rolls-Royce
<b>JTI-CS2-2015-CFP02-ENG-03-04</b>	<b>Development of coupled short intake / low speed fan methods and experimental validation</b>	WP6	2	2,8	IA	<p>The current proposal is aimed at understanding &amp; developing key technology items critical to the successful realisation of methods to predict &amp; design coupled short intakes and low speed fans so that they can be suitably optimised &amp; competitive for future large geared gas turbine engines.</p> <p>This proposal will evolve the TRL of these key technology items for the large engine market VHBR engine demonstrator in WP6 of Engine ITD.</p>	Rolls-Royce



Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP01-ENG-04-05</b>	<b>Powerplant Shaft Dynamic and associated damping system</b>	WP7.1.3	1,5	0,35	IA	Design and test of a propeller dedicated for direct drive jet-fuel reciprocating engine. The propeller stress and the powerplant dynamic behaviour will be analysed and may additionally lead to include damping devices.	SAFRAN SMA
<b>JTI-CS2-2015-CFP02-ENG</b>				<b>10,2</b>			
<b>JTI-CS2-2015-CFP02-SYS-01-01</b>	<b>Very high brightness &amp; compact full color display for next generation eyes-out cockpit products.</b>	WP1.2.2	3,5	3,8	RIA	The objectives of the project are to study, design and develop a full-color-very high luminance display system based on ~1” micro LED arrays on sapphire hybridized on an active matrix backplane. The final application of the component would be for the next generation of Avionics Head Up Displays applications	Thales

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-SYS-02-09</b>	<b>ALGeSMo (Advanced Landing Gear Sensing &amp; Monitoring )</b>	WP4.4 (to be created)	3	2,4	IA	Advanced Landing Gear Sensing & Monitoring – ALGeSMo – is a system that will measure load at the landing gear to provide loads data for use on the aircraft systems for integration with aircraft health monitoring, hard landing detection, flight management and flight controls. The work will consist in developing and flight testing LG loads measurement technology in view of further functional integration in large aircraft avionics systems.	Airbus
<b>JTI-CS2-2015-CFP02-SYS-02-10</b>	<b>Analysis of centrifugal compressor instabilities occurring with vaneless diffuser, at low mass flow momentum</b>	WP6	3	0,9	IA	The performance of compressors at low mass-flows is characterized by the occurrence of unsteady flow phenomena surge and rotating stall. These instabilities can cause noise nuisance and critical operating conditions with strong dynamical loading on the blades. Such phenomena must be detailed with the aim of applying a flow control strategy to enlarge the operating range and / or improve the stage performances.	Liebherr

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
JTI-CS2-2015-CFP02-SYS-02-11	Innovative design of acoustic treatment for air conditioning system	WP6	3	0,6	IA	The objective of this study is to design a new acoustic treatment for air conditioning system, specifically jet pump noise source. The innovative design should have a large absorption band of frequencies (100 Hz - 5000 Hz) with a small thickness and mass. The absorption would be optimized with a special study of the noise source and a development of a specific modal detection (or antenna) adapted to Liebherr jetpump source will be set up	Liebherr
JTI-CS2-2015-CFP02-SYS-02-12	Eco Design : Optimization of SAA chromium free sealing process	WP6	2	0,25	IA	The objective of the project is to optimize chromium free sealing process for SAA aminating at protecting from corrosion different kinds of aluminium alloys: AA2618, AU5NKZr, AS7G0.6.	Liebherr

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
<b>JTI-CS2-2015-CFP02-SYS-02-13</b>	<b>Analysis, validation and data collection of design and operating parameters for advanced cabin ventilation concepts related to future aircraft energy management systems</b>	WP6	4	2	IA	The intelligent management of electric and thermal power at aircraft level has a great impact on the cabin aero- and thermodynamics. The resulting needs to exploit the aircraft cabin heat capacity especially with respect to future ventilation systems and the passenger perception are obvious. Due to the complex, emergent boundary conditions experimental validations in cabin Mock-Ups, demonstrators as well as flight tests are necessary	Airbus
<b>JTI-CS2-2015-CFP02-SYS-03-01</b>	<b>Electromechanical actuator for primary moveable surfaces of small aircraft with health monitoring</b>	WP7.1	2,5	1	IA	To test an available EMA up to failure. Based on the evaluation of failure conditions to identify technologies that improve EMA reliability in respect of any failure leading to an uncontrolled EMA position. Health monitoring and any other technology which do not require additional sensors and/or electromechanical devices are preferred. The initial tests have to be repeated on the improved EMA to demonstrate compliance with reliability requirements.	Piaggio

