
This Work Plan covers the years 2014 and 2015. Due to the starting phase of the Clean Sky 2 Joint Undertaking under Regulation (EU) No 558/204 of 6 May 2014 the information contained in this Work Plan (topics list, description, budget, planning of calls) may be subject to updates. Any amended Work Plan will be announced and published on the JU’s website.

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Revision History Table

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<td>V1</td>
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<td>The ANNEX I: 1st Call for Core-Partners: List and Full Description of Topics has been updated and regards the AIR-01-01 topic description: Part 2.1.2 - Open Rotor (CROR) and Ultra High by-pass ratio turbofan engine configurations (link to WP A-1.2), having a specific scope, was removed for consistency reasons. The intent is to publish this subject in the first Call for Partners. The topic indicative funding was reduced accordingly.</td>
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  - Airframe ITD identification codes (pp. 237-326 of the Annex III v3)  
  - Fast Rotorcraft IADP topics:  
    - JTI-CS2-2014-CFP01-FRC-02-03 (pp. 118-124 of the Annex III v3)  
    - JTI-CS2-2014-CFP01-FRC-02-05 (pp. 132-156 of the Annex III v3)  
    - JTI-CS2-2014-CFP01-FRC-02-06 (pp. 157-171 of the Annex III v3)  
    - JTI-CS2-2014-CFP01-FRC-02-07 (pp. 172-209 of the Annex III v3)  
    - JTI-CS2-2014-CFP01-FRC-02-08 (pp. 210-236 of the Annex III v3) |
| V4         | 08/01/2015 | “Amendment nr. 1 to the Work Plan 2014-2015 v4” contains the following corrections:  
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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 CO₂ 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 6th of May, 2014 after consultations with the European Parliament and published on the 7th of June 20141.

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 CO₂ and reducing NOₓ and noise emissions. It will contribute strongly to the renewed ACARE SRIA2.

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.

Clean Sky 2 will build on the success of Clean Sky and will deliver full-scale in-flight

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1 OJ L 169/77 of 7 June 2014.

2 Advisory Council on Aviation Research in Europe, Strategic Research and Innovation Agenda (2012)
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 CO₂ emissions, similar or greater reductions in NOₓ 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 will be jointly funded by the European Commission and the major European aeronautics companies, and will involve 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.
PART A – CLEAN SKY PROGRAMME
2. INTRODUCTION TO THE PROGRAMME


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 (CO₂) emissions reduced by 50%, Nitrous oxides (NOₓ) 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 2014 - 2015

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 2014

Overview

The SWFA ITD is heading towards the stage of implementation and testing of these technologies through demonstration both in laboratory and in flight. As consequence, most of the work in 2014 will be dedicated to prepare and to conduct large ground and flight test demonstrations along the main technology streams, namely the natural laminar flow wing, the smart flap for low speed applications, low speed vibration flight demonstration, the business jet innovative after body demonstrator, as well as simulator tests and flight tests for active load control for large passenger aircraft and vibration control for business jets.

Final wind tunnel tests for the integration of the CROR propulsion are foreseen on selected issues of high speed performance, acoustics and handling quality. The identification and qualification of structural solutions for the engine integration and to manage potential failure cases will be continued. Based on the expected availability of a first set of CROR engine certification and qualification rules, related test activities will be launched in 2014.

Based on specifications made in 2013 and in close coordination with the SAGE-ITD the formal preliminary design review process for the CROR demo engine integrated to an Airbus test aircraft based flying test bed will start in summer 2014 with a significant number of dedicated component and system preliminary design activities. The baseline for the test aircraft is an Airbus A340-300.

Tests to down select passive and active means to control buffet will be conducted through most of 2014 to targeting for a technology readiness level of TRL3 at the end of 2014.

The preparation of the Airbus A340-300 BLADE test aircraft will require a strong effort in terms of man power and resources along all the 2014. Paralleled by the work to assemble the upper cover and leading edge parts of the laminar wing articles in Vitoria (at Aernnova), planned to start in June 2014, the first wing shall arrive in the hangar with the test aircraft in June 2014. The huge working party of the test aircraft is planned to begin at the end 2014, with ground tests planned to start in April 2014. The aircraft is booked to be exclusively available for the BLADE working party, flight test campaign and refurbishment from June 2014 until autumn 2016.
In parallel to the BLADE flight test, the “Phase 4 smart laminar wing ground based demonstrator” (GBD) will be assembled to validate key features of the laminar wing structural concept at large scale, in particular the integration of the leading edge, upper cover and the Krueger-based high lift components.

**Major milestones planned for 2014:**

- Start of the laminar wing BLADE Airbus A340-300 working group
- Complete the leading edge system demonstrator
- Pass the Low Speed Business Jet “Smart Flap” Critical Design Review
- Launch the simulator tests for active load control functions large transport aircraft
- Launch the simulator tests for vibration control tests for business jets
- Prepare the CROR engine demo Airbus A340-300 test aircraft Preliminary Design Review process
- Launch of preliminary design phase for CROR-Pylon
- Complete the SFWA principle contribution to CROR-engine integration rulemaking process
- Complete the preparation of Innovative Bizjet afterbody wind tunnel flutter test
- Complete the in-flight CROR blade deformation and CROR –pylon effort measurement system definition

**Major deliverables planned for 2014:**

- Blade fuselage Pod on dock at BLADE final assembly line
- Complete the laminar Wing Ground Based Demonstrator Phase 4 assembly
- Analysis and Completing of the Smart Flap Low Speed Business-Jet (LSBJ) Wind tunnel test
- Complete the application of aeroelastic and aerodynamic tailoring on concept aircraft
- Pass the test of the Critical Design Review for Low Speed Vibration Control of Business Jets
- Definition of the principle architecture of CROR demo–engine system integration to Airbus A340-300 FTD
- Complete test plan for impact & trajectory tests
- Large scale Innovative Bizjet afterbody demonstrator assembled, ready for test
- Definition of the in-flight PIV diagnostic concept for CROR demo-engine flight test, integration concept for test aircraft available
- Structural design and systems integration concept for camera pod in VTP accomplished (PDR)
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.
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 2014-2015.

Activities for year 2014

Overview

GRA1 did significant effort, in 2013, and made further progress on the development of advanced composite materials. The design of the sections of the: Fuselage, Wing Box and Cockpit of the Full Scale Ground Demo have been completed, so that, on 2014, activities will mainly focus on the manufacturing of these Ground Demos. It has been also planned to start the design and manufacturing of the Upper Crown Panel to be used for flight tests. In detail, during 2014, the tests needed to achieve the Permit to Flight will be performed; the ground demonstrators and the Panel to be tested in flight will be manufactured. In order to perform, ATR In Flight Demonstration in 2015, structural and Systems modifications on the ATR 72 aircraft will be performed during 2014.

Most of the activities performed in 2013 by Low Noise Configuration domain (GRA2) concerned the development of the technologies to reduce the Main and Nose Landing Gears noise of the Turboprop 90-seat A/C, as well as, the development of advanced aerodynamics and load alleviation technologies for both 130-seat and 90-seat Aircraft Configurations. These concepts will be experimentally investigated by large wind tunnel tests. The activities planned during 2014 will concern the design and the preparation of these aerodynamics and
acoustic experiments. In particular, the demonstration of the Laminar Flow technology and load alleviation technique on an elastic wing is planned to start at end of 2014 in the frame of project ETRIOLLA under CfP. Design, preparation and execution of acoustic wind tunnel experiments on a Nose Landing Gear 1:1 scaled mock-up, to test devices for noise reduction will be performed during 2014.

GRA3 2014 activities will mainly focus on the completion of the studies on A/C integration of on-board systems, technologies enabling the application of the All Electric Aircraft concept, such as: the “E-ECS”, the “Advanced EPGDS” including technique for the “Electric Energy Management (E-EM)”, and the "Electromechanical Actuation (EMA)’’ for Flight Control and Landing Gear Systems. In 2014, AEA will also contribute to EDS Copper Bird activities for the Laboratory Electrical Testing of the Regional A/C configuration including EPGDS and EMA.

Most of the activities planned by Mission and Trajectory Management (MTM) domain during 2014 will concern the development of the Green Flight Management System (FMS) and of the realistic Regional Flight Simulator. The flight simulator will be configured, during this year, to simulate the GRA TP90 passengers. This will allow performing Flight Simulation Demonstration in 2015.

The activities performed by New Configuration domain, during 2014, will be concerning the design of a wind tunnel Test Campaign to demonstrate and validate the high-lift performance and the whole stability & control dataset of the 130-seat Regional A/C. A powered complete model will be used for these investigations. In addition, the sizing of two Green Concepts, TurboProp 90 pax and 130 pax with different powerplants (Advanced-TurboFan and Geared TurboFan Engines) will be initiated and continued through Loop 3 during all 2014. The A/C Simulation Models (GRASM) to the Technology Evaluator for the assessment of environmental targets achievement in terms of air pollutants emission (CO₂ & NOₓ) and external noise reduction will be developed during this year to be finalized in 2015.

**Major milestones planned for 2014:**

- TRR Full Scale Demonstrator;
- Upper Crown Panel for the In-Flight Demonstration availability;
- NLF wing 1:3 Wind Tunnel model (HW) (ETRIOLLA project under CfP);
- WTT First Complete Aerodynamic Test (Clean Wing);
- Final Green FMS availability;

**Major deliverables planned for 2014:**

- Fuselage Test Article Availability;
- Wing Box Test Article Availability;
- Cockpit Test Article Availability;
- Test Set-Up & FCS-EMA Delivery for Copper Bird;
- Test Set-Up & LGS-EMA Delivery for Copper Bird;
- Electrical Power Generators and Controls equipment available for Demo Aircraft;
• Electrical Power Center (EPC) and Simulated Resistive Electrical Load available for Demo Aircraft;
• Completion of WT Testing of elastic modular transonic laminar wing model with load control devices (WTT2);
• Completion of LG Modular Scale WT Testing;
• NLG/MLG & Bay Concept: 2nd down selection;
• Green FMS final release availability;
• GRASM (TP90 pax and GTF 130 pax A/C of Design Loop 3).

Main events:
• TRR Full Scale Ground Demo;
• Test A/C available (ATR MSN 098);
• GRA Annual Review Meeting (ARM).

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\textsubscript{2} & NO\textsubscript{X}) 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).
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 2014 and 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 2014**

**Overview**

Most of the activities on GRC1 Innovative Rotor Blades sub-project will focus on the development of active and passive technologies. In particular, GRC1 objective can be broken down as follows:

- Assess the potential of active/passive rotor technologies to achieve a commercially viable solution enabling reduced rotor power consumption and reduced rotor acoustic signature. Targeted achievements shall be measured relative to fleet 2000 baseline helicopters (see GRC7).
- Pursue development of the active twist concept from Friendcopter.
- Carry out parametric study and optimisation of active and passive blade lay-out for global rotor benefits.
- Develop methods necessary for the optimisation of blade design, actuation system integration, sensory data transmission, power transfer and control algorithms.
- Develop suitable open-loop and closed-loop control algorithms to manage the active system behaviour.

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 (ERICA tiltrotor model) will be addressed numerically in wind tunnel and/or in flight.

The GRC3 objective of Innovative Electrical Systems domain is the development of electrically-powered systems to replace hydraulic systems on rotorcraft and the reduction of carbon emissions by improved overall electrical power system energy efficiency. The objective can be broken down as follows:

- Assess the potential for electrical technologies to achieve a commercially viable solution that enables removal of hydraulic systems, improved electrical systems functionality, and reduced power consumption. The targeted achievements shall be measured relative to existing technologies (Y2000 Baseline), and the Y2020 Reference Helicopters as defined by GRC7.
- Pursue model development of the electrical concepts.
• Carry out benefit analysis studies and optimisation of individual and collective technologies to provide electrical systems benefits.
• Definition and provision of technology prototypes, facilitating practical demonstration.
• Incorporation of prototypes into the Copper Bird, system test bench, or test airframe to demonstrate system behaviour and benefits.
• Optimisation of existing tasks to provide technology confidence at the highest Technology Readiness Level (TRL) demonstration possible.

GRC4 will focus on turbocharged high compression engine technology, developed in the automotive industry, with the objective to integrate this technology on helicopters to drastically reduce gas emission level (forecast: CO₂ more than 40%, NOₓ more than 53%). Most of the activities will concern the integration of a flight worthy helicopter demonstrator based on the adaptation of an aeronautical high compression engine to helicopter specifications and the transformation of a turbine powered light helicopter.

The GRC5 objective is to reduce, for helicopter and tiltrotor aircraft, noise and polluting emissions through the optimisation of flight paths and, in addition, to develop new low-noise procedures to minimise noise perceived on ground during departure, low level flight and approach.

The GRC5 sub-project is aimed to develop:
• tools to optimise trajectories for low-noise and low-emissions
• a process to promulgate noise abatement procedures
• software to plan environmentally friendly mission profiles
• airborne hardware, and software, to allow flight crew to fly the low-noise and low-emission trajectories.

The general objective of GRC6 is to demonstrate eco-friendly life cycle processes in the phases of manufacturing, maintenance and disposal for specific helicopter components. The WP will demonstrate the possibility to eliminate substances considered hazardous. Activities will focus on the following demonstrators:
• Composite based structures/ Cossstube Fairing: the aim is to design and manufacture a typical rotorcraft cowling/fairing geometry using economic (‘green’) materials and processes to achieve a cost & weight saving compared to today’s solutions. The selection of the demonstrator geometry shall represent typical design details the process technology has to master.
• Composite based airframe structures/ Structural parts: the aim is to design and manufacture a composite primary (load-carrying) structural element out of economic materials.
• Metallic based transmission structures/ Transmission parts: the aim is to design and manufacture a demonstrative main helicopter mast and tail gear box.
• Metallic based transmission structures/ Gear box: this demonstrator will address the build of a REACh compliant and ECO efficient Intermediate Gear Box (IGB) and associated shaft.
Subproject GRC7 is the interface between the GRC-ITD and the Technology Evaluator (TE). GRC7 in its support to the TE will endeavour to ensure that the uniqueness of rotorcraft operations in relation to fixed-wing aircraft is duly taken into account. GRC7 ultimately provides a rotorcraft assessment software platform called PhoeniX to be integrated in the TE simulation framework to allow the TE to evaluate the possible environmental benefits of GRC sub-project technologies. The PhoeniX platform will need to be refined and updated given the nature innovative of the developed technologies. Therefore the iterative cycle of evolution of the platform will be continued, which is to be supported by the interaction between GRC7 and the other GRC sub-projects and the TE as the Technology Readiness Level (TRL) evolves.

**Major milestones planned for 2014:**

- Critical Design Review (CDR) of the optimised shape of the common helicopter platform
- Critical Design Review (CDR) of the new air intake for the ECg light H/C.
- Critical Design Review (CDR) of the fuselage the AW heavy H/C.
- Test Specimen Ready
- Critical Design Review on full scale 3D active gurney flap Delivery of first prototype Starter Generator Ground test results
- Eco-flight IFR procedures for Toulouse-Blagnac airport FMS sim correctly coupled with flight simulator AWARE Evaluation and verification of the test results Software delivery to TE: several version of Phoenix Black Box

**Major deliverables planned for 2014:**

- Test Matrix on active twist
- Test Specimen
- Results 2D wind tunnel test
- Measured vibration data analysis and report
- Test Program for structural tests of blade model of AGF rotor
- Preliminary Design Review on full scale 3D active gurney flap.
- Delivery of helicopter donor blades
- Synthesis report on GRC2 common platform hub cap and blade neck optimisation
- Synthesis report on GRC2 common platform fuselage drag reduction
- Specification of wind tunnel test campaign on a heavy helicopter fuselage (Issue3)
- Synthesis of the benefits and related penalties for the technology demonstrations of GRC2 (issue 1)
- GRC3 benefits at H/C level for TEH configurations
- EMA for Landing Gear Final report
- HERRB Technology Assessment
- Baseline ETRD System Definition Report
- Piezo Power Supply Test Report
- Interface document for HEMAS and Adaptation Kit for HEMAS: final issue
Iron bird test report  
Ground test report  
Technical synthesis report  
AWARE upgrades to support ATC/TR simulation in Clean Sky Green Rotorcraft 5  
VFR low-noise approach guidance concept  
Pollutant emissions report (PZL, AG, EMICOPTER)  
Report on Cross Tube Fairing Demonstrator manufacturing and analysis/evaluation  
Tail cone: Report on panel manufacturing process  
Roof specimen: report on co-melting technical results  
Evaluation and verification of the test results EC  
Phoenix Black Box V4.1 for (TE) – TEM  
(Contributors: AWL, AWS, AH-sas, AH-D, NLR, CIRA, DLR, ONERA, PZL, CU, SAGE)  
Phoenix Black Box V4.1.2 for (TE) – SELU1  
(Contributors: AWL, AWS, AH-sas, AH-D, NLR, CIRA, DLR, ONERA, PZL, CU, SAGE)  
Phoenix Black Box V5.1 for (TE) – TEH U1+DEL  
(Contributors: AWL, AWS, AH-sas, AH-D, NLR, CIRA, DLR, ONERA, PZL, CU, SAGE)

Main events:

- 4th Assessment TE simulation framework results with updated PhoeniX.

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.
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 Turboshaft 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.

Activities plan for year 2014

Overview

SAGE1 - Activities were reviewed after the Go decision made in 2013. The outcome was to reduce the activities further and support the work breakdown structure shown in figure 1.

![Figure 1: New SAGE 1 Work Breakdown Structure.](image)

Therefore, SAGE 1 will now 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 objectives of the Geared Open Rotor Demonstrator projects 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 start to ground test a demonstrator 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 Preliminary Design Review in Q4 2013, 2014 will be the year of the freeze of the whole demonstrator definition with the completion of the CDR.

SAGE 3 - The Large 3 Shaft Engine project will demonstrate technologies applicable to large 3-shaft turbofan engines in the 60-95,000 lb thrust class, as concerns low pressure system. The project aim is to deliver TRL6 for these sub-systems through appropriate testing delivering engine conditions representative of potential future engine applications. Demonstration by rig testing will have completed in 2013 and the focus in 2014 will be on full-scale engine tests of the Composite Fan System and Low Pressure Turbine. Three engine tests are planned to be launched in 2014: flight test of the composite fan blades, ground test of the full composite fan system and ground test of the low pressure turbine. Additionally, the ground testing of the composite fan blades launched in 2013 will be completed.

SAGE 4 - The purpose of the advanced Geared Turbofan (GTF) Engine Demonstrator, as an important part of SAGE platform, is to improve necessary technologies in order to further reduce fuel burn / CO₂ by addressing efficiency and weight, to continue efforts to further decrease already low noise emission levels and to enhance reliability and cost. Main focus in 2014 will be manufacture, procurement and instrumentation work of modules and components, module level assembly work and test preparation for a successful test campaign in Q2-2015.

SAGE 5 - The Turboshaft 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. Further Turboshaft Demonstrator engine tests are scheduled in 2014 to demonstrate the innovative technologies related to the performance and thermo-mechanical behaviour.

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. It is anticipated that this
hardware will be subjected to both rig testing (2013 onwards), followed by engine testing (2015 – 2016).

**Major milestones planned for 2014:**

**SAGE1**
- Achieve next loop of test data evaluation from on-going data evaluations
- Update of on-going far and near filed noise predictions
- Update of associated transpositions to flight
- Further improved design, aero and prediction methods and tools
- CROR blade mechanical design methods
- Summary from on-going concept evaluations and according technology evaluations

**SAGE2**
- Launch of manufacturing. *Even if the manufacturing of most parts will start after the completion of the CDR, long lead-time items procurement will be anticipated and will thus start in February 2014.*
- Critical Design Review (CDR). Freeze demonstrator definition

**SAGE3**
- Composite Fan Blade Ground test completion. Completion of the ALPS CFS1 ground engine demonstration of the composite fan blades
- Composite Fan Blade Flight Test Pass to Test. First flight test of the ALPS FTB1 composite fan blade demonstrator.
- Low Pressure Turbine Demonstrator Pass to Test. Pass to Test of ALPS LPT1 build for ground demonstration of low pressure turbine technologies

**SAGE4**
- System Level Test Readiness Review

**SAGE 5**
- Engine Built 2 Endurance
- Engine Built 2 Performance Test The target is to validate the thermo-mechanical behaviour of the engine in very hot environment and verify the global performances of the innovative technologies implemented on the engine at high Turbine Entry Temperature

**SAGE6**
- Lean burn core engine demonstrator EFE Build 4 commissioning
- Critical Design Review (CDR), freeze of engine configuration
- Build start of ground test engine
Major deliverables planned for 2014:

SAGE1

- Test data evaluation reports from on-going data evaluations
- Summary from on-going far and near filed noise predictions
- Associated transpositions to flight
- Summary regarding improved design, aero and prediction methods and tools
- CROR blade mechanical design methods and tool progress report
- CROR blade manufacturability progress report
- Summary of definition of next generation RR CROR blades for Z49P2 testing projected for 2015
- Summary from on-going concept evaluations and according technology evaluations
- Design and manufacture of blades for tests

SAGE2

- Critical Design Review (CDR) closure report
- Freeze demonstrator definition
- First LLTI forging parts delivered

SAGE3

- Final Parts to Stores for Composite Fancase demonstration. Delivery of final parts for build of the ALPS CFS2 engine
- Composite Fan Blade Ground Test Reports. Delivery of post-test reports closing out the ALPS CFS1 composite fan ground test campaign

SAGE4

- Final Parts on Stores

SAGE5

- Completed module and components instrumentation
- Turboshaft Demonstration. Engine demonstration of the innovative technologies in order to demonstrate performance and thermo-mechanical behaviour

SAGE6

- Critical Design Review (CDR) report for the ground test engine
- Delivery of finished parts to stores for ground test engine
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 / CO₂ 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 Turboshaft 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 subsystems 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.
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 2014

Overview

Building on developments in the previous years of Clean Sky, SGO work will reach high TRLs (4 to 6 depending on the technology threads) in 2014. Many of these high TRLs will be obtained through high-fidelity ground- demonstrations or in flight tests, in collaboration with vehicle ITDs: Smart Fixed Wing Aircraft, Green Regional Aircraft and Green Rotorcraft. Thus, the SGO ITD will deliver large-scale ground-based architectural integration of electrical technologies comprising generation of electricity, distribution and electrical loads, together with their management. The demonstration of these integrated systems will be done in Airbus PROVEN test bench in 2014, early 2015 and will achieve up to TRL5 for the sub-systems.

In the field of electrical systems, including environmental conditioning, thermal management, electrical power generation and conversion, ice protection, major milestones will be reached in 2014:

- An innovative Ice detection system has reached TRL4 in 2013 and will be developed further during 2014 followed by the TRL5 review early 2015.
- Wing Ice protection systems have reached TRL4 in 2013 and enhanced prototypes will be delivered to the PROVEN test bench for ground validation starting end 2014, in order to prepare TRL5 gate early 2015.
- The maturity of the electrical environmental control system will also be enhanced during 2014, with two main streams contributing to the development: on-ground validation of the 70kW turbomachines with performance tests in altitude chamber on one hand. On the other hand – a reduced scale pack (50kW) will be designed and manufactured for integration in an A320 test aircraft, to evaluate the functional behaviour of the system during flight tests end 2015/beginning 2016.
- Another electrical ECS demonstrator for the Regional Aircraft application will be developed throughout 2014 reaching TRL4 end of the year.
- Flight proven technologies and sub-systems for thermal exchange and management, including liquid loops and large skin heat exchanger.
- The flight test campaign on the skin heat exchanger is scheduled mid-2014 to reach TRL6 end 2014.
- An innovative electrical power distribution centre will be completed early 2014 by using different equipment developed in SGO i.e. power modules, cooling equipment and...
switching components. The power centre will be delivered to PROVEN test rig and will achieve TRL5 in second half of 2014.

- An electrical synchronized actuation system for engine nacelle is under test and will reach TRL5 in second quarter of 2014.
- In the field of Thermal Load Management Function, the development in 2014 will lead to the delivery of a prototype by mid-2014 for integration in a system test rig.

SGO will also deliver a number of system prototypes and equipment to other ITDs in 2014, for tests to be carried out in 2014 and 2015:

- Power Generation and Conversion systems prototypes, adapted to the specifications of each platform will be delivered to Eco-design (Bizjet), GRA (regional aircraft) and helicopter (GRC) and will be integrated and tested in COPPER BIRD tests bench throughout 2014.
- An electrical ECS test bench will be delivered to COPPER Bird test rig for integration and test early 2014.
- Optimised trajectories for all flight phases, evaluated in representative conditions on simulators and integrated in existing Flight Management Systems for full automation – TRL5 for the first flight phases will be reached by end 2014, before final tests in 2015.
- Flight tests of a Flight Management function allowing continuous descent in time constrained environment will be prepared, with TRL5 reached by end 2014 after testing on GRACE flight simulator (Time and Energy Managed Operations – TEMO). The system should be ready for flight test early 2015.
- Integration of new weather radar algorithms and trajectory optimisation functions will be completed in 2014 and TRL4 will be achieved by the end of the year.
- Technologies for electrical taxi.
- The on-board wheel actuator system will be further developed to prepare full scale dynamometer tests early 2015. Developments on the dedicated autonomous towing vehicle have been completed in 2013, reaching TRL 6 by full scale demonstration with a large aircraft.

**Major milestones planned for 2014:**

- TRL5 Nacelle Actuation System
- TRL4 E-ECS for Regional A/C
- TRL4 50KW Power electronics for E- ECS for large Aircraft
- TRL5 for Electrical Power Distribution System
- TRL 5 and 6 Skin Heat Exchanger
- TRL6 Power module and converter design
- TRL5 Multi Criteria Departure function
- TRL5 Adaptive Increased Glideslope function
- TRL5 Time and Energy Managed Operations in descent function

**Major deliverables planned for 2014:**

- Prototype skin heat exchanger subsystem for flight tests
- Tested Power Electronic Module for Generic test bench
• Tested high-speed permanent magnet generator and its associated PEM for Generic test bench
• Hardware to demonstrate Power Electronic Module and converter technology
• Virtual test results for ground test campaign (G1)
• Electrical Nacelle Actuation System - Final test report
• Validated Flight Test results for F.4 (Skin Heat Exchanger flight tests)
• Two tested generators, two associated GCUs and one BPCU for GRA flight tests
• HEMAS: Swashplate actuators for SGO internal validation tests
• Prototype of thermal management function
• WIPS for Business jet Icing wind tunnel test report
• Two tested high-low DC / DC voltage bi-way converter
• ECS Control laws configuration for Regional A/C Electrical Test Bench
• GATAc v3 Development and Validation Report
• Advanced Weather Radar algorithms and trajectory optimisation agents Integration report
• Departure and Final Approach function FMS implementation report
• Final validation report on time-based operations using absolute spacing
• Smart Operation on ground development report

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
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 maturate environmentally sound (“green”) materials and processes for a/c production.
2. To identify and maturate 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 2014

Overview

In 2014, the work to be performed in the frame of EDA will continue on the following Work Packages:

- WP A.2 Technology Development,
- WP A.3 Application Studies,

In WP A.2, the work is dedicated to the maturation of the most innovative technologies selected at the end of 2010. The end of the development phase is beginning of October 2013 but remaining activities will be performed beginning of 2014 for the finalisation of CfP projects.

In WP A.3, WP A.3.1 (Eco-Statements) and A.3.2 (Extrapolation to Industrial Conditions) will be active:

- In WP A.3.1, after the finalisation of the development of evaluation tools (A.3.1.1) and of the eco-statement of current technologies (A.3.1.2), the work on 2014 will be devoted to the eco-statement of new technologies.
- In WP A.3.2, activities will continue on the extrapolation of the technologies developed in WP A.2 to industrial conditions. The WP should end mid of 2014.

After finalisation of WP A.4, WP A.5 will be active in the 1st quarter of 2014 and WP A.6 until end of 2015. Ground demonstration activities will be carried out for the equipment (A.6.2) as well as for the equipped airframe demonstrators (A.6.1).

The general objective the EDS part of the Eco-Design ITD is to gain a valuable and comprehensive insight into the concept of all-electric aircraft. It is expected that the use of electricity as the only energy medium, by removing the hydraulic fluid and by the use of on-board power-by–wire will offer significant benefits in terms of aircraft maintenance and disposal environmental impact, and will yield new possibilities in terms of energy
management (e.g.: intelligent load shedding, power regeneration on actuators, sharing of Electrical Control Unit over actuator).

The work to be performed in 2014 will consist in pursuing the common activities (WP S.1), performing the characterization of the business jet sub-systems architectures (WP S.2). On 2014, the preparation of the benches related activities (WP S.3 and WP S.4) will be finalised and the main activity will be the carrying out of the electrical and thermal tests (WP S.3.5 and S.4.5).

The WP S.1 common activities will continue in 2014 through WP S.1.6 (Models & Data), the last active WP in 2014.

