
The information contained in this Work Plan (topics list, budget, planning of calls) may be subject to updates. Any further amendments of the Work Plan will be made publicly available after its adoption by the Governing Board.

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<th>Date</th>
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<td>Bi-annual Work Plan and Budget 2018-2019</td>
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| First Amended Bi-annual Work Plan and Budget 2018-2019 | R2          | 05/03/2018 | - update of section 3.2.2 Scientific priorities & challenges, p. 16; ITD Airframe, pp. 38-48 and ITD Engines pp. 49-53  
- update of section 3.3 Call management rules, p. 74  
- update of Annex II: List of private members - beneficiaries of the grant agreements for members, pp. 96-106  
- inclusion of Annex IV: List and full description of topics to be launched under the eighth call for proposals, p.106  
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1. INTRODUCTION

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

The following work plan (and its accompanying budget plan) sets out the main highlights of the activities to be covered across the largest aeronautic research programme ever funded by the European Union budget over the period 2018 and 2019. As the Joint Undertaking enters its ninth year of existence, it can draw on some invaluable lessons learned and experience gained. The joint efforts of the private and public members, together with the JU programme office, have led to a successful start and use of this novel instrument in aeronautics research at EU level.

2. MULTI-ANNUAL PROGRAMMING

2.1. Multi-annual objectives

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. The objectives set in the regulation cannot be achieved within one financial year which is why the CS2 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.

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.

2.2. Multi-annual programme

Based on the multi-annual commitments approach of the JU under its new legal basis, this draft work plan includes the description of activities for the years 2018-2019.

The leaders’ activities are described in the following chapters and they are complemented by the core partners joining the programme through the calls for core partners. The commitment appropriations of the years 2018 when added to previous commitment appropriations [e.g. 2017] will be sufficient to entirely cover the grant agreements with the leaders and core-partners for 2018 and 2019 and the planned calls for proposals.

2.3. Human and financial resource outlook

The JU has 42 statutory staff planned in its establishment plan (see section 4.2) and allocated to complete the work plan and achieve the KPI targets set out here.

The running of the Clean Sky 2 programme at its mature phase during 2018-2019 implies a significant number of new grant agreements to be signed and reporting to be processed from the previous years.
Based on the current average number of reporting periods per project launched via calls for proposals and the current typology of applications, we expect the Clean Sky 2 programme to have a total of reporting periods and cost claims [per beneficiary] exceeding 3000 over the life of the programme. The annual reporting periods of the grant agreements for members and over 200 member-level participants will lead to another 2000 cost claims and beneficiary level reporting events. This will need to be accommodated in the JU’s resources over the programme’s life.
3. BI-ANNUAL WORK PLAN 2018-2019

3.1. Executive summary

The Clean Sky 2 programme is jointly funded by the European Commission and the major European aeronautics companies, and involves an EU contribution (financial) from the Horizon 2020 programme budget of €1.755 bn. This is complemented by the In-Kind contributions from the Private members and related to the Programmes’ activities [IKOP], and will be leveraged by further Additional Activities [IKAA] of the Private members funded at national, regional and private levels leading to a total public and private investment of approximately €4 bn. These so-called ‘additional activities’ will be enablers for the demonstrators or parallel research work necessary to develop an operational product in due time.

The Clean Sky 2 programme consists of four different elements:

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

The 16 Leaders are founding members of Clean Sky 2, as stated in the Annex II to the CS2JU Regulation, who have committed to deliver the full Clean Sky 2 programme throughout its duration and meet its high-level as stated in art. 2 of the Council Regulation:

(a) to contribute to the finalisation of research activities initiated under Regulation (EC) No 71/2008 and to the implementation of Regulation (EU) No 1291/2013, and in particular the
Smart, Green and Integrated Transport Challenge under Part III — Societal Challenges of Decision 2013/743/EU;
(b) to contribute to improving the environmental impact of aeronautical technologies, including those relating to small aviation, as well as to developing a strong and globally competitive aeronautical industry and supply chain in Europe.
This can be realised through speeding up the development of cleaner air transport technologies for earliest possible deployment, and in particular the integration, demonstration and validation of technologies capable of:
(i) increasing aircraft fuel efficiency, thus reducing CO2 emissions by 20 to 30% compared to ‘state-of-the-art’ aircraft entering into service as from 2014;
(ii) reducing aircraft NOx and noise emissions by 20 to 30% compared to ‘state-of-the-art’ aircraft entering into service as from 2014.

The Leaders and Core Partners are represented in the CS2JU Governing Board.

The Core Partners have committed to make substantial, long-term commitments towards the programme and to bring key competences and technical contributions aligned to the high-level objectives. They contribute to the global management of the IADPs/ITDs concerned, and contribute with significant in-kind contributions. Core partners have been selected in accordance with Article 4.2 of the Statutes on the basis of topics for core partners launched in the 2014 – 2016 timeframe, and have acceded to the CS2JU as members once completing the membership approval, technical negotiation and grant accession process. Core Partners being private members, they are represented in the CS2JU Governing Board on a rotational basis.

The technical activities of the Core partners are aligned with the Programme’s high-level objectives and strategic direction as laid down in the Development Plan of the Clean Sky 2 programme and will be referred to in the relevant grant agreement for members.

Actions performed by the private members in the grant agreements for members are all considered to be Innovation Actions as defined in Horizon 2020.

The partners will carry out objective driven research activities aiming at developing new knowledge, new technologies and/or solutions that will bring a contribution to the high-level goals of the Clean Sky 2 programme, and will complement actions developed and executed in the IADP/ITDs/TAs.

The partners’ activities will be determined through topics defined in the work plan and launched as calls for proposals via the EU Participant Portal. The calls for proposals will follow the H2020 Rules for Participation. Upon selection, the partners will sign a grant agreement for partners with the JU and their contribution may be made to either demonstrator activities in the IADPs/ITDs/TAs, or to a set of technological research activities which are performed by one or several CS2 members in the frame of the grant agreement[s] for members. Partners will not become members of the JU and will not contribute to the administrative costs of the JU. Similarly, they will not participate in the steering committees of the IADP/ITDs or in the Governing Board.
Actions performed by the partners in the grant agreements for partners may be Research and Innovation Actions, or Innovation Actions, as earmarked in the call topics.
3.2. Operations

3.2.1. Objectives, indicators, risks and mitigations

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

- Quarterly Reports of the ITD/IADPs, which inform on the resources consumption, the achievements and the resulting forecasts for level of project implementation
- Steering Committees at ITD/IADPs level with involvement of the CS project officers
- Annual Reviews of the ITD/IADP’s performance organised by the JU with the involvement of independent experts.
- This monitoring information is summarized and reported regularly to the Governing Board.

The overall objectives for the Clean Sky 2 programme for the period 2018-2019 are:

 TCHAR $$\Rightarrow$$ To execute the technical content as defined for the two-year period and as stabilized at the end of 2017 and upon completion of the private member accession through the four core partner calls executed from 2014 through 2017, and ensure this is adequately incorporated in the Clean Sky 2 Development Plan and the grant agreements;
 TCHAR $$\Rightarrow$$ To determine in the course of 2018 – 2019 the definitive configuration of the Programme’s major demonstrators and technology development themes, based on robust risk and progress reviews based on the 2017 baseline set in the CS2DP; where necessary diverting resources to safeguard the achievement of the programme’s High-Level Goals [HLGs];
 TCHAR $$\Rightarrow$$ To implement solutions for leveraging Clean Sky 2 funding with structural funds;
 TCHAR $$\Rightarrow$$ To implement an effective and efficient management and governance of the programme;
 TCHAR $$\Rightarrow$$ To implement an appropriate and agreed approach for each transverse area that allows for the transversal coordination to be executed and technical synergies to be extracted;
 TCHAR $$\Rightarrow$$ To implement four further calls for proposals [including the seventh call to be launched end 2017 and closing in the first quarter of 2018], and implement within these calls the additional and complementary format of “thematic topics” enabling a wide range of competing technology solutions to address broad problem-oriented topics that are geared towards the Clean Sky 2 programme-level HLGs;
 TCHAR $$\Rightarrow$$ To widely disseminate the information about the calls for proposals (for partners), in order to reach a healthy level of applications and ensure the success of the topics; including participation from SMEs higher than 35%. To proceed with the selection of participants through these calls;
 TCHAR $$\Rightarrow$$ To ensure a time-to-grant no greater than eight months for the calls for proposal in no less than 80% of topics and selected proposals;
 TCHAR $$\Rightarrow$$ To execute at least 90% of the budget and of the relevant milestones and deliverables;
 TCHAR $$\Rightarrow$$ To ensure a high level of technical and process integrity in the execution of the programme, including the calls and their resulting selection of CS2 participants; and a maximum relevance of research actions performed towards the programme’s goals.
 TCHAR $$\Rightarrow$$ To finalise and implement the impact assessment strategy and reference framework for the TE (including the selection of and the performance levels of reference aircraft against which the progress in CS2 will be monitored); to finalize the assessment criteria...
and evaluation schedule for the TE for each technical area. To complete the selection of its key participants; to conduct within the timeframe of the work plan the first TE assessment of CS2 in order for its completion in early 2020.

**Clean Sky 2 Demonstrators and Technology streams**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Demonstration area</th>
<th>LPA</th>
<th>REG</th>
<th>FRC</th>
<th>AIR</th>
<th>ENG</th>
<th>SYSE</th>
<th>M</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakthroughs in Propulsion Efficiency</td>
<td>CROR</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>M</td>
<td>C</td>
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<tr>
<td>(incl. Propulsion-Airframe Integration)</td>
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<td></td>
<td>Ultra-high Bypass and High Propulsive Geared Fan</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td></td>
<td>M</td>
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<tr>
<td></td>
<td>Hybrid Electric Propulsion</td>
<td>✓</td>
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<td></td>
<td>Small Aircraft, Regional and Business Aviation Turboprop</td>
<td>✓</td>
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<td>M</td>
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<tr>
<td>Advances in Wings, Aerodynamics and Flight Dynamics</td>
<td>Advanced Laminar Flow Technologies</td>
<td>✓</td>
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<td>C</td>
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<tr>
<td></td>
<td>Regional Aircraft Wing Optimization</td>
<td>✓</td>
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<td>M</td>
<td>C</td>
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<tr>
<td>Innovative Structural / Functional Design and Production System</td>
<td>Advanced Manufacturing</td>
<td>✓</td>
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<td>C</td>
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<tr>
<td></td>
<td>Cabin &amp; Fuselage</td>
<td>✓</td>
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<td>M</td>
<td>C</td>
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<tr>
<td></td>
<td>Innovative Solutions for Business Jets</td>
<td>✓</td>
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<td></td>
<td></td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Next Generation Cockpit Systems and Aircraft Operations</td>
<td>Cockpit &amp; Avionics</td>
<td>✓</td>
<td></td>
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<tr>
<td></td>
<td>Advanced MRO</td>
<td>✓</td>
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<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Novel Aircraft Configurations and Capabilities</td>
<td>Next-Generation Civil Tiltrotor</td>
<td>✓</td>
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<td>M</td>
<td>C</td>
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<tr>
<td></td>
<td>RACER Compound Helicopter</td>
<td>✓</td>
<td></td>
<td></td>
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<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Aircraft Non-Propulsive Energy and Control Systems</td>
<td>Electrical Systems</td>
<td>✓</td>
<td></td>
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<td></td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Landing Systems</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>C</td>
</tr>
<tr>
<td>Optimal Cabin and Passenger Environment</td>
<td>Environmental Control System</td>
<td>✓</td>
<td></td>
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<td></td>
<td></td>
<td>M</td>
<td>C</td>
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<tr>
<td></td>
<td>Innovative Cabin Passenger/Payload Systems</td>
<td>✓</td>
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<tr>
<td>Eco-Design</td>
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<tr>
<td>Long-term Technologies</td>
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*Contribution as E: Environment, M: Mobility, C: Competitiveness*

**Indicators**

The Key performance Indicators set up for the CS2 programme are presented in Annex I.
## 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. None of the described risks is considered to present a critical residual risk level taking into account the planned actions.