Identification Code	Title	WP Ref. (JTP V5)	Duration (in Years)	Value (Funding in M€)	Type of Action	3-line short Summary	Topic Leader
JTI-CS2-2015-CFP02-SYS-03-02	Passive thermo-acoustic insulation for small aircraft.	WP7.5.1 WP7.5.3	3	0,4	IA	Preparation of small testing specimens of basic insulation materials (passive system of insulation) and their testing in lab, development of the composites for optimal insulation, preparation of small testing specimens of this composite, testing this composites in lab, development and production of reference demonstrator (without optimization), development and production of demonstrator (optimized according to new results)	Evektor
JTI-CS2-2015-CFP02-SYS-03-03	Database of dynamic material properties for selected materials commonly used in aircraft industry.	WP7.5.2.	1,1	0,3	IA	The aim of this CfP is to develop a test methodology (Including design & manufacturing of specimens), and to perform testing of the material specimens in order to create a database of selected materials with sufficient amount of material properties which are to be used in computer simulation of crash behavior.	Evektor
JTI-CS2-2015-CFP02-SYS				11,65			
<b>TOTAL</b>				<b>57,95</b>			

## **23. GENERAL ANNEXES OF THE WORK PLAN**

### **A. List of countries, and applicable rules for funding**

#### **I. Calls for Core Partners**

Legal entities established in the following countries and territories will be eligible to participate and receive funding as Core Partners of Clean Sky 2 JU selected through calls for Core Partners:

- The Member States of the European Union, including their overseas departments;
- The Overseas Countries and Territories (OCT) linked to the Member States<sup>17</sup>:
  - Anguilla, Aruba, Bermuda, Bonaire, British Virgin Islands, Cayman Islands, Curaçao, Falkland Islands, French Polynesia, Greenland, Montserrat, New Caledonia, Pitcairn Islands, Saba, Saint Barthélemy, Saint Helena, Saint Pierre and Miquelon, Sint Eustatius, Sint Maarten, Turks and Caicos Islands, Wallis and Futuna.
- The Countries Associated to Horizon 2020<sup>18</sup>: the latest information on which countries are associated, or in the process of association to Horizon 2020 can be found in the online manual<sup>19</sup>.

International European interest organisations<sup>20</sup> will also be eligible to receive funding from Horizon 2020.

#### **II. Calls for Proposals (for Partners)**

Legal entities established in the following countries and territories will be eligible to participate and receive funding through Clean Sky 2 JU calls for proposals:

- The Member States of the European Union, including their overseas departments;
- The Overseas Countries and Territories (OCT) linked to the Member States<sup>21</sup>:

---

<sup>17</sup> Entities from Overseas Countries and Territories (OCT) are eligible for funding under the same conditions as entities from the Member States to which the OCT in question is linked

<sup>18</sup> Signed an agreement with the Union as identified in Article 7 of the Horizon 2020 Regulation

<sup>19</sup> [http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/international-cooperation\\_en.htm](http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/international-cooperation_en.htm)

<sup>20</sup> These are international organisations, the majority of whose members are Member States or associated countries, and whose principal objective is to promote scientific and technological cooperation in Europe.

<sup>21</sup> Entities from Overseas Countries and Territories (OCT) are eligible for funding under the same conditions as entities from the Member States to which the OCT in question is linked

- Anguilla, Aruba, Bermuda, Bonaire, British Virgin Islands, Cayman Islands, Curaçao, Falkland Islands, French Polynesia, Greenland, Montserrat, New Caledonia, Pitcairn Islands, Saba, Saint Barthélemy, Saint Helena, Saint Pierre and Miquelon, Sint Eustatius, Sint Maarten, Turks and Caicos Islands, Wallis and Futuna..

The Countries Associated to Horizon 2020<sup>22</sup>: the latest information on which countries are associated, or in the process of association to Horizon 2020 can be found in the online manual<sup>23</sup>.

- Any application from the following third countries, except where this is explicitly excluded in the call text, will be assessed based on H2020 rules for participation

Afghanistan, Albania, Algeria, American Samoa, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, Colombia, Comoros, Congo (Democratic Republic), Congo (Republic), Costa Rica, Côte d'Ivoire, Cuba, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Korea (Democratic Republic), Kosovo\*, Kyrgyz Republic, Lao, Lebanon, Lesotho, Liberia, Libya, former Yugoslav Republic of Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Micronesia, Moldova, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Palau, Palestine, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Rwanda, Samoa, Sao Tome and Principe, Senegal, Serbia, Seychelles, Sierra Leone, Solomon Islands, Somalia, South Africa, South Sudan, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Swaziland, Syrian Arab Republic, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Tunisia, Turkey, Turkmenistan, Tuvalu, Uganda, Ukraine, Uzbekistan, Vanuatu, Uruguay, Venezuela, Vietnam, , Yemen, Zambia, Zimbabwe.

(\* This designation is without prejudice to positions on status and is in line with UNSCR 1244/99 and the ICJ Opinion on the Kosovo declaration of independence).