The work within WP S.2 will continue throughout 2014 essentially at the level of the bizjet architecture trade-off (S.2.6) supported by modelling activities (S.2.5).

The WP S.3 (Electrical Test Bench) and S.4 (Thermal Test Bench) activities will continue in 2014. Beginning of 2014 will see the finalisation of the ETB (Electrical Test Bench) and TTB (Thermal Test Bench) integration and the electrical and thermal tests initiated in 2013 will continue during 2014.

The main technical deliverables to be produced in 2014 are set out in the following table.

**Major milestones planned for 2014:**

- End of technology development to TRL 5 (including GAPs)
- End of current eco-statement on reference parts
- End of final eco-statement on reference parts
- Technical and economical impacts review
- Eco-design guidelines deliverables
- Electrical Test Bench: 2nd Test Readiness Review (TRR)
- Electrical Test Bench: Generic configuration acceptance report
- End of Air Cooling Calorimeter integration
- End of Mock-Up integration
- General synthesis of WP S.1

**Major deliverables planned for 2014:**

- Eco-Design Guideline
- Eco-statement & eco-analysis on reference technologies: final report
- Equipped Airframe demonstration preparation: Synthesis Report
- Electrical Test Bench: Generic configuration acceptance report
- Report on integrated ACC
- General synthesis of WP S.1
Year 2015

Overview

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 maturate environmentally sound (“green”) materials and processes for a/c production.
2. To identify and maturate 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 aircraft production, use/maintenance, and disposal. 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
3.7. **TE - Technology Evaluator**

The TE will perform in 2014 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 2014 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 first and second assessments beginning 2012 and 2013 respectively. A further assessment is underway for mid-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 and second assessments beginning 2012 and 2013 respectively. A further assessment is underway for mid-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.

All these global or partial assessments aim to help secure the final TE Assessment which is planned for the mid of 2016.
Detailed Scope of Work of Technology Evaluator

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

- In June 2014 another global TE assessment will be produced.
- In 2015, either another global TE assessment or only partial TE assessments will be achieved, according to the status of the technology achievements and demonstrations in the ITDs.
- In 2016, the final CS year, the final assessment will be produced.

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 2014, possibly in 2015, and final in 2016);
- The issue of the results of partial assessments of the year.

These outputs are strongly dependent 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 2014

Overview

Objective
To perform the 2014 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
- 2014 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
- ITDs a/c models
- 2014 PANEM update (bizjet/mainliners): integration of new or updated functionalities as required
- 2014 GRASM update: integration of new or updated functionalities as required
- 2014 Phoenix update or release of: SEL/TEM/DEL models, including the integration of Turbomeca engine modules for SEL and TEM

WP3 : TE system
- Update TE computer system: TE-IS and 3 platforms simulation framework

WP4: TE assessments
- TE global assessment in June 2014, including PANEM, GRASM and PHOENIX models updates
- Mission level: Mission assessments defined begin 2014 including development/updates of ITD models
- Airport level: Airport assessments according to specification defined begin 2014 including updates of and new airports and updated ITD models
- ATS level: ATS assessments according to specification defined begin 2014 including updates of forecasts / traffic scenarios and updated ITD models
- LCA: Perform demonstration LCA for production phase for CleanSky reference aircraft/rotorcraft, definition of ground operations data

Major milestone planned for 2014
- End June 2014 : TE assessment report

Major deliverables planned for 2014
- Mid March : 2013 Annual report
- End June 2014 : TE assessment report
Year 2015

Overview

Objective: to perform the 2015 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
- 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
- ITDs a/c models
  - 2015 PANEM update (bizjet/mainliners): integration of new or updated functionalities as required, i.e. full SGO functionalities should be inserted into the PANEM mainliner model and an update of the HSBJ model made
  - 2015 GRASM update: integration of new or updated functionalities as required (loop 3 and SGO functionalities)
  - 2015 Phoenix update or release of: TEH, TEL models

WP3: TE system
- Update TE computer system: TE-IS and 3 platforms simulation framework

WP4: TE assessments

TE partial or global assessment according to the availabilities of the 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 begin 2015 including updates of and new airports and updated ITD models.
ATS level: ATS assessments according to specification defined begin 2015 including updates of forecasts / traffic scenarios and updated ITD models and continuation of economic study activity.
LCA: Perform demonstration of LCA environmental improvement by comparing LCA for CleanSky reference and conceptual aircraft/rotorcraft.

Major milestones planned for 2015:
- End Jan 2015: TE assessments specifications
- End June 2015: 2015 TE assessment performance completed (partial or global according to Specifications)
Major deliverables planned for 2015:

- Mid-March 2015: 2014 annual report
- End June 2015: TE assessment reports (including JU Member Summary Report and Publishable Executive Summary)
4. CALL ACTIVITIES IN 2014-2015

Grant agreements for Partners (GAPs)

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 (the minimum 200 m € to be granted to partners arising from the calls process).
5. OBJECTIVES AND INDICATORS

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

Objectives for 2014 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

<table>
<thead>
<tr>
<th>Demonstrator</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>SFWA</strong></td>
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<tr>
<td>High Speed Smart Wing Flight Demonstrator</td>
<td>- Airbus A340-300 flight test</td>
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<tr>
<td>Advanced load control for Smart Wing</td>
<td>- Ground test bed for large transport aircraft</td>
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<td></td>
<td>- Flight test for vibration control for bizjet</td>
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<td>Smart Wing High Lift Trailing Edge Device</td>
<td>- Full scale demonstrator, ground test only</td>
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<tr>
<td>Innovative afterbody</td>
<td>- Full scale demonstrator, ground test only</td>
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<tr>
<td>Innovative Empennage Demonstrator</td>
<td>- Full scale demonstrator, ground test only</td>
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<td><strong>GRA</strong></td>
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<tr>
<td>Static &amp; Fatigue Test</td>
<td>- Full Scale Ground Demonstration</td>
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<tr>
<td>Large scale Wind Tunnel Test Demonstration</td>
<td>- Acoustic &amp; Aerodynamic WT Test - Turbo Prop 90 pax</td>
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<td>- NLF wing aerodynamic &amp; aeroelastic design WT Tests - 130</td>
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<td></td>
<td>- Geared Turbo Fan configuration</td>
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<tr>
<td>Ground Laboratory Test (COPPER BIRD and other)</td>
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<tr>
<td>Flight Simulator on ground</td>
<td>- Green FMS Final Demonstration on GRA Flight Simulator</td>
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<tr>
<td>Integrated In-Flight DEMO</td>
<td>- ATR Integrated In-Flight Test - ATR 72 FTB</td>
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<tr>
<td><strong>GRC</strong></td>
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<tr>
<td>Innovative Rotor blades, passive and active (AGF),</td>
<td>- on Ground and in Flight</td>
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<tr>
<td>Drag reduction on Ground / in Flight</td>
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<tr>
<td>Medium helicopter electrical system demonstrator</td>
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<td>Lightweight helicopter electromechanical actuation</td>
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<td>Electric Tail Rotor Prototype</td>
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<td>Diesel powered flight worthy helicopter Demonstrator</td>
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<tr>
<td>Flightpath operational Demonstrations</td>
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<tr>
<td>Thermoplastic composite fairing demonstrator</td>
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</table>
| **SGO** | 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 |
|----------|--------------------------------------------------------------------------------------------------|
| **SGO** | VIRTUAL IRON BIRD  
**COPPER BIRD**  
- Ground Test (Nacelle Actuation System, Power Generation and Conversion, Generators, Power Rectifiers, Electrical ECS Demonstrator, HEMAS) |
| **SGO** | PROVEN (Ground test rig at Airbus Toulouse)  
- Flight Test (Environemental Control System Large Aircraft - Ice Protection and Ice Detection Systems)  
- Ground Tests (Power Generation and Conversion S/Gs, PEM - Eletrical Power Distribution System/Power Center)  
- Flight Tests (Thermal Management Skin Heat Exchanger)  
- Ground Tests (Thermal Management Vapour Cycle System including Compressor) |
| **SGO** | AIR LAB, MOSAR & GRACE simulations  
Electric systems integration  
- Ground Tests (Power Generation and Conversion EDS ITD) |
| **SAGE** | Geared Open Rotor  
- CROR Ground Test Demonstrator |
| **SAGE** | Advanced Low Pressure System (ALPS) Demonstrator |
| **SAGE** | Geared Turbopfan Demonstrator  
- Ground Test - Engine demonstrator based on a GTF donor engine |
| **SAGE** | Large 3-shaft Turbopfan  
- Ground tests Demonstrator (to study aero-performance, flutter, blade integrity and bird impact capability for the composite fan system and low pressure turbine).  
- Flight test Demonstrator (in-flight operability of the composite fan blades).  
- Outdoor ground testing (to determine composite fan system flutter behaviour under cross-wind conditions and noise performance.  
- Icing tests (to determine ice shedding behaviour of blades and impact damage tolerances of new liners). |
| **SAGE** | Lean Burn Demonstrator  
- Ground Test - Lean Burn Combustion System demonstrator engine |
| **ECO** | Electrical Ground Test (Copper Bird®)  
- 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) |
| **ECO** | Thermal Ground Test  
- 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. |
| **ECO** | Clustered technologies airframe and equipment demonstrators  
- 12 demonstrators related to Airframe (e.g. Fuselage panel, Cabin furniture)  
- 6 Equipment demonstrators (e.g. Cables, connectors, part of air cooling unit) |
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.

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>CO₂ [%]</th>
<th>NOₓ [%]</th>
<th>Noise area difference ratio at take-off (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Speed Bizjet</td>
<td>-30 to -40</td>
<td>-30 to -40</td>
<td>-60 to -70</td>
</tr>
<tr>
<td>Regional turboprop</td>
<td>-25 to -30</td>
<td>-25 to -30</td>
<td>-40 to -50</td>
</tr>
<tr>
<td>Short/ Medium Range / CROR</td>
<td>-25 to -35</td>
<td>-25 to -35</td>
<td>-30 to -40</td>
</tr>
<tr>
<td>Light twin engine rotorcraft</td>
<td>-15 to -30</td>
<td>-55 to -70</td>
<td>-40 to -50</td>
</tr>
</tbody>
</table>
Objectives for 2014/2015

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 2014/2015. 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 Turboshaft 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 and will be updated in early 2015.

<table>
<thead>
<tr>
<th>Indicator ID</th>
<th>Indicator short name</th>
<th>Description of the indicator</th>
<th>Target for 2014/2015 % or nr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ind 1.9.2 A</td>
<td>Risk mitigation JU</td>
<td>Number of very important or critical risks on JU level without mitigation action (including also action defined but not implemented and unsuccessful actions)</td>
<td>0</td>
</tr>
<tr>
<td>Ind 1.9.2 B</td>
<td>Risk mitigation ITDs</td>
<td>Number of very important or critical risks on ITD level without mitigation action (including also actions defined but not implemented and unsuccessful actions)</td>
<td>0</td>
</tr>
<tr>
<td>Ind 2.5.6 A</td>
<td>Finalising of GAPs</td>
<td>Percentage of contracts signed in less than 8 months after the call closure</td>
<td>50%</td>
</tr>
<tr>
<td>Ind. 2.6 A</td>
<td>Deliverables of GAPs</td>
<td>Percentage of final reports due from partners on the schedule</td>
<td>80%</td>
</tr>
<tr>
<td>Ind. 2.7.1 A</td>
<td>AIP execution by members - resources</td>
<td>Percentage of resources consumption versus plan (members only)</td>
<td>90%</td>
</tr>
<tr>
<td>Ind 2.7.1 B</td>
<td>AIP execution by members - deliverables</td>
<td>Percentage of deliverables available versus plan (members only)</td>
<td>90%</td>
</tr>
<tr>
<td>Ind 2.9 C</td>
<td>Budget execution - payments operational</td>
<td>Percentage of payments made within the deadlines</td>
<td>85%</td>
</tr>
<tr>
<td>Ind 2.11 A</td>
<td>Dissemination of results</td>
<td>Number of publications from ITDs registered at JU level</td>
<td>3*ITD / 21</td>
</tr>
<tr>
<td>Ind 5.3 A</td>
<td>Ex-post audits - coverage</td>
<td>Percentage of operational expenses (incurred for FP7 projects) covered by ex-post audits</td>
<td>20%</td>
</tr>
<tr>
<td>Ind 5.3 D</td>
<td>Ex-post audits - error rates</td>
<td>Residual error rates resulting from audits at the beneficiaries per year and accumulated for the programme (FP7).</td>
<td>2%</td>
</tr>
</tbody>
</table>
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 2014*.

<table>
<thead>
<tr>
<th>Risk Description</th>
<th>CS-process</th>
<th>Action Plan Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td><em>Manage the Programme</em></td>
<td>Tightly monitor the work progress on this item through the Project Officers and the GAMs. Have preliminary models implemented where needed.</td>
</tr>
<tr>
<td>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.</td>
<td><em>Manage the Programme</em></td>
<td>Have an early warning capability through quarterly reports and alert at Governing Board level. Propose re-orientations when needed and possible.</td>
</tr>
<tr>
<td>The “share of the pie” logic could result in a lack of focus on the major, critical activities.</td>
<td><em>Manage the Programme</em></td>
<td>Challenge the ITDs in order that they focus on optimising the global output.</td>
</tr>
<tr>
<td>Technical setbacks in one or several ITDs may result in a significant under-spending of annual budget.</td>
<td><em>Manage the Programme</em></td>
<td>Re-balance the budget across ITDs and with Partners if necessary at mid-year, according to the 2nd quarterly reports.</td>
</tr>
<tr>
<td>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</td>
<td><em>Communicate</em></td>
<td>Harmonize the dissemination plans of ITDs. Monitor the dissemination actions</td>
</tr>
<tr>
<td>Risk Description</td>
<td>CS-process</td>
<td>Action Plan Summary</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>-------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Continued understaffing could result in a continuous backlog of grant agreements and resulting payments affecting both activities progressing and budget execution of the JU both within the JU and in the ITDs.</td>
<td>Run the Executive Team</td>
<td>Get support from the Members according to the Statutes, and make use of framework contracts to service providers. See chapter 15. JU Executive team where the JU will provide opportunity for new permanent support to the executive team</td>
</tr>
<tr>
<td>The above mentioned understaffing could result in insufficient ex-ante control, resulting in an error rate above the limit of 2%</td>
<td>Run the Executive Team</td>
<td>Same action as above. Educate the members and apply the recently defined procedure to make sure that potential errors from previous year are checked and detected in cost claims.</td>
</tr>
<tr>
<td>The lack of experience in European Research Programmes from many Partners (SMEs) could result in a difficult and late closure process of their projects.</td>
<td>Run the Executive Team</td>
<td>Reinforce the information, mainly through relevant Information Days and Web conferences; reinforce the role and the awareness of Topic Managers</td>
</tr>
<tr>
<td>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.</td>
<td>Run the Executive Team</td>
<td>Condition the CS2 funding by SPD/TAs and by beneficiary to the actual execution of CS budgets and technical progress</td>
</tr>
<tr>
<td>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.</td>
<td>Run the Executive Team</td>
<td>Proceed as quickly as possible to the recruitment of the right level of staff.</td>
</tr>
</tbody>
</table>

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 2014 therefore does not show any Commitment appropriations (CA) for 2014 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 2014-2015 expenditure in the budget are set out below.*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Title 1</td>
<td>2,291,667</td>
<td>2,291,667</td>
<td>1,900,000</td>
<td>2,011,008</td>
</tr>
<tr>
<td>Title 2</td>
<td>1,535,226</td>
<td>1,535,226</td>
<td>1,067,616</td>
<td>1,548,578</td>
</tr>
<tr>
<td>Title 3</td>
<td>92,249,851</td>
<td>122,216,299</td>
<td>75,550,380</td>
<td>135,485,596</td>
</tr>
<tr>
<td>Title 5</td>
<td>27,640,835</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Budget</td>
<td>123,717,579</td>
<td>126,043,191</td>
<td>78,517,996</td>
<td>139,045,182</td>
</tr>
</tbody>
</table>

*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. For 2014 the JU continues to allow Clean Sky to fund the main part of these expenses as the new programme will not start before summer 2014. Only those expenses which can directly attributed to the Clean Sky 2 programme are budgeted in the running costs for 2014 in the CS2 budget. For 2015, this has been revised and reflects the reality of cost distribution more accurately.
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.

Since JU has a limited number of staff and this is not foreseen to increase through its own staff plan at the beginning of 2014, JU foresees to use other possibilities to have external support to its team where possible. At present this is done through interim support and through the recent tender procedure for services from the private members.

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. The JU foresees the need to rent further office space to house the extra staff to be recruited relating to CS2 which will be included in the CS2 part of the budget.

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 Farnborough in July 2014 and Paris Air Show in 2015. Other communication costs are related to organising stakeholders’ events in 2014 and 2015. 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. As some ITDs chose to use multi-annual grant agreements in 2013, they do not require significant CA in 2014 but rather re-allocate unused funds from 2012 or previous years. For all ITDs, amounts have been estimated based on the figures provided to the JU. It is expected that the latter phases of the programme will produce a second year of peak of commitments in 2014 as the ITDs move ever closer to their demonstrators. It is foreseen to sign a multi-annual agreement with GRA ITD in 2014 for the remainder of the programme while SAGE ITD sees a significant peak of funding in 2014. This is linked to the scheduled activities (see related chapter above).
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, the 2014 and 2015 ITDs estimated allocations are:

<table>
<thead>
<tr>
<th>OPERATIONAL EXPENDITURE</th>
<th>2014 Commitment Appropriations (CA)</th>
<th>2014 Payment Appropriations (PA)</th>
<th>2015 Commitment Appropriations (CA)</th>
<th>2015 Payment Appropriations (PA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMART FIXED WING AIRCRAFT</td>
<td>15,485,546</td>
<td>10,279,386</td>
<td>14,600,000</td>
<td>20,530,621</td>
</tr>
<tr>
<td>GREEN REGIONAL AIRCRAFT</td>
<td>17,202,906</td>
<td>7,323,673</td>
<td>1,035,096</td>
<td>9,952,534</td>
</tr>
<tr>
<td>GREEN ROTORCRAFT</td>
<td>12,640,872</td>
<td>7,430,478</td>
<td>12,044,092</td>
<td>9,813,731</td>
</tr>
<tr>
<td>SUSTAINABLE AND GREEN ENGINES</td>
<td>44,141,183</td>
<td>30,420,592</td>
<td>26,000,000</td>
<td>34,235,715</td>
</tr>
<tr>
<td>SYSTEMS FOR GREEN OPERATIONS</td>
<td>0</td>
<td>11,752,660</td>
<td>11,131,953</td>
<td>15,244,290</td>
</tr>
<tr>
<td>ECO-DESIGN</td>
<td>71,104</td>
<td>3,527,556</td>
<td>0</td>
<td>4,875,204</td>
</tr>
<tr>
<td>TECHNOLOGY EVALUATOR</td>
<td>0</td>
<td>1,506,321</td>
<td>2,121,165</td>
<td>2,382,321</td>
</tr>
<tr>
<td>CALLS FOR PROPOSALS</td>
<td>2,708,241</td>
<td>49,975,633</td>
<td>8,618,074</td>
<td>38,451,180</td>
</tr>
<tr>
<td>TITLE 3 - TOTAL</td>
<td><strong>92,249,851</strong></td>
<td><strong>122,216,299</strong></td>
<td><strong>78,517,996</strong></td>
<td><strong>139,045,182</strong></td>
</tr>
</tbody>
</table>

The calls for proposals budget line shows an amount of 2.7m € in 2014 which covers the increase of some Grant agreements for partners up to the published threshold values where the scope of activity implied an increase in the funding to be provided to the beneficiaries concerned and as agreed with the Joint Undertaking in those specific cases. The amount of 8.6m € showed in CA 2015 represents the amount already allocated to Calls budget line in previous years for which no project could be signed as of December 2014. As a consequence, it has to be re-entered for the last remaining projects under negotiation that will be signed in 2015.
PART B – CLEAN SKY 2 PROGRAMME
8. OVERVIEW OF THE CLEAN SKY 2 PROGRAMME

8.1. Meeting the Challenges set in Horizon 2020

As underlined in the EC Communication of July 2013, progress towards the Europe 2020 objective of investing 3% of GDP in R&D has been slow, with particular weaknesses in private investments. The Clean Sky PPP has proven effective: delivering innovations by combining efforts from public and private stakeholders. The European Aeronautics sector today accounts for nearly half of the world’s fleet in operation or on order. It is of paramount importance to the EU economy; and it helps to meet society’s needs by ensuring:

- Safe, reliable and competitive mobility for passengers, goods and public services;
- Minimal impact of aviation on the environment through key innovations;
- Significant contribution to the balance of trade, economic growth and competitiveness;
- Retention and growth of highly skilled jobs, supporting Europe’s knowledge economy.

Continued growth in demand for air travel raises new environmental and socio-economic challenges. Research and innovation has been and remains core to EU competitiveness and sustainable value creation. The long-term public-private investment made by the European Union and its Aeronautics Sector has made the industry globally competitive, allowing it to drive the innovation agenda in many areas, including environmental performance. But the new challenges identified in ACARE SRIA highlight the need for more accelerated innovation and for more far-reaching solutions. A continuation of the existing Clean Sky JTI will ensure new concepts are fully validated in order to accelerate the market adoption of step-change solutions. A continued PPP through Clean Sky 2 will deliver major gains within the key pillars defined in H2020:

- Creating resource efficient transport that respects the environment. Clean Sky 2 must finish the job of achieving the ACARE SRA goals as set for 2020.
- Ensuring safe and seamless mobility. New concepts will allow the air transport system to meet the mobility needs of citizens: more efficient use of local airports, faster connections, and reduced congestion.
- Building industrial leadership in Europe. Clean Sky 2 will help protect and develop highly skilled jobs within European aeronautics and its supply chain, including academia, ROs and SMEs; against a backdrop of significantly increased global competition.

By pursuing joint European research in breakthrough innovations and demonstrating new vehicle configurations in flight, Clean Sky 2 will position industry to invest in the development and introduction of game-changing innovations in timeframes otherwise unachievable. In doing so, it will significantly contribute to Europe’s Innovation Union.

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3 COM (2013) 494 Final: Public-private partnerships in Horizon 2020: a powerful tool to deliver on innovation and growth in Europe
8.2. The objectives of Clean Sky 2

The renewed ACARE SRIA was completed in 2012, with ambitious goals for a sustainable and competitive aviation sector. These include a 75% reduction in CO₂ emissions, a 90% reduction in NOₓ and a 65% reduction in perceived noise by 2050 compared to 2000 levels, and 4 hour door-to-door journeys for 90% of European travellers. These substantial emissions reductions and mobility goals require radically new aircraft technology inserted into new aircraft configurations. Building on the substantial gains made in Clean Sky, Clean Sky 2 aims to meet the overall high-level goals with respect to energy efficiency and environmental performance shown in the following:

<table>
<thead>
<tr>
<th></th>
<th>Clean Sky 2 as proposed*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ and Fuel Burn</td>
<td>-20% to -30% (2025 / 2035)</td>
</tr>
<tr>
<td>NOₓ</td>
<td>-20% to -40% (2025 / 2035)</td>
</tr>
<tr>
<td>Population exposed to noise / Noise footprint impact</td>
<td>Up to -75% (2035)</td>
</tr>
</tbody>
</table>

* 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).
8.3. Building on Clean Sky: the structure of Clean Sky 2

Clean Sky has demonstrated clear benefits in terms of accelerating technology development. Major developments are being made possible in different systems such as optimized wing designs, new fuselage construction concepts, energy efficient engine architectures, new flight guidance systems and ‘more electric’ on-board systems. These technological advances need to be integrated into complete aircraft to render the next generation of air vehicles more efficient and reduce emissions and noise. In addition, new vehicle configurations will have to be evaluated with flight demonstrators as they will be essential to fulfil the ambitious objectives of renewed ACARE SRIA.

Clean Sky 2 will continue to use the Integrated Technology Demonstrators (ITDs) mechanism but will also involve demonstrations and simulations of several systems jointly at the full vehicle level through Innovative Aircraft Demonstrator Platforms (IADPs). A number of key areas will be coordinated across the ITDs and IADPs through Transverse Activities where additional benefit can be brought to the Programme through increased coherence, common tools and methods, and shared know-how in areas of common interest. As in Clean Sky, a dedicated monitoring function - the Technology Evaluator (TE) will be incorporated in Clean Sky 2.

Innovative Aircraft Demonstrator Platforms (IADPs)

IADPs will aim to carry out proof of aircraft systems, design and functions on fully representative innovative aircraft configurations in an integrated environment and close to real operational conditions. To simulate and test the interaction and impact of the various systems in the different aircraft types, vehicle demonstration platforms are proposed covering passenger aircraft, regional aircraft and rotorcraft. The choice of demonstration platforms is geared to the most promising and appropriate market opportunities to ensure the best and most rapid exploitation of the results of Clean Sky 2. The “integrated IADP approach” can provide:

- Focused, long-term commitment of project partners;
- An “integrated” approach to R&T activities and interactions among the partners;
- Stable, long-term funding and budget allocation;
- Flexibility to address topics through open Call for Proposals;
- Feedback to ITDs on experiences, challenges and barriers to be resolved longer term;
- A long-term view to innovation and appropriate solutions for a wide range of issues.

Integrated Technology Demonstrators (ITDs)

In addition to the complex vehicle configurations, Integrated Technology Demonstrators (ITDs) will accommodate the main relevant technology streams for all air vehicle applications. They allow the maturing of verified and validated technologies from their basic
levels to the integration of entire functional systems. They have the ability to cover quite a wide range of technology readiness levels. Each of the three ITDs orientates a set of technology developments that will be brought from component level maturity up to the demonstration of overall performance at systems level to support the innovative flight vehicle configurations:

- Airframe comprising topics affecting the global vehicle-level design;
- Engines for all propulsion and power plant solutions;
- Systems comprising on all board systems, equipment and the interaction with the ATS

Transverse Activities

Some activities can be relevant for various IADPs and ITDs. These “Transverse Activities” do not form a separate IADP or ITD, but are an integral part of the other IADPs and ITDs. A dedicated budget will be reserved inside the concerned IADPs and ITDs to perform these activities. Leaders will be nominated for each Transverse Activity. So far, two Transverse Activities are agreed for Clean Sky 2:

- ECO-Design: life cycle optimization of the technologies, components and vehicles;
- Small Air Transport (SAT): airframe, engines and systems technologies for small aircraft, extracting synergies where feasible with the other segments.

The Technology Evaluator (TE)

A Technology and Impact Evaluation infrastructure is an essential element within the Clean Sky PPP and will be continued. Impact Assessments such as at Airport and ATS level currently focused on noise and emissions will be expanded where relevant for the evaluation of the Programme’s delivered value. Where applicable they can include the other impacts, such as the mobility or increased productivity benefits of Clean Sky 2 concepts. The TE will also perform evaluations on aircraft “Mission Level” to assess innovative long term aircraft configurations.

Membership and participation in the Clean Sky 2 Programme

Membership of Clean Sky 2 will be comprised of:

- The European Commission representing the Union and ensuring EU public policy;
- Leaders committed to achieving the full research and demonstrator activity of the Programme
- Core-Partners with a substantial long-term commitment towards the Programme

Core-Partners will be chosen through open and competitive calls, guaranteeing a transparent selection of the best membership and strategic participation. In addition, Partners, i.e. beneficiaries selected as a result of open Calls for Proposals (CfP) will carry out actions (projects) in specific topics in the scope of a well-defined limited commitment.
With 60% of funding open to competition, Clean Sky 2 will foster wide participation where SMEs, research organisations and academia interact directly with key industry stakeholders. Up to half of this 60% will be awarded to Core Partners who will join the JU as Members, ensuring the long term Programme stability needed to meet the relevant ACARE Goals. Clean Sky 2 is expected to involve at least 800 participants from the European aeronautics players and also new entrants in this field.

**From Clean Sky to Clean Sky 2: the principles of transition**

A phased approach will be taken to the start-up of Clean Sky 2 projects. In very broad terms, in the first 4 years Clean Sky developed and demonstrated technologies up to TRL4-5. From there on a selection of the most promising and mutually additive technologies are now being subsequently taken to TRL6 system level demonstration, by 2016. In some specific cases, Clean Sky ITDs will bring a small number of high-potential - but less mature - technologies up to TRL4 through a focused effort during the 2014-17 period. These will not be validated at TRL6 within Clean Sky but can be good candidates for continuation in Clean Sky 2.

Many Clean Sky 2 IADPs will use results from Clean Sky as a start towards integration studies in the 2014-2017 timeframe. Clean Sky or Clean Sky 2 ITD level outputs will form key inputs into the configuration and content of demonstrations.