<table>
<thead>
<tr>
<th>Risk Description</th>
<th>CS Process</th>
<th>Action Plan summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Execution of the technical activities in Clean Sky 2 may not result in the achievement of the High-Level Goals [HLGs] as stated in the Regulation</td>
<td>Manage the programme</td>
<td>Build and maintain a robust “flow-down” of targets from the Regulation’s quantitative HLGs into objectives of each IADP/ITD and 1st level Work Packages and Major Demonstrator elements. Integrate monitoring into the TE work plan and support with Annual [periodic] Reviews with external experts and Scientific Committee, adjusting programme content where necessary. Define “SMART” objectives for the IADPs/ITDs in all areas of qualitative goals of the Regulation [e.g. competitiveness and mobility and monitor progress towards these goals through periodic assessments with the TE and by the JU directly via supporting studies and Coordination &amp; Support actions, where necessary. Propose and implement adjustments to the technical content of the programme where justified in order to safeguard the achievement of the HLGs, both within the membership and through [revised] calls for proposal topics, including “thematic topics” where external stakeholder input can widen the portfolio of technologies with a high potential for contributing to the HLGs.</td>
</tr>
<tr>
<td>Strategic or technical priorities within industrial companies may result in a lack of resources available for Clean Sky 2, delays in the completion of the activities and/or a need to revise programme content.</td>
<td>Manage the programme</td>
<td>Maintain an early warning capability through quarterly reports, the Annual and Intermediate Progress Reviews and where necessary alert the Governing Board. Propose re-orientations when needed and ensure these are reflected in the CS2DP and WP. Use GAM Amendment</td>
</tr>
</tbody>
</table>

**CS-GB-2018-04-05 First Amended Work Plan and Budget 2018-2019**
<table>
<thead>
<tr>
<th>Risk Description</th>
<th>CS Process</th>
<th>Action Plan summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical setbacks in one or several IADPs / ITDs / TAs may result in under achievement of milestones and deliverables and/or a significant under-spending of annual budget.</td>
<td>Manage the programme / Manage the IADPs/ITDs</td>
<td>Review each quarter and advise GB where issues arise. Re-balance the budget across ITDs/IADPs and with partners if necessary. Propose re-orientations when needed and ensure these are reflected in the CS2DP and WP. Use GAM Amendment process to officiate. Re-balance the overall budget towards increased Calls for Proposals, in particular “thematic topics” allowing for input of proposed programme content from external stakeholders, on the basis of a prior validation of this thematic content delivering demonstrable progress towards the Programme’s HLGs.</td>
</tr>
<tr>
<td>Planning for cost and effort for complex, large ground and flight demonstrators (10 year programme) may lack maturity and/or accuracy, leading to delayed completion of technical activities or reduced scope of activities.</td>
<td>Manage the programme / Manage the IADPs/ITDs</td>
<td>Each IADP / ITD to deploy a detailed risk management and “through to completion” plan with critical path management. CS2DP process to highlight “through to completion” plans, budgets and risks, allowing due assessment and revision opportunities. Implement a robust “Gate” process for major demonstrators [in particular flight demonstration], diverting resources if necessary to alternative programme content that demonstrates clear progress towards the HLGs at lower and more manageable risk. Re-balance budget between 1st Level Work Packages and/or between IADPs/ITDs to divert funding and resource available toward alternative actions that will reduce the risk of not achieving the programme’s HLGs.</td>
</tr>
<tr>
<td>Risk Description</td>
<td>CS Process</td>
<td>Action Plan summary</td>
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<tr>
<td>----------------------------------------------------------------------------------------------------------------</td>
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<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Competences and resource to successfully enable the completion and test of flight demonstrators may be underestimated or insufficient</td>
<td>Manage the programme / Manage the IADPs/ITDs</td>
<td>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. Have clear descriptions of work in call texts for such activities directly related to flightworthy hardware, including requested skills and agreements.</td>
</tr>
<tr>
<td>Some costs may be overrun, and some participants may be unable to carry on until completion. Competences and resource to successfully enable completion of the technical work programme may be insufficient</td>
<td>Manage the IADPs/ITDs</td>
<td>Manage priorities: abandon non-crucial technology development and integrate only the crucial ones in the demonstration area of the programme. Implement a contingency margin. Identify the required competences and resources and closely monitor through PDR/CDR and milestone management. Enforce consistent and robust risk management; implement early-warning system to avoid late discovery of critical path related risks. Propose re-orientations when needed and ensure these are reflected in the CS2DP and work plan. Use GAM Amendment process to officiate.</td>
</tr>
</tbody>
</table>
3.2.2. Scientific priorities & challenges

The following subchapter presents the Clean Sky 2 programme high-level scope of work and the main scientific priorities and challenges to be performed by the ITDs, IADPs and TAs through the Grant Agreements for Members during the period 2018-2019\(^\text{[1]}\).

These activities are complemented and supported by actions executed by Partners selected in Calls for Proposals throughout 2014-2016 and the calls for proposals planned for the period 2018 – 2019 [including the 7\(^{th}\) Call for Proposals launched in November 2017, and which closed in February 2018, with grants to be placed from Q3/2018].

The private members of the following nine ITDs, IADPs and TAs are listed in Annex II.

**IADP Large Passenger Aircraft**

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

**Platform 1: “Advanced Engine and Aircraft Configurations”**

The major objective of Platform 1 is to provide the development environment for the integration of the most fuel efficient propulsion concepts into compatible airframe configurations and concepts targeting next generation aircraft. The major objective remains untouched despite very important decisions have been taken during the previous contractual period (2016/2017) with respect to three demonstrators:

- CROR Flight-Test Demonstrator (D1)
- CROR Rear-End Demonstrator (D2)
- UltraFan Flight-Test Demonstrator (D10)

The decisions taken were not to pursue with the development of D1 in CS2 and to stop the associated work on D2. D10 is subjected by the decision not to perform the flight test of the integrated UltraFan engine on A380 and instead exploring the opportunity to perform the flight test with another aircraft. This study has not been finished yet, but is expected to be finished in the course of 2018. With respect to D1 and D2, the according WPs were re-oriented in 2017, not turning away from the major objective of Platform 1 but putting more gravity on the parametric and systematic investigation of design - constraints, - parameters and - sensitivities for UHBR (especially fan) integration on future short-range aircraft combined with the possibility to make use of Boundary Layer Ingestion (BLI) design opportunities. The detailed elaboration of the plan is still under refinement and the implementation of the work across the LPA IADP and ENG ITD is subject to a technical evaluation scheduled end of 2017.

Overall, the considered propulsion concepts in Platform 1 range from Open Rotor engine architectures over advanced Ultra-High Bypass Ratio (UHBR) turbofans up to “hybrid”

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\(^{[1]}\) 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.
propulsion concepts (combination of combustion - and electric-based components) for different levels of electrification of the power plant. For all these aforementioned propulsion concepts design opportunities will be investigated to further increase the propulsive- and airframe efficiency. Examples for this are the application of Boundary Layer Ingestion (BLI) design or by exploring the potential of distributing the thrust generating part of the power plant over the aircraft.

In the context of improved engine performance and novel system architectures detailed studies for Non-Propulsive Energy Generation (NPE) will be performed to reduce the power off-take level from turbofan engines for improved thermal efficiency. In any case the validated plan will reveal full coherence, technical and financial, for UHBR integration on short range aircraft regarding airframe-engine integration tasks and engine module maturation across the both SPDs LPA and ITD Engines.

To avoid detrimental effects on overall aircraft performance when integrating UHBR engines on airframe, Platform 1 is developing and demonstrating integrated flow control techniques applied at the wing-pylon interface, an area which is prone to interference effects between wing and engine. Another important flow control activity in the reporting period is the maturation of the Hybrid Laminar Flow Control technology (HLFC) applied on tails and wing for skin-friction drag reduction. For scaled flight test demonstration the development of the actual flight-test vehicle and supporting prototypes is key during the reporting period and also its preparation for flight testing in late 2019/early 2020.

It is overall objective of Platform 1 that all technologies being developed and demonstrated are following consistent target aircraft configurations and concepts, which means that the compatibility between airframe and propulsion technologies is assured.

Platform 2 aims to develop, mature, and demonstrate an entirely new, advanced fuselage structural concept developed in full alignment towards next-generation cabin & cargo architectures, including all relevant aircraft systems. 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, covering the Next Generation Fuselage, Cabin and Systems Integration, the Next Generation Cabin & Cargo Functions and the Next Generation Lower Center Fuselage. These major demonstrators will be supported by a number of smaller test rigs and component demonstrators in the preparatory phase of the programme. 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” including advanced systems maintenance activities
In 2018 and 2019, the IADP LPA platform 3 activities will focus upon continuing the development and starting the integration and tests of the functions and technologies developed by the several Core partners in Platform 3 and in the ITD systems, within the Large aircraft Disruptive Cockpit, Regional aircraft Active cockpit and business jet ground demonstrators.

Flight tests for selected cockpit-avionics functions and technologies will be prepared and executed on Large Aircraft and on business jet.

CS-GB-2018-04-05 First Amended Work Plan and Budget 2018-2019
The definition and design of the Overall integrated system for pilot workload reduction will be completed, the roadmap for certification analysis and delivery of HW prototypes for individual integration into the demonstrator will be matured. The Active Cockpit Demonstrator enhancement plan will be fulfilled and the final test plan for on Ground Workload Reduction Assessment will be delivered. The development and the integration of the large Aircraft Disruptive Cockpit demonstrator will be launched, and operational test scenarios will be defined for the first demonstration phase. The first test sessions will take place. The Development and integration of major demonstrators for ADVANCE enabling Technologies (Health Monitoring, Collaborative Environment and line maintenance mobile tool applications) will be finalized, and final technology demonstration of ADVANCE will take place at end of 2019.