<sup>22</sup> Signed an agreement with the Union as identified in Article 7 of the Horizon 2020 Regulation

<sup>23</sup> [http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/international-cooperation\\_en.htm](http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/international-cooperation_en.htm)

## **B. Admissibility conditions and related requirements**

### **I. Calls for Core Partners**

1. To be considered admissible, an application for Core Partner must be:

- a) Submitted in the electronic submission system before the deadline given in the call conditions;
- b) Readable, accessible and printable.

2. Incomplete applications for Core Partner may be considered inadmissible. This includes the requested administrative data, the application description, and any supporting documents specified in the call.

3. Operational capacity – requested inputs

The following will be required to determine the operational capacity of an applicant for Core Partner, unless otherwise specified:

- curriculum vitae or description of the profile of the persons who will be primarily responsible for carrying out the proposed research and/or innovation activities;
- the applicant<sup>24</sup> reports of research and development activities, products, services executed in the same relevant area;
- a lists of previous projects and activities performed and connected to the topic and Programme area;
- a description and evidences of the key capabilities of the entity, significant infrastructures, technical equipment, design and test tools, facilities, design offices patents and other IP rights at the disposal of the applicant;
- Other inputs to assess the operational capacity as requested in the topic description in the Call;
- A description of any third parties (including affiliates<sup>25</sup>) and their contribution to the action that are not represented as applicants, but who will nonetheless be contributing towards the work (e.g. providing facilities, computing resources).

4. Applications for Core Partners shall include a draft plan for the exploitation and dissemination of the results. The section on exploitation shall be showing and committing on a clear exploitation path of the results brought by their participation in the Programme showing the contribution to European competitiveness of the sector. The JU will check this aspect at evaluation stage and reserves the right to check this aspect also during the implementation stage.

5. Page limits will apply to applications for Core Partners. The limits will be clearly set out in the electronic submission system. If a submitted application exceeds the limits, the applicant will receive an automatic warning, and will be advised to re-submit a version that conforms.

---

<sup>24</sup> In the case of legal entities forming one applicant (clusters) the above requirements apply to the Cluster as such and to those entities composing the cluster.

<sup>25</sup> See the definition under Article 2 of H2020 Rules for Participation



After the relevant call deadline, excess pages in any over-long application will be automatically overprinted with a “watermark”. Expert evaluators will be instructed to disregard these excess pages.

6. In the light of the specific structure of the Programme and the governance framework of the JU, the specific legal status and statutory entitlements of the “Members” of the JU and in order to prevent any conflict of interest and to ensure a competitive, transparent and fair process, the following specific admissibility rules shall apply to the calls:

- **The 16 Leaders of JU listed in Annex II to Regulation n° (EU) No 558/2014 and their affiliates<sup>26</sup>** may apply to Calls for Core Partners and Calls for Proposals only in another IADP/ITD where they are not involved as Members. In case of selection of Leaders and their affiliates as Core Partners or Partners in the Programme, their participation will be accounted by the JU within the **40% budget share of the programme allocated to the Leaders** thereto Article 16.1 a) of the Statutes, therefore without any impact on the 30% budget share allocated to the Core Partners thereto Article 16.1 b) of the Statutes.
- **The Core Partners and their affiliates** may apply in subsequent waves of Calls for Core Partners in all IADP/ITD. They may apply to Calls for Proposals only in another IADP/ITD where they are not involved as Members.
- **The Partners** selected by Call for Proposal may apply to Calls for Core Partners and Calls for Proposal in all IADP/ITD.

All applicants will be requested in the application submission forms to:

- officially state whether they are an affiliate<sup>27</sup> to a Member of the JU;
- to issue a declaration of absence of conflicts of interest<sup>28</sup> that will determine its admissibility.

The above criteria and the declarations will be checked by the JU which will determine the admissibility of the applicants for Core Partners. The CSJU reserves its right to request any supporting document and additional information at any stage of the process.

---

<sup>26</sup> See the definition under Article 2.1 of H2020 Rules for Participation

<sup>27</sup> Applicants shall check the definition based on Article 2.1 of H2020 Rules for Participation

<sup>28</sup> As part of the declaration, the legally authorized representative of the applicants entities will be requested to declare whether the representative(s) of the entity participate to the IADP/ITD steering committees and whether they representative(s) of the entity was involved in the preparation, definition and approval of the topics of the calls.

### ***Special condition for participation applicable to Core Partners***

7. Pursuant to Article 4 of the Statutes, Annex I of Regulation n. 558/2014, a legal entity may apply to become a Core Partner provided that that it contributes to the funding referred to in Article 15 of the Annex I of the Regulation to achieve the objectives of the CSJU set out in Article 2 of the Regulation and it accepts the Statutes of the CSJU.

Based on the above, applicants to the Calls for Core Partners shall declare, at the application stage, a commitment to endorse the Statutes and its provisions. The formalization of the acceptance of the Statutes by formal endorsement letter will be made upon selection of the applicants as part of the negotiation stage.