The activities within Clean Sky will be pursued until completion according to plan. Then the technology integration may be launched in a Clean Sky 2 IADP or, if the maturity at this point is deemed not sufficient for integration, the technology development will be continued as part of the relevant ITD. An IADP may start in Clean Sky 2 while some of the integrated technologies have not yet passed the final validation tests. The architecture and configuration trade-off studies can be launched in an IADP as soon as the specifications and interfaces of the components and subsystems to be integrated can be frozen. Consequently, the activities within Clean Sky ITDs can be completed according to their own work plan at the latest in 2016 while new activities are launched within Clean Sky 2 ITDs and IADPs according to a staggered schedule starting in 2014, the start of Horizon 2020, at the earliest.
8.4. **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.
8.5. Overview of the Programme Research and Demonstration Activities

1) Large Passenger Aircraft IADP

The Large Passenger Aircraft IADP approach builds on the positive experience in Smart Fixed Wing Aircraft (SFWA) in Clean Sky. The Airbus A340-300 based BLADE laminar wing flight test demonstrator, the Airbus A340-600 based CROR demo engine flying test-bed and two different Dassault Falcon-based low speed and load control flight tests under preparation in Clean Sky will provide unique contributions towards maturing technologies for application in next generations of aircraft.

For Clean Sky 2, the Large Passenger Aircraft goal is highTRL demonstration of the best technologies to accomplish the combined key ACARE goals with respect to the environment, fulfilling future market needs and improving the competitiveness of future products. The setup of the main programme objectives is to further push the value of technologies tackled in Clean Sky, e.g. the integration of CROR propulsion systems, and to add the validation of additional key technologies like hybrid laminarity for the wing, horizontal and vertical tail plane as well as an all-new next generation fuselage cabin and cockpit-navigation suite validated at integrated level with large scale demonstrators in operational conditions.

The focus is on large-scale demonstration of technologies integrated at aircraft level in three distinct ‘Platforms’:

- **Platform 1 “Advanced Engine and Aircraft Configurations”** will provide the environment to explore and validate the integration of the most fuel efficient propulsion concept for next generation short and medium range aircraft, the CROR engine. Large scale demonstration will include extensive flight testing with a full size demo engine mounted to the Airbus A340-600 test aircraft, and a full size rear end structural ground demonstrator. Two demonstrators are planned to mature the concept of “hybrid laminarity” targeting for a substantial aerodynamic drag reduction for next generation long range aircraft. A further demonstration is planned for a comprehensive exploration of the concept of dynamically scaled flight testing. The target is to examine the representativeness of dynamically scaled testing for technology demonstration with highly unconventional aircraft configuration, which means flight test demonstrations that are virtually impossible with modified “standard” test aircraft.

- **Platform 2 “Innovative Physical Integration Cabin – System – Structure”** aims to develop, mature, and demonstrate an entirely new, advanced fuselage structural concept developed in full alignment towards a next generation cabin-cargo architecture, including all relevant principle aircraft systems. To be able to account for the substantially different requirements of the test programs, the large scale demonstration will be based on three individual major demonstrators. A lower centre section fuselage and one “typical” fuselage stretching from aft of the center section to the pressure bulkhead will be developed, manufactured and tested with focus on loads and fatigue aspects. A further “typical” fuselage demonstrator will be dedicated to integrate and test a next generation of
large passenger aircraft cabin and cargo. A number of smaller test rigs and component demonstrators will also be part of the Programme in the preparatory phase. Targeting to accomplish technology readiness level 6, manufacturing and assembly concepts for the next generation integrated fuselage-cabin-cargo approach will be developed and demonstrated.

- **Platform 3 “Next Generation Aircraft Systems, Cockpit and Avionics”** has a clear focus to develop and demonstrate a next generation cockpit and navigation suite. Based on the results of a number of research programmes which are currently ongoing or to be started shortly, platform 3 shall allow the Programme to integrate and validate all functions and features which are emerging from individual developments into a disruptive new concept in a major demonstrator suite. With the core of platform 3 being a major ground based demonstrator, selected features and functions will be brought to flight test demonstration. The scope of platform 3 will cover the development of a new next generation cockpit concept, a rethinking towards a “function” based cockpit to operate the aircraft, specifically including all navigation and flight guidance features and function required to incorporate next generation flight and trajectory management capabilities.

2) **Regional Aircraft IADP**

Regional aircraft are a key element of *Clean Sky* through a dedicated ITD - Green Regional Aircraft (GRA), providing essential building blocks towards an air transport system that respects the environment, ensures safe and seamless mobility, and builds industrial leadership in Europe. In *Clean Sky 2* the Regional Aircraft IADP will bring the integration of technologies to a further level of complexity and maturity than currently pursued in *Clean Sky*. The goal is to integrate and validate, at aircraft level, advanced technologies for regional aircraft so as to drastically de-risk their integration on future products.

The following demonstration programmes for regional aircraft a/c are currently foreseen:

- 2 Flying Test-beds (to minimize the technical and programme risks) using modified existing regional TP a/c with underwing mounted engines, for demonstration campaigns of: air vehicle configuration technologies; wing structure with integrated systems and propulsion integration; flight dynamics, aerodynamic and load alleviation; advanced flight controls and general systems, and avionics functionalities.
- 5 Large Integrated Ground Demonstrators: full-scale wing, full-scale cockpit; full-scale fuselage and cabin; all including their associated systems; flight simulator; iron bird. In addition a Nacelle ground demonstrator will be done in the Airframe ITD.

Full-scale demonstrations, with acceptable risk and complexity but still providing the requested integration, are essential to allow the insertion of breakthrough technologies on regional aircraft entering into service from 2025. The individual Technology Developments are arranged along with 8 “Waves” and several individual roadmaps. These technology
waves will be developed through roadmaps defined to satisfy the high-level requirements of the future Highly-Efficient Next Generation Regional Aircraft, the configuration of which will be developed at conceptual level in a dedicated work package. To increase synergies and cross fertilization across the different ITDs and IADPs some of the above technological roadmaps will be shared with the “streams” of the Airframe ITD and with the developments of sub-systems and systems planned inside Systems and Engine ITD. The Demonstration Programme will be divided into technologically compatible and “scope close” demonstrations sub-programmes:

- **FTB1 - Innovative Wing and Flight Controls (Regional IADP):** Integration and flight testing of technologies suitable to regional aircraft applications for a new generation wing and advanced flight control systems. Innovative wing related systems and wing structural solutions will also be incorporated where feasible. Aerodynamic enhancements and LC&A features will be considered to complement FTB2, such as: outboard wing featuring laminar airfoils for skin friction reduction; high A/R by means of adaptive/innovative winglets.

- **FTB2 - Flight Demonstration of a high efficient and low noise Wing with Integrated Structural and related Systems solution, including power plant aspects (Regional IADP):** A new wing will be designed, manufactured and equipped with new structural solutions strongly integrated with advanced low power and high efficient systems such as ice protection, fuel, flight control, engine systems, LE and winglets morphing.

- **Full-scale innovative fuselage and passenger cabin (Regional IADP):** Integration and on-ground testing of a full scale innovative fuselage and passenger cabin including all the on board systems and advanced solutions for increasing passenger comfort and safety. The fuselage will be a full scale demonstration of technologies for composite material, structures and manufacturing aimed to weight and cost reduction and to minimize the environmental impact through eco-design and energy consumption optimization all along the life-cycle (towards a zero-impact).

- **Flight Simulator (Regional IADP):** Starting from the Clean Sky GRA Flight Simulator, an advanced Flight Simulator will be set up and used to demonstrate new cockpit interaction concepts as well as advanced avionics functionalities.

- **Iron Bird (Regional IADP):** Virtual and Physical “Iron Birds” will also be an important part of the Regional A/C Ground Demonstration Programme. These will be used to integrate, optimize and validate the systems modification of the Flying Test Bed and the results of their simulations and ground testing will be essential to achieve the permit-to-fly.

- **Ground Demonstration of the wing (Airframe ITD),** including the airframe and the related systems.

- **Ground Demonstration of the Cockpit (Airframe ITD),** including the structure and related system.

- **Nacelle ground demonstration (Airframe ITD).**
3) Fast Rotorcraft IADP

The Fast Rotorcraft IADP consists of two concurrent demonstrators, the Tiltrotor demonstrator and the Compound Rotorcraft demonstrator along with transversal activities relevant for both fast rotorcraft concepts.

- **Joint activities:**

  These activities cover the methodology for technology evaluation of fast rotorcraft demonstrations and the Eco-Design concept implementation, along with the programme management activities for the Fast Rotorcraft IADP.

  Concerning the methodology for technology evaluation, the activities will allow defining SMART objectives and criteria adapted to the fast rotorcraft missions in line with the general TE approach for *Clean Sky 2*. In addition, 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.

  Concerning Eco-Design concept implementation, the activities will allow coordinating approaches and work plans in the two demonstration projects regarding the greening of rotorcraft production processes and ensuring complementarity of case studies. The general Life Cycle Assessment approach will be coordinated with the participants of the Eco-Design TA.

- **The Tiltrotor demonstrator NextGenCTR:**

  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. NextGenCTR’s demonstration activities will aim at validating its architecture; technologies/systems and operational concepts. Demonstration activities will show significant improvement with respect to current Tiltrotors’ state-of-the-art. The project will also allow to develop substantial R&T activities to increase the know-how about a new platform like a tiltrotor (not yet certified as a civil aircraft), and to generate a research and innovation volume of activities above a certain critical mass (not available today for Tiltrotors within EU), somewhat comparable to that of well proven conventional helicopter platforms.

  NextGenCTR will continue and further develop what has been initiated in Clean Sky, and launch new activities specific to Clean Sky 2 and NextGenCTR project. In the area of CO2 emissions reduction, NextGenCTR will continue/develop engine installation and flight trajectories optimisation (this is now done by analytical models and with scaled model tests, whereas Clean Sky 2 will validate it at full scale), while specific Clean Sky 2 new activities on drag reduction of the prop-rotor and airframe fuselage and wing will be necessary (due to a new generation of prop-rotor, modified fuselage-wing architecture). This latter Clean Sky 2 specific topic will also be related to operation costs reduction to
address competitiveness of the architecture and solutions adopted. The new prop-rotor will require substantial research (aero-acoustics, by modelling/ by tests) to reduce noise emissions (then validated at full scale); in the current Clean Sky, noise reduction is mainly addressed through trajectories optimisation (that will anyhow continue in Clean Sky 2 and will be linked to SESAR concepts where necessary). Clean Sky 2 transversal subjects will cover new material (e.g. thermoplastics, surface treatments, less hydraulics and more electrical systems) validating them at full scale and in real operational conditions, and sustain the development of the Technology Evaluator for the case of the tiltrotor (today not widely considered).

Parameters need to be defined to show Clean Sky 2 achieved progress according to a specific tiltrotor roadmap (a direct comparison with conventional helicopter architecture seems not appropriate as the two configurations must be regarded as substantially different types of rotary-wing platforms). Today, certified Tiltrotors are not available in the civil sector (while only one product is available in the military); hence, a database from which baseline information for the current state-of-the-art can be extracted is not available. Therefore, ‘key performance parameters’ (KPP) will be introduced to show NextGenCTR’s progress with respect to reference data taken as baseline (mainly referring to technologies which have been tested or conceptually designed in the period 2005-2012). Objectives will be defined considering tiltrotor specificities and in line with the main pillars of Horizon 2020 towards a Smart, Green and Integrated Transport and Clean Sky 2 which addresses environmental compatibility (Greening Objectives), competitiveness (Industrial Leadership) and mobility. Considerable attention to the project’s impact on EU Economy and Jobs creation will be considered, to confirm and further sustain a steady growth of the sector with regard to revenues, workforce productivity, high rate of new employment (in particular of higher educated personnel) and R&D expenditure.

• The Compound Rotorcraft demonstrator:

The LifeRCraft project aims at demonstrating that the compound rotorcraft configuration implementing and combining cutting-edge technologies as from the current Clean Sky Programme opens up new mobility roles that neither conventional helicopters nor fixed wing aircraft can currently cover in a way sustainable for both the operators and the industry. The project will ultimately substantiate the possibility to combine in an advanced rotorcraft the following capabilities: payload capacity, agility in vertical flight including capability to land on unprepared surfaces nearby obstacles and to load/unload rescue personnel and victims while hovering, long range, high cruise speed, low fuel consumption and gas emission, low community noise impact, and productivity for operators.

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 Technology Readiness Level 6 at whole aircraft level in 2020. The project is based on:
- identified mobility requirements and environmental protection objectives;
- lessons learnt from earlier experimentation with the low scale exploratory aircraft X3;
- technology progress achieved for rotorcraft subsystems on one side through participation to Clean Sky projects and other research activities at EU or local level;

The individual technologies from the first Clean Sky Programme (Green Rotorcraft ITD, Smart Green Operations ITD, Eco-Design ITD) that will be further matured and integrated in this LifeRCraft demonstration concerns:

- New rotor blade concepts aiming rotor blade concepts aiming at improved lifting efficiency and minimum noise esp. through 3D-optimised shape; the methodology and computational tools required for such optimization;
- Airframe drag reduction through shape modifications and interference suppression;
- Engine intake loss reduction and muffling;
- Innovative electrical systems e.g. brushless generators, high voltage network, efficient energy storage and conversion, electrical actuation designed for weight and on-board energy savings;
- Eco-Design approach, with substitution of harmful materials by new ones and green production techniques, demonstrated for specific rotorcraft components;
- Helicopter fly-neighbourly demonstration based on new flight guidance function and specific approach procedures in both VFR conditions and ATM, SESAR-compliant;

This LifeCraft project essentially consists of the following main activities and deliveries:

- **Airframe structure and landing system**: Advanced composite or hybrid metallic/composite construction, featuring low weight and aerodynamic efficiency;
- **Lifting rotor and propellers**: Low drag hub, pylon and nacelles, 3D-optimized blade design;
- **Drive train and power plant**: New drive train architecture and engine installation optimised for the LifeRCraft configuration;
- **On board energy, cabin and mission systems**: Implementation of the more electrical rotorcraft concept to minimise power off-takes from the engines and drive system;
- **Flight control, guidance and navigation**: Smart flight control exploiting additional control degrees of freedom inherent to LifeRCraft configuration for best fuel economy and quieter flight;
- **LifeCraft Demonstrator overall design, integration and testing**: All coordination and cross cutting activities relevant to the whole vehicle delivering a full range of ground & flight test results and final conclusion.
4) **Airframe ITD**

Aircraft level objectives on greening, industrial leadership and enhanced mobility, and the fulfilment of future market requirements and contribution to growth cannot be met without strong progress on the airframe. A more efficient wing with natural laminar flow, optimised control surfaces and control systems will be demonstrated in Clean Sky. Also, novel engine integration strategies will have been derived and tested, and innovative fuselage structures investigated.

Altogether strong progress towards the 2020 targets will have been obtained when *Clean Sky* is completed (estimated at 75% of the relevant part of the initial ACARE goals, applicable to aircraft with an EIS from 2020/22). However further progress is required on the most complex and challenging requirement on new vehicle integration to fully meet the 2020 objective, and to progress towards the 2050 goals. To make this possible, different directions are proposed. All of these directions of progress will be enabled throughout the foreseen execution of 9 major Technology Streams:

- **Innovative Aircraft Architecture**, to investigate some radical transformations of the aircraft architecture.
  The aim of this Technology Stream is to demonstrate the viability of some most promising advanced aircraft concepts (identifying the key potential showstoppers & exploring relevant solutions, elaborating candidate concepts) and assessing their potentialities.

- **Advanced Laminarity** as a key technological path to further progress on drag reduction, to be applied to major drag contributors: nacelle and wing;
  This Technology Stream aims to increase the Nacelle and Wing Efficiencies by the mean of Extended Laminarity technologies.

- **High Speed Airframe**, to focus on the fuselage & wing step changes enabling better aircraft performances and quality of the delivered mobility service, with reduced fuel consumption and no compromise on overall aircraft capabilities (such as low speed abilities & versatility).

- **Novel Control**, to introduce innovative control systems & strategies to gain in overall aircraft efficiency. The new challenges that could bring step change gains do not lay in the optimisation of the flight control system component performing its duty of controlling the flight, but in opening the perspective of the flight control system as a system contributing to the global architecture optimization. It could contribute to sizing requirements alleviations thanks to a smart control of the flight dynamics.

- **Novel Travel Experience**, to investigate new cabins including layout and passenger oriented equipment and systems. The cabin interiors progress is indeed on the path of all societal challenges of the future transport system:
  - As a key enabler of product differentiation,
  - As having an immediate & direct physical impact on the traveller,
  - As having a great potential in terms of weight saving & eco-compliance.

- **Next Generation Optimized Wing Boxes**, leading to progress in the aero-efficiency and the ground testing of innovative wing structures;
The challenge is to develop and demonstrate new wing concepts (including architecture) that will bring significant performance improvements (in drag & weight) while improving affordability and enforcing stringent environmental constraints.

- **Optimized High Lift Configurations**, to progress on the aero-efficiency of wing, engine mounting & nacelle integration for aircraft who needs to serve small, local airports thanks to excellent field performances.

- **Advanced Integrated Structures**, to optimize the integration of systems in the airframe along with the validation of important structural advances and to make progress on the production efficiency and manufacturing of structures.

- **Advanced Fuselage** to introduce innovation in fuselage shapes and structures, including cockpit & cabins. New concepts of fuselage are to be introduced to support the future aircrafts and rotorcrafts. More global aero structural optimizations can lead to further improvements in drag & weight in the context of a growing cost & environmental pressure, including emergence of new competitors.

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 above 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 towards **High Performance & Energy Efficiency (HPE)**;

- Activity Line 2: Demonstration of airframe technologies focused toward **High Versatility and Cost Efficiency (HVE)**.
5) Engines ITD

In Clean Sky the industry leaders committed to build and test five engine ground demonstrators covering all the civil market. The goals were to validate to TRL 6 a 15% reduction in CO\textsubscript{2} compared to 2000 baseline, a 60% reduction in NO\textsubscript{X} and a 6dB noise reduction. This is roughly 75% of the ACARE objectives. Following the worst economic downturn and the consequent changes to market assumptions Clean Sky’s SAGE has adjusted its content to ensure these goals remain achievable. Apart from the consequent delay to the open rotor programme which means that TRL6 is not possible by 2016, the bulk of SAGE objectives remain on track. An open rotor ground demonstrator will run and confirm the CO\textsubscript{2} objective, a lean burn combustion ground demonstrator will run to confirm the NO\textsubscript{X} objective and a GTF will run to confirm the CO\textsubscript{2} improvements and noise advantage of such a configuration. An advanced turbo-shaft engine has already run to ensure the environmental goals extend across the whole market while SAGE 3 has run for the first time to validate the cost and weight advantages of an advanced dressings configuration. The original plans for the open rotor from both Airbus and the engine manufacturers had to be revised and require further work to confirm both the advantages and credibility of this novel concept.

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

- **Open Rotor Flight Test, 2014-2019:** A 2nd version of a Geared Open Rotor demonstrator carrying on Clean Sky SAGE 2 achievements and aimed to validate TRL 6 will be tested on ground and then on the Airbus A340 flying test bed (see IADP LPA Programme). From initial SAGE 2 demonstrator some engine modifications aimed to various improvements, control system update, and engine/aircraft integration activities will be necessary.

- **Ultra High Propulsive Efficiency (UHPE) demonstrator addressing Short / Medium Range aircraft market, 2016-2022:** Design, development and ground test of a propulsion system demonstrator to validate the low pressure modules and nacelle technology bricks necessary to enable an Ultra High By-pass Ratio engine (e.g. advanced low pressure fan, innovative nacelle modules, gearbox, pitch change mechanism if any, high speed power turbine). This ground demonstrator will be built around an existing high pressure core.

- **Business aviation / Short range regional Turboprop Demonstrator, 2014-2019:** Design, development and ground testing of a new turboprop engine demonstrator in the 1800-2000 shp class. Base line core of ARDIDEN3 will be improved specifically for turboprop application (compressor up-date, combustion chamber, power turbine) and then integrated with innovative gear box, new air inlet and innovative propeller.
• **Advanced Geared Engine Configuration (HPC and LPT technology demonstration), 2015-2020:** Design, development and ground testing of a new demonstrator to validate key enablers to reduce CO\textsubscript{2} emissions and noise as well as engine weight. Key elements are: improvement of efficiencies, reduction of parasitic energy flows, innovative lightweight and temperature resistant materials, low pressure turbine and exhaust noises reduction.

• **Very High Bypass Ratio (VHBR) Large Turbofan demonstrator, 2014-2019:** Design, development, building, ground testing and flight testing of an engine to demonstrate key technologies on a scale suitable for large engines. An existing engine will provide the core gas generator used for the demonstrator. Key technologies included in this demonstrator will be: integrated low pressure system for a high power very-high bypass ratio engine (fan, compressor, gearbox, LP turbine, VAN), Engine core optimisation and integration, and optimised control systems.

• **Very High Bypass Ratio (VHBR) Middle of Market Turbofan technology, 2014-2018:** Development and demonstration of technologies in each area to deliver validated powerplant systems matured for implementation in full engine systems. Research and demonstration will require the following: behaviour of fans at low speeds and fan pressure ratios and structural technology, aerodynamic and structural design of low pressure turbines for high speed operation, Systems Integration of novel accessory and power gearboxes, optimised power plant integration, Compressor efficiency, and control & electrical power system technology developments.

• **The Small Aero-Engine Demonstration** projects related to SAT [Small air Transport] 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. As the demonstration project on business aviation and short-range regional turboprop aircraft (see above) will demonstrate the reliability and efficiency gains in small turbine engines, this area in the Engines ITD will focus on light weight and fuel efficient diesel engines (including the potential exploitation of the 300 kW helicopter engine launched through a CfP under the current Clean Sky); and potential hybrid engine architectures (piston/electric engine). In addition (within the overall SAT project scope), the development and use of low-noise, highly efficient propellers (aimed at hybrid engine, small turbines, diesel engines) will be undertaken.
6) **Systems ITD**

While systems and equipment account for a small part of the aircraft weight and environmental footprint, they play a central role in aircraft operation, flight optimisation, and air transport safety at different levels:

- Direct contributions to environmental objectives: optimised green trajectories, electrical taxiing, more electrical aircraft approach, and have a direct impact on CO\(_2\) emissions, fuel consumption, perceived noise, air quality, weight gain.
- Enablers for other innovations: for example, bleedless power generation, actuators, are necessary steps for the implementation of innovative engines or new aircraft configurations.
- Enablers for air transport system optimisation: many of the major improvements identified in SESAR, NextGen and *Clean Sky* for greening, improved mobility or ATS efficiency can only be reached through the development and the integration of on-board systems such as data link, advanced weather systems, trajectory negotiation, and flight management predictive capabilities.
- 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: kW/kg, flux/dm\(^3\) are key indicators of systems innovation.

In *Clean Sky*, the Systems for Green Operations ITD has developed solutions for more efficient aircraft operation. Further maturation and demonstration as well as new developments are needed to accommodate the needs of the next generations of aircraft. In addition, the systemic improvements initiated by SESAR and NextGen will call for new functions and capabilities for environmental or performance objectives, but also for flight optimisation in all conditions, flight safety, crew awareness and efficiency, better maintenance, reduced cost of operations and higher efficiency. Finally, framework improvements will be needed to allow for more efficient, faster and easier-to-certify development and implementation of features and functions.

The Systems ITD in *Clean Sky* 2 will address these challenges 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 toTRL 5). The main technological domains to be addressed are cockpit environment and mission management, computing platform and networks, innovative wing systems (WIPS, sensors, and actuators), landing gears and electrical systems. Other contributive activities are foreseen and will be carried on by core partners and partners. The outcome of these developments will be demonstrated systems ready to be customized and integrated in larger settings. An important part of this work will be to identify potential synergies between future aircraft at an early stage to reduce duplication.
• Customisation, integration and maturation of these individual systems and equipment in IADPs demonstrators. This will enable full integrated demonstrations in IADPs 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. Examples of these transverse actions can be development framework and tools, simulation, incremental certification, integrated maintenance, eco-design etc.

7) **Small Air Transport (SAT) 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 includes more than 40 industrial companies (many of which SMEs) accompanied by dozens of research centres 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 organizations.

The approach builds on accomplished or running FP6/FP7 projects. Key areas of societal benefit that will be addressed are:
• Multimodality and passenger choice
• ore safe and more efficient small aircraft operation
• 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 strong co-ordinating and transversally integrating leadership from within a major WP in Airframe ITD.
8) **Eco-Design Transverse Activity**

Eco-Design will research for a roadmap of excellence, to give high (European) individuality in quality and eco-compliance in the aeronautics vehicles\(^4\), in their whole product life. Eco-Design is reshaped from the former two domain concept – “Airframe” and “Systems” – to transformed, interfacial sub-activity areas that are more open and entrepreneurial. These are:

- The Eco-Design Analysis (EDAS) activity for next concept (full) REcycle and commensurate Eco-Design Life.
- All pillars of life value are addressed, beyond the conventional “cradle to grave” philosophy, to stimulate better RE-Use options and new, best know-how service options, embracing all the supply chain and OEM actors. Eco-Design Analysis is a knowledge & responsibility empowerment, addressing more widened stakeholder suitability. It shall open up a new supplier/SME interaction basis, and will serve better to grasp full *ground pollution*\(^5\) issues and catalyse more clean and efficient processes for improved economic and societal return.
- Eco-Design principles should be owned by all new programmes and contributors to them. The analysis shall program Eco-Design as enthusiasm value partner for user benefit analyses of the IADP/ITD (acceptance and repeatability, ergonomics and flair, competitive edge value, ecological and economic asset improvement).
- The Vehicle Ecological, Economic Synergy (VEES) activity, that is driven from Materials, Processes, Resources (MPR) innovations, secondly from the assimilation of cooperative modules from the ITD/IADP demonstrators with an adaptive Eco Hybrid Platform (EHP), which is totally “LCA+” (Life Cycle Analysis-plus) design driven and an open platform on the level of complete vehicles. This is networked with clustered REcycle for REuse ground facility realisations. LCA+ is used as a receiving-end methodology from the developing Design for Environment (DfE) vision. Eco-Design work units inside the sub-activities give a practical footing, always relating to the *Eco-Design Life and REcycle* theme reference, see below this section, tracked by the transversal coordination. Eco-Design ensures a collective vision of these themes on-board the various ITD/IADP technology streams.

“Eco Architectures”, as one example, covers the main eco-footprint impact on the vehicle from systems performance and indirect energy, water etc. consumption. Close co-operation for these outputs from the major physical benches (electrical, consumer heat output, etc.) will be incorporated. ITD/IADP advanced optimisation methodologies, special physical frame architecture concepts such as next Thermal Frame Benches, Fluid Management Benches etc. will help new *interface trade-offs research*, that fortifies the straight-to-the-point ecolonomics in energy, water/air footprints results.

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\(^4\) Includes also Engine and Systems, and regardless of aircraft, rotorcraft frame definition.

\(^5\) Global Warming Potential of substances equated to CO\(_2\)-impact, negative potentials on health and bio diversity, depletion of resources, primary energy demand.
In the work units’ concept, ECOTech units of clear universal issues (e.g. on corrosion, surface treatments, fire, contamination etc.) will be implemented. Eco-Design will upkeep a sophisticated MPR-Database suitable for aeronautics from the initial Clean Sky achievement, offer technical workshops for exchange on LCA, the discourse on DfE, REACH, RoHS, evolving European Standards impacts (indirect water consumption etc.), on concerns such as primary energy demand in production with cost knock-on.

A deeper Eco-Design Statements (ES) concept will ensure the best developed Eco-Design recommendation guidelines come from these collaborative sub-activity areas. Stakeholder balanced consultation and user benefit analyses in the so-called ecolonomic harmonisation process will be exercised on different micro-economic tiers with industrialization scoping to produce well backed socio-economic derivative data; this includes quality labour growth impacts or remedial volumes to tackle and suppress any ground pollution sensitivities. The closure on its material flow and logistics’ output is given through close co-operation with TE in the ITD/IADP top level aggregate delivery.

Eco-Design delivery focuses on quality, eco-compliance and processes whereas the ITDs/IADPs are front lining the TRL-maturity in the technology streams with component application identity. Together, this will raise the technology strengths in the new Clean Sky 2 Programme.

Eco-Design will deliver success by:

- demonstrating Eco-Design interaction through the ITD/IADP (through shared components contributing to process optimality and eco-compliance up to a/c level),
- bringing all the ITD/ IADPs really on board, for instance for the Eco Statements (ES) having consistent and validated process improvements for the technology take-up into big impact technology pathways,
- generating master scientific approaches to match eco-quality and -compliance to high technology readiness promoted through the ITD/IADP,
- creating user enthusiasm value feed-back through Eco-Design principles
- reducing down-cycling, no-future technology down-selection and withdrawal menaces.
- MPR database enhancing EU competitiveness dimension.