Description of main activities for the year 2018

Platform 1: “Advanced Engine and Aircraft Configurations”
The Launch Review for the Hybrid Laminar Flow Control technology (HLFC) wing is scheduled for 1st half of 2018. The underlying innovative structure and manufacturing concepts will be assessed by means of ground-based demonstrator tests. Following the HLFC flight-test campaign in the EU project AFLoNext (FP7) with the HLFC fin, a review in 2018 will determine if and how to move on and to integrate the developed flight-test opportunities in Platform 1 (HLFC demonstration platform, DLR’s A320 ATRA). In case of a Launch Review will be scheduled in 2018/2019.

Major Milestones planned for 2018
- Shaftline design completed for UHBR test rig (D1)
- TRL2 for BLI integrated design concept incl. optimised fan design (D1)
- Outcome of 2018 plateau phase: summary of enabling technologies, e.g. safety, acoustics, loads, etc. (D2)
- Ground tests of the integrated Scaled Flight Demonstrator (D3)
- TRL4 for HLFC HTP (D4)
- Decision gate about potential use of the HLFC flight-test demonstrator of AFLoNext in Platform 1 (D7)
- Launch Review HLFC wing (D6)
- Preliminary integrated design concept of HLFC wing agreed (D6)
- TRL3 and PDR for the propulsion system (UltraFan) (D10)
- Technical readiness review of ground test mock-up, including the delivery of all parts required to perform the ground test (D11)
- Aircraft configuration converged and selected (D8)
- Hybrid propulsion, preliminary component development studies performed (D9)

Major Deliverables planned for 2018
- CDRTRL4 of design concept UHBR test rig (D1)
- Specification of TRL3 criteria (D2)
- Specifications for the Dynamically Scaled Flight Demonstrator (D3)
- PDR for HLFC HTP (D4)
• Wind-Tunnel Test demonstration plan HLFC wing (D6)
• Specification for UHBR pylon/aircraft interface (D10)
• Analysis report available of cryogenic Wind–Tunnel test (D11)
• “Divergent” aircraft configurations, preliminary design report available (D8)
• Hybrid propulsion components, development report available (D9)


With respect to the Multi-Functional Fuselage Demonstrator (MFFD) the main focus of the Multifunctional fuselage demonstrator project will be on the maturation phase and preparation of the demonstrator manufacturing with priority on the development and design of the multifunctional fuselage structure, systems, and cabin elements, based on the currently available and evaluated technology bricks, which have been generated within the consortium during the concept phase.

The Next Generation Cabin & Cargo Functions demonstrators will continue the design of an innovative Passenger Service Unit (PSU). After having passed TRL3 for a first functional demonstrator of a Micro PSU, in 2018 the design shall be refined to a new Advanced Micro PSU (AMPSU) targeting to cover two different scenarios with concepts finalized until the end of 2018.

A Multi System Port (MSP) concept will be defined targeting to ease the customization and reconfiguration of monuments with the cabin and structure environment. This shall include the integration of piping/routing into monument walls and a change of integration on aircraft side.

A Universal Cabin Interface (UCI) shall be available at begin of 2018, followed by trials under real operation conditions based on the defined use cases.

The Environmental Friendly Fire Protection demonstrator will be prepared in 2018 for testing in 2019.

Currently the fuel cell in galley approach is currently under revision for potential expansion with an adaption of the demonstrator roadmap for 2018 and beyond.

Finally, the printed electrics technology will focus on testing of substrates, printed specimen, and substrates, and component prototypes in 2018.

In 2018 the main focus of the Next Generation Lower Centre Fuselage demonstrator project will be on the maturation phase and preparation of the demonstration phase.

The lower centre fuselage activities will focus on the industrial challenge to secure the high production rate of 60 aircraft per month (extensible to rate 100).

Focus will be on the definition of the section integration requirements, system modules, interface location design principles to reduce assembly lead times, using of new assembly technologies with increased utilization of robots and cobots. An important item to implement new assembly technologies is to systematically conduct tolerances analysis for the different major Center fuselage components. First assembly studies shall be conducted in 2018 using simulation trials.

The content of the demonstration phase will be defined during 2018.

Activities related to Non-specific cross functions & ITD Airframe will continue on the development of enablers and will transfer to Platform 2 first results from mature technology developments conducted in ITD-Airframe and first ended Partner Projects inputs aligned with specific implemented agreement agreed with partners from CS2 open calls.
Technology development will focus on cost reduction on composite by final works on nut cap technology reducing sealant application, development of monitoring process of blind fasteners on structural assemblies reducing the impact on assembly process and offering new closed-boxes design options and to implement and support the interface between WP 2.1 and automated thermoplastic welding process developed in the ecoTECH work package in ITD Airframe.

Based on the results of conceptual work and the selection of suitable technologies in 2016 and 2017 a significant share of activities will be dedicated to the development of automated cabin & cargo installations solutions, the design for automation and the assembly planning using AR and VR together with Partner form CS2 open calls related to the lower centre fuselage demonstrator needs. Furthermore the design and selection of concepts of an automated circumferential and longitudinal joint and the automated assembly of parts in an open fuselage will start related to WP 2.1 demonstrator.

Another focus will be laid on reduction of structural testing lead times by the development of specific sensor for automated inspection technologies related to Platform 2 structural demonstrators needs, and a first TSA integration with implementation of uncertainty quantification of digital image correlation and the implementation of a so-called “multi-scale” strategy on an Airbus use case at coupon level, both with partners from CS2 open calls.

**Major Milestones planned for 2018**

- Start of the multifunctional fuselage demonstrator manufacturing phase with detailed tool design
- Concept reviews for advanced cargo doors, integrated cabin and cargo structure, integrated lining and wiring
- Design reviews for cabin and cargo demonstrators, i.e. Advanced Micro PSU, Multi system Port
- Simulation of next generation Lower Centre Fuselage assembly
- Review of thermoplastic welding techniques for large fuselage components
- Review of Augmented and Virtual reality tool concepts for automated assembly of large and complex composite structures

**Major Deliverables planned for 2018**

- Detailed design package for Multifunctional Fuselage Demonstrator main tools
- Environmental Friendly fire Protection demo items and specimens for printed electrics ready for testing,
- Lower Centre Fuselage section integration requirements and system module specifications
- Test reports on non-intrusive inspection technologies for large and complex composite structures

**Platform 3: “Next Generation Aircraft Systems, Cockpit and Avionics” including advanced systems maintenance activities**

**Activities related to the Large Aircraft Disruptive Cockpit Demonstrator:**

In relation to Cockpit avionics functions and technologies, the Core Partner and partners will define and develop prototypes in accordance with the system specifications delivered by
the topic leader. The results to be delivered will be integrated on ground demonstrator in 2019, or integrated on Large aircraft flight tests aircraft.
The Cockpit Utility Management System demonstrator specification and associated interfaces with cockpit systems and smart air system sensors and application will be defined for Large Aircraft application, to be further integrated on the “airframer” ground test bench linked to the disruptive cockpit demonstrator.
Virtual Avionics Platform components will be specified for demonstrator preparation, Flight Warning application will be integrated
The ITD Systems Display System Definition and Development will be followed up with a definition in IADP Large Passenger Aircraft Platform 3.
In relation to Cockpit functions and technologies flight tests, the activities include the preparation of flight tests for several cockpit functions and technologies among which: Pilot protective Device, Software Defined Radio, Image Based Landing. In 2018 the flight tests will take place for Pilot protective Device.
In relation to Disruptive cockpit demonstrator definition and development, its first version ground test benches and the test means will be defined and the integration will start.

Activities related to the Regional Aircraft Active cockpit demonstrator:
The activities will focus on the completion of the definition & design of the Overall integrated system for pilot workload reduction (PWLRs) and the maturation of the roadmap for certification analysis and delivery of HW prototypes for individual integration into the demonstrator.
The REACTOR Pilot Workload Reduction System will progress through the Critical Design Review and into the implementation stage. Pilot Health Monitoring and Voice Command Systems will be delivered to the Airbus Defence & Space Active Cockpit simulator (WP3.4).
The activities related to Ground and flight tests demonstration for Business jet will consist in maturing the cockpit functions and technologies developed in 2017 and prepare the prototype development for further integration in the business jet cockpit simulator.
With regard to the End to end Maintenance demonstrator, the focus will be the Development, maturation of major demonstrators for ADVANCE enabling Technologies (IHMM, SHM, Collaborative Environment and line maintenance mobile tool applications), intermediate integration demonstrators (e.g. Mobile tools with collaborative environment, Prognostics with Maintenance Planning Optimization among others)
In the area of Transversal activities, the efforts will concentrate on the identification of Cockpit avionics functions and technologies performance models for integration into overall large aircraft Technology Evaluator model.

Major Milestones planned for 2018
• Decision gate for flight tests for SDR, for Touch Down Point Designation
• Cockpit Avionics platform: Data Centric Communication Protocol agreement
• Critical Design Review for Pilot Workload Reduction System

Major Deliverables planned for 2018
• Flight tests prototypes for Pilot Protective Device
• Disruptive Cockpit test bench first version
• Pilot Health Monitoring and Voice command systems delivery to Regional Aircraft Active cockpit Simulator
• ADVANCE Maintenance concept Demonstrators prototypes deliveries

Description of main activities for the year 2019

Platform 1: “Advanced Engine and Aircraft Configurations”
In 2019 the majority of the demonstrators and its underlying technologies are facing important milestones, which determines the change from non-specific to specific design and the according build-up of hardware (prototypes, rigs, etc.).

Major Milestones planned for 2019
• Shaftline for UHBR test rig manufactured and assembled (D1)
• TRL3 for BLI integrated design concept incl. optimised fan design (D1)
• Decision Gate on type of rear end, “advanced or powered” (D2)
• Flight test campaign with the Scaled Flight Demonstrator (D3)
• TRL5 for HLFC HTP (D4)
• PDR for Wind-Tunnel model design HLFC wing passed (D6)
• CDR for the propulsion system (UltraFan) (D10)
• CDR FTD: flow control technology applied on engine/ pylon (D11)
• Radical aircraft concept decision gate (D8)
• Availability of Hybrid Ground Test Bench for medium power level (D9)

Major Deliverables planned for 2019
• Scope and test set-up of low-speed test with UHBR test rig defined and associated documentation available (D1)
• Report about outcome of TRL3 for enabling technologies (D2)
• Qualification Test Report for the Dynamically Scaled Flight Demonstrator (D3)
• CDR for HLFC HTP (D4)
• Long Lead Items design for Wind Tunnel model HLFC wing (D6)
• Specification for UHBR pylon/ aircraft interface (D10)
• Final report on flow control ground test (D11)
• “Convergent” aircraft configuration definition, preliminary design report available (D8)
• Hybrid Ground Test Bench for medium power level (D9)

With respect to the Multi-Functional Fuselage Demonstrator (MFFD) the continuation of the activities started in 2018 will in particular include window-less and stringer/ frame stiffened thermoplastic composite skin with integrated system elements and cabin interfaces, advanced cargo door concept, surrounding and interfaces, integrated fuselage lining and wiring, cabin and cargo structure, load carrying modules pre-equipped with systems as well as the design and preparation of tooling and manufacturing infrastructure for a
preproduction phase from 2019 on. The delivery of the equipped half-barrel shells is planned for beginning of 2020.