## **II. Calls for Proposals (for Partners)**

1. To be considered admissible, an application must be:

- a) Submitted in the electronic submission system before the deadline given in the call conditions;
- b) Readable, accessible and printable.

2. Incomplete applications may be considered inadmissible. This includes the requested administrative data, the application description, and any supporting documents specified in the call.

3. Operational capacity – requested inputs

The following will be required to determine the operational capacity of the applicant(s), unless otherwise specified:

- curriculum vitae or description of the profile of the persons who will be primarily responsible for carrying out the proposed research and/or innovation activities;
- the applicant<sup>29</sup> reports of research and development activities, products, services executed in the same relevant area;
- a lists of previous projects and activities performed and connected to the topic and Programme area;
- a description of the capabilities of the entity, significant infrastructures, technical equipment, design and test tools, facilities, design offices patents and other IP rights at the disposal of the applicant;
- Other inputs to assess the operational capacity as requested in the topic description in the Call.

---

<sup>29</sup> In the case of legal entities forming one applicant (clusters) the above requirements apply to the Cluster as such and to those entities composing the cluster.

- A description of any third parties (including affiliates<sup>30</sup>) and their contribution to the action that are not represented as applicants, but who will nonetheless be contributing towards the work (e.g. providing facilities, computing resources)
1. The Proposals must include a draft plan for the exploitation and dissemination of the results, unless otherwise specified in the call conditions. The section on exploitation shall be showing and committing on a clear exploitation path of the results brought by their participation in the Programme showing the contribution to European competitiveness of the sector. The JU will check this aspect at evaluation stage and reserves the right to check this aspect also during the implementation stage and the reporting on exploitation.
  2. Page limits will apply to proposals. The limits will be clearly set out in the electronic submission system. If a submitted proposal exceeds the limits, the applicant will receive an automatic warning, and will be advised to re-submit a version that conforms. After the relevant call deadline, excess pages in any over-long proposals will be automatically overprinted with a “watermark”. Expert evaluators will be instructed to disregard these excess pages.
  3. In the light of the specific structure of the Programme and the governance framework of the JU, the specific legal status and statutory entitlements of the “Members” of the JU and in order to prevent any conflict of interest and to ensure a competitive, transparent and fair process, the following "additional conditions" within the meaning of Art 9(5) of the Horizon 2020 RfP shall apply to the calls for proposals in the form of admissibility conditions:
    - **The 16 Leaders of JU listed in Annex II to Regulation n° (EU) No 558/2014 and their affiliates<sup>31</sup>** may apply to Calls for Core Partners and Calls for Proposals only in another IADP/ITD where they are not involved as Members. In case of selection of Leaders and their affiliates as Core Partners or Partners in the Programme, their participation will be accounted by the JU within the **40% budget share of the programme allocated to the Leaders** thereto Article 16.1 a) of the Statutes, therefore without any impact on the 30% budget share allocated to the Core Partners thereto Article 16.1 b) of the Statutes.
    - **The Core Partners and their affiliates** may apply in subsequent waves of Calls for Core Partners in all IADP/ITD. They may apply to Calls for Proposals only in another IADP/ITD where they are not involved as Members.
    - **The Partners** selected by Call for Proposal may apply to Calls for Core Partners and Calls for Proposal in all IADP/ITD.

---

<sup>30</sup> See the definition under Article 2 of H2020 Rules for Participation

<sup>31</sup> See the definition under Article 2.1 of H2020 Rules for Participation

All applicants will be requested in the application submission forms to:

- officially state whether they are an affiliate<sup>32</sup> to a Member of the JU;
- to issue a declaration of absence of conflicts of interest<sup>33</sup> that will determine its admissibility.

The above criteria and the declarations will be checked by the JU which will determine the admissibility of the applicants. The CSJU reserves its right to request any supporting document and additional information at any stage of the process.

---

<sup>32</sup> Applicants shall check the definition based on Article 2.1 of H2020 Rules for Participation

<sup>33</sup> As part of the declaration, the legally authorized representative of the applicants entities will be requested to declare whether the representative(s) of the entity participate to the IADP/ITD steering committees and whether they representative(s) of the entity was involved in the preparation, definition and approval of the topics of the calls or had any privileged access information related to that.

## C. Eligibility criteria

### I. Calls for Core Partners

An application as Core Partner will only be considered eligible if:

- 1) its content corresponds, wholly or in part, to the topic description against which it is submitted, in the relevant work plan part;
- 2) submitted by a legal entity established in a Member State or H2020 associated country;
- 3) submitted by a Consortium<sup>34</sup> of legal entities established in a Member State or H2020 associated country jointly applying to become individual Members.
- 4) submitted by a Cluster as single legal entity established in a Member State or H2020 associated country.<sup>35</sup>

### II. Calls for Proposals (for Partners)

An application as Partner will only be considered eligible if:

- 1) its content corresponds, wholly or in part, to the topic description against which it is submitted, in the relevant work plan part;
- 2) it complies with the eligibility conditions set out below, depending on the type of action.