Key Eco-Design & REcycle themes:

Identification and Life Information Strategy (not a copy of SHM), MPR, manufacture & production, services to component and system (MRO, Finances/IT Know-How, limited life and extended life integration, inside-outside gate synergy processes), Integration/field-assembly-disassembly-separation, RE-Use, End of Life, Alternative Sectoral Applications, Use Phase (TE feed-back, vehicle utilization closure; eco-values).
9) Technology Evaluator

A Technology and Impact Evaluation project organization and infrastructure was and remains an essential element within the Clean Sky PPP, and will be continued. 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 and agreed jointly within the JU Membership they may be expanded to include other relevant environmental or societal impacts, such as mobility benefits or increased productivity.

The analysis of single or logically grouped core technologies on system / vehicle level will be embedded within the IADPs and ITDs, with the TE taking an integrative and ‘synthetic’ approach focusing on the relevance of the Clean Sky 2 output on the Aviation Sector and simulating Air Transport System Impacts. Therefore, the core aircraft performance characteristics (at the so-called ‘mission level’) will be reported by the IADPs, with clear assigned responsibilities, resource and project tasks embedded in each IADP. Reporting the mission level aircraft capability will reside under the responsibility of the leading company. The IADPs will provide verification and validation of the performance modelling, so as to certify validity of performance predictions. Impact Assessment will be the responsibility of the TE / Impact Evaluator and will focus on aggregate impacts.

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 aircrafts’ 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.

Finally, the progress of each demonstration platform (ITDs and IADPs) will be monitored against the defined environmental and socio-economic benefits and targets via an efficient and effective interfacing between the TE and the ITDs and IADPs. For this, dedicated work packages in the TE (WP2) as well as in the ITDs and IADPs are intended.

In summary, the Technology Evaluator consists of three major tasks:

- Progress Monitoring of Clean Sky 2 achievements vs. defined environmental and societal objectives;
- Evaluation at Mission Level by integrating particular ITD outputs into TE concept aircraft / rotorcraft models;
- Impact Assessments at Airport and ATS Level using IADPs and TE's concept aircraft / rotorcraft models.
8.6. Summary of Major Demonstrators and Technology Developments

The table below summarizes the major demonstrators and technology developments foreseen over the life of the Programme. Supporting activities not directly embedded into a demonstrator are listed separately. The funding required for the running costs of the Joint Undertaking as well as for the Technology Evaluator are taken into account through a dedicated budget calculated in accordance with the CS2 Statutes. For the Eco-Design and Small Air Transport Transverse Activities the funding is embedded within the IADPs and ITDs funding amounts.

Note activities highlighted as follows: these are currently under further preparation and revision and will be subject to a Technical Evaluation.

<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
<th>Reference Chapter</th>
<th>Complete by</th>
<th>ROM EC funding (in M€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Passenger Aircraft</td>
<td>Advanced Engine Design &amp; Integration for Large Passenger Aircraft</td>
<td>CROR demo engine flight test demo</td>
<td>CROR performance noise, vibration</td>
<td>6.5.2</td>
<td>2020</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced engine integration driven fuselage ground demonstrator</td>
<td>CROR structure and system integration Full CFRP fuselage</td>
<td>6.5.3</td>
<td>2020</td>
<td>39</td>
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<tr>
<td></td>
<td></td>
<td>Validation of dynamically scaled integrated flight testing</td>
<td>Potential unique enabler for demo of advanced a/c configuration at full aircraft level</td>
<td>6.5.4</td>
<td>2020</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Advanced Laminar Flow Rig Reduction for Large Passenger Aircraft</td>
<td>HLFC large-scale specimen demonstrator in flight operation</td>
<td>Aerodynamic drag reduction through laminar flow for L/R aircraft at high transonic speed</td>
<td>6.5.5</td>
<td>2020</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High speed demonstrator with hybrid laminar flow control wing</td>
<td>Aerodynamic drag reduction through laminar flow for L/R, high transonic speed</td>
<td>6.5.5</td>
<td>2020</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Innovative Aircraft Configuration and</td>
<td>Applied Technologies for Enhanced Aircraft Performance</td>
<td>Development of enabling technologies for enhanced A/C performance</td>
<td>6.5.6</td>
<td>2020</td>
<td>18</td>
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<tr>
<td>IADP / ITD</td>
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<tr>
<td></td>
<td>Operation</td>
<td>Demonstration of advanced short-medium range aircraft configuration</td>
<td>Demo of a target a/c configuration with combinations of disruptive technologies</td>
<td>6.5.7</td>
<td>2020</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Innovative Cabin &amp; Cargo Systems and Fuselage Structure Integration for Large Passenger Aircraft</td>
<td>Full-scale advanced fully integrated fuselage cabin &amp; cargo demonstrator</td>
<td>Cabin functionalities, advanced networks for energy and data transfer</td>
<td>6.6.2</td>
<td>2020</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Next generation lower centre-fuselage structural demonstrator</td>
<td>Advanced fuselage structure fully integrated the next generation wing and main landing gear concept</td>
<td>6.6.3</td>
<td>2020</td>
<td>37</td>
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<tr>
<td></td>
<td>Next generation large module fuselage structural demonstrator</td>
<td>Advanced fuselage architecture fully integrated next generation cabin &amp; cargo concepts and systems</td>
<td>6.6.3</td>
<td>2020</td>
<td>34</td>
<td></td>
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<tr>
<td></td>
<td>Next Generation Aircraft Systems, Cockpit and Avionics</td>
<td>LPA-03-1 Enhanced Flight Operations and Functions</td>
<td>Development of functions and solutions enabling easier control of the aircraft, on-board systems, and improved man-machine efficiency</td>
<td>6.7.3</td>
<td>2020</td>
<td>17</td>
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<td></td>
<td>LPA-03-2 Innovative enabling technologies</td>
<td>Development of innovative technologies in radio communication, ground support to the crew and in avionic components</td>
<td>6.7.4</td>
<td>2020</td>
<td>13</td>
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<td>LPA-03-3 Next generation cockpit functions flight demonstration</td>
<td>Cockpit related technologies demonstrated in flight environment</td>
<td>6.7.5</td>
<td>2022</td>
<td>18</td>
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<td></td>
<td>LPA-03-4 Enhanced Cockpit demonstration</td>
<td>Demonstration of integration of novel functions/equipment in overall cockpit</td>
<td>6.7.6</td>
<td>2020</td>
<td>14</td>
<td></td>
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<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
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|            |                  | LPA-03-5 Disruptive Cockpit demonstration | Demonstration of new cockpit concept:  
- new crew resource paradigm  
- integrated cockpit design  
- functional organisation and architecture  
- technology enablers (functions, equipments) | 6.7.7 | 2023 | 34 |
<p>|            |                  | LPA-03-6 Maintenance service operations enhancement demonstrator | Demonstration of the technical and economic maturity and performance of a value and service oriented architecture and its enablers: | 6.7.8 | 2019 | 12 |
| Large Passenger Aircraft |                  |                                   |              | Total: | 518 |</p>
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
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<tbody>
<tr>
<td>Regional Aircraft</td>
<td>Highly Efficient Low Noise Wing Design for Regional Aircraft</td>
<td>Air Vehicle Technologies – Flying Test Bed#1 (FTB1)</td>
<td>Low noise and high efficient HLD, NLF, Active LC&amp;A, Innovative wing structure and systems</td>
<td>7.5.3 (I)</td>
<td>2021</td>
<td>22</td>
</tr>
</tbody>
</table>
| Regional Aircraft | Innovative Passenger Cabin Design & Manufacturing for Regional Aircraft          | Full scale innovative Fuselage and passenger Cabin     | – Advanced High-toughness materials  
– Highly integrated structural concepts  
– SHM for damage detection and condition based maintenance  
– Advanced low-cost manufacturing  
– Highly automated assembly  
– Human centered cabin design  
– All electric/smart Systems integration | 7.5.2 (III)  
7.5.3 (II)   | 2021        | 31                     |
| Regional Aircraft | Advanced for Regional Aircraft:  
1. Power Plant  
2. Flight Simulator  
3. Iron Bird       | WTT for Configuration of Next Generation Hi-Efficient Regional A/C  
Flight Simulator  
Iron Bird          | Innovative configuration, advanced powerplant integration, efficient technologies insertion at A/C level  
New cockpit interaction concepts, advanced avionics functionalities (including pilot workload reduction) , MTM (green functions in a global environment)  
Innovative systems integration, Next generation flight control systems (H/W and pilot in the loop) | 7.5.1          | 2020        | 6                      |
|                  |                                                                                  |                                                        | 7.5.3 (III)  
7.5.2 (II)   | 2020        | 6                      |
|                  |                                                                                  |                                                        | 7.5.3 (IV)  
7.5.2 (III)  
7.5.2 (IV)   | 2020        | 12                     |
| Regional Aircraft | Innovative Future Turboprop Technologies for Regional Aircraft                | High Lift Advanced Turboprop – Flying Test Bed#2 (FTB2) | – Active Wing  
– Adaptive Aerodynamics, including Morphing Winglets  
– Wing related Systems integration  
– Advanced CFRP Wing structures  
– Optimized Powerplant integration | 7.5.3 (V)  
7.5.2          | 2017        | 23                     |
<p>|                  |                                                                                  |                                                        | 7.5.2          | 2020        | -                      |</p>
<table>
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<tr>
<th>IADP / ITD</th>
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<tr>
<td>Regional Aircraft</td>
<td></td>
<td>Linked to all the above Regional Aircraft Demonstrators</td>
<td>Other research activities and management: – R-IADP Management (WP 0) – Technologies Development &amp; Demonstrations Results Assessment (WP4), including interfaces with TE and Eco-Design transverse activity</td>
<td>7.4.2 7.5.4</td>
<td>2022</td>
<td>5</td>
</tr>
<tr>
<td>Regional Aircraft</td>
<td></td>
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<td>Total:</td>
<td>104</td>
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<td>IADP / ITD</td>
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<td>Demonstrator / Technology Stream</td>
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<tr>
<td>Fast Rotorcraft: Joint/Transverse activities</td>
<td>Technology Evaluation &amp; Eco Transversal Technologies</td>
<td></td>
<td>Transverse activities relevant to both FRC demonstrators and management (WP0)</td>
<td>8.5.1</td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>
| Fast Rotorcraft: Tiltrotor                                               | Advanced Tilt Rotor Structural & Aerocoustic Design                              | D1: Mock-up of major airframe sections and rotor D2: Tie-down helicopter (TDH) D3: NextGenCTR flight demonstrator (ground & flight) | • System design  
• Structural and dynamics modelling and analysis software  
• Advanced electrical system  
• Aerodynamics/aeroacoustics modelling and analysis  
• Prototyping technologies  
<p>|                                                                          | D4: Prop-rotor components and assembly                                           |                                                                                                  |                                                                                                                                         | 8.4 (WP1.2) | 2018/2019 | 11                     |</p>
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
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<th>Complete by</th>
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<tbody>
<tr>
<td>Fast Rotorcraft: Tiltrotor</td>
<td>Advanced Tilt Rotor Aerodynamics and Flight Physics Design</td>
<td>D6: NextGenCTR’s fuselage assembly</td>
<td>– Aerodynamics modelling and analysis</td>
<td>8.4 (WP1.4)</td>
<td>2018/2019</td>
<td>(22 M€ funding is part of Airframe ITD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D7: NextGenCTR’s wing assembly</td>
<td>– Aerodynamics modelling and analysis</td>
<td>8.4 (WP1.4)</td>
<td>2018/2019</td>
<td>12</td>
</tr>
<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
<td>Demonstrator / Technology Stream</td>
<td>Technologies</td>
<td>Reference Chapter</td>
<td>Complete by</td>
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|           |                  | D10: intelligent electrical power system and ancillary/auxiliary components  
|           |                  | D11: Flight control & actuation systems and components                       | – High-speed brushless generators  
|           |                  |                                                                               | – Solid statepower conversion and switching units  
|           |                  |                                                                               | – Advanced energy management architectures  
|           |                  |                                                                               | – Smart actuation systems  
<p>|           |                  |                                                                               | – Advanced sensors and inceptors                                                             | 8.4 (WP1.6) | 2018/2019  | 22                     |
| Fast Rotorcraft: Tiltrotor | Technology Evaluation &amp; Eco Transversal Technologies | Other research activities and management (including support to TE Impact Evaluator): | | 8.4 (WP1.0 +WP1.7) | 2024 | 3 | |
| Fast Rotorcraft: Tiltrotor |                  |                                                                               | Total: | 89 |</p>
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
<th>Reference Chapter</th>
<th>Complete by</th>
<th>ROM EC funding (in M€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Rotorcraft: Compound R/C</td>
<td>Innovative Rotorcraft Design</td>
<td>Airframe structure &amp; landing system NB: Wing and tail addressed in Airframe ITD dedicated WPs (1.8, 1.11)</td>
<td>Advanced composite or hybrid metallic/composite structure using latest design and production techniques e.g. topological optimization, fibre/tape placement, out of autoclave curing, targeting very low weight and accommodating required cabin volume with low drag shape and wide access door for versatile usage (pax, SAR, EMS); Specific landing system architecture &amp; kinematics suited for compound R/C configuration, using composite materials for weight reduction, electrically actuated. Environment-friendly materials and production techniques</td>
<td>8.7.11 8.7.12</td>
<td>2020</td>
<td>17</td>
</tr>
<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
<td>Demonstrator / Technology Stream</td>
<td>Technologies</td>
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<tr>
<td>Fast Rotorcraft: Compound R/C</td>
<td>Innovative Compound Rotorcraft Power Plant Design</td>
<td>Lifting Rotor &amp; Propellers</td>
<td>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); All optimized for best mission performance and noise reduction with provision for icing protection capability, based on extensive use of state-of-art CFD and coupled CFD-CSD tools.</td>
<td>8.7.13 8.7.14</td>
<td>2020</td>
<td>6</td>
</tr>
<tr>
<td>Drive train &amp; Power Plant</td>
<td></td>
<td>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.</td>
<td></td>
<td>8.7.15 8.7.16</td>
<td>2020</td>
<td>22</td>
</tr>
<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
<td>Demonstrator / Technology Stream</td>
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<tr>
<td>Fast Rotorcraft: Compound R/C</td>
<td>Innovative Compound Rotorcraft Avionics, Utilities &amp; Flight Control Systems</td>
<td>On board energy, cabin &amp; mission systems</td>
<td>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.</td>
<td>8.7.17 8.7.20</td>
<td>2020</td>
<td>10</td>
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<tr>
<td>Fast Rotorcraft: Compound R/C</td>
<td>LifeRCraft Flight Demonstrator</td>
<td>LifeRCraft Flight Demonstrator</td>
<td>Smart flight control exploiting additional control degrees of freedom for best vehicle aerodynamic efficiency and for noise impact reduction.</td>
<td>8.7.18 8.7.19 8.7.21</td>
<td>2020</td>
<td>13</td>
</tr>
<tr>
<td>Fast Rotorcraft: Compound R/C</td>
<td></td>
<td></td>
<td>Integration of all technologies on a unique large scale flight demonstrator, success &amp; compliance with objectives validated through extensive range of ground &amp; flight tests</td>
<td>8.7.10 8.7.22</td>
<td>2020</td>
<td>21</td>
</tr>
<tr>
<td>Fast Rotorcraft: Compound R/C</td>
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<td>Total: 89</td>
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<td>IADP / ITD</td>
<td>Technology Areas</td>
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<td></td>
<td></td>
<td>Advanced Laminarity</td>
<td>Laminar nacelle, flow control for engine pylons, NLF, advanced CFD, aerodynamic flow control, manufacturing and assembly technologies, accurate transition modelling, optimum shape design, HLF</td>
<td>9.6.2</td>
<td>TRL 6: 2017 for further IADP testing</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High Speed Airframe</td>
<td>Composites (D&amp;M), steering, wing / fuselage integration, Gust Load Alleviation, flutter control, innovative shape and structure for fuselage and cockpit, eco-efficient materials and processes</td>
<td>9.6.3</td>
<td>TRL 4/5: 2020</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Novel Control</td>
<td>Gust Load Alleviation, flutter control, morphing, smart mechanism, mechanical structure, actuation, control algorithm</td>
<td>9.6.4</td>
<td>TRL 5/6: 2019</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Novel Travel Experience</td>
<td>Ergonomics, cabin noise reduction, seats &amp; crash protection, eco-friendly materials, human centered design, light weight furniture, smart galley</td>
<td>9.6.5</td>
<td>TRL 6: 2020</td>
<td>11</td>
</tr>
<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
<td>Demonstrator / Technology Stream</td>
<td>Technologies</td>
<td>Reference Chapter</td>
<td>Complete by</td>
<td>ROM EC funding (in M€)</td>
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<tr>
<td>Airframe</td>
<td>High Versatility and Cost Efficiency</td>
<td>Next Generation Optimized Wing Box</td>
<td>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</td>
<td>9.7.1</td>
<td>TRL 5: 2018 for further IADP testing  TRL 6: 2020</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optimized High Lift Configurations</td>
<td>Tprop integration on high wing, optimised nacelle shape, high integration of Tprop nacelle (composite/metalllic), high lift wing devices, active load protection</td>
<td>9.7.2</td>
<td>TRL 5: 2018 for further IADP testing</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced Integrated Structures</td>
<td>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</td>
<td>9.7.3</td>
<td>TRL 5: 2018 for further IADP testing  TRL 6: 2020</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced Fuselage</td>
<td>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</td>
<td>9.7.4</td>
<td>TRL 5: 2018 for further IADP testing</td>
<td>68</td>
</tr>
<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
<td>Demonstrator / Technology Stream</td>
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<tr>
<td>Airframe</td>
<td>Management and interfacing</td>
<td>Business jet, LPA, SAT, Rotorcraft and Regional a/c OAD and configuration</td>
<td>n/a</td>
<td>9.5</td>
<td>2020</td>
<td>10</td>
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<tr>
<td>Airframe</td>
<td></td>
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<tr>
<td>Engines</td>
<td>Innovative Open Rotor Engine Configurations</td>
<td>Open Rotor Flight Test</td>
<td>Ground test and flight test of a Geared Open Rotor demonstrator: - Studies and design of engine and control system update and modifications for final flight test - Manufacturing, procurement and engine assembly for ground test checking before flight Following on flight test planned in LPA IADP and test results analysis</td>
<td>10.5.1, 10.6.1, 10.7.1</td>
<td>TRL 6</td>
<td>Included in LPA IADP figures</td>
</tr>
<tr>
<td>Engines</td>
<td>Innovative High Bypass Ratio Engine Configurations I : UHPE Concept for Short/Medium Range aircraft (Safran)</td>
<td>UHPE demonstrator</td>
<td>Design, development and ground tests of a propulsion system demonstrator for an Ultra High By-pass Ratio engine: validation of the low pressure modules and nacelle technology</td>
<td>10.5.2, 10.6.2, 10.7.2</td>
<td>TRL 5</td>
<td>77</td>
</tr>
<tr>
<td>Engines</td>
<td>Business Aviation/Short Range Regional Turboprop Demonstrator</td>
<td>Business aviation/short range regional Turboprop Demonstrator</td>
<td>Design, development and ground testing of a new turboprop engine demonstrator for business aviation and short range regional application</td>
<td>10.5.3, 10.6.3, 10.7.3</td>
<td>TRL5/6 (2019)</td>
<td>22</td>
</tr>
<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
<td>Demonstrator / Technology Stream</td>
<td>Technologies</td>
<td>Reference Chapter</td>
<td>Complete by</td>
<td>ROM EC funding (in M€)</td>
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<tr>
<td>Engines</td>
<td>Advanced Geared Engine Configuration</td>
<td>Advanced Geared Engine Configuration (HPC and LPT technology demonstration)</td>
<td>Design, development and ground testing of an advanced geared engine demonstrator: improvement of the thermodynamic cycle efficiency and noise reduction</td>
<td>10.5.4</td>
<td>Engine Demo 2020</td>
<td>44</td>
</tr>
</tbody>
</table>
| Engines   | Innovative High Bypass Ratio Engine Configurations II: VHBR Middle of Market Turbofan Technology (Rolls-Royce) | VHBR Middle of Market Turbofan Technology | – behaviour of fans at low speeds and fan pressure ratios (e.g. fan stall margin, variable cold nozzle geometries) and structural technology  
– aerodynamic and structural design of low pressure turbines for high speed operation  
– Systems Integration of novel accessory and power gearboxes, including oil system and bearing technologies.  
– optimised power plant (e.g. integration of engine and nacelle structures, externals and dressings, Noise, Logistic & Build challenges)  
– compressor efficiency  
– control & electrical power system technology developments | 10.5.5 | TRL 4/5 2018 | 46 |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
<th>Reference Chapter</th>
<th>Complete by</th>
<th>ROM EC funding (in M€)</th>
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<tbody>
<tr>
<td>Engines</td>
<td>Innovative High Bypass Ratio Engine Configurations III: VHBR engine demonstrator for the large engine market (Rolls-Royce)</td>
<td>VHBR engine demonstrator for the large engine market</td>
<td>-- integrated low pressure system for a high power very-high bypass ratio engine (fan, compressor, gearbox, LP turbine, VAN) -- engine core optimisation and integration -- optimised control systems -- ground and flight test of Large VHBR engine</td>
<td>10.5.6 10.6.6 10.7.6</td>
<td>Engine Demo 2017-2019</td>
<td>69</td>
</tr>
<tr>
<td>Engines</td>
<td>Small Aircraft Engine Demonstrator</td>
<td>Small Aircraft Engine Demonstrator</td>
<td>-- reliable and more efficient operation of small turbine engines -- light weight and fuel efficient diesel engines</td>
<td>12.4.2</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Engines</td>
<td>[Not for evaluation]</td>
<td>Other research activities and management: Budget for activities performed by airframer (Airbus) and for Eco-Design Transverse Activity</td>
<td></td>
<td></td>
<td></td>
<td>14</td>
</tr>
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</table>

 Engines                                         | Total: 290 |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
<th>Reference Chapter</th>
<th>Complete by</th>
<th>ROM EC funding (in M€)</th>
</tr>
</thead>
</table>
– Advanced functions: communications, surveillance, systems management, mission management
– Cockpit Display Systems: new cockpit, HMI, EVO, etc.
– IMA platform and networks | 11.6.1
11.6.2
11.6.7 (I) | – TRL 5/6 in 2015
– TRL 5/6 in 2018+ | 58 |
| Systems   | Innovative and Integrated Electrical Wing Architecture and Components | Innovative Electrical Wing Demonstrator (including ice protection) | – New actuation architectures and concepts for new wing concepts
– High integration of actuators into wing structure and EWIS constraints
– Inertial sensors, drive & control electronics
– New sensors concepts
– Health monitoring functions, DOP
– WIPS concepts for new wing architectures
– Shared Power electronics and electrical power management
– Optimization of ice protection technologies and control strategy | 11.6.3 | TRL 5 to 6 between 2018 to 2020+ | 32 |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
<th>Reference Chapter</th>
<th>Complete by</th>
<th>ROM EC funding (in M€)</th>
</tr>
</thead>
</table>
| Systems    | Innovative Technologies and Optimized Architecture for Landing Gears | Advanced systems for nose and main landing gears applications | - Wing Gear and Body Gear configurations  
- Health Monitoring  
- Optimized cooling technologies for brakes  
- Green taxiing  
- Full electrical landing gear system for NLG and MLG applications  
- EHA and EMA technologies  
- Electro-Hydraulic Power Packs  
- Remote Electronics, shared PE modules  
- Innovative Drive & Control Electronics | 11.6.4 | TRL 4 to 6 between 2018 & 2020 | 30 |
| Systems    | High Power Electrical and Conversion Architectures | Non propulsive energy generation | - AC and DC electrical power generation  
- AC and DC electrical power conversion  
- SG design for high availability of electrical network  
- Integrated motor technologies, with high speed rotation and high temperature material | 11.6.5 (I)  
11.6.5 (III) | TRL6: 2020 | 27 |
<p>|            | Equipments and Systems for new aircraft generations | Electrical motors for loads applications | 11.6.6 (II) | TRL 4 to 5 between 2019 &amp; 2020 | 9 |</p>
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
<th>Reference Chapter</th>
<th>Complete by</th>
<th>ROM EC funding (in M€)</th>
</tr>
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</table>
| Systems    | Innovative Energy Management Systems Architectures | Innovative power distribution systems, (including power management) | -- Electrical Power Centre for Large Aircraft – load management and trans-ATA optimization  
-- High integrated power center for bizjet aircraft (multi ATA load management, power distribution and motor control)  
-- Smart grid, develop & integrate breakthrough components to create a decentralized smart grid, partly in non-pressurized zone.  
-- Electrical Power Centre – load management optimization  
-- Health Monitoring, DOP compliant | 11.6.5 (II) | TRL 5 & 6: from 2018 to 2020+ | 33 |
| Systems    | Innovative Technologies for Environmental Control System | Next Generation EECS, Thermal management and cabin comfort | -- New generation of EECS including a global trans ATA visionable to answer the needs for load management, Inerting systems, Thermal Management, Air quality & cabin comfort  
-- Development / optimisation of Regional A/C EECS components for full scale performance demonstration  
-- New generation of cooling systems for additional needs of cooling | 11.6.6 (I) | TRL 5 & 6: from 2018 to 2020+ | 26 |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
<th>Reference Chapter</th>
<th>Complete by</th>
<th>ROM EC funding (in M€)</th>
</tr>
</thead>
</table>
| Systems | Advanced Demonstrations Platform Design & Integration | Demonstration Platform – PROVEN, GETI & COPPER Bird® | – Use to maturate technologies, concepts and architectures developed in Clean Sky 2 or from other R&T programs and integrated in Clean Sky 2  
– Large demonstration platform  
– Optimization and validation of the thermal and electrical management between the main electrical consumers | 11.6.7 (II) 11.6.7 (III) 11.6.7 (IV) | Large test platform to reach higher TRL level for electrical equipment / systems (from 4 to 6 depending on the application) | 6 |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
<th>Reference Chapter</th>
<th>Complete by</th>
<th>ROM EC funding (in M€)</th>
</tr>
</thead>
</table>
| Systems   | Small Air Transport (SAT) Innovative Systems Solutions | Small Air Transport (SAT) Activities | – Efficient operation of small aircraft with affordable health monitoring systems  
– More electric/electronic technologies for small aircraft  
– Fly-by-wire architecture for small aircraft  
– Affordable SESAR operation, modern cockpit and avionic solutions for small a/c  
– Comfortable and safe cabin for small aircraft  
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 | 12.4.3 | 20 |
<p>| Systems   | ECO Design       | ECO Design activities             | Refers to ECO Design chapter | ECO Design | 5 |
| Systems   |                  |                                  |              | Total: 246        | 246        |</p>
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
<th>Technologies</th>
<th>Reference Chapter</th>
<th>Complete by</th>
<th>ROM EC funding</th>
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</table>
| Technology Evaluator (TE) | A systematic overall approach to the Technology Evaluation process and monitoring activity |                                  | – Progress Monitoring of Clean Sky 2 achievements  
– Evaluation at Mission Level of particular ITD outputs  
– Impact Assessments at Airport and ATS Level  
The funding required for the Technology Evaluator will be taken from the Total Clean Sky 2 EC funding as a “tax in advance”. | 12 | 17 |                      |
<p>| JU Running Costs    |                                                                                  |                                  | The funding required for the running costs of the Clean Sky 2 Joint Undertaking will be taken from the Total Clean Sky 2 EC funding as a “tax in advance”. |                  | 39 |                  |
| Total CS2 EC funding: |                                                                                  |                                  |                                                                              |                  |             | 1.755           |</p>
<table>
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<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Technologies</th>
<th>Reference Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco-Design Transverse Activity</td>
<td>An overall innovative approach and &quot;agenda&quot; for Eco-Design activity in the CS2 Programme</td>
<td>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. The co-ordination of all Eco-Design activities will be established in the Airframe ITD. The funding dedicated to the Eco-Design Transverse Activity is 39.06 M€ in total.</td>
<td>13</td>
</tr>
<tr>
<td>Small Air Transport (SAT) Transverse Activity</td>
<td>An overall innovative approach and &quot;agenda&quot; for Small Air Transport activity in the CS2 Programme</td>
<td>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. The funding required for the Small Air Transport Transverse Activity is 67.95 M€ in total.</td>
<td>14</td>
</tr>
</tbody>
</table>
8.7. 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.

The following chapter presents the Clean Sky 2 Programme scope of work and the main activities to be performed in the period 2014-20156.

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.

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6 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.
Description of activities in 2014 and 2015

The LPA activities in 2014 are focused to launch activities in all three platforms, Platform 1 “Advanced Engine and Aircraft Configuration, Platform 2 “Innovative Physical Integration Cabin, System and Structure” and Platform 3 “Next generation aircraft systems, cockpit systems and avionics”.