Regarding the Next Generation Cabin & Cargo Functions demonstrators, test specimen for an AMPSU shall be available for PSC integration or integration into a PSC-less cabin end 2019.

In 2019 the results of the MSP concept UCI are planned to be fed into an overall concept in order to realize a common functional platform demonstrator, followed by the conduction of a verification and validation test campaign.

Another main topic to develop the Environmental Friendly Fire Protection demonstrator unit for verification tests scheduled for 2019.

Based on the results further refinements of the printed electrics system concept, the development of design rules and to challenge the compliance with the existing electrical infrastructure and industrialization aspects are scheduled for 2019.

In 2019, the main part of the activity related to the Next Generation Lower Centre Fuselage demonstrator project will be dedicated to the demonstration phase. Two scenario are still under discussion whether a physical demonstration or not is required.

In relation to Non-specific cross functions & ITD Airframe, the development of enablers and the transfer of results from mature technology development either in ITD Airframe and LPA will continue in close coordination with the Platform 2 demonstrator programs in 2019.

**Major Milestones planned for 2019**

- Critical review of key modules contributing to the Multifunctional fuselage demonstrator
- Handover of Multi System Port and Universal Cabin Interface for integration to a joint demo platform
- Review of industrial feasibility and assembly lead times for advanced Lower Centre Fuselage
- Review of results from advanced fastener and assembly technologies, automated inspection and predictive simulation
- Review of automated cabin and cargo installation solutions in the context of the future factory concept

**Major Deliverables planned for 2019**

- Multifunctional Fuselage demonstrator shells manufactured (delivery early 2020)
- Thermoplastic components welding qualification tests completed, results available
- Advanced Micro PSU test specimen available
- Delivery and testing of the OBBIGS Environmental Friendly Fire Protection demonstrator
- Package of demo and simulation results on industrial feasibility of advanced lower centre fuselage concept

Platform 3: “Next Generation Aircraft Systems, Cockpit and Avionics” including advanced systems maintenance activities

**Activities related to the Large Aircraft Disruptive Cockpit Demonstrator:**

In relation to Cockpit avionics functions and technologies development, efforts will concentrate on the development of the GPS aided MEMS AHRS prototype to be installed in Large aircraft avionics bay for flight tests, the development of virtual Cockpit Utility Management System Platform, the implementation of Data Centric protocol prototype in the Virtual reference platform Core Processing Module, the development of smart air
system sensor interface with Utility System Platform and the ITD systems display system and selected functions integration preparation in Disruptive cockpit
In relation to Cockpit functions and technologies flight tests, the activities include the preparation of flight tests for additional cockpit functions and technologies among which: Speech to Text, Ground collision avoidance. In 2019 the flight tests will take place for SDR and Image Based Landing.
In relation to Disruptive cockpit demonstrator definition and development, the activities will focus on the integration of the version 2 of the DISCO test bench, including Data centric virtual IMA communication protocol, new Flight Warning function and ITD systems selected functions and components.
Activities related to the Regional Aircraft Active cockpit demonstrator:
Efforts will be directed towards the fulfillment of the Active Cockpit Demonstrator enhancement plan and delivery of final test plan for on Ground Workload Reduction Assessment, the Enhanced Lightweight Eye Visor and the Aircraft Monitoring Chain Ground Support Systems to be delivered to the active cockpit simulator, the integration of the REACTOR systems into the cockpit and commissioned to operate as stand-alone sub-systems and finally, the validation testing to be carried out targeting TRL 4 for each technology.
The activities related to Ground and flight tests demonstration for Business jet will consist in the development and delivery of a Multi Modal Human Machine Interface prototype for integration and tests on Business jet simulator.
With respect to the End to end Maintenance demonstrator, activities in 2019 will be the integration of prognostics, IHMM, remote maintenance solutions platform and TRL6 demonstration and the integration and demonstration of all ADVANCE End to End maintenance solutions, and provide OEM global impact assessment
Finally, in the area of transversal activities, efforts will be dedicated to the definition of selected cockpit avionics functions and technologies performance models for further integration into Large Aircraft Technology Evaluator models.

**Major Milestones planned for 2019**
- Flight tests Decision Gate for Speech to text and for Ground Collision Avoidance
- Operational validation in Active Cockpit Simulator: TRL4 of standalone technologies
- TRL4 Milestone for Pilot Workload Reduction Functions (Q2 2019)
- ADVANCE Maintenance solutions TRL6

**Major Deliverables planned for 2019**
- Flight tests prototypes for Software Defined Radio
- DISCO test bench second version
- Multimodal Human Machine Interface Prototype for Business Jet cockpit demonstration
- REACTOR Standalone technologies operational validation (TRL4)
- ADVANCE Maintenance solutions demonstration final reports
IADP Regional Aircraft

Multi-annual overview and strategic planning

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

With activities performed in 2016 and 2017 the implementation of a fully operative REG IADP has been achieved through: the proper and complete transition from GRA; the full integration of core partners, all selected in Wave 1 and 2; the consolidation of interactions and interfaces with the other SPDs, in particular with the Airframe ITD, the ECO Transverse Activities (TA) and the Technology Evaluator (TE); and the selection of several partners through Call for Proposals (CfPs) that will be continued in the following years.

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

The main high-level objectives pursued in this timeframe are:

- Design loops (2\textsuperscript{nd} & 3\textsuperscript{rd}) through preliminary a/c design activities for both A/C configurations and delivery of ASMs to TE
- Detailed design phase for all Demonstrators, with achievement of CDRs for Iron Bird, Fuselage Structural Demonstrator and FTB2
- Manufacturing of components for the demonstrators
- Qualification of items for ground tests and for safety of flight
- Deliver of inputs to ECO TA for LCA evaluations.

Description of main activities for the year 2018

WP0 – Management
Leonardo-Aircraft Division will perform IADP coordination, administration and management, ensuring proper interactions and interfaces with the JU and other SPDs.

Airbus DS (CASA) will support Leonardo-Aircraft Division in management and administrative tasks in the same way than in 2014 – 2017. Core partners (AIRGREEN2, ASTIB, EWIRA, IRON) will also provide their contributions to the activities of this work package.

WP1 – High Efficiency Regional A/C
Activities will be devoted to the developments of design loop #2 of innovative configuration and to the technological studies for the conventional platform. For both configurations the following main activities will be carried out by Leonardo-Aircraft Division and IRON:

- Loop 2 (aerodynamic design, performance assessment, final engine dataset);
- Aircraft Simulation Models (ASM) for design loops 2.
Airbus DS (CASA) will provide inputs of reference and future Regional a/c configurations, mission analysis, emissions and noise evaluation to the Technology Evaluator.

**WP2 – Technologies Development**

**WP2.1 – Adaptive Electric Wing**

For the innovative wing structure, Leonardo-Aircraft Division will continue the development of A/C Life cycle methodologies development and of eco-design technologies; AIRGREEN2 will complete the design, manufacturing and validation of advanced process, SHM/NDI systems and outer wing structural items. For Air Vehicle technologies (morphing, high lift, loads alleviation, Natural Laminar Flow, drag reduction), AIRGREEN2 will: complete the detailed structural design of technology concepts. Leonardo-Aircraft Division will complete the 2nd technologies down-selection and preliminary assessment at A/C level of developed technologies and relevant Concepts PDR. Furthermore, Fraunhofer may contribute to morphing structures technologies development, i.e. Drop Nose skin integration with robustness maximization.

**WP2.2 – Regional Avionics**

Leonardo-Aircraft Division will continue activities related to the Integrated Vehicle Health Management (IVHM) focusing on the definition of maintenance application SW requirements; the maintenance application SW development will be started.

**WP2.3 – Energy Optimized Regional Aircraft**

The following main activities will be carried out by Leonardo-Aircraft Division and other members/partners as indicated below between brackets:
- Design of selected E-ECS relevant technological bricks (Liebherr);
- Electro-Mechanical Actuators (EMAs) and Electronic Control Units (ECUs) for Landing Gear System manufacturing (ASTIB);
- First conceptual low noise propeller down-selection based on aero-acoustic results;
- Start of CFP Projects (partners) providing design and manufacturing for innovative on-board systems technologies in the areas of: Wing Ice Protection, Thermal Management, Advanced Electrical Power Generation and Distribution.

**WP2.4 – Flight Control System**

The following main activities will be carried out by Leonardo-Aircraft Division and ASTIB:
- Design and development (including SW development) of WL/WT EMA/EACU;
- Definition of prognostics and health monitoring architecture to be applied to the Winglet/Wingtip (WL/WT) EMAs;
- Design and development (including SW development) of Aileron EMA/EACU.

**WP3 – Demonstrations**

**WP3.1 – Airvehicle Technologies Demonstrator (FTB#1)**

The following activities will be performed by Leonardo-Aircraft Division: completion of feasibility activities for the experimental modifications on the selected demo A/C; A/C Modifications / Flight Test Instrumentation (FTI)/refurbishment design; start of A/C modifications development; preparation of A/C modifications Technical Dossiers.

The following activities will be performed by Leonardo-Aircraft Division and AIRGREEN2: Start of Design and development of the wing modification structural test items; structural design and engineering drawings of the Outer Wing Box for ground tests; start with mould tool for upper and lower panels design.

**WP3.2 – Fuselage / Cabin Integrated Demonstrator**
The following activities will be performed by Leonardo Aircraft Division:
- Manufacturing of Pre-Production Manufacturing (PPM), Pre Production Verification (PPV) and start with manufacturing of first components for fuselage.
- Development of the Regional Aircraft Cabin Interiors and Service Area layouts for On-Ground Pax Demonstrator Platform in accordance with the elements identified in the WP B-4.4 of AIR ITD.

Moreover, Fraunhofer will perform activities related to integration/testing of the Functional Cabin Demonstrator as well as to integration/assembly of the Fuselage Structural Demonstrator. Particularly the interfaces to testing infrastructure and measurement and control systems as well as reference elements will be addressed.