	Eligibility conditions <sup>36,37</sup>
<b>Research &amp; innovation action</b>	At least <u>one legal entity</u> established in a Member State or associated country
<b>Innovation action</b>	At least one legal entity established in a Member State or associated country

<sup>34</sup> When a group of legal entities apply jointly as Consortium, its members are all requested singularly to become a Member of CSJU and sign the Grant agreement for Members. In this case, all entities become beneficiary in the sense of the Grant agreement for Members and are bound directly by its provisions.

<sup>35</sup> See section Joint applications by legal entities in the Rules for submission, evaluation, selection, award and review procedures of Calls for Core Partners.

<sup>36</sup> The eligibility criteria formulated in Commission notice Nr. 2013/C 205/05 ([OJEU C 205 of 19.07.2013, pp.9 11](#)) shall apply for all actions under this Work Plan, including with respect to third parties receiving financial support in the cases where the respective action involves financial support to third parties by grant beneficiaries in accordance with Article 137 of the EU's Financial Regulation, notably Programme Co-Fund actions.

<sup>37</sup> Some entities from third countries are covered by the Council sanctions in place and are not eligible to participate in Union programmes. Please see: the consolidated list of persons, groups and entities subject to EU financial sanctions, available at [http://eeas.europa.eu/cfsp/sanctions/consol-list\\_en.htm](http://eeas.europa.eu/cfsp/sanctions/consol-list_en.htm).

<sup>38</sup> Eligible costs for all types of action are in accordance with the Financial Regulation and the Rules for Participation. In addition, as training researchers on gender issues serves the policy objectives of Horizon 2020 and is necessary for the implementation of R&I actions, applicants may include in their proposal such activity and the following corresponding estimated costs that may be eligible for EU funding:

## **D. Types of action: specific provisions and funding rates<sup>38,39</sup>**

### **Research and innovation actions<sup>40</sup>**

*Description:* Action primarily consisting of activities aiming to establish new knowledge and/or to explore the feasibility of a new or improved technology, product, process, service or solution. For this purpose they may include basic and applied research, technology development and integration, testing and validation on a small-scale prototype in a laboratory or simulated environment.

Projects may contain closely connected but limited demonstration or pilot activities aiming to show technical feasibility in a near to operational environment.

The activities performed will not exceed TRL 6.

*Funding rate:* 100%

### **Innovation actions**

*Description:* Action primarily consisting of activities directly aiming at producing plans and arrangements or designs for new, altered or improved products, processes or services. For this purpose they may include prototyping, testing, demonstrating, piloting, large-scale product validation and market replication.

The activities performed will not exceed TRL 6.

*Funding rate:* 70% (except for non-profit legal entities, where a rate of 100% applies)

### **Coordination and support actions**

*Description:* Actions consisting primarily of accompanying measures such as standardisation, dissemination, awareness-raising and communication, networking, coordination or support services, policy dialogues and mutual learning exercises and studies, including design studies for new infrastructure and may also include complementary activities of strategic planning, networking and coordination between programmes in different countries.

*Funding rate:* 100%

---

<sup>38</sup> Eligible costs for all types of action are in accordance with the Financial Regulation and the Rules for Participation. In addition, as training researchers on gender issues serves the policy objectives of Horizon 2020 and is necessary for the implementation of R&I actions, applicants may include in their proposal such activity and the following corresponding estimated costs that may be eligible for EU funding:

- i. Costs of delivering the training (personnel costs if the trainers are employees of the beneficiary or subcontracting if the training is outsourced);
- ii. Accessory direct costs such as travel and subsistence costs, if the training is delivered outside the beneficiary's premises;
- iii. Remuneration costs for the researchers attending the training, in proportion to the actual hours spent on the training (as personnel costs).

<sup>39</sup> Participants may ask for a lower rate.

## **E. Technology readiness levels (TRL)**

Where a topic description refers to a TRL, the following definitions apply, unless otherwise specified:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

## F. Evaluation

### I. Calls for Core Partners

#### Selection Criteria

a) *Financial capacity*: In line with the Financial Regulation, at the proposal stage, applicants for Core Partners will be invited to complete a self-assessment using an on-line tool. The CSJU may perform a risk assessment based on the financial information provided by the applicant. This will apply also to the entities composing a grouping in case of applications submitted by groupings jointly applying as a one entity<sup>41</sup>.

b) *Operational capacity*: As a distinct operation, experts will indicate whether the participants meet the selection criterion related to operational capacity (as described in section B 3 above), to carry out the proposed work, based on the capabilities, competence and experience of the individual participant(s).