Platform 1

In Platform 1, the priority is to implement and launch all activities related to the development of the CROR flight test demonstrator, based on the latest possible results and outcome from the SFWA-ITD in Clean Sky, adjusted to the key milestones of the CROR ground demonstrator engine in SAGE 2. The work will first focus on the assessment of the “as is” situation of the last CROR Flight Test Demonstrator (FTD) configuration to enable the build-up of an architecture dossier for the CROR FTD in CS2, incl. a risk and cost estimation. This will serve as a solid basis for the preparation of the CROR FTD concept phase and the decision for the CROR FTD launch.

Any additional work required for achieving the economic viability, such as weight reduction efforts and the demonstration of the aerodynamic and acoustic performance of the integrated engine will be performed in the Airframe ITD. On engine side the focus is to prepare a gap analysis between the Ground Test Demonstrator (GTD) and the Flight Test Demonstrator (FTD) and an update of the route-book for CROR integration on A340-300 aircraft.

A specific work package starting in 2014 is associated to the non-propulsive energy generation systems architectures of advanced engine concepts with a principle elaboration of the requirements.

Further priorities in Platform 1 will be the launch of activities for the advanced engine integration driven fuselage demonstrator, which is a key contributor to develop and proof the viability of an aircraft configuration with a CROR propulsion system integrated at the rear of the aircraft. A suite of associated technologies will be developed and matured in a fully coherent, combined approach to provide key elements to demonstrate and validate the prospected added values of the CROR engine integrated into a next generation large passenger aircraft. Major activities are the preliminary architecture definition as well as the completion of the V&V pyramid, in particular for TRL levels between 5 to 6.

A further work package in Platform 1 is the systematic proof of scaled flight testing as viable means to mature and validate new aircraft technologies and aircraft configurations to high levels of technology readiness and the representativeness of the results for full-scale vehicles. This includes the evaluation of the reliability and quality of this mean, including the definition of a principle set of standard rules and procedures for all contributing elements as well as the quality of the equipment and measurement instrumentation. In the reporting period the composition of the partner consortium will be one major task. Another one will be the build-up of the preliminary project plan for the work package considering the basic requirements for the entire testing environment such as test platform, type of test range, data acquisition, etc.
The HLFC technology status for the CS2 LPA objectives based on the progress achieved in running projects at EU and national level, such as AFLoNext and HIGHER-LE, will be reviewed and adopted in a first phase. Based on this concept studies for even more efficient structural concepts will be carried out, in terms of simplified manufacturing, weight, non-recurring and recurring costs. In parallel to that, the definition of rules and procedures required for in-service long term demonstration and deployment of the HLFC technology on airframe will be launched. This will be done in close alignment with the relevant “Extended Laminarity” work packages in the Airframe ITD.

Ultra-High Bypass Ratio (UHBR) turbofans clearly bring an ecologic and economic benefit. But with the increasing nacelle size the engine integration under the wing will become even more challenging than today. To fully exploit the benefit of UHBR engines their integration must be taken into account already in the early development stage. In CS2 LPA the key design parameters will be identified and carefully studied in a multi-disciplinary conceptual design.

Beside an appropriate design approach, enabling technologies are needed to realize the physical wing/engine integration by providing answers to technical challenges resulting from the close coupling of engine to wing and therefore the close vicinity and interaction (flow, loads, thermal impact, etc.) of both major components to each other. This requires for example to master highly 3-dimensional flows accompanied by partly separated flow areas on wing, any potential clashes between moving and fixed structural parts (high-lift elements, thrust reverser, fixed wing, etc.), an increased thermal load impact on structure, load carryover effects between engine and wing, noise problems (airframe-, engine-, structural noise), etc.

In many cases conventional design methods currently applied in industrial offices are often not sufficient to tackle the challenges described above. However, state-of-the art research with a significant involvement of academia and research establishments clearly indicate that innovative and attractive alternatives are within reach for further maturation up to flight test demonstration. In this regard, highly promising technical solutions for flow-, load- and noise-control could be, if they are successfully designed and applied, the crucial physical enablers so that the expected net benefit of the targeted wing/engine integration scenario will be realized. The focus in the reporting period is on the exploitation of the results achieved in the running EU L2 project AFLoNext and the former EU project EUROLIFT2 to develop a flow control concept applied and demonstrated in the wing/pylon region of a short range aircraft in CS2 LPA. Supporting technology development at component level will be performed in the work packages of “Flow and Shape Control” and “Next generation optimized wing box” in the Airframe ITD in a complementary fashion.

For the benefit of next generation civil transport aircraft, concepts will be developed comprising of an airframe design with associated propulsion technology architecture, such as a novel hybrid propulsion power chain.

A further objective is to integrate and demonstrate UHBR engine technology for future long-range aircrafts. Linked to these objectives well-suited testing strategies and processes as well as enabling technologies will be developed. The reporting period focus on the preliminary architectural work for engine integration (UHBR engine on FTD, long range aircraft type), which will be performed in close collaboration between LPA Platform 1 and the respective
work packages in ITD Engines. In addition a value-for-money analysis will decide about the best “Validation and Verification” strategy for this project.

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**

The activities in 2014 will mainly focus on the compilation of requirements and functions that the integrated concept is expected to fulfil, as well as defining a lean process for cascading them down to sub-components, modules or elementary parts. A first study on disruptive architecture configurations will be conducted as well as several screenings on needed building blocks, such as interface technologies, materials and development processes.

Keeping in mind the objectives of the platform, the effect of requirements on key parameters will start to be analysed and challenged in order to move towards an innovative overall optimisation. For example, highly integrative approaches can lead to changes with respect to customisation compared to the state of the art solution. It could affect the visible cabin area as well as the installations covered behind linings and which define functionality, e.g. electrical network architecture, routing and manufacturing.

A particular share of work to start in 2014 will be related to the definition of requirements to alleviate the current certification procedures and constraints and to challenge the number and duplications of design rules and requirements. This work will start in collaboration with partners and certification authorities and will aim to tackle a wide scope of domains in order to identify arbitrary rules. A review and redefinition in specification, design and certification rules with respect to a future “cross ATA” design is a key element of this work. In 2015, the specification of the Platform 2 target integrated demonstrators will start. It is expected that inputs from Core-Partners selected through wave 1, and to a lesser extent wave 2, will lead to gradual updates of the Work Plan during 2015. Links to the Clean Sky 2 ITDs will be established to include technology modules for the innovative cabin. These links will also integrate systems relevant for the development of the integrated next generation fuselage-cabin and cargo Systems integrated concept from the early stages of the project at least until the critical design review of the demonstrators.

In 2015 the Platform 2 will also focus on the development and manufacturing of cabin & cargo functional elements within the cabin & cargo perimeter as enabler for weight savings, reduced production costs, operational efficiency, ancillary revenue and comfort. Specific areas of research shall be:

- A moveable Passenger Service Unit satellite;
- The development of fuel cell technologies for decentralised power supply systems, e.g. for galleys;
- Onboard Inert Gas Generation System (OBIGGS) able to perpetuate nitrogen enriched air as part of a halon-free, environmentally friendly cargo fire suppression system.
Platform 3

In 2014, only the advanced system maintenance activities will be started within Platform 3. These activities include features of integrated health management and monitoring, service oriented architectures and enhanced maintenance execution capabilities. Similar to the research and development activities planned towards a new fully integrated fuselage-cabin and cargo structure and system approach in platform 2, it is expected to derive explicit eco-design relevant benefits, e.g. through fewer scheduled routine maintenance or overhaul actions by the end of 2015.

In 2015, activities regarding the cockpit and avionics part of Platform 3 will be started. The development of innovative avionic functions and technologies will be initiated with a TRL target of 4 by 2018. The objective is to develop, within Platform 3 WP3.1 and WP3.2, the avionic functions and technologies that cannot be transferred from other platforms or projects. These activities will be performed in collaboration with several key systems suppliers as well as with other airframers (business jet and regional aircraft). Involvement of other European airframers will allow for leveraging the results on case by case basis.

Major milestones planned for 2014:

**Platform 1**
- Identification of Core-Partners, first wave

**Platform 2**
- Identification of Core-Partners, first wave

**Platform 3**
- Initiation of the maintenance work package architecture definition

Major deliverables planned for 2014:

**Platform 1**
- Architecture dossier for flight test demonstrator-vehicle selection
- Analysis report of expected scope and constraints for scaled flight testing for Large Passenger Aircraft and associated testing approaches, (1st issue)

**Platform 2**
- Next generation fuselage architecture dossier, requirements and functionalities (1st issue)
- Definition of concepts for new Cabin & Cargo architecture

**Platform 3**
- Maintenance architectural concepts definition
- Identification of platforms for maintenance demonstrations

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.

The following topics are opened for the first call for Core Partners:

<table>
<thead>
<tr>
<th>JTI-CS2-2014-CPW01-LPA</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JTI-CS2-2014-CPW01-LPA-01-01</td>
<td>Advanced Engine and Aircraft Configurations Strategic complementary research to prepare, develop</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-LPA-01-02</td>
<td>Integrated Flow Control Applied to large Civil Aircraft</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-LPA-01-03</td>
<td>Advanced HLFC fin design work: Structural design and manufacturing of operational HLFC fin</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-LPA-01-04</td>
<td>Specific Design and Manufacturing of fuselage rear end and engine supports</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-LPA-01-05</td>
<td>PoWer Turbine of the flight demonstrator CROR engine</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-LPA-01-06</td>
<td>Rotating Frames of the flight demonstrator CROR engine</td>
</tr>
<tr>
<td>JTI-CS2-CPW01-LPA-02-01</td>
<td>Airframe Cabin and Cargo and System integration Architecture</td>
</tr>
<tr>
<td>JTI-CS2-CPW01-LPA-02-02</td>
<td>Cabin &amp; Cargo Functional System and Operations</td>
</tr>
</tbody>
</table>

Detailed description of the topics is provided in Annex 1 - 1st Call for Core-Partners: List and Full Description of Strategic Topics.

Type of action: [Innovation action, funding rate 70%]**

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**Research organisations may apply for the 100% funding rate in accordance with H2020 rules
List of Leaders and participating affiliates

<table>
<thead>
<tr>
<th>Nr</th>
<th>Leaders</th>
<th>Description of activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Airbus SAS</td>
<td>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.</td>
</tr>
<tr>
<td>8</td>
<td>Dassault Aviation SA</td>
<td>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. As from 2015, Dassault Aviation SA is also contributing to the specifications of cockpit and avionics technologies in LPA Platform 3.</td>
</tr>
<tr>
<td>9</td>
<td>Airbus Defense &amp; Space - SA (CASA)</td>
<td>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. As from 2015, CASA is also contributing to the specifications of cockpit and avionics technologies in LPA Platform 3.</td>
</tr>
<tr>
<td>10</td>
<td>Fraunhofer</td>
<td>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. 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</td>
</tr>
<tr>
<td>11</td>
<td>Rolls-Royce plc</td>
<td>Activities are related to integrate advanced and radical engine concepts to a future aircraft configurations which require significant changes in the aircraft architecture</td>
</tr>
<tr>
<td>12</td>
<td>Thales Avionics</td>
<td>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.</td>
</tr>
<tr>
<td>Nr</td>
<td>Participating Affiliates</td>
<td>Description of activities</td>
</tr>
<tr>
<td>----</td>
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</tr>
<tr>
<td>2</td>
<td>Airbus Operations SAS</td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>Airbus Operations GmbH</td>
<td>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.</td>
</tr>
<tr>
<td>3a</td>
<td>Airbus DS GmbH</td>
<td>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.</td>
</tr>
<tr>
<td>4</td>
<td>Airbus Operations Ltd</td>
<td>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.</td>
</tr>
<tr>
<td>5</td>
<td>Airbus Operations SL</td>
<td>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.</td>
</tr>
<tr>
<td>6</td>
<td>Airbus Group SAS</td>
<td>Activities in LPA are associated to the demonstration of radical aircraft configuration with focus on hybrid power bench development and testing.</td>
</tr>
<tr>
<td>7</td>
<td>Airbus Defense &amp; Space - Germany</td>
<td>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.</td>
</tr>
<tr>
<td>13</td>
<td>SNECMA (Safran-Group)</td>
<td>Sncema has a main share of responsibility in the LPA Platform 1 to coordinate the FTD CROR Demo Engine project and the</td>
</tr>
<tr>
<td>Nr</td>
<td>Participating Affiliates</td>
<td>Description of activities</td>
</tr>
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</tr>
<tr>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>14</td>
<td>Microturbo (Safran-Group)</td>
<td>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.</td>
</tr>
<tr>
<td>15</td>
<td>Aircelle (Safran-Group)</td>
<td>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.</td>
</tr>
<tr>
<td>16</td>
<td>SAFRAN S.A. (Safran Group)</td>
<td>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)</td>
</tr>
</tbody>
</table>
9.2. IADP REGIONAL AIRCRAFT

In *Clean Sky*, a dedicated ITD - Green Regional Aircraft (GRA) - provides essential building blocks towards an air transport system that respects the environment, ensures safe and seamless mobility and builds industrial leadership in Europe. In *Clean Sky 2*, the Regional Aircraft IADP will bring the integration of technologies to a further level of complexity and maturity than currently pursued in *Clean Sky*. Taking into account the outcomes of GRA and considering the high-level objectives derived from recent market analysis performed by the Leaders, the strategy is to integrate and validate, at aircraft level, advanced technologies for regional aircraft so as to drastically de-risk their integration on the following future products:

- **Near/midterm (in-service from 2022-25on):** Regional Aircraft with underwing mounted turboprop engines,
- **Long term (enter in service beyond 2035):** Breakthrough Regional Aircraft Configurations, e.g. a/c with rear fuselage mounted turboprop engines

The proposed demonstration programmes are:

- **2 Flying TestBeds (FTB), in the IADP,** (to minimize the technical and programme risks) using modified existing regional turbo-prop aircraft with under-wing mounted engines, for demonstration campaigns; FTB#1 (Alenia Aermacchi) will mainly focus on the demonstration of technologies improving the cruise and climb performance, while FTB#2 (EADS-CASA) will be oriented to test technologies for Regional A/C optimized for short point to point flights, connecting airports with short runways in the middle of a city and pleiad of islands and, in general, towards more advanced high lift performances and more efficient configuration for climb and descending phases.
- **5 large integrated Ground Demonstrators:** full-scale wing (Airframe ITD), full-scale cockpit (Airframe ITD), full-scale fuselage and cabin (IADP), flight simulator and iron bird (IADP).

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 IADP Demonstration Programme will be divided into technologically compatible demonstrations sub-programmes:

- **Innovative Wing and Flight Controls:** integration and flight testing of technologies for a new generation wing and advanced flight control systems;
- **Flight Demonstration of a highly efficient and low noise wing including structural aspects;**
- **Full scale innovative fuselage and passenger cabin for increased passenger comfort and safety;**
- **Flight Simulator demonstrating new cockpit interaction concepts as well as advanced avionics;**
- **Virtual and Physical “Iron Birds”** as part of the Regional A/C Ground Demonstration Programme.
Such a demonstration programme is very challenging and the first phase of the R-IADP project (time frame years 2014-2015) is of paramount importance since it will enable the detailed definition of all the necessary technical and management activities so as to ensure that through the project development the demonstrators objectives will be achieved as planned in the JTP and fully in accordance with the strategic objectives for regional aircraft mentioned in the above text.

In particular, the overall main objectives for the 2014-2015 period are:

- to select all the R-IADP Core Partners;
- to define the Preliminary Requirements for the Demonstration Program;
- to define the first loop of the Technological Waves Roadmaps for Demonstrators;
- to initialize the technical activities for WP1, WP2 and WP3

During the time frame 2014-2015, 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 2014**

**Overview**

During 2014, a more detailed definition of the technical activities, WBS (Work Packages Breakdown Structure) covering the complete R-IADP project, will performed. Obviously, this will be a preliminary version to be revised once Core Partners are selected and main program workstream is established. The technical activities will start in the following 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, 3.3, 3.4, 3.5)

Furthermore, the following technical transversal activities will be performed in 2014:

- Contribution to the strategic topics descriptions for the Core-Partners selection (1st wave)
- Negotiations with Core Partner Winners (1st Wave)
- Preliminary development of Waves technological roadmaps
- Initial Activities on Systems Engineering Technical Management in terms of Processes, Methods and Tools (definition and set-up).
- Contribution to the strategic topics descriptions for the Core-Partners selection (2nd wave)
**WP0 – Management**

Coordination, administration and management of technical activities assuring interactions and interfaces with the JU and other IAs; participation and preparation work to *Clean Sky 2* committees.

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

Preliminary studies of innovative turboprop aircraft configurations will be started. The activities will be based on two conceptual aircraft configurations. The first one will be a conventional turboprop architecture (underwing engine mounted as GRA TP90) that will be sized on the following parameters (preliminary):

- About 1000 - 1300 nm design mission
- 90 pax class
- Cruise speed $M = 0.52 – 0.55$ at 250 FL
- Ground performance as GRA TP90

The second conceptual aircraft will consist of a breakthrough regional aircraft configuration: Turboprop rear fuselage Engines installation.

Sizing of this conceptual a/c will be started on the basis of the following preliminary requirements:

- About 1500 - 2000 nm design mission
- 100 pax class (final pax number to be defined)
- Cruise speed $M > 0.60$ at 300-350 FL
- Ground performance (TBD)

A preliminary general market analysis will be performed in order to have, in the starting phase of the project, a first issue of Top Level Aircraft Requirements. A relevant figure will be defined on aspects regarding the definition of external and internal noise TLAR, in order to assess the reduction of noise footprint impact in airport areas and assess the technologies that increase the passenger comfort.

In order to enable the technologies studies of WP2, this work package will also provide initial targets to be applied to single technological aspects.

**WP2 – Technologies**

The activities of this work package will start with a review of the technologies developed in the current CS GRA Domains and in other EU projects. For each sub-work package a roadmap will be defined and in synergy with other relevant ITDs, in particular Airframe ITD and Systems ITD.

To start the activities on the Adaptive Electric Wing, during 2014 a selection of reference A/C baseline configuration will be performed as a common working base for Technology Waves iterations. In parallel the evaluation criteria for first technologies down selection and the aerodynamic design procedure for NLF wing will be defined; relevant baseline existing
Computer Aided Engineering (CAE) modelings for technologies scaling and assessments will be selected; procedures for concepts evaluation of Morphing Structures, High Lift Devices (HLD), Loads Control & Alleviation, Natural Laminar Flow (NLF) wing design, drag and noise reduction will be defined for technologies down selections. In particular, the effect of all investigated concepts will be evaluated in terms of effect on noise footprint reduction.

For the Wing Structure: i) preliminary architectural trade-offs will be performed; ii) manufacturing tools preliminary requirements will be defined and the set-up of processes for wing components realization will be started; iii) preliminary requirements will be defined for the Rational Engineering A/C Life Cycle methodologies for Core Partners involvement, leading to the high level description of objectives and requirements at A/C level.

For the Avionics Technologies development, the following activities will be performed: i) definition of preliminary Regional aircraft customization requirements for Display, FMS and avionic functions; ii) definition of preliminary requirements for Regional a/c Maintenance/Health Monitoring function.

For the On Board Systems, activities will start with a review and assessment of candidate Systems technologies to be developed for the “Energy Optimized Regional A/C“ in the area 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/Inheriting System.

For the Flight Control System, preliminary architecture studies will be performed. They will be based on new actuation technologies (Electro-Mechanical Actuators), on innovative bus interconnection/data exchange and on leading-edge technology computing systems, considering certification targets.

For all the above systems, the activities will be performed in synergy with the Systems ITD. In particular, through proper interactions and interfaces with this ITD, the architectures evaluation and trade-off studies will be performed and technology roadmaps (objectives, process and sharing of responsibilities for technology Verification and Validation) will be defined.

WP3 – Demonstrations

Initial requirements for the Flight Demonstration Program as well as for the Iron Bird and Flight Simulator will be defined.

The requirements for the Flight Demonstration Program will be preliminarily defined in close cooperation between Alenia and EADS-CASA so as to maximize the synergies and cross-fertilization between the FTB#1 and FTB#2.

For the Iron Bird, which is linked to FTB#1 only, preliminary architecture will be performed, identifying the goals (TRL 5/6 achievement), the typology of testing and the configuration
under test. Evolution capabilities shall be also considered. Preliminary requirements for the CS2 Regional Aircraft Flight Simulator will be defined.

**Major milestones planned for 2014:**

- M1 - Kick-off Meeting
- M2 - Selection of the first batch of Core Partners
- M3 - Initialization of Technology developments
- M4 - 2014 Year End Activities Review

**Major deliverables planned for 2014:**

**WP0 – Management**

- Contribution to the strategic topics descriptions for the Core-Partners selection (1st wave):
  - Development of advanced systems technologies and hardware/software for the Flight Simulator and Iron Bird ground demonstrators for regional aircraft
  - Advanced Wing for Regional A/C - Technologies Development, D&M for FTB1 (Alenia)
  - Flight Physics and wing integration in FTB#2 (Airbus Aerospace and Defence (EADS-CASA))
- R-IADP System Engineering and IT tools and methods – 1st issue (Alenia):
  - Preliminary System Engineering Management Plan (SEMP) with Quality and Convention Rules definition for Preliminary Design Phase
  - IT Tools and Methods Implementation Plan (Set up of Operative Model) for Preliminary Design Phase
- Preliminary Roadmaps for each Technological Wave (Alenia/ Airbus Aerospace and Defence (EADS-CASA))

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

- Preliminary Top Level Aircraft Requirements (Alenia)
- High Efficiency Regional Aircraft - Preliminary design loop (Alenia)

**WP2 – Technologies**

- Morphing Structures and HLD Concepts Down-Selection Criteria (Alenia)
- Loads Control and Alleviation Devices Concepts Down-Selection Criteria (Alenia)
- NLF design and Drag reduction concepts Criteria (Alenia)
- Wing components Manufacturing tools preliminary requirements. (Alenia)
- Preliminary requirements of methodologies for Rational Engineering A/C Life Cycle. (Alenia)
- Preliminary customization requirements for Display, FMS and avionic functions (Alenia)
- Systems technologies trade-off analyses, preliminary Architecture, preliminary Verification and Validation Plan (Alenia)
WP3 – Demonstrations

- Preliminary Requirements for the Flight Demonstration Program (Alenia/ Airbus Aerospace and Defence (EADS-CASA))
- Preliminary requirements for the flight simulator (Alenia)
- FCS preliminary architecture and Iron Bird concept document (Alenia)
- Roadmap for FTB#2 GLA/MLA concept and wing conceptual design (Airbus Aerospace and Defence (EADS-CASA))
- Identification of available technologies and TRL associated. Assessment of potential added value (Airbus Aerospace and Defence (EADS-CASA))

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\textsuperscript{nd} wave) and CfPs (1\textsuperscript{st} batch)
- Negotiations with Core-Partner Winners (2nd Wave) and Partners (1st 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 (2nd 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 (2nd 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)

All the above 2015 deliverables will be confirmed at the end of 2014 results, upon Core-Partners selection.

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.
The following topics are opened for the first call for Core Partners:

<table>
<thead>
<tr>
<th>JTI-CS2-CPW01-REG</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JTI-CS2-2014-CPW01-REG-01-01</td>
<td>Development of advanced systems technologies and hardware/software for the Flight Simulator and Iron Bird ground demonstrators for regional aircraft</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-REG-01-02</td>
<td>Advanced wing for regional A/C - Technologies Development, Design and Manufacturing for FTB#1</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-REG-02-01</td>
<td>Flight Physics and wing integration in FTB2</td>
</tr>
</tbody>
</table>

Detailed description of the topics is provided in *Annex I - 1st Call for Core-Partners: List and Full Description of Strategic Topics*

Type of action: *Innovation action, funding rate 70%*

**List of Leaders and participating affiliates**

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

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9 Research organisations may apply for the 100% funding rate in accordance with H2020 rules

10 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.

In 2014, the preliminary sizing and design of the two demonstrators (tiltrotor architecture, compound rotorcraft architecture) will be initiated by the IADP Leaders.
Description of activities 2014-2015

WP0 – Management and transversal activities

WP 0.0: Consortium Management. In 2014, the Leaders will jointly adapt the Clean Sky GRC ITD organization and common procedures to the new scope and framework of FRC IADP. Planning and reporting activities will be implemented in 2014 and 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 2014, the IADP Leaders and the TE points of contact will jointly define SMART objectives and criteria adapted to the fast rotorcraft missions in line with the general TE approach for Clean Sky 2. 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 2014-2015, 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 2014:

- Rules of procedures for FRC-IADP management are settled and implemented
- Methodology defined for the extension of TE to mobility and productivity criteria
- Roadmap for Eco Design transversal activities settled

WP0 Main Deliverables planned for 2014:

- TE baselines and objectives for the Fast Rotorcraft demonstrations documented
- First selection of Eco-Design case studies issued.

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.
Year 2014

Overview

WP1 – NextGenCTR - Next Generation Civil Tiltrotor Demonstrator

During year 2014 the activities related to the following Work Packages will be launched.

WP1.0 – Management

This task is related to CS2 implementation, administration and management of technical activities and participation and preparation work to Clean Sky 2 committees.

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

Task 1.1.1a (Aircraft Requirements Definition & General Architecture) will be performed in 2014 and 2015. This task can be split into different phases with due consideration of the CS2 objectives (i.e. CO2 and noise reduction) and technical engineering trade-off implications:

- First level aircraft sizing & preliminary design specification
  Aircraft size, performance and general architecture definition.

- Aircraft systems trade studies
  Detailed feasibility and trade studies on: proprotor, fuselage and wings, power plant, flight controls, hydraulics, fuel system, pressurization, avionics, EPGDS. The output will be the preliminary technical specifications for the individual systems.

- Aircraft systems design requirements & specifications
  Definition of requirements for systems design, aerodynamic, aeroacoustic and flight mechanic modeling, analyses and simulations focused on the solutions selected during the previous step. The final step of Task1.1.1 is the definition of aircraft systems design requirements and specifications.

WP1.3 / Task 1.3.1 – Drive System Architecture Definition

A detailed feasibility study shall address drivetrain architectures, considering engine installation, integration of proprotor and proprotor actuator system, nacelle structure and aerodynamics, accessories location and sizing, weight, environmental impact and maintainability aspects.

The output will be the preliminary specification for the drivetrain system and related subsystems.

WP1.7 / T1.7.1 - Preliminary Activities Preparatory to Technology Evaluator Interface

In 2014 preliminary performance and mission analyses will be performed internally to establish and substantiate Key Performance Indicators and other suitable metrics to assess the progress towards the environmental objectives (i.e. CO2 and noise) within the NextGenCTR programme (T1.7.1.1) and feed into further assessments to be performed in the Clean Sky 2 TE Impact and Technology Evaluator.
The most suitable CTR baseline (T1.7.1.2) shall be defined; as such a reference is non-existent for tiltrotors.

A dedicated sub-task (T1.7.1.3) will perform a trade-off study to assess whether to adopt the tools already integrated in PHOENIX, or to develop and integrate civil tiltrotor (CTR) models based on different platforms (e.g. FlightLab).

In Task 1.7.1.4 and T1.7.1.5 non-environmental goals and related metrics and Key Performance Indicators will be defined to support assessments of transport productivity, time efficiency and ability to operate in confined spaces, as compared to conventional helicopters.

**Major milestones planned for 2014:**

- First Level Aircraft Sizing Complete - Internal report release
- Proprotor System Trade Studies Complete - Internal report release
- Fuselage and Wing Trade Studies Complete - Internal report release
- Airframe Systems Trade Studies Complete - Internal report release
- Drive Systems Trade Studies Complete - Internal report release
- First Iteration of Environmental Goals Metrics and KPIs Complete - Internal report release
- Civil Tilt Rotor Assessment Tools for CleanSky 2 objectives selected
- Non-Environmental Goals Defined – Internal report release
- System Requirement Review – Completed

**Major deliverables planned for 2014:**

- Preliminary Aircraft Design Specification – External report release
- Preliminary Engine Installation Specification – External report release
- Preliminary Drive System Specification – External report release

**Year 2015**

*Overview*

**WP1.0 - Management**

This task is a continuation of 2014 activities and 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 shall be completed by end of 2014 and 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. CO2 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.** Starting mid-2014, the LifeRCraft planning and reporting organization will be set up internally within the Leader’s legal entities in line with the H2020 rules of participation and the operational procedures as agreed in WP0.1. Administrative activities will be implemented as soon as defined. 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.** Starting mid-2014, the preliminary sizing and design of the demonstrator will be initiated by the LifeRCraft demo Leader. The relevant Clean Sky results e.g. rotor optimization techniques, airframe drag reduction solutions, advanced electrical systems projects, etc will feed this preliminary design. General aerodynamic and structural and mechanical studies will be engaged in support of the preliminary design process. The general specification of the demonstrator will be consolidated end of 2014. For the Technology Evaluator, a baseline for comparison will be established.