**WP3.3 – Flight Simulator**
No technical activities will be performed.

**WP3.4 – Iron Bird**
The activities of Leonardo Aircraft Division and ASTIB will proceed with the definition and assessment of the overall architecture of the Iron Bird, passing through each component design consolidation in terms of functionalities, mechanical and electrical interfaces and human interfaces. These activities will affect both mechanical and software components. During the second half of the year the Critical Design Review will take place and the final Iron Bird architecture will be consolidated. The semi wing skeleton and the mechanical and electrical components manufacturing will start by the end of the year.

**WP3.5 – Integrated Technologies Demonstrator Flight Test Bed#2 (FTB#2)**
With activities performed by CASA and EWIRA during 2018, the technologies that will be demonstrated in the Regional FTB#2 will evolve from Technology Readiness Level 4 (TRL) to TRL 5. Detailed design of structural components will be finished and innovative elements (i.e. manufactured in ALM) will be finally checked with final design loads. Manufacturing of components will start using explored technologies in the IADP (i.e. jigless methods, One-Shot-Drilling and One-shot-Assembly).

The preparation of the FTB#2 flight test campaign will be launched with activities like test requirements, aircraft instrumentation definition and first contacts with Airworthiness Authorities to prepare the achievement of demonstrator Permit to Fly.

**WP4 – Technologies Development / Demonstrations Results**

**WP4.1 – Technology Assessment**
Continuation of interactions and interface with TE.

The second loop of ASMs for both configurations for TE evaluations will be delivered.

**WP4.2 – Eco-design Interface**
Continuation of interaction and interface with ECO TA.

Activities will be performed to ensure the proper interfacing between the REG/AIR WPs containing development of innovative technologies with Eco-design content and ECO TA for the evaluation of the relative environmental impact.

**Major milestones planned for 2018**
- Annual Review (WP0)
- New adaptive wing devices structural design assessment (WP2.1)
- Updating of Fuselage Structural Design (WP3.2)
• Iron Bird Critical Design Review (WP3.4)
• Validation of final optimized aerodynamic shapes with results from analysis and WTTs (WP3.5)

Major deliverables planned for 2018
• Adaptive Wing Technologies second down selection results (WP2.1)
• Collection of on-board systems technologies status report for year 2018 (WP2.3)
• FTB#1 A/C Modifications Technical Dossiers – Preliminary (WP3.1)
• Implementation studies on predictive geometries for the Assembly of a Regional Wing structure (WP3.5)
• Assessment of the aerodynamic performances of the new devices (flap & aileron) against experimental WTT results (WP3.5)

Description of main activities for the year 2019

WP0 – Management
Leonardo-Aircraft Division will ensure IADP coordination, administration and management, assuring proper interactions and interfaces with the JU and other SPDs. Airbus DS (CASA) will continue to support Leonardo-Aircraft Division in management and administrative tasks. Core partners (AIRGREEN2, ASTIB, EWIRA, IRON) will also provide their contributions to the activities of this work package.

WP1 – High Efficiency Regional A/C
Activities will be devoted to the final design phase for both conventional and innovative platforms (Loops 3). For both configurations the following main tasks will be performed by Leonardo Aircraft Division and IRON:
- Loop 3 aerodynamic design;
- Loop 3 performance assessment;
- Loop 3 final engine dataset;
- ASM for design loops 3
- Small scale WTT for 3D lateral-directional studies for the innovative configuration

By the end of 2019 Airbus DS (CASA) will complete the set of mission analysis and will provide aircraft models operative to the Technology Evaluator simulation environment.

WP2 – Technologies
WP2.1 – Adaptive Electric Wing
For the innovative wing structure, Leonardo-Aircraft Division will complete the development and validation of A/C Life cycle methodologies and of ecodesign technologies. AIRGREEN2 will complete the experimental validation of advanced process, SHM/NDI systems and outer wing structural items at components level. For Air Vehicle technologies (morphing, high lift, loads alleviation, drag reduction devices), AIRGREEN2 will: complete the low speed and high speed aerodynamic validation (Wind Tunnel) of morphing devices, with the contribution of selected partners; complete manufacturing of full scale demonstrators of morphing devices ground structural-mechanical demos and perform relevant structural-mechanical tests. Leonardo-Aircraft Division will perform concepts Critical Design Reviews, final technologies assessments at A/C level, certifying the TRL step up to 5 (Turbo Prop A/C configuration).
Furthermore, Fraunhofer may contribute to morphing structures technologies development, i.e. Drop Nose skin integration with robustness maximization.

**WP2.2 – Regional Avionics**
Regarding Integrated Vehicle Health Management, the SW requirements for maintenance application will be finalized and related development will be continued by Leonardo-Aircraft Division.

**WP2.3 – Energy Optimized Regional Aircraft**
The following main activities will be carried out by Leonardo-Aircraft Division and other involved members/partners as indicated below between brackets:
- Manufacturing of selected E-ECS relevant technological bricks (Liebherr);
- EMAs and ECUs for Landing Gear System lab testing and integration on Iron Bird (ASTIB);

**WP2.4 – Innovative Flight Control System**
The following main activities will be carried out by Leonardo-Aircraft Division and ASTIB:
- Manufacturing and integration of WL/WT EMA/EACU;
- Development and implementation of a set of prognostics, health and usage monitoring algorithms for the WL/WT EMAs.

Furthermore, with the contribution of the selected Partner, activities related to manufacturing and integration of Aileron EMA/EACU will be performed.

**WP3 – Demonstrations**

**WP3.1 – Airvehicle Technologies Demonstrator (FTB#1)**
The following activities will be performed by Leonardo-Aircraft Division: preparation and release of Final Modifications Technical Dossiers and Final Modifications Interface Control Documents (ICD); definition of requirements and preliminary Planning of the Flight test; preparation of the Electrical, Mechanical and Installation drawings as well the Justification for Flight Clearance for each A/C modification; completion of FTI development activities; Furthermore, the following activities will be performed with the contribution of AIRGREEN2: Outer Wing Box (OWB) items fabrication for PPV characterization; start manufacturing of parts and components for ground tests.

**WP3.2 – Fuselage / Cabin Integrated Demonstrator**
The following activities will be performed by Leonardo Aircraft Division: manufacturing of fuselage components; assembling tool preparation; experimental specification preparation; start with test rig definition and design; development of the Pax Cabin and Service Area installation solutions with reference to the major interior items identified in the WP B-4.4 of AIR ITD through the definition of the interface control drawing in order to define the Regional Aircraft Cabin of the On-Ground Pax Demonstrator Platform. Moreover, Fraunhofer will contribute to integration/testing of the Functional Cabin Demonstrator as well as to integration/assembly of the Fuselage Structural Demonstrator. Particularly the design integration for cabin reference elements and their interfaces to the supply systems, assembly inspection, test schedule design and preparation of the testing environment (i.a. environmental conditioning, supporting installations, measurement and control systems) will be approached.
WP3.3 – Flight Simulator
No activities will be performed.

WP3.4 – Iron Bird
Leonardo Aircraft Division and ASTIB will continue activities related to the Iron Bird equipment manufacturing. In addition the specific topic related to Health Management Module will be concluded. The integration and assembly phase of the Iron Bird will start according to an incremental strategy based on the gradual insertion of modules in order to mitigate the risks arising from the overall integration. Each new available module will be first installed and integrated in the Iron Bird as an independent module, its specific interfaces will be tested and then the interactions with the other system parts will be evaluated.

WP3.5 – Integrated Technologies Demonstrator (FTB#2)
With activities performed by CASA and EWIRA during 2019, the TRL technologies associated to the Regional FTB#2 is foreseen to pass from TRL 5 to TRL 6 for those technologies selected for in-flight demonstration in the first step. The assembly, structural and functional tests will be completed at element level and the aircraft modification will be started. Aircraft qualification and ground tests will be completed and flight tests means installed for test campaign. The most significant milestones will be the Start of the Assembly and the Demonstrator Delivery at the end of the year.

WP4 – Technologies Development / Demonstrations Results

WP4.1 – Technology Assessment
Continuation of interactions and interface with TE as well as with ECO TA.
The third loop of ASM for both configurations for TE evaluations will be delivered.

WP4.2 – Eco-design Interface
Continuation of interaction, interface and data exchange with ECO TA.

Major milestones planned for 2019
- Annual Review (WP0)
- Ecocompatible Technologies final assessment and validation (WP2.1)
- Experimental specifications for Fuselage Structural Demo (WP3.2)
- Iron Bird manufacturing & configuration review (WP3.4)
- Initiation of HQ & Loads flight clearance for PtF (WP3.5)

Major deliverables planned for 2019
- Conventional configuration Weight & balance analysis, aerodynamics and aero-acoustic integration studies - Loop 2 (WP1.1)
- Sub-components representative of outer wing box Verification and Validation (WP2.1)
- FTB#1 A/C Modification Technical Dossier –Updated (WP3.1)
- Installation layouts and interface control drawing of the Regional Aircraft Cabin major items of the On-Ground Pax Demonstrator Platform (WP3.2)
- Static & Dynamic Loads assessment on the capabilities of the Load Alleviation System. (WP3.5)
IADP Fast Rotorcraft

Multi-annual overview and strategic planning

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

NGCTR aims to design, build and fly an innovative next generation civil tiltrotor technology demonstrator. The configuration will go beyond current architectures of this type of aircraft and will involve tilting proprotors mounted in fixed nacelles at the tips of the wing. The wing will have a fixed inboard portion and a tilting outboard portion to minimize rotor downwash impingement in hover and increase efficiency. Demonstration activities will aim at validating the, technologies/systems and operational concepts. Specific activities will also be launched in Clean Sky 2 to include drag reduction of the proprotor, airframe fuselage and wing and research to reduce proprotor noise emissions.

The RACER project (formerly LifeRCraft) aims at developing and flight-testing in 2020-2022 a full scale flightworthy demonstrator in the 7 to 8 tons class, which embodies the new European compound rotorcraft architecture. This architecture combines a lifting rotor with two lateral rotors at the tips of wings, in pusher configuration. Feasibility and conceptual design studies performed in 2014-2015 confirmed capabilities similar to a conventional helicopter in hovering and vertical flight and 50% faster cruise with lower environmental impact. In the period 2016-2017, the involvement of all core partners and partners will allow completing the Preliminary Design phase and freezing the interfaces and specifications of subsystems, then progress with the detailed design of components, perform specific technology validation tests and launch the manufacturing of long lead-time parts.

Description of main activities for the year 2018

Activities relevant to the Next Generation Civil Tiltrotor demonstrator (WP1)

Programme Management activities specific to the NGCTR demonstrator platform will continue. The overall aircraft level SFR will be performed; along with sub-system reviews for technologies related to the wing, airframe structure, transmission, avionic and flight control systems.

Low speed wind tunnel testing will be launched, whilst the conclusion of the Interactional aerodynamic (CfP06) and high speed wind tunnel testing (CfP07) Calls negotiations will be accomplished.

WP 1.1: NGCTR Demonstrator Management and Co-ordination

This WP includes the Programme Management activities specific to the NGCTR demonstrator platform.