#### Award criteria

Experts will evaluate the applications on the basis of the criteria ‘excellence’, ‘impact’ and ‘quality and efficiency of the implementation’. The aspects to be considered are set out in the table below, unless stated otherwise in the call.

Type of action	Excellence	Impact	Quality and efficiency of the implementation
	The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.	The extent to which the outputs of the project should contribute at the European and/or International level to:	The following aspects will be taken into account:
<b>Research and innovation; Innovation;</b>	<ul style="list-style-type: none"> <li>- Relevance and adequacy of the required key capabilities, competences and track record in the relevant topic area and experience with respect to the Topic (e.g. capability to efficiently contribute to a permit-to-fly application) and the overall level of key capabilities required to implement the Programme;</li> <li>- Clarity and pertinence</li> </ul>	<ul style="list-style-type: none"> <li>- Level of technical contribution and key capabilities brought to the IADP/ITD and Programme objectives</li> <li>- The expected impact as described under the relevant topic and the strategic contribution brought to the Programme and the;</li> <li>- Enhancing innovation capacity and integration of new knowledge;</li> <li>- Strengthening the competitiveness and</li> </ul>	<ul style="list-style-type: none"> <li>- Consistency of the proposed activity with the background, skills and competences as described;</li> <li>- Coherence and effectiveness of the application, including appropriateness of the allocation of tasks and resources;</li> <li>- Appropriateness of the management structures and procedures, including risk and innovation management;</li> </ul>

<sup>41</sup> See footnote 44.



Type of action	Excellence	Impact	Quality and efficiency of the implementation
	<p>The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.</p> <p>of the objectives;</p> <ul style="list-style-type: none"> <li>- Credibility of the proposed approach;</li> <li>- Soundness of the concept, including trans-disciplinary considerations, where relevant;</li> <li>- Relevance and adequacy of proposed work and results as compared with the Topic description;</li> <li>- Extent that proposed work is ambitious, has innovation potential, and is beyond the state of the art (e.g. ground-breaking objectives, novel concepts and approaches)</li> <li>- Suitability of the technologies, approaches and solutions proposed, including the complementary activities, where applicable, with respect to the Topic description and the IADP/ITD area and objectives.</li> </ul>	<p>The extent to which the outputs of the project should contribute at the European and/or International level to:</p> <p>growth of companies by developing innovations meeting the needs of European and global markets, and where relevant, by delivering such innovations to the markets;</p> <ul style="list-style-type: none"> <li>- Demonstrating the environmental and socially important impacts as relevant for the CS2 Programme;</li> <li>- Performance of the “core research” activities within Europe and Associated Countries;</li> <li>- Plan on exploitation of results showing the contribution on the European competitiveness in the sector;</li> <li>- Effectiveness of the proposed measures to exploit and disseminate the project results (including management of IPR), to communicate the project, and to manage research data where relevant;</li> <li>- Level of strategic contribution and key capabilities brought to the IADP/ITD and Programme objectives;</li> <li>- Level of new capabilities and skills brought to the Programme compared to the ones already existing within the Membership;</li> <li>- Probability of application/valorization of technology results, including soundness of the exploitation plan and</li> </ul>	<p>The following aspects will be taken into account:</p> <ul style="list-style-type: none"> <li>- Match of technical capabilities and skills with the Topic and Programme objectives;</li> <li>- strategic ability to work in the topic area;</li> <li>- Coordinating capability in the supply chain and ability to work effectively both with a supply base and into an equal or higher tier industrial organization as integrator/leader;</li> <li>- Capability and management skills for Calls for Proposal coordination, when acting as Topic Manager (where applicable);</li> <li>- Clear demonstration of adequate level of financial and operational resources (committed) based on the Topic value indicated in the call and the overall Programme needs;</li> <li>- Best “value for money” on the activities proposed and efficiency of the allocation of resources;</li> <li>- Complementarity of the participants within the consortium or cluster (where applicable);</li> <li>- Capacity of the cluster or consortium or leader to efficiently coordinate activities of the participants (where applicable).</li> </ul>

Type of action	Excellence	Impact	Quality and efficiency of the implementation
	The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.	The extent to which the outputs of the project should contribute at the European and/or International level to:	The following aspects will be taken into account:
		its ability to contribute to the competitiveness of the sector.	
<b>Coordination &amp; support actions</b>	<p>Clarity and pertinence of the objectives;</p> <p>Credibility of the proposed approach;</p> <p>Relevance and adequacy of proposed work and results as compared with the Topic description;</p> <p>Soundness of the concept;</p> <p>Quality of the proposed coordination and/or support measures.</p>	<p>The expected impacts listed in the work programme under the relevant topic</p> <p>Effectiveness of the proposed measures to exploit and disseminate the project results (including management of IPR), to communicate the project, and to manage research data where relevant.</p>	<p>Coherence and effectiveness of the work plan, including appropriateness of the allocation of tasks and resources;</p> <p>Complementarity of the participants within the consortium (when relevant);</p> <p>Appropriateness of the management structures and procedures, including risk and innovation management.</p>

**Note:** Unless otherwise specified in the call conditions:

Evaluation scores will be awarded for the criteria, and not for the different aspects listed in the above table. Each criterion will be scored out of 5. The threshold for individual criteria will be 3. The overall threshold, applying to the sum of the three individual scores, will be 10.