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 2014, most of these WPs relevant to the components and subsystems will start mid-2014 at the same time and in coordination with the preliminary sizing and design of the complete demonstrator as conducted in WP2.1 in order to check the feasibility of each subsystem against its specific objectives and constraints. The candidate subsystem concepts will be compared, in support of that preliminary design process. Wherever necessary, topic descriptions will be prepared and issued for the first call for Core Partners aiming to involve strategic partners in the design and realization of the relevant components/subsystems. After selection of Core Partners by the JU, the LifeRCraft leader will enter into negotiation with the winning candidates in order to harmonize the work share until completion of the demonstration and conclude with them a Consortium Agreement. In the last quarter of 2014, some further topic descriptions will be prepared either for the 2nd Call for Core Partners or for the 1st Call for Partners, according to size and strategic character of the foreseen partnership. Participants to the WPs 2 to 12 will start contributing to the LifeRCraft preliminary design phase as they enter the Consortium end of 2014. The different work packages are assigned either to Core Partners or Partners mainly based only the estimated volume of activities and on the required level of system integration.

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 2nd Call for Partners will be prepared either by the LifeRCraft leader or by the Core Partners in order to support further design and realization process of other components and systems. Further topics will be prepared for WPs proposed in the 2nd 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.** Starting mid-2014, general structural concepts will be reviewed and assessed. Interfaces between major airframe sections will be established. In 2015, the construction technologies will be selected in liaison with Core Partners and the design and sizing process will be initiated with the support of stress analysis.WP2.2.5 (fuselage) to be proposed for a Core Partner in 2014. 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.** Starting fourth quarter of 2014, landing gear specifications to be defined and configuration to be selected in order to prepare the topic description for WP2.3.1 (design, manufacturing) to be proposed for the selection of a Partner. 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.** Starting mid-2014, requirements for rotor blades and hub will be specified. Different options for either reusing some existing helicopter design or defining new/modified design will be assessed in order to found the best trade-off between performance, loads and noise. In 2015, the design option(s) will be selected at the PDR based on further studies.

**WP 2.5: Propellers.** Starting mid-2014, descriptions of WPs 2.5.8 (aeroacoustic design & tailoring) and 2.5.9 (mechanical design, realization) will be prepared to 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.** Starting mid-2014, the general architecture for power transmission from engines to rotor and props will be reviewed and assessed in coordination with the general demonstrator architecture studies. Specifications for gearboxes and shafts will be established. Topic descriptions will be derived for: WP2.6.9 (Main Gear Box modules, Propeller Gear Boxes) proposed for a Core Partner in 2014; 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.** Starting fourth quarter of 2014, the engine specifications and installation requirements will be established based on the preliminary estimation of LifeRCraft performance (altitude envelope, power rating, fuel consumption, power turbine speed range). As these specifications will evolve with the refinement of preliminary design, the description of WPs 2.7.2.2 (turboshaft engine) is expected to be settled only by mid-2015 and proposed in the 2nd Call for Partners.

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

**WP 2.8: Electrical System.** Starting mid-2014, the electrical system study will start and 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 1st or 2nd 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 2nd 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 will start in the fourth quarter of 2014 aiming 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 2014-2015.

**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.** In 2014, 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. Two
topic descriptions (WP2.12.2.2 – flight profiles for fuel savings, and 2.12.3.2 – design of terminal procedures for low noise) are expected to be ready for the 1st Call for Partners.

- **W1 Partner Topic FRC2.12-1** - (WP2.12.2.2) Flight profile for fuel saving
- **W1 Partner Topic FRC2.12-2** - (WP2.12.3.2) Noise abatement flight procedures

**Major milestones planned for 2014:**
- LifeRCraft general requirement specs and preliminary component interfaces defined

**Major deliverables planned for 2014:**
- Strategic Topics defined for the first 2 Calls for Core Partners
- Topics defined for the first Call for Partners

**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.

The following topics are opened for the first call for Core Partners:
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<tr>
<th>JTI-CS2-CPW01-FRC-02-01</th>
<th>LifeRCraft airframe - Central and front fuselage sections - Design, Optimization, Manufacturing, V&amp;V including airworthiness substantiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>JTI-CS2-2014-CPW01-FRC-02-02</td>
<td>LifeRCraft drive system - Main Gear Box input modules and equipped Propeller Gear Boxes - Design, Optimization, Manufacturing, V&amp;V including airworthiness substantiation</td>
</tr>
</tbody>
</table>

Detailed description of the topics is provided in *Annex I - 1st Call for Core-Partners: List and Full Description of Strategic Topics.*

Type of action: *[Innovation action, funding rate 70%]*

**List of Leaders and participating affiliates**

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<th>Nr</th>
<th>Leaders</th>
<th>Description of activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Airbus Helicopters S.A.S.</td>
<td>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 &amp; Partners.</td>
</tr>
<tr>
<td>2</td>
<td>AgustaWestland S.p.A.</td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>AgustaWestland Ltd.</td>
<td>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.</td>
</tr>
</tbody>
</table>

*Research organisations may apply for the 100% funding rate in accordance with H2020 rules*
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<th>Nr</th>
<th>Participating Affiliates</th>
<th>Description of activities</th>
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</thead>
<tbody>
<tr>
<td>1a</td>
<td>Airbus Helicopters Deutschland GmbH</td>
<td>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 &amp; Partners.</td>
</tr>
<tr>
<td>2a</td>
<td>PZL-Swidnik S.A.</td>
<td>Supporting activities foreseen to AW SpA and AW Ltd on airframe and structures topics, following general architecture requirements.</td>
</tr>
</tbody>
</table>
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.

Description of activities 2014-2015

The activities in 2014 will mainly consist in initiating the definition works of the first set of AIRFRAME’s technology developments and demonstrators, leading to the high level description of objectives and requirements for those demonstrators. In addition, a refinement and detailing of the overall technical definition of the Clean Sky 2 programme will be carried out, enabling the sublevel definition of the WBS, as required from the expert panel’s review of 2013. The refinement will be supported via design studies and manufacturing trials of wingbox structures benefitting from experience gained in Clean Sky, and here further
matured and enhanced. Planning of technical activities covering the complete Clean Sky 2 programme and the associated schedule definition will be matured and developed. The proper interfacing between the AIRFRAME ITD and the IADPS and other ITD will be set up.

On 2014 and till 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.

Preparation works will also already during 2014 consist of wing box design studies, benefitting from the highly integrated wing box upper cover design initiated in Clean Sky SFWA. The concept will be further developed and matured, focusing on specific topics identified as critical for achieving a more complete NLF concept in the long term perspective and as such enable reaching higher TRL levels in Clean Sky 2. Development trials will be conducted in 2014 potentially supported by additional trials in 2015, required to conduct proper assessment of strength capability and manufacturability.

**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 in 2014.

Based on the state-of-the-art of applied flow control technologies, developed so far in European and National research projects, the activities in 2014/2015 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 (2014). 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.** In 2014, 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 in 2014 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 2014:

- Refined description of the AIRFRAME technical objectives
- Contribution to the definition of strategic topics descriptions for Core Partners Selection and support to the selection process of the first batch of Core Partners
- AIRFRAME Annual Review

Major Deliverables planned for 2014:

- Contribution to the strategic topic descriptions for the first wave of Core Partners. Foreseen topics are listed on table at end of this AIRFRAME section
- High-level description of objectives and requirements of initial demonstrators
- Preliminary requirements for more affordable manufacturing, assembly, processes & tools for both metallic and composite structures
- Preliminary requirements of quality manufacturing for laminar surface
- Preliminary design concepts for laminar surfaces, and assessment of results from initial development trials for evaluation of strength capability and manufacturability.

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 2014/2015. 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 acceed 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.
The following topics are opened for the first call for Core Partners:

<table>
<thead>
<tr>
<th>JTI-CS2-2014-CPW01-AIR</th>
<th>Description of activities</th>
</tr>
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<tbody>
<tr>
<td>JTI-CS2-2014-CPW01-AIR-01-01</td>
<td>New Innovative Aircraft Configurations and Related Issues</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-AIR-01-02</td>
<td>e-WIPS integration on novel control surface</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-AIR-02-01</td>
<td>New wing and aircraft systems design and integration for Turboprop regional aircraft</td>
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<tr>
<td>JTI-CS2-2014-CPW01-AIR-02-02</td>
<td>Wing and Tail Unit Components Multifunctional Design and Manufacturing (including Out of Autoclave composite)</td>
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<tr>
<td>JTI-CS2-2014-CPW01-AIR-02-03</td>
<td>Advanced technologies for more affordable composite fuselage</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-AIR-02-04</td>
<td>Design and manufacturing of an advanced wing structure for rotorcraft additional lift</td>
</tr>
</tbody>
</table>

Detailed description of the topics is provided in *Annex I - 1st Call for Core-Partners: List and Full Description of Strategic Topics.*

Type of action: [Innovation action, funding rate 70%]¹²

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**List of Leaders and participating affiliates**

<table>
<thead>
<tr>
<th>Nr</th>
<th>Leaders</th>
<th>Description of activities</th>
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<tbody>
<tr>
<td>1</td>
<td>Dassault Aviation</td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td>Saab</td>
<td>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</td>
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¹² Research organisations may apply for the 100% funding rate in accordance with H2020 rules
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<tr>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>Fraunhofer</td>
<td>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 ecolonomic impact by a tight cooperation with Eco-design TA.</td>
</tr>
<tr>
<td>5</td>
<td>Airbus SAS</td>
<td>Identification of candidates technologies enabling UHBR Engine efficient integration into the Aircraft. Mature technology candidates enabling a viable CROR Aircraft up to TRL2.</td>
</tr>
<tr>
<td>9</td>
<td>Airbus Defence and Space S.A.U. (EADS CASA)</td>
<td>The activities in HVCE Airframe will be devoted to the 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.</td>
</tr>
<tr>
<td>11</td>
<td>Alenia Aermacchi</td>
<td>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.</td>
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<tr>
<td>Nr</td>
<td>Leaders</td>
<td>Description of activities</td>
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<tr>
<td>14</td>
<td>AgustaWestland S.p.A.</td>
<td>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.</td>
</tr>
<tr>
<td>15</td>
<td>AgustaWestland Ltd.</td>
<td>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.</td>
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<tr>
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<tbody>
<tr>
<td>4</td>
<td>Airbus Operations SAS</td>
<td>Identification of candidates technologies enabling UHBR Engine efficient integration into the Aircraft. 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. 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 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.</td>
</tr>
<tr>
<td>4a</td>
<td>Airbus Group SAS</td>
<td>Contribution to the identification of candidates 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.</td>
</tr>
<tr>
<td>6</td>
<td>Airbus Operations Ltd</td>
<td>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.</td>
</tr>
<tr>
<td>7</td>
<td>Airbus Operations SL</td>
<td>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. Furthermorees studies on new HTP LE structure concepts.</td>
</tr>
<tr>
<td>Nr</td>
<td>Participating affiliates</td>
<td>Description of activities</td>
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<tr>
<td>8</td>
<td>Airbus Operations Gmbh</td>
<td>Identification of candidates 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.</td>
</tr>
<tr>
<td>10</td>
<td>Airbus Helicopters España</td>
<td>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 the launching of a couple of CfP for the second or third wave.</td>
</tr>
<tr>
<td>13a</td>
<td>Evektor Aeroteknik</td>
<td>Production of coupons, subassemblies and prototypes.</td>
</tr>
<tr>
<td>14a</td>
<td>PZL-Swidnik SA</td>
<td>Supporting activities foreseen to AW SpA and AW Ltd on airframe and structures topics, following general architecture requirements.</td>
</tr>
<tr>
<td>16</td>
<td>Airbus Helicopters Deutschland GmbH</td>
<td>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 windscreens and doors for the compound rotorcraft and possibly further topics.</td>
</tr>
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</table>
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 CO₂ compared to 2000 baseline, a 60% reduction in NOₓ and a 6dB noise reduction. This is roughly 75% of the ACARE objectives. Whereas some activities were delayed for the Open Rotor programme for example, the bulk of SAGE objectives 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 CO₂ emissions and noise as well as engine mass;
- Very High Bypass Ratio (VHBR) Middle of Market Turbopan technology, 2014-2018: 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 powerplant solutions, spanning from piston/diesel engines to small turboprop engines.
Description of activities 2014-2015

Work Package 1 – Open Rotor flight Test (Sncema)

During the second half of 2014 and 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 1st quarter of 2017.

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

The activity will start in the 4th quarter of 2014 in WP 2.1 (WP 2.1: Candidate, Concept, Demo Architecture, and Demo Integration). Several ultra-high bypass ratio (UHBR) turbofans architectures for high propulsive efficiency concepts (engine + nacelle + systems) will be drafted and their overall interest evaluated using preliminary studies tools (specific fuel consumption, noise emissions, drag and weight).

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.

2014 activities will focus on the high level specifications of the Integrated Power Plant System with the support of an airframer and the preparation of the calls for the Core Partners.

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.


Key objectives of the activities in 2014 and 2015 are the definition and preparation of the entire programme. Up to mid of 2014 conceptual design studies for Engine Demo and Rigs will be performed to define basic configurations for the demonstrator vehicles. These studies will include all modules outlined in the joint technical proposal. As a result preliminary requirement documents will be established. It will be ensured that the validation requirements for the defined technologies can be met in order to finally achieve TRL6. The preliminary concept definitions will also be used to specify the contribution of core partners and partners.

In the 4th quarter of 2014 and enforced in 2015 a first identification and selection of the technology streams will be carried out to ensure that the selected technologies will be available at the necessary TRL level for incorporation in the demonstrator vehicles. Starting in 2015 the engineering team will be ramped up.

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.

Having already established a strong technical management organisation, the ramp-up of engineering resource and work will be significant and is reflected in the budget planned for the period. 2014 will see the immediate launch of this work package, initiating studies and conceptual design of low speed fan/pressure systems, low pressure turbines optimized to high speed operation, the system integration of power gear systems, optimized power plant and nacelle technology, and compressor systems. The requirements and verification strategies for the technologies will be authored, and detailed design will follow. Early 2014 Core partner engagement is essential – for VHBR engine LP turbine and Structural technology.

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.

Throughout 2014, conceptual engine studies will be completed, trade studies undertaken, and whole-engine architectural options down-selected (in conjunction with the LPA IADP) to define the demonstrator. The whole engine requirements and validation strategy will be authored, culminating in completion of the concept review in 2015. Additionally, 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.

The following topics are opened for the first call for Core Partners:

| JTI-CS2-2014-CPW01-ENG-01-01 | Low Pressure Turbine Rear Frame (LP TRF) and Low Pressure Spool Shaft (LPS) for Ultra High Propulsive Efficiency (UHPE) Demonstrator for short / Medium Range Aircraft (WP2) |
| JTI-CS2-2014-CPW01-ENG-01-02 | Power GearBox (PGB) for Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short/Medium Range Aircraft |
| JTI-CS2-2014-CPW01-ENG-01-03 | Business Aviation / Short Regional TP demonstrator Front Power Plant Module |
| JTI-CS2-2014-CPW01-ENG-02-01 | Aerodynamic Design and Testing of advanced Geared Fan Engine Modules |
| JTI-CS2-2014-CPW01-ENG-02-02 | LPC, ICD and TEC development for next generation geared fan engines |
| JTI-CS2-2014-CPW01-ENG-03-01 | VHBR Engine - IP Turbine Technology |
| JTI-CS2-2014-CPW01-ENG-03-02 | VHBR Engine Structural Technology |
| JTI-CS2-2014-CPW01-ENG-04-01 | More advanced and efficient small turbine engines for SAT market |

Detailed description of the topics is provided in Annex I - 1st Call for Core-Partners: List and Full Description of Strategic Topics.

Type of action: [Innovation action, funding rate 70%]

List of Leaders and participating affiliates

<table>
<thead>
<tr>
<th>Nr</th>
<th>Leaders</th>
<th>Description of activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/6</td>
<td>Rolls-Royce plc</td>
<td>As the leader of work packages 5 and 6, Rolls-Royce will technically lead and manage the R&amp;T programmes for the long range VHBR engine (Ultrafan™). Rolls-Royce will also play a key role in management of the Engines-ITD.</td>
</tr>
</tbody>
</table>

13 Research organisations may apply for the 100% funding rate in accordance with H2020 rules
<table>
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<th>Description of activities</th>
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<tbody>
<tr>
<td>5</td>
<td>MTU Aero Engines AG</td>
<td>MTU takes technical and management ownership for work package 4. The R&amp;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.</td>
</tr>
<tr>
<td>6/1</td>
<td>SNECMA</td>
<td>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.</td>
</tr>
</tbody>
</table>

Note: SAFRAN S.A. (for information): Safran S.A. is not involved in 2014/15 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.

<table>
<thead>
<tr>
<th>Nr</th>
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<th>Description of activities</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>Airbus Operations SAS</td>
<td>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).</td>
</tr>
<tr>
<td>3</td>
<td>Aircelle</td>
<td>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.</td>
</tr>
<tr>
<td>4</td>
<td>Turbomeca</td>
<td>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.</td>
</tr>
<tr>
<td>7</td>
<td>Rolls-Royce Deutschland</td>
<td>Rolls-Royce Deutschland are providing key systems for the long range VHBR (Ultrafan™) 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. 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.</td>
</tr>
<tr>
<td>8</td>
<td>SMA (SAFRAN)</td>
<td>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.</td>
</tr>
<tr>
<td>Nr</td>
<td>Participating Affiliates</td>
<td>Description of activities</td>
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<tr>
<td>1a/6a</td>
<td>Rolls Royce Corporation</td>
<td>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). The work will mostly be completed in 2014 reflecting the completion of the knowledge transfer to Europe.</td>
</tr>
</tbody>
</table>
9.6. 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 CO₂ emissions, fuel consumption, etc.
- 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. Clean Sky work on green trajectories has shown that significant improvements are possible to reduce CO₂ emission, fuel consumption, and perceived noise in specific flight phases. The next step, to be developed in Clean Sky 2, is to integrate these results in a multi-criteria optimisation process of the whole flight plan, to allow for:

- Global optimisation taking into account the whole flight and ATS constraints.
- Possibility to introduce new criteria depending on specific mission or environment parameters (populated areas, weather, icing or contrail-prone situations, etc.). For example, the next generation flight management systems for fixed wing aircraft and helicopters will take into account the perceived noise as one of the flight optimisation constraints.
- Possibility to introduce new criteria for global optimisation without redeveloping and recertifying the flight management systems.
- Automation of flight in all phases to secure the environmental gains made possible by the system.

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 2014-2015

- **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**

  2014 & 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.

- 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 2014 & 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**

2014 & 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**

For regional and large aircraft demonstrators, the work will start in the second semester of 2014, except for the structure integrated system where partner participation is expected.

The smart integrated wing systems architecture design will begin in 2014 with trade-off studies and 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 will start 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 in 2014 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 taxing and the short TAT brake cooling.

For the Main Landing Gears (MLG), activities regarding electrical actuation will start in 2014, with a down selection of the preferred electrical MLG extension retraction system. Definition of the specifications for the braking EMA components will also take place.

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 Nose Landing Gear (NLG) development activities will focus on Electro-Hydraulic Actuation (EHA), where in 2014 firstly several trade studies will be carried out to define project baseline configuration.

The preliminary design starts with full system and equipment design activities will run in 2014. 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.

The Tiltrotor landing gear system activities will start in the second half of 2014 jointly with IADP Rotorcraft leader Agusta Westland by the definition of the complete system and the preliminary concept and design phases. Then, the partner content will be defined and the calls will be prepared.
- **Work Package 5 (depending on re-evaluation outcome)**

The electrical chain distribution activities to start in 2014 will be organized around the power generation and two distribution architectures.

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.) will start in 2014. In a second time, activities will be launched in 2015 for functional need / topology selection and technological block developments.

At the end of 2014, analyze and evaluation the performances of power management center developed in Clean Sky are planned. 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 2014, the resources will be mainly charged on design activities for the E-ECS for Large Passenger Aircraft, on electrothermal wing ice protection system and on electrical motors.
In 2014 and 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 2014/15 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 for 2014-2015**

**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
DGCU 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 (1st 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 – ElectrothermalWIPS
  • Optimized architecture for Large aircraft
  • Design and development of a ground demonstrator for performance tests in icing Wind Tunnel
  • Performance test report (IWT)

Implementation

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

Thales and Liebherr, 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.

Thales and Liebherr, 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.

The following topics are opened for the first call for Core Partners:

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<tr>
<th>JTI-CS2-2014-CPW01-SYS</th>
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<tbody>
<tr>
<td>JTI-CS2-2014-CPW01-SYS-02-01</td>
<td>Power Electronics and Electrical Drives</td>
</tr>
<tr>
<td>JTI-CS2-2014-CPW01-SYS-03-01</td>
<td>Model, Tools, Simulation and Integration</td>
</tr>
</tbody>
</table>

Detailed description of the topics is provided in *Annex I - 1st Call for Core-Partners: List and Full Description of Strategic Topics.*

Type of action: [Innovation action, funding rate 70%]<sup>14</sup>

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<sup>14</sup> Research organisations may apply for the 100% funding rate in accordance with H2020 rules
List of Leaders and participating affiliates

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<td>1</td>
<td>Liebherr Aerospace Lindenberg</td>
<td>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.</td>
</tr>
<tr>
<td>4</td>
<td>Thales Avionics</td>
<td>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.</td>
</tr>
<tr>
<td>8</td>
<td>Safran SA</td>
<td>Stakeholder coordination and management of call for Partners and Core Partners.</td>
</tr>
<tr>
<td>13</td>
<td>Airbus SAS</td>
<td>Stakeholder coordination and management of call for Partners and Core Partners.</td>
</tr>
<tr>
<td>16</td>
<td>Evektor</td>
<td>Investigation on possible solutions to improve the thermal and acoustic comfort of the cabin on small aircraft.</td>
</tr>
<tr>
<td>17</td>
<td>Piaggio Aerospace</td>
<td>Feasibility studies on health monitoring for small aircraft systems. Trade off study for electrical system and fly-by-wire on small aircraft.</td>
</tr>
<tr>
<td>18</td>
<td>Dassault Aviation</td>
<td>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.</td>
</tr>
</tbody>
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<td>2</td>
<td>Liebherr Aerospace Toulouse</td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>Liebherr Elektronik GmbH</td>
<td>HVDC Network investigation and power electronics technological bricks development for electrical actuation, high speed bearing machines and power center cooling.</td>
</tr>
<tr>
<td>5</td>
<td>Thales electrical systems</td>
<td>Contribution to Partners and Core Partners topics definition. Specification of generation activities and capture of Airframers requirements.</td>
</tr>
<tr>
<td>6</td>
<td>Thales UK Ltd</td>
<td>Participation in WP meetings, contribution to CP and CFP topics, work on communication architecture and Integrated Modular</td>
</tr>
<tr>
<td>Nr</td>
<td>Participating affiliates</td>
<td>Description of activities</td>
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</tr>
<tr>
<td>7</td>
<td>Thales Training &amp; Simulation SAS</td>
<td>Participation in WP meetings, and contribution to CP and CfP topics, work on cockpit environment and crew interface (IHS, monitoring, simulation)</td>
</tr>
<tr>
<td>9</td>
<td>Sagem</td>
<td>Top level specification of the flight control system and architecture level system modeling. Definition of overall system benched and subsystem analysis.</td>
</tr>
<tr>
<td>10</td>
<td>Messier-Bugatti-Dowty</td>
<td>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</td>
</tr>
<tr>
<td>11</td>
<td>Safran Engineering Services</td>
<td>Innovative Electrical network preliminary topology studies and components design. System architecture definition.</td>
</tr>
<tr>
<td>14</td>
<td>Airbus Operations SAS</td>
<td>Requirements for LPA enhanced cockpit components studied in ITD Systems</td>
</tr>
</tbody>
</table>
9.7. 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 2014-2015

The activities in 2014 will mainly consist of the initializing work on the definitions for the first set of technology developments and demonstrators, and selection of the first Core Partners. The high level objectives, definitions and requirements for those demonstrators will be confirmed and the overall SAT CS2 technical description will be improved.

The planning of CS2 programme technical activities will be matured and precised. 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 initiated.

The technical description and the scope of the work of key Core Partners will be finalized, enabling a proper Cope Partner selection process. After the successful selection of Core Partners, technical descriptions will be discussed in order to define planned activities of the Core Partners. Improvement of the Work Plan based on the Core Partner’s activities will be initialized.
These activities will continue 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 in 2014 will be focus on preparation of CP selection in 2nd 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 in 2014 of this WP 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. Activities in 2014 will be focused on identification of proper flying/ground demonstrators. 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. In the 2014 will be initialized works on technical description of demonstrators and overall planning of demonstrator testing in interaction with selection of Core partner for cockpit in the first wave and during the 2015 the selection of core partner for fly by wire in the second wave.

**WP B 3.5 - More Affordable Small a/c Manufacturing**

The activities in 2014 of this WP will be focused on the trade-off study which will consolidate the orientations of automation towards targeted low costs and multidisciplinary use (such as boring, reaming, riveting and optical inspection) for “nest” join configuration. Works on the high level description of technology requirements will be initialized. Analysing of usage Rapid prototyping technologies in aircraft production will start. Key factor will be preparation of Core partners’ selection in 2nd 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**

The activities in 2014 will mainly consist in initiating the definition works of the first set of Engine ITD SAT Small Turboprops technologies developments and demonstration for engine components (High performance gas generator, Enhanced power turbine, Reduction gearbox and low noise propellers with integrated control system), leading to the high level description of objectives and requirements for those demonstrators.

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 in 2014 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.
Those activities will be continued in 2015 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.

- **ITD Systems**

**WP S.1 - Efficient operation of small aircraft with affordable health monitoring systems**

The activities in 2014 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, 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 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 in 2014 will mainly consist in initiating the definition works of the technology developments and demonstration for more electric systems.

Those activities will be continued in 2015 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 in 2014 will mainly 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, those 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 in 2014 will mainly 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

Those activities will be continued in 2015 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 in 2014. The first CfP in this area are planned to 2015. Analytical tools for prediction of acoustic environment during passive/active damping will be overviewed and the analytical environment will be settled in 2014. Selection of suitable aerospace materials for their dynamic properties investigation will be done in 2014 with the first CfP for coupon testing in 2015.

Milestones and Deliverables for 2014-2015

Major milestones planned for 2014:

- Selection of the Core Partners in First Wave for planned Core Partners activities in, WP B 3.4 (cockpit), and WP E.1
- Initiation of technology development for automated assembling WP B 3.5 and initial works on the definition of new materials/technologies in WP S.5

Major deliverables planned for 2014:

- High level description of objectives and requirements of Engine and Cockpit Systems demonstrators

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

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 Evektor, as the TA Leaders, 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.

Piaggio and Evektor, as the TA 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 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.

The following topics are opened for the first call for Core Partners:

<table>
<thead>
<tr>
<th>JTI-CS2-2014-CPW01-ENG</th>
<th>More advanced and efficient small turbine engines for SAT market</th>
</tr>
</thead>
</table>

Detailed description of the topics is provided in Annex 1 - 1st Call for Core-Partners: List and Full Description of Strategic Topics.
Type of action: [Innovation action, funding rate 70%]}

15 Research organisations may apply for the 100% funding rate in accordance with H2020 rules
9.8. ECO DESIGN TRANSVERSE ACTIVITY

Since the beginning of Clean Sky Programme, hundreds of partners and technologies have risen to the challenges of Eco-Design for Airframe - EDA and ECO-Design for Systems – EDS, but all confine in a small vertical activity definition. A bigger transversal playing field, namely ECO-Design Transversal Activity, is necessary and the opening to apply the technology from the lab through the integration to complete component application on aircraft level is essential.

Eco-Design will co-ordinate research geared toward high (European) eco-compliance in air vehicles, over their product life. As transverse activity it profit from activity developed in the frame of Clean Sky Eco design ITD. Eco Design in Clean Sky 2 is based on two domain concepts, namely:

The Eco-Design Analysis (EDAS) activity where all pillars of life value are addressed, beyond the conventional “cradle to grave” philosophy, to stimulate better re-use options and new, best practice service options, embracing all the supply chain and SPD’s players priority. Eco-Design Analysis, directly linked to the development of advanced Life Cycle Assessment tools and methodologies, is a knowledge and responsibility empowerment approach, addressing widened stakeholder interests and enabling a better grasp of the full domain of ground pollution issues.

The Vehicle Ecological Economic Synergy (VEES) activity is driven from Materials, Processes & Resources (MPR) innovations, from the assimilation of cooperative modules from the SPD demonstrators with an adaptive Eco Hybrid Platform (EHP). This is “LCA+” (Life Cycle Analysis-plus) design driven in line to develop Design for Environment (DfE) vision, and is an open platform on the level of complete vehicles. It ensures a collective vision to enhance the SPD technology streams.