The activities and objectives in 2018 are to progress the appropriate management infrastructure between Leonardo, CSJU and other parties (i.e. core partners and partners) to properly execute the programme. To carry out all tasks needed to co-ordinate orient, report
and plan the NGCTR project specific activities in line with IADP level requirements including Core Partner/Partner coordination. To timely deliver all documents and information as required by the FRC IADP in line with the Management Manual. These activities run continuously for the 2018 period.

**WP 1.2: Air Vehicle Design and Development**

This WP deals with system integration activities that are needed at aircraft and sub-system level. The concept of the NGCTR is developed, including general architecture and integrated system design activities as well as design to manufacture and maintenance aspects. The major activities are split by aircraft system level (Design Integration and TiltRotor System Design) transversal activities and the major sub-system areas (Transmissions, Rotors, Airframe Structures, Electrical & Avionic and Airframe Systems) to work in an integrated project team employing a traceable Systems Engineering approach.

The tasks to be performed in the period 2018 will be the closure of the System Functional Review (SFR) actions for the NGCTR-TD and full integration of the Wing Core partners and other partners’ activities managed by the NGCTR Integrated Project Team. The activities will deal with the evolution of the analyses, modelling and simulation of the NGCTR-TD at global and sub-system level, integrating the Key Technologies to SFR maturity level and beyond in preparation of the Preliminary Design Review (PDR) in 2019. The IPT will continuously support the integration of existing selected partners and seek opportunities for new partners needed in the programme via Call topics for the NGCTR activities still required.

In parallel, a review of the requirements for the development of the future New Tiltrotor Concept (full size NGCTR) will be started, receiving fundamental inputs from NGCTR-TD design experience. Call fiches to launch Call topics for innovative technologies to be embodied on the future aircraft will be prepared.

The main deliverables will be the update of the General Requirements and Objectives (GRO) and NGCTR Configuration documents to SFR maturity level as well any necessary Call fiches required to launch Call topics for partners to join the NGCTR IPT. The major Milestones will be the completion of aircraft level SFR and integration of the Wing Core partners.

**WP 1.3: Aircraft Final Assembly**

This WP contains the activities associated with NGCTR Industrial Engineering, including the manufacture of jigs, tooling and components, plus the modification of the donor test vehicle to Technology Demonstrator flight standard.

For the period 2018 activities will include the conclusion of trade studies to evaluate manufacturing technologies for improved quality and cost reduction, consolidation of the industrialisation strategy across the manufacturing centres and with Core partners/partners, as well as the active participation in the NGCTR System Engineering design process. All milestones and deliverables will be covered by WP 1.2 leading up to PDR level of maturity.

**WP 1.4: Aircraft Test and Demonstration**

This WP refers to the activities that include both demonstrator ground and flight tests, including Instrumentation.

In 2018, in support of the Systems Engineering process leading up to the PDR phase, support will be given by Pilots Flight Test Engineering and Instrumentation to preliminary design phase ensuring key capabilities of NGCTR. All milestones and deliverables will be covered by WP 1.2 leading up to PDR level of maturity.
Activities relevant to the RACER demonstrator (WP2)

RACER demonstrator Programme Management activities will continue. Critical Design Review at RACER level should be attained in Dec 2018. This key milestone will be supported by the Critical Design Review in 2017. Both milestones will be supported by sub-systems PDR and CDR for technologies related to the wing, canopy, fuselage, tail-boom, rear-parts, rotor, propeller, landing gear, cowlings, and electrical system. Design and manufacture of tooling and tests rigs will continue.

WP 2A: RACER Flight Demonstrator Integration
The aircraft-level Critical Design Review should be in Dec 2018, closing a significant design phase, and opening the way to manufacturing and testing to be performed subsequently (2019 and beyond). Aeromechanics Critical Design Review is planned first, during Q1 2018, freezing key detailed aeromechanic features. Subsequent key parts will start being manufactured for testing in Q2 2018, so as to confirm design features for later flyable parts.

WP 2B: RACER Airframe Integration
RACER Central Fuselage is planned beginning of Q3 2018, followed by upper cowlings, windshield, and fuel system CDRs. Doors, wings, and tail parts CDR, hosted in AIRFRAME ITD, will also be performed during same Q3 2018 period.
A very high effort is planned for coordination involved in RACER Airframe Integration activities. Most activities are performed by FRC IADP Leader AH, and Core Partner RoRcraft (central fuselage), but critical contributions, mandatory for flight, will come as well from AIRFRAME ITD Core partners (tail parts, wings), and partners from both SPDs.

WP 2C: RACER Dynamic Assembly Integration
RACER Dynamic Assembly Integration road to CDR in 2018 will rely not only on design, but also on anticipating mandatory tests to be performed later. Q2 in 2018 will thus include CDRs for Main Gear Box back-to-back rig test.
RACER Dynamic Systems design related work should achieve in 2018 CDR for lateral shaft (Q2), MGB long cycle items (Q2), complete MGB (Q3), Lateral Gear Box (Q3), Main Rotor hub/blades/suspension (Q3), main rotor fairing (Q3).

WP 2D: RACER On-board Systems Integration
Electrical Wiring Integrated System should pass its pre-CDR by Oct 2018 (M2.9). The partners will finalize prototype models of equipment and submit them to laboratory tests against key airworthiness criteria: Main HVDC generator will reach TRL 5 gate in 2018.
CDR for Fuel System should be achieved in Q3 2018, as CDR for Avionics and Antennas, Primary Flight Control System, Hydraulics, and Environmental Control System.

Transversal Fast Rotorcraft Activities (WP3 & WP4)

WP 3: Eco-Design Concept Implementation to Fast Rotorcraft
To implement the Life Cycle Assessment (LCA) relevant to the defined case studies for each demonstrator (RACER for AH and NGCTR for LH), including data collected from Leaders, Core partners and active partners.
During 2018 FRC leaders will establish Eco-related objectives that are achievable within the scope of Clean Sky 2, ensure ECO-TA analysis tools are realistic and provide appropriate outputs and establish an appropriate scope of ECO-related activity relative to its objectives. This will include if relevant, issue call topic descriptions related to calls for partners. The
technologies to be considered for LCA will be confirmed, and related Projects could be proposed for ECO-TA funding.

WP 4: Technology Evaluator Methodology for Fast Rotorcraft
Develop simplified models for the two FRC concepts capable of evaluating rotorcraft performance, productivity, efficiency, fuel consumption and noise emission at against the reference aircraft for the same mission. Establish Metrics and Indicators for FRC to be used by the TE-TA to assess the impact on the European (and global) mobility and connectivity of the introduction of a new transportation means, with particular attention to the connectivity of remote/rural areas, where the possibility to speed up the mobility with low-cost and low-budget ground infrastructure is a non-negligible factor.
Support the TE-TA to analyse existing forecast about the volume and movements of Rotorcraft in the relevant years, establish a new forecast for the fleet and the number of movements up to 2035 and estimate the market share of European products in the related markets.
Support the TE-TA to undertake at the airport and ATS level, Rotorcraft assessments of environmental (emissions and noise) and mobility (connectivity and productivity) improvements that may be accrued through replacement of reference technology over the designated time scales.

Major milestones planned for 2018
- System Functional Review (SFR) (WP1)
- Preliminary Design Review (PDR) (WP1)
- CfP06 Interactional Wind tunnel test partners on contract (WP1)
- CfP07 High Speed Wind tunnel test partners on contract (WP1)
- RACER Flight Demonstrator Integration Critical Design Review (CDR) Meeting (WP2)
- RACER Airframe Integration CDR meeting (WP2)
- RACER Dynamic Assembly Integration CDR meeting (WP2)
- RACER On-board Systems Integration (WP2)
- RACER Demonstrator Critical Design Review (WP2)
- FRC Eco Topics agreed with Eco-TA (WP3)
- Simplified models for the two FRC concepts (WP4)

Major deliverables planned for 2018
- General Requirements & Objectives (GRO) - SFR maturity (WP1)
- NGCTR-TD Configuration – SFR maturity (WP1)
- RACER PDR Minutes of Meeting Summary Report (WP2)
- Potential Project Proposals submitted for ECO-TA funding (WP3)
- NGCTR Conceptual Model delivered to TE (WP4)
- RACER Conceptual Model delivered to TE (WP4)

Description of main activities for the year 2019
Activities relevant to the Next Generation Civil TiltRotor demonstrator (WP1)
Programme Management activities specific to the NGCTR demonstrator platform will continue. Design activities will progress throughout 2019 with increasing maturity to complete PDR. Further activities will be launched for long lead items in anticipation of CDR in 2020 as well as integration of partners from CfP 08.

WP 1.1: NGCTR Demonstrator Management and Co-ordination
This WP includes the Programme Management activities specific to the NGCTR demonstrator platform.

The activities and objectives in 2019 are to progress the appropriate management infrastructure between Leonardo, CSJU and other parties (i.e. Core partners and partners) to properly execute the programme. To carry out all tasks needed to co-ordinate, report and plan the NGCTR project specific activities in line with IADP level requirements including Core Partner/Partner coordination. To timely deliver all documents and information as required by the FRC IADP in line with the Management Manual. These activities run continuously for the 2019 period.

WP 1.2: Air Vehicle Design and Development
This WP deals with system integration activities that are needed at aircraft and sub-system level. The concept of the NGCTR is developed, including general architecture and integrated system design activities as well as design to manufacture and maintenance aspects. The major activities are split by aircraft system level (Design Integration and TiltRotor System Design) transversal activities and the major sub-system areas (Transmissions, Rotors, Airframe Structures, Electrical & Avionic and Airframe Systems) to work in an integrated project team employing a traceable Systems Engineering approach.

The tasks to be performed in the period 2019 will be the execution of the Preliminary Design Review (PDR) for the NGCTR-TD with full integration of the key partners activities managed by the NGCTR Integrated Project Team (IPT). The activities will finalise studies of the NGCTR-TD at global and sub-system level required for PDR and initiate as soon as possible the detailed design and test plans in preparation of the Critical Design Review (CDR) in 2020. Results from the Wind Tunnel launched in CfP 06 and CfP 07 will be incorporated in the design.

Following closure of the NGCTR-TD PDR a further step in the concept development of the future NGCTR aircraft will be also completed. Call fiches to launch Call topics for innovative technologies to be embodied on the future aircraft will be prepared.

The main deliverables will be the finalization of the General Requirements and Objectives (GRO) and NGCTR Configuration documents in anticipation of the CDR as well any necessary Call fiches required to launch Call topics for partners to join the NGCTR IPT. The major Milestones will be the completion of aircraft level PDR and the partners from CfP 08 on contract.

WP 1.3: Aircraft Final Assembly
This WP contains the activities associated with NGCTR Industrial Engineering at NGCTR level, including the manufacture of jigs, tooling and, components, plus the modification of the donor test vehicle to Technology Demonstrator flight standard.