### **Complementary activities**

If an applicant as Core Partner considers that it has different applications or different technologies or innovative solutions to propose in relationship to one topic, the applicant should present them in the same single application as “complementary activities” in the relevant section of the submission forms (description and budget).

If the applicants indicate complementary activities and innovative solutions within the general topic area related to the topic for which they are applying and within the scope of the IADP/ITD, they should demonstrate that these activities would:

- be in line with Clean Sky 2 Programme key goals and objectives;
- represent an enhancement or improvement of the content of an IADP/ITD and lead to a demonstrable additional move beyond the state of the art in the topic’s general area.

Complementary activities will be evaluated by the independent experts in the framework of the topic evaluation process as indicated by the evaluation criteria mentioned above. However, the inclusion of these complementary activities in any subsequent grant will be subject to the CSJU Governing Board approval and CSJU funding availability.

### **Priority order for applications with the same score**

Unless the call conditions indicate otherwise, the following method will be applied.

As part of the evaluation by independent experts, a panel review will recommend one or more ranked lists for the applicants under evaluation, following the scoring systems indicated above. A ranked list will be drawn up for every indicative budget shown in the call conditions.

If necessary, the panel will determine a priority order for applications which have been awarded the same score within a ranked list. Whether or not such a prioritisation is carried out will depend on the available budget or other conditions set out in the call text. The following approach will be applied successively for every group of *ex aequo* proposals requiring prioritisation, starting with the highest scored group, and continuing in descending order:

- (i) Applications that address topics not otherwise covered by more highly-ranked applications will be considered to have the highest priority.
- (ii) These proposals will themselves be prioritised according to the scores they have been awarded for the criterion *excellence*. When these scores are equal, priority will be based on scores for the criterion *impact*. In the case of Innovation actions, this prioritisation will be done first on the basis of the score for *impact*, and then on that for *excellence*.

If necessary, any further prioritisation will be based on the following factors, in order: size of budget allocated to SMEs; gender balance among the personnel named in the proposal who will be primarily responsible for carrying out the research and/or innovation activities.

If a distinction still cannot be made, the panel may decide to further prioritise by considering how to enhance the quality of the project portfolio through synergies between projects, or other factors related to the objectives of the call or to Horizon 2020 in general. These factors will be documented in the report of the Panel.

- (iii) The method described in (ii) will then be applied to the remaining *ex aequos* in the group.

## II. Calls for Proposals (for Partners)

### Selection Criteria

a) *Financial capacity*: In line with the Financial Regulation and the Rules for Participation. At the proposal stage, coordinators will be invited to complete a self-assessment using an on-line tool.

b) *Operational capacity*: As a distinct operation, carried out during the evaluation of the award criterion 'Quality and efficiency of the implementation', experts will indicate whether the participants meet the selection criterion related to operational capacity, to carry out the proposed work, based on the competence and experience of the individual participant(s).

### Award criteria

Experts will evaluate on the basis of the criteria 'excellence', 'impact' and 'quality and efficiency of the implementation'. The aspects to be considered in each case depend on the types of action as set out in the table below, unless stated otherwise in the call conditions.

Type of action	Excellence	Impact	Quality and efficiency of the implementation
	The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.	The extent to which the outputs of the project should contribute at the European and/or International level to:	The following aspects will be taken into account:
<b>All types of action</b>	Clarity and pertinence of the objectives;  Credibility and demonstrated excellence and ambition of the proposed approach.	The expected impacts listed in the work programme under the relevant topic	Coherence and effectiveness of the work plan, and the allocation of tasks and resources;  Efficient and well justified application of resources for the expected outcomes and impacts  Appropriateness of the management structures and procedures, including risk and innovation management.
<b>Coordination &amp; support actions</b>	Soundness of the concept;  Quality of the proposed coordination and/or support measures.	Effectiveness of the proposed measures to exploit and disseminate the project results (including management of IPR), to communicate the project, and to manage research data where relevant.	
<b>Research and innovation; Innovation;</b>	Soundness of the concept and approach,  Extent that proposed work is ambitious, has	The expected impact towards the objectives as described under the relevant topic;	Match of technical capabilities and skills with the Topic description and congruent with the Programme objectives