Eco design TA activity is geared toward compliance on quality, repeatability, and recommendations for ecological and economic improvements.

The ECO-Design Transversal Activity will support and interact with the other ITDs and IADPs by basically providing methodologies for Materials, Processes and Resources. Airframe and LPA represent the backbone of the technologies development, which will be then implemented at vehicle level also in the biz and regional demonstrators. ECO-Design activity will bring on board stronger activities from Systems and Engines ITDs compared to Clean Sky. The management will support all necessary interface requirements and will foster not only technical activities within the ITDs but also collaborative activities amongst ITDs and IADPs.
Description of activities

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 for 2014-2015**

Eco design transversal activity major outcomes in the first 2 years (2014-15) are summarized in the following table.

In 2014 the set-up of the transversal activity will be managed together with the understanding and definition of requirements from SPDs in line with technology stream contribution to be assessed from a life cycle’s perspective. Initial activities will concern definition of all the 3 activity delivery levels and ways of interaction with SPDs/TE.

Sub-teams to support the collaborative EDAS and VEES issues will be set up that continuously monitor, optimise links and responses and submit recommendations to the Eco Design TA committee. The Work units’ definition needs to be assessed through a dedicated deliverables. In 2014 most technical activities are performed in the frame of T1 where the scoping-screening-identification giving Life Information Technologies (LIFT) is addressed.

Other tasks are foreseen and are further described in the table below.

A first batch of calls is intended to be proposed at mainline level to support the TA in line with the agreed scope.
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 ecolonomic 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 2014-2015:**

- First Eco Design CFP topics definition and launch
- 1st 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 2014 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 2014-2015:**

- High level description of each SPD objectives and requirements prioritisation as input
- Arbitration of ecolonomic 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 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 ecolonomic 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 ecolonomic harmonisation with respect to the respective user benefit analysis of each major integrator

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 oneGrant 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 accord 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.
9.9. 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 TE’s concept aircraft / rotorcraft.

Description of activities

The 1st Clean Sky 2 TE assessment is foreseen for 2017. In that context the 2014-2015 Clean Sky 2 TE activities will be preparatory work in terms of the assessment and models input and output specifications. Preparation for TE concept aircraft modeling and Air Transport System (ATS) scenarios definition will also be done. The existing Clean 1 TE toolsuite will be reused. Organizational issues will also be dealt with (e.g. CFP and core partner definition).

Description of high level work packages 2014

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 IADP and ITD objectives in terms of environment, mobility and socio-economic aspects. Additionally the CS2 TE reference point will be defined for 2015 state of the art aircraft.

The TE inputs and outputs will be defined through WP1.2. This encompasses the inputs from the IADPs and ITDs and the outputs of the TE.
**WP2 TE Interfacing with IADPs, ITDs and transversal activities**

WP2 covers the interfacing between the TE and the three ITDs, namely Airframe, Engine and Systems, and the IADPs, namely Large Passenger Aircraft, Regional Aircraft and Fast Rotorcraft. In 2014 one meeting will be held for to discuss WP1 issues and deliverables. TE timing and integrated planning with IADPs and ITDs will be discussed and iterated based on the 2014-2015 foreseen CS2 activities.

**Main milestones / deliverables 2014**

Activities are planned to start in October 2014. Milestones will be those done through the WP2 “interfacing with IADPs, ITDs and transversal activities”. One meeting will be held in October to monitor and discuss the WP1 activity.

Two deliverables for 2014 are planned [D1 and D2]; see also the figure overleaf
- D1 will encompass the TE set-up, methodology and metrics as related to WP 1.1
- D2 will encompass the definition of the TE’s interfaces and inputs/outputs as related to WP 1.2

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<th>CS2 TE workplan 2014</th>
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<td>Deliverable</td>
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<table>
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<tr>
<th>WP 1</th>
<th>TE Scope and Set-up</th>
<th>deliverables</th>
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<tbody>
<tr>
<td>WP 1.1</td>
<td>Methodology for evaluation, impact assessment and interdependencies</td>
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<tr>
<td></td>
<td>Metrics/objectives</td>
<td>D 1</td>
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<td></td>
<td>Reference points</td>
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<td>WP 1.2</td>
<td>Definition of TE inputs and outputs</td>
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<td>IADP inputs to TE</td>
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<td>ITD inputs to TE</td>
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<td>TE outputs</td>
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<td>WP 2</td>
<td>TE interfacing with IADPs, ITDs and Transversal Activities</td>
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<td></td>
<td>Regular 3 month meetings</td>
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**Description of high level work packages 2015**

**WP0 TE management**

Possible CFP topic descriptions will be prepared by taking into account available expertise in Europe. The setup of the CS2 TE core team will be prepared.

**WP1 TE scope and set up**

The results of the 2014 deliverable will be updated for WP 1.1 and WP 1.2.

In WP1.3 consistency with SESAR and other projects like environmental CSAs in Horizon 2020 will be checked and discussed.
WP1.4 will specify a 1st version of the 2017 planned CS2 TE 1st assessment.

**WP2 TE Interfacing with IADPs, ITDs and transversal activities**

Four meetings are planned to discuss WP0, WP1, WP3 and WP5 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 ITDs a set of technologies will be defined as preparation for future TE concept aircraft modelling for 2035 and 2050 concept aircraft.

**WP5 TE ATS impact assessment**

The preparation of generic ATS airline scenarios and assessments will be started.

**Main milestones and deliverables for 2015**

Milestones will be the done through the WP2 “interfacing with IADPs, ITDs and transversal activities”. 4 meeting sessions will be held to monitor the progress of WP0, WP1, WP3 and WP5 activities and foreseen deliverables.

**WP 0 TE management**

- CFP topic description
- Core team topic description

**WP 1 TE Scope and Set-up**

- WP 1.1 Methodology for evaluation, impact assessment and interdependencies
  - Metrics/objectives update
  - Reference points update
- WP 1.2 Definition of TE inputs and outputs
  - IADP inputs to TE update
  - ITD inputs to TE update
  - TE outputs update
- WP 1.3 Consistency with respect to external projects
  - SESAR interaction and inputs on other projects (CSAs)
- WP 1.4 Global workflow
  - Overall Specification of 2017 assessment

**WP 2 TE interfacing with IADPs, ITDs and TAs**

- Regular 3 month meetings

**WP 3 TE independent integration on mission levels**

- WP 3.3 Innovative aircraft design
WP 5 TE ATS Impact assessments

- WP 5.1 Forecasts, Scenarios and Airport Capacity Constraints
  - ATS scenario preparation

Clean Sky TE / Clean Sky 2 TE transition

The figure below shows an excerpt of the transition from Clean Sky TE to Clean Sky 2 TE with respect to the 1st assessment for Clean Sky 2 TE in 2017. Some Clean Sky results will be taken over in the Clean Sky 2 TE 1st assessment as e.g. the outcomes of the BLADE test that is scheduled for the end of 2016. The last Clean Sky TE assessment is planned for mid of the year 2016. In parallel to Clean Sky TE Clean Sky 2 TE work will be performed on the TE concept aircraft modeling as shown here in the example of the long range aircraft model to be performed by the TE in cooperation and through inputs from the Clean Sky 2 engine ITD.

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. 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 2014-2015

10.1. Calls for Core-Partners

Core Partners

The Core Partners will be Members of the JU and, with a strategic long-term commitment to the funding and implementation of the Programme, will perform strategic tasks and bring key capabilities to implement the Programme through the research actions in which they are involved.

More specifically, the Core Partners shall bring to the Programme the following:

- Strategic long-term commitment;
- Key competences/capabilities necessary to carry out strategic activities of the programme such as the development of major elements of one or several demonstrators (from the study to its final integration) and closely related to the needs as defined in the IADP/ITD;
- 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. The indicative average total value of a Topic for the selection of Core Partners will be approximately 10 M€ throughout the Programme.\(^\text{16}\)

The activities to be carried out will address the following aspects:

- 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;

\(^{16}\) 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 value is indicative and is set also in view of selecting a total number of Core Partners which would fit with the work plans and management structures of the IADP/ITDs and with the governance structure of the CSJU. This may take the form of participation to the Steering Committees of the IADP/ITDs which require an effective and efficient decision-making process. Core partners as members of the CSJU shall also pay their respective contribution to the running costs of the JU – based on the percentage of their operational activity in the overall programme and will be expected to sign the funding agreement for members. 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.
Direct contributions to building up integrated demonstrators, designed to prove the viability of new technologies that offer a potential economic advantage, up to TRL 6;

Other contributing 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.

The Core Partners will engage in performing the following tasks:

- Address the Strategic Topic for Core Partners and commit to its level of in-kind contributions by performing the activities defined in the topic and (providing) delivering the required deliverables in accordance with the specified schedule;
- Be responsible for a Level 1 or Level 2 Work Package in an IADP/ITD or TA
- Contribute to the management of demonstrators;
- Become a member of JU, commit to at application stage and endorse the Statutes of JU by signing an official letter of acceptance and a funding agreement for their proportion of the running costs of the JU;
- Contribute to the overall funding, objectives and implementation of the Programme in the relevant IADP/ITD;
- Act where appropriate as a Topic Manager in the Calls for Proposals of the relevant Work Package for which they are responsible, and consequently, be in charge of 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.

10.2. Definition of Strategic Topics

Core Partners will be selected on the basis of Strategic 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 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 proposals will be evaluated and the highest ranked applications will be proposed for acceptance to the Governing Board and may be selected for funding by the JU.

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 description of the overall Clean Sky 2 Programme is the “Joint Technical Programme [published by JU on the 27th of July]” 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.

The Strategic Topic descriptions are indicated in the Work Plan and in detail in the *Annex I - 1st Call for Core-Partners: List and Full Description of Strategic Topics*.

**Content of the Strategic Topic description:**

- the name of the IADP/ITD to which the activity is linked;
- the key capabilities, operational capacity and competences required to implement the Programme (expertise, skills and track record) and to deal with the risks associated to the activity under the topic and the Programme area (both at IADP/ITD and applicant level);
- the proposed scope of work and activities outputs as required within the IADP/ITD;
- the name of the CS2 Leader opening the topic;
- an indicative total topic value (or ‘total project cost’);
- the topic area;
- the alignment with the strategic objectives of the IADP/ITD;
- the expected overall contribution: output, timeframe, major deliverables;
- the short-medium term objectives/milestones;
- the requirements related to the operational capacity (level of competences, level of technical capabilities, availability and capacities of specific resources, equipment, machineries track record etc);
- any specific legal, intellectual property and liability aspects in line with the provisions under the JU Model Grant Agreement for Members and with the IADP/ITD Consortium Agreement;
- any specific confidentiality and competitive issues and any specific requirement (e.g Design Organism Agreement, Production Organism Agreement, etc)
- specific issues related to the Transversal Activities (TAs) where contributions stemming from the Topic will have relevance to one or more of the IADP/ITDs in addition to the TA itself.

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17 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.

18 To be published by the CSJU at the launch of the call

19 To be published by the CSJU at the launch of the call or in due time before the start of the negotiation
Complementary Activities

Applicants as Core Partners may also indicate in their proposal 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 activities proposed:

- 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 Topic’s general area.
- would be in line with the Programme’s key goals and objectives

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20 Applicable to calls for Core-Partners. Complementary activities shall not be misunderstood with the additional activities defined in Article 4.2 of CSJU Regulation.
10.3. **Accession of the Core Partner to the Grant Agreement for Member**

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 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.

10.4. **First Call for Core Partners JTI-CS2-2014-CPW01**

The first call for Core Partners was launched on the 9th of July 2014.

Detailed descriptions of the topics opened in the Call for Core Partners (JTI-CS2-2014-CPW01) have been provided in *Annex I - 1st Call for Core-Partners: List and Full Description of Strategic Topics* (see previous versions of Work Plan v2 to v6).
10.5. General outline for the Call for Core Partners JTI-CS2-2014-CPW01

Publication date: 09 July 2014
Deadline for submission (call closure date): 05 November

Overall indicative funding value: 206 million EUR

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes of the Work Plan.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part F of the General Annexes of the Work Plan.

Evaluation procedure: The procedure for setting a priority order for applications with the same score is given in part F of the General Annexes to the Work Plan.

The full evaluation procedure is described in the Rules for submission, evaluation, selection, award and review procedures for Calls for Core Partners as published on the JU website and on the Participant Portal.

ITD/IADP Consortium agreement: Core Partners will be required to accede to the applicable ITD/IADP consortium agreement prior to the signature of grant agreement for members.

10.6. Second Call for Core Partners JTI-CS2-2014-CPW02

The second Call for Core Partners will be launched in the first quarter of 2015. The related list of topics for this second call for Core-Partners is further presented in Annex IV: 2nd Call for Core-Partners: List and full description of Topics.

(see separate document published on the Participant Portal)
10.7. Calls for Proposals (for Partners)

A first Call for Proposals (for Partners or ‘complementary grants’) was launched in the last quarter of 2014. The related list of topics for Partners is further presented in the Annex III: List of Topics for the 1st Call for Proposals (for Partners).

The second and third Call for Proposals are foreseen to be launched in the 2nd and 4th quarters of 2015.

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 are defined through topics proposed by the private Members of the JU. Upon their verification by the JU in terms of innovation and/or new knowledge to result, they are validated and launched by the JU in order to support and complement the Programme’s research and innovation activities where appropriate. The list of topics and their descriptions are defined in the Work Plan with information such as the related IADP/ITD/TA, its estimated duration, the type of action (RIA or IA) and an indicative topic funding value. Topics for Partners will be smaller in terms of magnitude and duration than the Topics for Core Partners.

Partners’ activities will be launched through Calls for Proposals (CfP) organised by the JU. The Partners' activities 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 the demonstrators or other research 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.

More specifically, the Partners shall bring to the Programme the following:

- Short/medium-term commitment;
- A level and quality of resources consistent with the funding value of each Topic;
- Competences / capabilities necessary to carry out the activities aiming at developing new knowledge, new technologies and solutions contributing to the action.
- The activities may be of various types (study, design, simulation, development, manufacturing, integration etc.) and closely related to the needs as per defined in every IADP/ITD;
• The achievement of the topics’ deliverables will support the overall Research and Innovation agenda of the Programme

The activities to be carried out in the context of the action performed by Partners may include the following:

• Research and technological development activities reflecting the core activities of the action, aimed at a significant advance beyond the established state-of-the-art, including scientific coordination; and/or
• Demonstration activities, designed to prove the viability of new technologies that offer a potential economic advantage, but which cannot be commercialised directly (e.g. testing of product-like prototypes), and/or
• Any other activities such as:
  ✓ monitoring activities, over and above the technical management of individual work packages, linking together all the action components and maintaining communications with both the JU and the Topic Manager;
  ✓ activities directly related to the action’s objectives and likely to have a potential impact on the outcome of the action;
  ✓ activities to disseminate and exploit the research results and to prepare for their take-up and use, including knowledge management and, activities directly related to the protection of foreground;
  ✓ training of the researchers and key staff, including research managers and industrial executives (in particular for SMEs) and any potential users of the knowledge generated by the project. The training should aim to improve the professional development of the personnel concerned and be necessary to carry out the project work.

10.8. 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.);

10.9. 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.\(^{21}\)

\(^{21}\) Under the conditions set out in Article 25.2 and 25.3 of the H2020 model grant agreement
10.10. First Call for Proposals 2014 (for Partners) - General outline

The first Call for Proposals for Partners JTI-CS2-2014-CFP01 was launched on the **10th of December 2014**.

Detailed descriptions of the topics are provided in *Annex III - 1st Call for Proposals (for Partners): List and Full Description of Topics.*

Deadline for submission (call closure date): **31 March 2015**

Overall indicative funding value: **47,96 million EUR**

For time to grant: maximum 8 months from the publication of the call.

The indicative date of signature of the Grant Agreement for Partners by the CSJU: **10 August 2015**.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes of the Work Plan.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part F of the General Annexes of the Work Plan.

Evaluation procedure: The procedure for setting a priority order for applications with the same score is given in part F of the General Annexes to the Work Plan.

The full evaluation procedure is described in the *Rules for submission, evaluation, selection, award and review procedures for Calls for Proposals* to be published on the JU website and on the Participant Portal.

In line with Article 41.3 of the model GAP, where applicable in case of multi-beneficiaries GAPs, the participants must conclude an internal consortium agreement.

Under the applicable option complementary grant (Article 41.4 of the model GAP) the GAP single or multi-beneficiaries must agree on the accession to the ITD/IADP consortium agreement or sign an implementation agreement with the private member acting as topic manage. The template of the ITD/IADP consortium agreement and the template Implementation Agreement will be published with the call for proposal or as soon as available.
10.11. 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) will be based on 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 6th 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:

11. OBJECTIVES AND INDICATORS

The overall objectives for the period 2014-2015 are:

➢ To staff the JU team up to the agreed level of 42;
➢ To elaborate the technical content of the overall programme and ensure this is adequately incorporated in the CS2 Joint Technical Programme and the Grant Agreements: (including the (re-)evaluation of elements of the Programme where needed);
➢ To conduct Launch Reviews for 100% of technical activity commencing in the 2014-15 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 Launch Reviews, in order to ensure an effective and appropriate transition from CS to CS2;
➢ To define the requirements for the Demonstration Programme – as this is a new programme with new objectives, the requirements of the demonstrators which are targeted need to be worked out; within each area, this step is essential to help to set the basis for the following years’ work plans to be drawn up;
➢ 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 propose solutions for leveraging Clean Sky 2 funding with Structural Funds;
➢ To define and implement an effective and efficient management and governance set of rules through the Clean Sky 2 Management Manual;
➢ To define an appropriate model for each transverse area that allows for the transversal coordination to be executed and technical synergies to be extracted;
➢ To launch and select the first and second wave of Core-Partners;
➢ To widely disseminate the information about the first three Calls for Proposals (i.e. call for partners), in order to reach a participation from SMEs higher than 35%. To proceed with the selection of 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 ensure a time-to-grant lower than 8 months from the call for proposal closure;
➢ To train the JU financial staff on the specific eligibility rules for CS2 Programme and organise information sessions on the subject with the members and core partners.
➢ To execute at least 90% of the budget and of the relevant milestones and deliverables;
➢ To contribute to the development of the Terms of Reference required for adequate reporting of the private members contributions to the JU.
### 11.1. Clean Sky 2 Demonstrators and Technology streams

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<tr>
<td>Fast Rotorcraft: Tiltrotor</td>
<td>Advanced Tilt Rotor Aerodynamics and Flight</td>
<td>D6: NextGenCTR’s fuselage assembly D7: NextGenCTR’s wing assembly</td>
</tr>
<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
<td>Demonstrator / Technology Stream</td>
</tr>
<tr>
<td>------------</td>
<td>------------------</td>
<td>----------------------------------</td>
</tr>
</tbody>
</table>
|            | Physics Design   | D8: Engine-airframe physical integration  
|            |                  | D9: Fuel system components         |
| Fast Rotorcraft: Tiltrotor | Advanced Tilt Rotor Energy Management System Architectures | D5: NextGenCTR’s drive system components and assembly  
|            |                  | D10: intelligent electrical power system and ancillary/auxiliary components  
|            |                  | D11: Flight control & actuation systems and components |
| Fast Rotorcraft: Tiltrotor | Tiltrotor Flight Demonstrator | Tiltrotor Flight Demonstrator |
| Fast Rotorcraft: Compound R/C | Innovative Compound Rotorcraft Airframe Design | Airframe structure & landing system  
|            |                  | NB: Wing and tail addressed in Airframe ITD dedicated WPs (1.8, 1.11)  
|            |                  | To include:  
|            |                  | - advanced composite or hybrid metallic/composite structure using latest design and production techniques  
|            |                  | - Specific landing system architecture & kinematics |
| Fast Rotorcraft: Compound R/C | Innovative Compound Rotorcraft Power Plant Design | Lifting Rotor & Propellers  
|            |                  | 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>|            |                  | Drive train &amp; Power Plant 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>
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
</tr>
</thead>
</table>
| Fast Rotorcraft: Compound R/C | Innovative Compound Rotorcraft Avionics, Utilities & Flight Control Systems | On board energy, cabin & mission systems  
Implementation of innovative electrical generation & conversion, high voltage network, optimized for efficiency & low weight; advanced cabin insulation & ECS for acoustic and thermal comfort. |
| Fast Rotorcraft: Compound R/C | LifeRCraft Flight Demonstrator | 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 |
| Airframe | High Performance and Energy Efficiency | 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 |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Novel Travel Experience</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ergonomics, cabin noise reduction,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>seats &amp; crash protection, eco-friendly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>materials, human centered design,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>light weight furniture, smart galley</td>
</tr>
<tr>
<td>Airframe</td>
<td>High Versatility and Cost Efficiency</td>
<td>Next Generation Optimized Wing Box 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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optimized High Lift Configurations Turboprop integration on high wing, optimised nacelle shape, high integration of Tprop nacelle (composite/metallic), high lift wing devices, active load protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced Integrated Structures 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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced Fuselage 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</td>
</tr>
<tr>
<td>Engines</td>
<td>Innovative Open Rotor Engine Configurations</td>
<td>Open Rotor Flight Test Ground test and flight test of a Geared Open Rotor demonstrator: - Studies and design of engine and control system update and modifications for final flight test - Manufacturing, procurement and engine assembly for ground test checking before flight Following on flight test planned in LPA IADP and test results analysis</td>
</tr>
<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
<td>Demonstrator / Technology Stream</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Engines</td>
<td>Innovative High Bypass Ratio Engine Configurations I: UHPE Concept for Short/Medium Range aircraft (Safran)</td>
<td>UHPE demonstrator Design, development and ground tests of a propulsion system demonstrator for an Ultra High By-pass Ratio engine: validation of the low pressure modules and nacelle technology</td>
</tr>
<tr>
<td>Engines</td>
<td>Business Aviation/Short Range Regional Turboprop Demonstrator</td>
<td>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</td>
</tr>
<tr>
<td>Engines</td>
<td>Advanced Geared Engine Configuration</td>
<td>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</td>
</tr>
<tr>
<td>Engines</td>
<td>Innovative High Bypass Ratio Engine Configurations II: VHBR Middle of Market Turbofan Technology (Rolls-Royce)</td>
<td>VHBR Middle of Market Turbofan Technology Design, development and ground testing of a VHBR Middle of Market Turbofan</td>
</tr>
<tr>
<td>Engines</td>
<td>Innovative High Bypass Ratio Engine Configurations III: VHBR engine demonstrator for the large engine market (Rolls-Royce)</td>
<td>VHBR engine demonstrator for the large engine market Design, development and ground testing of a large VHBR engine demonstrator</td>
</tr>
<tr>
<td>Engines</td>
<td>Small Aircraft Engine Demonstrator</td>
<td>Small Aircraft Engine Demonstrators - reliable and more efficient operation of small turbine engines - light weight and fuel efficient diesel engines</td>
</tr>
<tr>
<td>IADP / ITD</td>
<td>Technology Areas</td>
<td>Demonstrator / Technology Stream</td>
</tr>
<tr>
<td>------------</td>
<td>------------------</td>
<td>---------------------------------</td>
</tr>
</tbody>
</table>
| Systems   | Integrated Cockpit Environment for New Functions & Operations | Extended Cockpit Demonstrations for:  
- Flight Management evolutions: green technologies, SESAR, NextGen, interactive FM  
- Advanced functions: communications, surveillance, systems management, mission management  
- Cockpit Display Systems: new cockpit, HMI, EVO, etc.  
- IMA platform and networks |
| Systems   | Innovative and Integrated Electrical Wing Architecture and Components | Innovative Electrical Wing Demonstrator (including ice protection) for:  
- New actuation architectures and concepts for new wing concepts  
- High integration of actuators into wing structure and EWIS constraints  
- Inertial sensors, drive & control electronics  
- New sensors concepts  
- Health monitoring functions, DOP  
- WIPS concepts for new wing architectures  
- Shared Power electronics and electrical power management  
Optimization of ice protection technologies and control strategy |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
</tr>
</thead>
</table>
| Systems   | Innovative Technologies and Optimized Architecture for Landing Gears | Advanced systems for nose and main landing gears applications for:  
- Wing Gear and Body Gear configurations  
- Health Monitoring  
- Optimized cooling technologies for brakes  
- Green taxiing  
- Full electrical landing gear system for NLG and MLG applications  
- EHA and EMA technologies  
- Electro-Hydraulic Power Packs  
- Remote Electronics, shared PE modules  
- Innovative Drive & Control Electronics |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
</tr>
</thead>
</table>
| **Systems** | High Power Electrical and Conversion Architectures | Non propulsive energy generation for:  
- AC and DC electrical power generation  
- AC and DC electrical power conversion  
- SG design for high availability of electrical network  
- Integrated motor technologies, with high speed rotation and high temperature material |
| **Systems** | Innovative Energy Management Systems Architectures | Innovative power distribution systems, (including power management) for:  
- Electrical Power Centre for Large Aircraft – load management and trans-ATA optimization  
- High integrated power center for bizjet aircraft (multi ATA load management, power distribution and motor control)  
- Smart grid, develop & integrate breakthrough components to create a decentralized smart grid, partly in non-pressurized zone.  
- Electrical Power Centre – load management optimization  
- Health Monitoring, DOP compliant |
| **Systems** | Innovative Technologies for Environmental Control System | Next Generation EECS, Thermal management and cabin comfort for:  
- New generation of EECS including a global trans ATA visionable to answer the needs for load management, Inerting systems, Thermal Management, Air quality & cabin comfort  
- Development / optimisation of Regional A/C EECS components for full scale performance demonstration  
- New generation of cooling systems for additional needs of cooling |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
</tr>
</thead>
</table>
| Systems             | Advanced Demonstrations Platform Design & Integration                           | Demonstration Platform – PROVEN, GETI & COPPER Bird®  
- To mature technologies, concepts and architectures developed in Clean Sky 2 or from other R&T programs and integrated in Clean Sky 2  
- For optimization and validation of the thermal and electrical management between the main electrical consumers |
| Systems             | Small Air Transport (SAT) Innovative Systems Solutions                           | Small Air Transport (SAT) Activities  
- Efficient operation of small aircraft with affordable health monitoring systems  
- More electric/electronic technologies for small aircraft  
- Fly-by-wire architecture for small aircraft  
- Affordable SESAR operation, modern cockpit and avionic solutions for small a/c  
- Comfortable and safe cabin for small aircraft  
*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* |
| Systems             | ECO Design                                                                       | ECO Design activities  
Refers to ECO Design chapter |
| Technology Evaluator (TE) | A systematic overall approach to the Technology Evaluation process and monitoring activity | - Progress Monitoring of Clean Sky 2 achievements  
- Evaluation at Mission Level of particular ITD outputs  
- Impact Assessments at Airport and ATS Level |
<table>
<thead>
<tr>
<th>IADP / ITD</th>
<th>Technology Areas</th>
<th>Demonstrator / Technology Stream</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco-Design Transverse Activity</td>
<td>An overall innovative approach and &quot;agenda&quot; for Eco-Design activity in the CS2 Programme</td>
<td>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. The co-ordination of all Eco-Design activities will be established in the Airframe ITD. The list of technology areas and “story boards” and demonstrators will be established during the 2014-15 period.</td>
</tr>
<tr>
<td>Small Air Transport (SAT) Transverse Activity</td>
<td>An overall innovative approach and &quot;agenda&quot; for Small Air Transport activity in the CS2 Programme</td>
<td>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. The planned demonstrators are included in the above descriptions of the Airframe, Engines and Systems ITDs.</td>
</tr>
</tbody>
</table>

**LEGEND**

IADP/ITD/TA | Technology Area | Demonstrator / Technology Stream
--- | --- | ---
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.
11.2. Environmental forecast

The table below shows the environmental targets of the Clean Sky 2 Programme as defined in the Joint Technical Proposal.

<table>
<thead>
<tr>
<th>Indicator ID</th>
<th>Indicator short name</th>
<th>Description of indicator</th>
<th>Target set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ind 1.4 C</td>
<td>SME share in CfPs - numbers</td>
<td>number of SME participation in CfP versus total number of applicants</td>
<td>&gt;40%</td>
</tr>
<tr>
<td>Ind 2.5.1 B</td>
<td>Core Partner Topics success rate</td>
<td>percentage of topics resulting in signature of the GAM</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Ind 2.5.4 B</td>
<td>Core Partner Strategic Topics Redress procedures - all</td>
<td>Number of redress requests</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>Ind 2.5.1 B</td>
<td>CfP Topics success rate</td>
<td>percentage of topics resulting in signature of the GAP</td>
<td>&gt;90%</td>
</tr>
</tbody>
</table>

* 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.