For the period 2019 activities will include the detailed planning of the implementation of manufacturing technologies for improved quality and cost reduction in co-ordination with the Leonardo Helicopters industrialisation strategy and with Core partners/partners. Contribution to the NGCTR System Engineering design process will made and the
manufacture of long lead aircraft components, jigs and tooling will be launched. All milestones and deliverables will be covered by WP 1.2 leading up to CDR level of maturity.

WP 1.4: Aircraft Test and Demonstration
This WP refers to the activities that include both demonstrator ground and flight tests, including Instrumentation.

In 2019, in support of the NGCTR Systems Engineering process leading up to the CDR phase, support will be given by Pilots, Flight Test Engineering and Instrumentation to the detailed design phase of NGCTR and prepare the GTV and FTV test plan. All milestones and deliverables will be covered by WP 1.2 leading up to CDR level of maturity.

Activities relevant to the RACER demonstrator (WP2)


2019 will be key for RACER demonstrator, as most components and sub-systems mandatory for Flight demonstration will be delivered by Core partners, partners, as well as from internal Leader sources between Q2 and Q4 2019. RACER demonstrator assembly will start in Q3 2019.

WP 2A: RACER Flight Demonstrator Integration
After CDR end 2018, WP2.A activities will cover integration follow-up of all components and sub-systems delivery follow-up.

Using strong synergies with Additional Activities in National Research framework, RACER WP2A will also integrate latest key predictions to ease Flight Test campaign.

WP 2B: RACER Airframe Integration
Delivery of most RACER Airframe components from Core partners and partners is planned in Q3 2019. A first Fuselage Pre-Assembly, including canopy, will integrate key systems (Fuel, Flight Controls, etc.), and should take place at AHD premises in 2019. A dummy Landing Gear, not flightworthy, but useful for assembly and ground testing of other systems will be delivered by ANGELA consortium during Q3 2019.

WP 2C: RACER Dynamic Assembly Integration
Thanks to good synergy with National Projects, RACER engines will be available Q2 2019. Those engines will include advanced eco-mode and High Voltage electrical network compatibility.

As Main Gear Box testing will not be concluded yet, a scale 1 mock-up of Main Gear Box will be delivered Q2 2019, in cooperation between ARTEMIS and AH. Lateral Gear Box will be delivered in Q3 2019 by Mobility Discovery consortium.

WP 2D: RACER On-board Systems Integration
Primary Flight Control System will be delivered Q3 2019. Various systems like avionics, light, sensors, antennas, mandatory for Flight Demonstration, will be available in 2019 as well.

Major milestones planned for 2019
- CfP 08 partners on contract (WP1)
- All parts received from partners and Core partners, and accepted by Leader (WP2)
- RACER assembly start (WP2)
• FRC input to 1st TE Global assessment report (WP4)

Major deliverables planned for 2019
• General Requirements & Objectives (GRO) - PDR maturity (WP1)
• NGCTR Configuration – PDR maturity (WP1)
• NGCTR input to FRC Mission level Results in support of 1st TE Global assessment (WP4)
• RACER input to FRC Mission level Results in support of 1st TE Global assessment (WP4)

Transversal Fast Rotorcraft Activities (WP3 & WP4)

WP 3: Eco-Design Concept Implementation to Fast Rotorcraft
To implement the Life Cycle Assessment (LCA) relevant to the defined case studies for each demonstrator (RACER for AH and NGCTR for LH), including data collected from Leaders, Core partners and active partners.
During 2019 FRC leaders will develop the Life Cycle Inventories of relevant parts/technologies applied on the parts defined in support of the Eco-TA EDAS Mapping. Data may include; Life cycle of production, operation and end of life taking into account Re-Use and Re-Definition of material and part recycling and recovery, Maintenance, repair and overhaul e.g. related to material and manufacturing activities, new technology pathways that contribute to a new life cycle plus vision.
In the case Project submitted by FRC in 2018 for ECO-TA funding may have been launched, activities in 2019.

WP 4: Technology Evaluator Methodology for Fast Rotorcraft
Maintain FRC models and undertake an in-depth analysis of the results and verification of the fidelity of the initial models against the evolving platform configurations. Assessment of concept technology benefits against the reference models limited to a small set of case studies aimed at evaluating a subset of the most significant and critical outputs, providing input to 1st TE Global assessment report.
Support the TE-TA to analyse existing forecast about the volume and movements of Rotorcraft in the relevant years, establish a new forecast for the fleet and the number of movements up to 2035 and estimate the market share of European products in the related markets.
Support the TE-TA to undertake at the airport and ATS level, Rotorcraft assessments of environmental (emissions and noise) and mobility (connectivity and productivity) improvements that may be accrued through replacement of reference technology over the designated time scales.
ITD Airframe

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

- Activity Line 1: High Performance & Energy Efficiency (HPE); Related Technology Streams are noted “A” hereafter.
- Activity Line 2: High Versatility and Cost Efficiency (HVC); Related Technology Streams are noted “B” hereafter.
- Activity Line 3: Eco-Design; Related Technology Stream are noted “C” hereafter.

An Activity Line dedicated to “Management & Interface” completes the high-level WBS.

On the HPE project the high-level objectives for the period 2018-2019 are:

- On TS A-1 (Innovative Aircraft Architecture), continuation of study of novel concepts of engine integration on rear fuselage, novel aircraft architectures, and progress on TRL for the UHBR concept.
- On TS A-2 (Advanced Laminarity) investigations on concepts and technologies for NLF and HLFC will be continued for the nacelle and the wing.
- On TS A-3 (High Speed Aircraft) will be focused on the demonstration of benefits of a LPA wing and the design of the BJ root wing box demonstrator and of an innovative aircraft door.
- On TS A-4 (Novel Control) project NACOR, GAINS and MANTA will concentrate respectively on design of control for load and flutter control, integration of WIPS on innovative control surfaces and study of innovative movables.
- On TS A-5 (Novel Travel Experience) maturation of technologies and concepts for the ergonomic flexible cabin will continue. Development of the BJ cabin arrangement will be carried out (project CASTLE).

On the HVC project, the main objectives for the 4 major Technology Streams are:

- On TS B-1 (Next Generation Optimized Wing Boxes), to develop the detail design of new wing concepts improving performance.
- On TS B-2 (Optimized High Lift Configurations), to progress on the design and to freeze design of wing elements improving aero-efficiency of wing.
- On TS B-3 Advanced Integrated Structures objectives, to develop a final design of systems with and optimization of the integration in airframe along applying structural advances.
- On TS B-4 Advanced Fuselage objectives, to have detail design of new fuselage shapes and structures for rotorcrafts and more affordable, weight optimized structural components, looking for optimized integration of equipment & systems in the structural design.

On the Eco-Design activity, the most promising technology will be developed to TRL 4 and large demonstrators design will start for a maturation of technologies to TRL 5-6.

Description of main activities for the year 2018

M – Management & Interface
General Management activities of the ITD will be performed by the 3 Co-Leaders, in addition to the Coordination of the ITD by the ITD coordinator of the period. With respect to “Business Aviation OAD and configuration management”, after production of the reference aircraft design and model in 2017, 2018 will be devoted to first loop of the conceptual aircraft design and model for the TE2. With respect Rotorcraft and Regional “OAD & Configuration management”, Management and coordination activities related with the interdependencies between related IADPs and AIR ITD will be carried out.

A - High Performance and Energy Efficiency

Technology Stream A-1: Innovative Aircraft Architecture:
With respect to “Optimal engine integration on rear fuselage”, an overall assessment of the optimized scarfed nozzle concept will be performed at aircraft level: noise reduction, integration aspects, aircraft performance. In addition, the integration of L1/L2 tools for the evaluation and down selection of the 4 rear engine integration options for both A320 and business jet will be carried out.
After the decision gate about CROR of July 2017, the activities dedicated to “UHBR and CROR configuration” will be reshuffled and redefined. Based on the new baseline, the activities about CROR and UHBR will carry on.
Activities on “Novel High Performance Configuration” will be devoted to the integration of structural analysis and rapid CFD tools for optimisations and down selection of the most promising concepts for both A320 and business jet.
With respect to “Virtual Modelling for Certification”, the activities will focus on the requirements and development of the tools on the following 6 topics: Improvement of aircraft external noise modelling using certification data; Advanced criteria for rapid dynamic / crash modelling for safety; Safety for composite fuel tank for lightning; Model based integrated systems analyses; Prediction of aerodynamic loads at high Reynolds number; Cabin thermal modelling including a human thermal model.

Technology Stream A-2: Advanced Laminarity:
With respect to “Laminar nacelle” activities, the design and validation of a structural concept of laminar nacelle for BJ will be carried out, as well as the trade-off between NLF & HLFC concepts.
Although BLADE activities are not funded for 2018-2019, the activity about “NLF smart integrated wing” will focus on preparation & performing the flight tests, as well as the analysis tests data and to perform developments to further mature NLF concept.
The activities related to “Extended laminarity” will mainly consist to prepare, design, perform and analyse results of a dedicated test in F2 wind tunnel to access the combination of an ACD and a suction device on the attachment line for a BJ configuration.

Technology Stream A-3: High Speed Aircraft
With respect to “Multidisciplinary wing for high and low speed”, the preliminary design of the Wing Root Box (WRB) Demonstrator will be carried out (PDR mid-2018), and the detailed design of one specific panel will start, to be completed mid-2019 (CDR mid-2019).
In addition, the completion of the concept phase of a Multifunctional Trailing Edge Device is planned to end beginning of 2018; PDR is to be performed during 2018 and CDR in 2019.
The activities related to “Tailored front fuselage” will mainly be focused on optimizing cockpit windshields for large diameter business aircrafts.
With respect to “Innovative shapes & structure”, following the PDR of the Cargo Door demonstrator planned end of 2017, detailed design of the doors and tooling will be performed with a CDR planned end of 2018. In addition, priority will be put on the WRB demonstrator rather than on the composite Central Wing Box (CWB) for BJ applications; the planned activity could be to study thermomechanical compatibility between a composite WRB and a metallic CWB.

*Technology Stream A-4: Novel Control*

With respect to “Smart Mobile Control Surfaces”, the development of the mixed thermal ice protection including mechanical integration, related simulation tools and the electrical architecture will continue. Investigation on the ultra-low power IPS using piezoelectric technology will be pursued. The development of the integration of the EWIPS on a slat to produce a demonstrator for ground IWTT will continue. In addition, the potential benefit of the best concepts for the Target applications outer wing/winglet, multi-functional flap / adaptive TE, morphing air inlet and affordable slat will be assessed on aircraft level. Activities on “Active load control” will consist for BJ applications in performing a comprehensive analysis of the data collected during the vibrations control flight demonstration. In addition, this will be complemented by: (i) first, design of feedforward and feedback active gust load control laws of a business jet use-case, then (ii) model a detailed flexible generic long range aircraft accompanied with preliminary control laws, and finally, (iii) prepare wind tunnel tests for load control validation in controlled environment. The work targeting LPA applications will be mainly focused on aeroelastic modeling for Active Flutter Control (AFC).