Type of action	Excellence	Impact	Quality and efficiency of the implementation
	The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.	The extent to which the outputs of the project should contribute at the European and/or International level to:	The following aspects will be taken into account:
	<p>innovation potential, and is beyond the state of the art.</p> <p>Suitability of the technologies, approaches and solutions proposed, with respect to the Topic description and the IADP/ITD area and objectives.</p>	<p>Enhancing innovation capacity and integration of new knowledge;</p> <p>Demonstrating the congruence with and progress towards the environmental and socially relevant impacts stated for the CS2 Programme;</p> <p>A clear and credible path towards the exploitation of results showing a demonstrable contribution towards European competitiveness</p> <p>Effectiveness of the proposed measures to disseminate the project results (including management of IPR), to communicate the project, and to manage research data where relevant.</p>	<p>embodied in the topic;</p> <p>Demonstrated ability to work in the topic area;</p> <p>Ability to work effectively within a supply chain and into an equal or higher tier industrial organization;</p> <p>Evidence and quality of the operational resources</p> <p>Ability and efficiency to commit financial resources against the indicative topic value and based on the proposed content and JU funding request;</p> <p>Capacity of the cluster or consortium leader to efficiently coordinate activities of the participants (where applicable).</p>

### Note

Unless otherwise specified in the call conditions evaluation scores will be awarded for the criteria, and not for the different aspects listed in the above table. Each criterion will be scored out of 5. The threshold for individual criteria will be 3. The overall threshold, applying to the sum of the three individual scores, will be 10.

### Priority order for proposals with the same score

Unless the call conditions indicate otherwise, the following method will be applied.

As part of the evaluation by independent experts, a panel review will recommend one or more ranked lists for the proposals under evaluation, following the scoring systems indicated above. A ranked list will be drawn up for every indicative budget (for each topic) shown in the call conditions.

If necessary, the panel will determine a priority order for proposals which have been awarded the same score within a ranked list. Whether or not such a prioritisation is carried out will

depend on the available budget or other conditions set out in the call fiche. The following approach will be applied successively for every group of ex aequo proposals requiring prioritisation, starting with the highest scored group, and continuing in descending order:

(i) These proposals will themselves be prioritised according to the scores they have been awarded for the criterion excellence. When these scores are equal, priority will be based on scores for the criterion impact. In the case of Innovation actions, this prioritisation will be done first on the basis of the score for impact, and then on that for excellence.

If necessary, any further prioritisation will be based on the following factors, in order: size of budget allocated to SMEs; gender balance among the personnel named in the proposal who will be primarily responsible for carrying out the research and/or innovation activities.

If a distinction still cannot be made, the panel may decide to further prioritise by considering how to enhance the quality of the project portfolio through synergies between projects, or other factors related to the objectives of the call or to Clean Sky 2 Programme in general. These factors will be documented in the report of the Panel.

(ii) The method described in (i) will then be applied to the remaining ex aequos in the group.

## **G. Budget flexibility**

Budgetary figures given in this work plan are indicative and are based on an estimate of the topic values and the CSJU funding per topic. Unless otherwise stated, final funding may vary following the evaluation of the applications and the negotiation/grant preparation stage.

The funding values shall not be confused with the total topic value. The funding value corresponds to the average funding calculated by the JU based on the experience in the Clean Sky programme. The final funding value per topic will entirely depend on the cost structure of the winning entity, the funding rate, and the scope of work proposed in their application.

## **24. List of abbreviations**

**AB:** Annual Budget  
**ACARE:** Advisory Council for Aeronautics Research in Europe  
**AIP:** Annual Implementation Plan  
**ATM:** Air Traffic Management  
**CA:** Commitment Appropriations  
**CDR:** Critical Design Review  
**CfP:** Call for Proposals  
**CfT:** Call for Tender  
**CROR:** Counter Rotating Open Rotor  
**JU:** Clean Sky Joint Undertaking/ Clean Sky 2 Joint Undertaking  
**EC:** European Commission  
**ECO:** Eco-Design  
**EDA:** Eco-Design for Airframe  
**GAM:** Grant Agreement for Members  
**GAP:** Grant Agreement for Partners  
**GRA:** Green Regional Aircraft  
**GRC:** Green Rotorcraft  
**IAO:** Internal Audit Officer  
**ITD:** Integrative Technology Demonstrator  
**IADP:** Innovative Aircraft Demonstrator Platform  
**JTP:** Joint Technical Programme  
**PA:** Payment Appropriations  
**PDR:** Preliminary Design Review  
**QPR:** Quarterly Progress Report  
**SAGE:** Sustainable and Green Energy  
**SESAR:** Single European Sky Air Traffic Management Research  
**SFWA:** Smart Fixed Wing Aircraft  
**SGO:** Systems for Green Operation  
**SPD:** System & Platform Demonstrator  
**TA:** Transversal Activity  
**TE:** Technology Evaluator  
**ToP:** Type of Action  
**TP:** Technology Products  
**TRL:** Technology Readiness Level  
**WP:** Work Package