<table>
<thead>
<tr>
<th>Indicator ID</th>
<th>Indicator short name</th>
<th>Description of indicator</th>
<th>Target set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ind 1.4 C</td>
<td>SME share in CfPs - numbers</td>
<td>number of SME participation in CfP versus total number of applicants</td>
<td>&gt;40%</td>
</tr>
<tr>
<td>Ind 2.5.1 B</td>
<td>Core Partner Topics success rate</td>
<td>percentage of topics resulting in signature of the GAM</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Ind 2.5.4 B</td>
<td>Core Partner Strategic Topics Redress procedures - all</td>
<td>Number of redress requests</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>Ind 2.5.1 B</td>
<td>CfP Topics success rate</td>
<td>percentage of topics resulting in signature of the GAP</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Indicator ID</td>
<td>Indicator short name</td>
<td>Description of indicator</td>
<td>Target set</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------</td>
<td>--------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Ind 2.5.4 B</td>
<td>CfP Topics Redress procedures - all</td>
<td>Number of redress requests</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>Ind. 2.7.1 A</td>
<td>WP execution by Members - resources</td>
<td>percentage of resources consumption versus plan (Members only)</td>
<td>&gt;80%</td>
</tr>
<tr>
<td>Ind 2.7.1 B</td>
<td>WP execution by Members - deliverables</td>
<td>percentage of deliverables available versus plan (Members only)</td>
<td>&gt;80%</td>
</tr>
<tr>
<td>Ind 2.7.3 C</td>
<td>Launch reviews – percentage held</td>
<td>percentage of total major demo activity where Launch Reviews held and resulting in agreed launch of major projects</td>
<td>30%</td>
</tr>
<tr>
<td>Ind 2.9 C</td>
<td>Budget execution - payments operational</td>
<td>percentage of payments made within the deadlines</td>
<td>&gt;85%</td>
</tr>
<tr>
<td>Ind 3.7.3 A</td>
<td>Budget execution - payments running costs</td>
<td>percentage of payments made within the deadlines</td>
<td>&gt;75%</td>
</tr>
</tbody>
</table>
## 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.

<table>
<thead>
<tr>
<th>Risk Description</th>
<th>CS Process</th>
<th>Action Plan summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>Manage the Programme</td>
<td>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.</td>
</tr>
<tr>
<td>Technical setbacks in one or several ITDs may result in a significant under-spending of annual budget.</td>
<td>Manage the Programme</td>
<td>Re-balance the budget across ITDs/IADPs and with Partners if necessary at mid-year, according to the 2nd quarterly reports.</td>
</tr>
<tr>
<td>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</td>
<td>Manage the Programme</td>
<td>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</td>
</tr>
<tr>
<td>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</td>
<td>Manage the Programme</td>
<td>Have clear management plan and templates for required documentation, defined at the start of the programme.</td>
</tr>
<tr>
<td>Core Partner call may be not answered or quality of submissions results in non-selection</td>
<td>Manage the Programme / Manage the Calls</td>
<td>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</td>
</tr>
<tr>
<td>Planning for cost and effort for complex, large ground and flight demonstrators (10 year programme) may lack accuracy</td>
<td>Manage strategic planning risks Deploy lessons learned project</td>
<td>Each IADP / ITD to deploy an individual, tailored risk management and to completion plan</td>
</tr>
<tr>
<td>Negotiation processes with Core Partners may be lengthy, leading to delayed start of technical activities</td>
<td>Manage the Programme / Manage the Calls</td>
<td>Ensure appropriate training to Winners and Topic Managers; have a close follow-up of all negotiations and early warning/ escalating process for solving issues.</td>
</tr>
<tr>
<td>Risk Description</td>
<td>CS Process</td>
<td>Action Plan summary</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Efforts for interfaces and cooperation of partners for flight worthy hardware and complex flight demonstrators may be initially underestimated | Manage strategic planning risks  
Deploy lessons learned project Systematic Design Reviews | 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 | Manage the Programme / Manage the ITDs | 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 | Manage the Programme / Manage the Calls | 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. | Manage the ITDs | Manage priorities: abandon non crucial technology development and integrate only the crucial ones in the demonstration. Consider the implementation of a contingency margin. |
13. 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 2014 and 2015 as currently set out does not foresee carried over appropriations from previous years, nor interest gained on the bank account of Clean Sky. The only 2 sources of revenue are from the private members (for half of the annual running costs) and the EU subsidy. In total, the running costs will not surpass 80m € when both sources of revenue are combined and are shared 50/50. The available operational budget from the EU subsidy is therefore 1.715bn € (40m € for running costs in addition to this figure).

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.

The main features of the 2014-2015 expenditure in the budget are set out below:

<table>
<thead>
<tr>
<th>Budget Clean Sky 2 Expenditure</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014</td>
<td>2014</td>
<td>2015</td>
<td>2015</td>
</tr>
<tr>
<td>Title 1</td>
<td>1,682,067</td>
<td>1,682,067</td>
<td>2,850,000</td>
<td>3,153,677</td>
</tr>
<tr>
<td>Title 2</td>
<td>842,119</td>
<td>842,119</td>
<td>2,009,906</td>
<td>2,509,129</td>
</tr>
<tr>
<td>Title 4</td>
<td>103,00,000</td>
<td>25,000,000</td>
<td>357,277,704</td>
<td>101,232,274</td>
</tr>
<tr>
<td>Title 5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Budget</td>
<td>105,524,186</td>
<td>27,524,186</td>
<td>362,137,610</td>
<td>106,895,080</td>
</tr>
</tbody>
</table>

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 2014 the JU allowed to fund the main part of these expenses as the regulation entered into force on the 27th of June 2014. Only those expenses which can directly attributed to the CS2 programme are currently budgeted in the running costs for 2014 in the CS2 annual budget. For 2015, this is revised
further but it has been reduced to meet the reduced commitment and payment appropriations available from the EU subsidy.

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

The JU is still defining the staff costs which it can expect in 2014/2015 as a consequence to the establishment plan which will be adopted by the GB in July 2014. The current figures reflect the available commitment and payment appropriations of 2014/2015 for CS2 running 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 as with the other JTIs. In 2014, the JU expects to expand onto the 3rd floor in order to have adequate office space for the 42 staff of the JU and to facilitate the private members’ visits to the JU. The expansion is now planned for mid-July 2014 and is the result of a joint effort of all JTIs in the White Atrium to agree on a common sharing of the available space.
Title 3 (Operational Expenditure):

*The figures presented here reflect the state of play regarding Leaders, Core Partners and Partners’ activities for the years 2014 and 2015.*

The overall figures are set out in Title 4 in the budget. In summary, the amounts allocated for Leaders, Core Partners and Partners are reflected here. These amounts are flexible between each other while the total envelope, in particular for PA, is not flexible.

<table>
<thead>
<tr>
<th>OPERATIONAL EXPENDITURE</th>
<th>2014 Commitment Appropriations (CA)</th>
<th>2014 Payment Appropriations (PA)</th>
<th>2015 Commitment Appropriations (CA)</th>
<th>2015 Payment Appropriations (PA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LARGE PASSENGER AIRCRAFT</td>
<td>12,548,506</td>
<td>3,431,497</td>
<td>45,946,000</td>
<td>6,751,202</td>
</tr>
<tr>
<td>REGIONAL AIRCRAFT</td>
<td>4,414,473</td>
<td>1,207,176</td>
<td>12,589,000</td>
<td>2,037,610</td>
</tr>
<tr>
<td>FAST ROTORCRAFT</td>
<td>13,530,453</td>
<td>3,700,019</td>
<td>25,214,000</td>
<td>5,631,532</td>
</tr>
<tr>
<td>AIRFRAME</td>
<td>33,834,355</td>
<td>8,054,962</td>
<td>47,775,000</td>
<td>9,413,008</td>
</tr>
<tr>
<td>ENGINES</td>
<td>17,186,293</td>
<td>4,699,739</td>
<td>67,012,000</td>
<td>11,222,604</td>
</tr>
<tr>
<td>SYSTEMS</td>
<td>14,285,920</td>
<td>3,906,607</td>
<td>41,987,000</td>
<td>8,325,198</td>
</tr>
<tr>
<td>TECHNOLOGY EVALUATOR</td>
<td>720,000</td>
<td>0</td>
<td>408,000</td>
<td>67,500</td>
</tr>
<tr>
<td>ECO-DESIGN</td>
<td>5,420,000</td>
<td>0</td>
<td>3,800,000</td>
<td>855,000</td>
</tr>
<tr>
<td>TRANSVERSE ACTIVITY</td>
<td>1,060,000</td>
<td>0</td>
<td>3,800,000</td>
<td>477,000</td>
</tr>
<tr>
<td>CALLS FOR TENDERS</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CALLS FOR PROPOSAL</td>
<td>0</td>
<td>0</td>
<td>108,746,704</td>
<td>56,451,620</td>
</tr>
<tr>
<td>TITLE 4 - TOTAL</td>
<td>103,000,000</td>
<td>25,000,000</td>
<td>357,277,704</td>
<td>101,232,274</td>
</tr>
<tr>
<td>TITLE 5 – UNUSED APPROPRIATIONS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL TITLE 4 &amp; 5</td>
<td>103,000,000</td>
<td>25,000,000</td>
<td>357,277,704</td>
<td>101,232,274</td>
</tr>
</tbody>
</table>

*In order to match the overall level of CA and PA available from the EU subsidy, the Title 5 line ‘unused appropriations’ is currently allocated the ‘leftover’ appropriations until the final topic list is available. It is not envisaged to have any part of the available credits ‘unused’ in any amendment to this Work Plan or annual budget.*
14. 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

<table>
<thead>
<tr>
<th>TARGET GROUPS:</th>
<th>Potential applicants: IADP/ITD leaders, Large, Small and Medium Enterprises, academia</th>
</tr>
</thead>
<tbody>
<tr>
<td>MESSAGE:</td>
<td>Benefits of participation in Clean Sky 2 projects</td>
</tr>
</tbody>
</table>

**Promotion of Calls**

- Info Days sessions around Call launch
- Open Webinar
- SRG promotion in each country
- Clean Sky management and staff active participation at events
- Partnership with SMEs European organisations

**Clean Sky visibility at key events:**

- ILA Berlin, Farnborough Air Show 2014
- Paris-Le Bourget on 15-21 June 2015
- ASD Annual event
- Clean Sky 2 national events
b) Keep decision makers aware by demonstrating progress of Clean Sky 2

<table>
<thead>
<tr>
<th>TARGET GROUPS:</th>
<th>Policy-makers in the area of research, innovation, transport and environment in industry and public institutions. Special emphasis on newly elected European Parliament and newly appointed Commission</th>
</tr>
</thead>
<tbody>
<tr>
<td>MESSAGE:</td>
<td>Success of demonstrators in on-going technical projects</td>
</tr>
<tr>
<td></td>
<td>• <strong>High-level meetings</strong> with national and European policy-makers</td>
</tr>
<tr>
<td></td>
<td>• <strong>High-level media coverage</strong> through PR work, press releases and opinion articles in leading and specialised media</td>
</tr>
<tr>
<td></td>
<td>• <strong>Targeted events</strong> with representative of European Commission, European Parliament, EU countries Permanent Representatives and business community</td>
</tr>
</tbody>
</table>

c) Internal enabler: Support IADP/ITD/TA coordinators and project officers

<table>
<thead>
<tr>
<th>TARGET GROUPS:</th>
<th>CS ITD coordinators, CS2 IADP/ITD/TA coordinators, project officers</th>
</tr>
</thead>
<tbody>
<tr>
<td>MESSAGE:</td>
<td><strong>Ex-ante and post-project interaction</strong> with communications to optimise visibility, advocacy and influence of Clean Sky</td>
</tr>
<tr>
<td></td>
<td>Provide <strong>communications guidance</strong> and support for their contributions to the web site, events, printed and digital publications as well as other communication tools available.</td>
</tr>
</tbody>
</table>

d) Maximise efficiency and effectiveness of Clean Sky communications efforts.

<table>
<thead>
<tr>
<th>TARGET GROUPS:</th>
<th>ITD leaders communications professionals, Clean Sky management and staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>MESSAGE:</td>
<td>Maximise internal information and coordinate well external actions while aligning messages and timing</td>
</tr>
<tr>
<td></td>
<td>• <strong>Align messages</strong> to speak with a single voice at events, high-level meetings and when doing media relations. Improve narrative to reach out various audiences</td>
</tr>
<tr>
<td></td>
<td>• <strong>Coordinate communication activities</strong> with Communications network group</td>
</tr>
<tr>
<td></td>
<td>• Conclude <strong>contracts</strong> with external communication suppliers where more efficient and needed</td>
</tr>
</tbody>
</table>
15. JU EXECUTIVE TEAM

The JU team of statutory staff consists of 24 positions currently. It is proposed that this team will be increased to 42 statutory positions to manage the two programmes. The establishment plan for 2014 and 2015 shows the increased level. 13 additional positions are envisaged in 2014 while 5 additional posts are envisaged in 2015. Currently the JU manages 325\(^{22}\) grant agreement in addition to the 7 annual grant agreements for members (consisting of 192 beneficiaries financial reports and 7 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 24 positions currently recruited, 17 positions are involved in the grant management area (excluding senior management tasks). The obligations on the JU to comply with the same financial rules as bigger entities have reached a situation for the JU where it has had to rely on the external service providers and some of its members to provide the team with adequate support.

In the future, with the addition of 18 new positions, 15 of which are for managing purely operational activities, the JU will be in a better position to manage, with its own internal resources both programmes. The future operational team will be composed of project officers supported by a pool of project support officers. 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.

\(^{22}\) 423 total signed GAPs minus 98 closed projects.
16. **SUMMARY ANNUAL BUDGET**

The Clean Sky 2 Joint Undertaking will manage 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 2014 and 2015 of the Clean Sky 2 Joint Undertaking is summarized as follows:

<table>
<thead>
<tr>
<th>Budget 2014</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clean Sky 2 JU</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title 1 Expenditures</td>
<td>3,973,734</td>
<td>3,973,734</td>
</tr>
<tr>
<td>Title 2 Expenditures</td>
<td>2,377,344</td>
<td>2,377,344</td>
</tr>
<tr>
<td>Title 3 Expenditures</td>
<td>92,249,851</td>
<td>122,216,299</td>
</tr>
<tr>
<td>Title 4 Expenditures</td>
<td>103,000,000</td>
<td>25,000,000</td>
</tr>
<tr>
<td>Title 5 Unused Appropriations</td>
<td>27,640,835</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Budget</strong></td>
<td><strong>229,241,764</strong></td>
<td><strong>153,567,377</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Budget 2015</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clean Sky 2 JU</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title 1 Expenditures</td>
<td>4,750,000</td>
<td>5,164,685</td>
</tr>
<tr>
<td>Title 2 Expenditures</td>
<td>3,077,522</td>
<td>4,057,707</td>
</tr>
<tr>
<td>Title 3 Expenditures</td>
<td>75,550,380</td>
<td>135,485,596</td>
</tr>
<tr>
<td>Title 4 Expenditures</td>
<td>357,277,704</td>
<td>101,232,274</td>
</tr>
<tr>
<td>Title 5 Unused Appropriations</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Budget</strong></td>
<td><strong>440,655,606</strong></td>
<td><strong>245,940,262</strong></td>
</tr>
</tbody>
</table>
17. 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 year 2014 and 2015 at the JU’s beneficiaries covering mainly cost claims pertaining to the execution of FP7 GAMs of the years 2011 to 2014. 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\(^{23}\) for the entire programme period (FP7) of maximum 2% of total budgetary expenditure.

\(^{23}\) 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 2014 and 2015 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.
18. PROCUREMENT AND CONTRACTS

Procurement

For the year 2014-2015 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 2014-2015 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 2014-2015 are expected to support some core activities mainly in the field of communication for specific events and activities and in the IT field.

The start of the operational activities of JU and the planned increase of staff of the JU will require an extension of the current office allocation at the White Atrium Building which is planned to be dealt with through a joint amendment procedure of the existing building rental contract by the affected Joint Undertakings.

A summary table is made available below listing the tenders planned for 2014-2015 and the procurement procedure expected to be used at this stage on the basis of the information currently available, estimated budget and estimated timetable for publication. Only tenders with a value exceeding EUR 5,000 are listed in the following table.
### Contracts to be tendered in 2014 and 2015

<table>
<thead>
<tr>
<th>Title</th>
<th>Expenditure indicative</th>
<th>Type of procedure</th>
<th>Schedule indicative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IT infrastructure services</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT infrastructure and hardware including management and maintenance services</td>
<td>130,000 EUR</td>
<td>Open procedure (Joint procedure with other JUs)</td>
<td>Launch planned for 2nd quarter 2014</td>
</tr>
<tr>
<td><strong>Communication related activities and events</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organisation of stand at the Farnborough Air Show</td>
<td>&lt; 60,000 EUR</td>
<td>Negotiated procedures with three tenderers (^{25})</td>
<td>Launch planned for 1st/2nd quarter 2014</td>
</tr>
<tr>
<td>Organisation of stand at the ILA Berlin Air Show</td>
<td>&lt; 60,000 EUR</td>
<td>Negotiated procedures with three tenderers (^{26})</td>
<td>Launch planned for 1st quarter 2014</td>
</tr>
<tr>
<td>Organisation of stand at Paris Le Bourget Air Show</td>
<td>&lt; 60,000 EUR</td>
<td>Negotiated procedures with three tenderers (^{27})</td>
<td>Launch planned for 1st quarter 2015</td>
</tr>
</tbody>
</table>

---

\(^{24}\) Estimate

\(^{25}\) This procedure will be launched in case the recourse to Framework Contract (CSJU.2013.OP.01 Lot3) for communication and events organization could not be used in the light of the specific services required and the location of these events.

\(^{26}\) Idem

\(^{27}\) Idem
19. DATA PROTECTION

In 2014-2015, the JU will continue to ensure that personal data are protected and that Regulation (EC) No 45/2011 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 45/2011 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 45/2011.

- 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 2013 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 2013 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 2014 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
20. ANNEX I: 1st Call for Core-Partners: List and Full Description of Topics

[See annex in Work Plan 2014-2015 (from v2 to v6) available at www.cleansky.eu]
21. **ANNEX II: Amendment nr. 2 to Annual Budget 2014-2015**

(Available in separate document on [www.cleansky.eu](http://www.cleansky.eu))
22. ANNEX III: 1st Call for Proposals (for Partners): List and full description of Topics

(see separate document published on Participant Portal)
23. **ANNEX IV: 2nd Call for Core-Partners: List and full description of Topics**

*(see separate document published on Participant Portal)*
24. **ANNEX V: Amendment nr. 2 to Annual Budget 2014-2015**

*(see separate document published on [www.cleansky.eu](http://www.cleansky.eu))*
25. 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:\n
  o Anguilla, Aruba, Bermuda, Bonaire, British Virgin Islands, Cayman Islands, Curaçao, Falkland Islands, French Polynesia, Greenland, Montserrat, New Caledonia, Pitcairn Islands, Saba, Saint Barthélémy, Saint Helena, Saint Pierre and Miquelon, Sint Eustatius, Sint Maarten, Turks and Caicos Islands, Wallis and Futuna.

– The Countries Associated to Horizon 2020: the latest information on which countries are associated, or in the process of association to Horizon 2020 can be found in the online manual.

International European interest organisations 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:

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28 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

29 Signed an agreement with the Union as identified in Article 7 of the Horizon 2020 Regulation

30 http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/international-cooperation_en.htm

31 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.

32 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.
The Countries Associated to Horizon 2020\textsuperscript{33}: the latest information on which countries are associated, or in the process of association to Horizon 2020 can be found in the online manual\textsuperscript{34}.

– 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).

\textsuperscript{33} Signed an agreement with the Union as identified in Article 7 of the Horizon 2020 Regulation

\textsuperscript{34} \url{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\textsuperscript{35} reports of research and development activities, products, services executed in the same relevant area;
- a list 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\textsuperscript{36}) 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

\textsuperscript{35} 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.

\textsuperscript{36} See the definition under Article 2 of H2020 Rules for Participation
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 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**\(^{37}\) 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\(^{38}\) to a Member of the JU;
- to issue a declaration of absence of conflicts of interest\(^{39}\) 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.

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\(^{37}\) See the definition under Article 2.1 of H2020 Rules for Participation

\(^{38}\) Applicants shall check the definition based on Article 2.1 of H2020 Rules for Participation

\(^{39}\) 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 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\(^{40}\) 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;

\(^{40}\) 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.
• Other inputs to assess the operational capacity as requested in the topic description in the Call.

• A description of any third parties (including affiliates\textsuperscript{41}) 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 overwritten 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 \textbf{16 Leaders of JU listed in Annex II to Regulation n° (EU) No 558/2014 and their affiliates\textsuperscript{42}} 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 \textit{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.

• \textbf{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.

• \textbf{The Partners} selected by Call for Proposal may apply to Calls for Core Partners and Calls for Proposal in all IADP/ITD.

\textsuperscript{41} See the definition under Article 2 of H2020 Rules for Participation

\textsuperscript{42} 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\textsuperscript{43} to a Member of the JU;
- to issue a declaration of absence of conflicts of interest\textsuperscript{44} 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.

\textsuperscript{43} Applicants shall check the definition based on Article 2.1 of H2020 Rules for Participation

\textsuperscript{44} 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\(^{45}\) 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. \(^{46}\)

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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Eligibility conditions(^{47,48})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research &amp; innovation action</td>
<td>At least one legal entity established in a Member State or associated country</td>
</tr>
<tr>
<td>Innovation action</td>
<td>At least one legal entity established in a Member State or associated country</td>
</tr>
</tbody>
</table>

\(^{45}\) 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.

\(^{46}\) See section Joint applications by legal entities in the Rules for submission, evaluation, selection, award and review procedures of Calls for Core Partners.

\(^{47}\) 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.

\(^{48}\) 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.

\(^{49}\) 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\textsuperscript{49,50}

Research and innovation actions\textsuperscript{51}

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%

\textsuperscript{49} 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).

\textsuperscript{50} 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.

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.

<table>
<thead>
<tr>
<th>Type of action</th>
<th>Excellence</th>
<th>Impact</th>
<th>Quality and efficiency of the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and innovation; Innovation;</td>
<td>The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.</td>
<td>The extent to which the outputs of the project should contribute at the European and/or International level to:</td>
<td>The following aspects will be taken into account:</td>
</tr>
<tr>
<td></td>
<td>- 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;</td>
<td>- Level of technical contribution and key capabilities brought to the IADP/ITD and Programme objectives</td>
<td>- Consistency of the proposed activity with the background, skills and competences as described;</td>
</tr>
<tr>
<td></td>
<td>- Clarity and pertinence</td>
<td>- The expected impact as described under the relevant topic and the strategic contribution brought to the Programme and the;</td>
<td>- Coherence and effectiveness of the application, including appropriateness of the allocation of tasks and resources;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Enhancing innovation capacity and integration of new knowledge;</td>
<td>- Appropriateness of the management structures and procedures, including risk and innovation management;</td>
</tr>
<tr>
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<td></td>
<td>- Strengthening the competitiveness and</td>
<td></td>
</tr>
</tbody>
</table>

52 See footnote 44.
<table>
<thead>
<tr>
<th>Type of action</th>
<th>Excellence</th>
<th>Impact</th>
<th>Quality and efficiency of the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.</td>
<td>The extent to which the outputs of the project should contribute at the European and/or International level to:</td>
<td>The following aspects will be taken into account:</td>
</tr>
<tr>
<td></td>
<td>- Type of action</td>
<td>- Growth of companies by developing innovations meeting the needs of European and global markets, and where relevant, by delivering such innovations to the markets;</td>
<td>- Match of technical capabilities and skills with the Topic and Programme objectives;</td>
</tr>
<tr>
<td></td>
<td>- Impact</td>
<td>- Demonstrating the environmental and socially important impacts as relevant for the CS2 Programme;</td>
<td>- Strategic ability to work in the topic area;</td>
</tr>
<tr>
<td></td>
<td>- Quality and efficiency of the implementation</td>
<td>- Performance of the “core research” activities within Europe and Associated Countries;</td>
<td>- 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;</td>
</tr>
<tr>
<td></td>
<td>- of the objectives;</td>
<td>- Plan on exploitation of results showing the contribution on the European competitiveness in the sector;</td>
<td>- Capability and management skills for Calls for Proposal coordination, when acting as Topic Manager (where applicable);</td>
</tr>
<tr>
<td></td>
<td>- Credibility of the proposed approach;</td>
<td>- 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;</td>
<td>- 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;</td>
</tr>
<tr>
<td></td>
<td>- Soundness of the concept, including trans-disciplinary considerations, where relevant;</td>
<td>- Level of strategic contribution and key capabilities brought to the IADP/ITD and Programme objectives;</td>
<td>- Best “value for money” on the activities proposed and efficiency of the allocation of resources;</td>
</tr>
<tr>
<td></td>
<td>- Relevance and adequacy of proposed work and results as compared with the Topic description;</td>
<td>- Level of new capabilities and skills brought to the Programme compared to the ones already existing within the Membership;</td>
<td>- Complementarity of the participants within the consortium or cluster (where applicable);</td>
</tr>
<tr>
<td></td>
<td>- 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)</td>
<td>- Probability of application/valorization of technology results, including soundness of the exploitation plan and</td>
<td>- Capacity of the cluster or consortium or leader to efficiently coordinate activities of the participants (where applicable).</td>
</tr>
<tr>
<td></td>
<td>- 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.</td>
<td>- Strategic ability to work in the topic area;</td>
<td></td>
</tr>
</tbody>
</table>
### Type of action

<table>
<thead>
<tr>
<th>Excellence</th>
<th>Impact</th>
<th>Quality and efficiency of the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.</td>
<td>The extent to which the outputs of the project should contribute at the European and/or International level to:</td>
<td>The following aspects will be taken into account:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>its ability to contribute to the competitiveness of the sector.</td>
</tr>
</tbody>
</table>

#### Coordination & support actions

| Clarity and pertinence of the objectives; | The expected impacts listed in the work programme under the relevant topic | Coherence and effectiveness of the work plan, including appropriateness of the allocation of tasks and resources; |
| Credibility of the proposed approach; | 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. | Complementarity of the participants within the consortium (when relevant); |
| Relevance and adequacy of proposed work and results as compared with the Topic description; | | Appropriateness of the management structures and procedures, including risk and innovation management. |
| Soundness of the concept; | | |
| Quality of the proposed coordination and/or support measures. | | |

**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 online 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.

<table>
<thead>
<tr>
<th>Type of action</th>
<th>Excellence</th>
<th>Impact</th>
<th>Quality and efficiency of the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.</td>
<td>The extent to which the outputs of the project should contribute at the European and/or International level to:</td>
<td>The following aspects will be taken into account:</td>
</tr>
<tr>
<td>All types of action</td>
<td>Clarity and pertinence of the objectives; Credibility and demonstrated excellence and ambition of the proposed approach.</td>
<td>The expected impacts listed in the work programme under the relevant topic</td>
<td>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.</td>
</tr>
<tr>
<td>Coordination &amp; support actions</td>
<td>Soundness of the concept; Quality of the proposed coordination and/or support measures.</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Type of action</td>
<td>Excellence</td>
<td>Impact</td>
<td>Quality and efficiency of the implementation</td>
</tr>
<tr>
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<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Research and innovation; Innovation;</td>
<td>The following aspects will be taken into account, to the extent that the proposed work corresponds to the topic description in the work plan.</td>
<td>The extent to which the outputs of the project should contribute at the European and/or International level to:</td>
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</tr>
<tr>
<td></td>
<td>Research and innovation; Innovation;</td>
<td>Impact</td>
<td>Quality and efficiency of the implementation</td>
</tr>
<tr>
<td></td>
<td>Soundness of the concept and approach,</td>
<td>The expected impact towards the objectives as described under the relevant topic;</td>
<td>Match of technical capabilities and skills with the Topic description and congruent with the Programme objectives embodied in the topic;</td>
</tr>
<tr>
<td></td>
<td>Extent that proposed work is ambitious, has innovation potential, and is beyond the state of the art.</td>
<td>Enhancing innovation capacity and integration of new knowledge;</td>
<td>Demonstrated ability to work in the topic area;</td>
</tr>
<tr>
<td></td>
<td>Suitability of the technologies, approaches and solutions proposed, with respect to the Topic description and the IADP/ITD area and objectives.</td>
<td>Demonstrating the congruence with and progress towards the environmental and socially relevant impacts stated for the CS2 Programme;</td>
<td>Ability to work effectively within a supply chain and into an equal or higher tier industrial organization;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A clear and credible path towards the exploitation of results showing a demonstrable contribution towards European competitiveness</td>
<td>Evidence and quality of the operational resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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.</td>
<td>Ability and efficiency to commit financial resources against the indicative topic value and based on the proposed content and JU funding request;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Capacity of the cluster or consortium leader to efficiently coordinate activities of the participants (where applicable).</td>
</tr>
</tbody>
</table>

**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.
26. 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