*Technology Stream A-5: Novel Travel Experience*

With respect to “Ergonomic Flexible Cabin”, on the Human Centred Cabin three topics will be specified, prototypically implemented and evaluated: the multi-functional cabin crew rest area, the digital galley module and the In-Seat Ventilation (ISV) concept. On the Immersive Cabin Services, no activities are planned in 2018. The activities related to “Office Centred Cabin” will be to finalise the concept development of the innovative layout (proposed in April 2017) until mid-2018 for the PDR planned in September 2018. After the PDR the detailed design phase will start. In addition, some activities will focus on studying the new concept of compact shower and the galley new equipment installation.

*B - High Versatility Cost Efficient*

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

With respect to “Wing for lift & incremental mission shaft integration”, PDR actions will be performed and the detailed design carried out. In addition, the noise emission of the RACER Compound helicopter using refined simulation methodologies will be further assessed and means to reduce noise emission of the aircraft will be developed. Under “Optimised composite structures”, regarding composite wing box design, the sizing and analysis will continue to hold PDR and the selection on optimal automation technology for the wing box be performed. Virtual testing, advanced bonding technology and using optical fibers for health monitoring of a large critical bond line will be done.
With respect to “More efficient Wing technologies”, morphing winglets final concept will be developed to close a CDR and start the manufacturing. In addition, the validation of the design through full scale component test will be finalized. The highly integrated actuation system to control surface tabs with EMAs will finish between 2018 and 2019. Activities under “Flow & shape control” will be focused on developing the affordable Load Control System in status CDR for Step1 configuration for FTB#2 flight test campaign. Further activities will be focused to be ready for PDR for Step2 for FTB#2 configuration. For the Morphing Leading Edge, numerical investigations will be performed in order to define the skin layup as well as the number, position and required actuation direction of load application points. This will complemented by supporting systematic concept and detailed design development of the modified leading edge (MLE); CFD and CAA analysis will be performed as well as selection of the promising MLE wing profiles.

Technology Stream B-2: Optimized high lift configurations
With respect to “High wing / large Turboprop nacelle configuration”, the activities will mainly be focused on having a CDR of the system developed by PIPS project by 2018. The works on the integration of ice protection based on heat transport devices (Loop Heat pipes) into the engine air intake will also start. Under “High lift wing”, Winglet Morphing and Multifunctional flap will be integrated on the wing of FTB#2. In addition, the characterization for the Out-of-Autoclave (OoA) composite wing of FTB#2 and the installation of the Aluminum Rib in Hot Stamping technologies will be completed. For the Multifunctional flap, all the action from the CDR will be closed and manufacturing will start. The highly integrated actuation system to control surface tabs with EMAs will finish between 2018 and 2019. High-Lift installations will be considered and optimized for the P180 and M28 aircraft architectures. For each A/C architecture, the manufacturer will provide a DMU of a meaningful wing section.

Technology Stream B-3: Advanced integrated structures
With respect to “Advanced integration of system in nacelle”, baseline activities will be defined and conducted. Under “All electrical wing”, EMAs activities to control aileron and spoiler will be focused on closing a PDR in 2018. Embedded antenna in the Fuselage Fairing activities will be focused on closing the PDR and CDR for Step1 FTB#2 configuration. HVDC (High Voltage Direct Current) will be focused on closing a PDR. Induction Ice protection System integrated in the Leading Edge will be focused on having a CDR of the system within 2018. CNT Ice Protection system activities will be focused to perform reliable tests, electrical and mechanical, to prove its performance under icing conditions and over a certain time phase. Finally, a concept design of the EMA actuation architecture for a MLE will be done, load control system with all HW and SW interfaces will be specified and the detail design phase will begin. With respect to “Advanced integrated cockpit”, activities on innovative materials for regional cockpit structure elements will be focused on closing a PDR; while those on innovative SHMS will be focused on be ready for the PDR. Characterization of panels for EMC and Lightning Strike will be carried out. Preparation and execution of the EMC, Lightning Strikes and Bird Strikes on the Structural Cockpit of Regional FTB#2 will be done. With respect to Hail impact, the development of improved simulation methodologies will be finalized; while for Lightning Strike, the numerical tool for lightning strike damage prediction
in the CFRP panel will be focused on the direct impact damage caused by the surface explosion of the protection layer during the lightning strike. Ergonomic cockpit activities will be focused on a PDR and CDR. For LPA cockpit structural elements, the activities will be oriented on four axes: multifunctional composite, functional coating, automatized inspection technologies from manufacturing to in service, and, repair process for structural composite components. Finally, FRC related activities will focus on the manufacturing of four side-shell structures as part of FRC ITD airframe using Automated Fiber Placement layup technology.

Under “More affordable small A/C manufacturing”, reference and innovative specimens of hybrid joints will be produced and tested for strength and EMC behavior. In addition, Aileron demonstrator will be manufactured for new jig-less assembly technologies after a Critical Design Review. Finally, it is planned to complete the design activity including CDR and detail design of the cabin part (demonstrator A) and nacelle (demonstrator B).

With respect to “Assembly of Fast Rotorcraft airframe”, the airframe of the compound rotorcraft will be assembled considering doors and side shells as well as canopy, cowling and fuel system. The activity will start in 2018.

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

With respect to “Rotor-less Tail for Fast Rotorcraft”, activities will be focused in the Detailed Design, Tooling development and delivery, and Test Rigs development and delivery for Structural Test Campaign.

Under “Pressurized Fuselage for Fast Rotorcraft”, development of the new “V” tail concept for NGCTR-TD will be progressed, in particular the definition of preliminary interface loads with existing fuselage structure. Trade studies into tail configurations will assess weight, strength and manufacturing advantages and disadvantages between a conventional “T” Tail and proposed “V” Tail architecture.

“More affordable composite fuselage” activities will consist in the completion of stressed lay-out of fuselage structural main components, Testing of Level 2 fuselage elements, Manufacturing of Level 3 fuselage sub-components, and Development of surface treatments processes on aluminum alloys. In addition, Manufacturing and testing of sensorised elements related to the 5 structural items and repair complemented with extensive modelling related to design, optimization and virtual testing will be performed. Finally, Design-Against-Distortion for metallic additive-manufactured structure model validation will be completed. The integration of distortion prediction in Design Optimization will continue. For composite structure, the work on model development and establishing limits of validity will also continue. Integration of the simulation with topology optimization for composite Design-Against-Distortion will start.

With respect to “Affordable low weight, human centred cabin”, major cabin items conceptual layouts will be defined with initial evaluation of the interfaces versus the structural, items will be investigated and comfort key drivers and wellbeing parameters at cabin level is envisaged. In addition, the first down selection for the proposed interiors technologies will be developed on numerical simulations with validation approach at coupon level of environmental friendly materials.

**C – Eco-Design**

*C-1: Eco-Design TA Link*
The connection of the overall AIRFRAME ITD to the ecoDESIGN Coordination Committee will be realized. Regular participation in the ecoTA CCM and participation in the reviews is foreseen by the members.

**C-2: Eco-Design for Airframe**
With respect to “Technology Development”, after finalisation of the trade-off studies in 2017, the most promising and relevant technologies will have been selected to be further developed. LCA data for technologies will be collected in order to be stored in the CS-AED database created in Clean Sky / EDA.

Eco-statements will be performed under the “Life Cycle Assessment” task for the AIRFRAME demonstrators which will be developed within CS2, and if available or needed, their reference parts. Data collection will be conducted for technologies which will be applied on one or more demonstrators in AIRFRAME.

Finally under the “Demonstration” task, activities on two demonstrators will be performed: Composite Aircraft Wheel and Hybrid Seating Structure (FHG).

**C-3: New materials and manufacturing**
The following activities are planned:
- Eco efficient factories of the future: torsion box eco-efficient assembly.
- Future leakage identification system: validation of model and simulation of hydraulic, fuel system and tanks and gas fluid system.
- Integration of testing systems on DMU: tool for interconnection and integration between product structure-testing structures.
- Automated testing technologies: enhanced Auto-Test capabilities demonstrator and predictive model development.
- HMI in productive environments: requirements and solution of HW for HMI of test system for automatization and digitalization support of test system process.
- Connected Factory: requirements and integrated solution for the interconnection via Wi-Fi of portable devices and tools for manufacturing & assembly processes.
- Laser sintered samples and simulation: guidelines for the CAE development and Additive Manufacturing (AM) process on the demonstrator component
- Innovative manufacturing and functional testing of aerostructures: testing and optimisation the collaborative robot cell installed during 2017.

**Major milestones planned for 2018:**
- A-3 Composite Wing Root Box Demonstrator PDR
- A-4 IWTT for slat demonstrator PDR
- B-1 Wing box PDR
- B-1 Winglet Morphing actions Closure from CDR
- B-2 OoA Composite Wing Box PDR closure

**Major deliverables planned for 2018:**
- A-2 Analysis the second batch of the BLADE flight tests
- A-3 Door demonstrator CDR report
- A-4 GLA evaluation for business jet application
- B-1 CDR RACER’s Wing
- B-2 OoA Composite Wing Box PDR closure
Description of main activities for the year 2019

**M – Management & Interface**
Same activity as for 2018

**A – High Performance and Energy Efficiency**

*Technology Stream A-1: Innovative Aircraft Architecture*

With respect to “Optimal engine integration on rear fuselage”, aerodynamic and acoustic tests on an optimized scarfed nozzle concept and a final synthesis of the scarfed nozzle study will be performed. In addition, activities related to down selection of rear engine integration option for LPA and BJ configurations will be continued. Design and preparation of future WTT campaigns on the most promising rear engine concept work will also start in 2019.

The activities related to “CROR and UHBR configuration” will be a continuation of those planned in 2018.

Activities on “Novel High Performance Configuration” will be the continuation of the 2018 activity. Design and preparation of future WTT campaigns on the most promising rear engine concept work will also start in 2019.

With respect to “Virtual Modelling for Certification”, the activities will continue the development of the tools on the 6 topics. Definition of the validation plans will be initiated.

*Technology Stream A-2: Advanced Laminarity*

With respect to “Laminar nacelle” activities, a WTT to evaluate the benefits of innovative concepts of laminar nacelle installed on a business jet configuration will be performed and the tests results will be analysed in comparison with flight tests results already available.

Design activity of a NLF nacelle will be also pursued.

Under “NLF smart integrated wing”, BLADE activity will be continued. The analysis of the durability and BLADE flight tests will be pursued and an aerodynamic WTT in low speed velocity and high Reynolds number conditions for evaluation of a NLF business jet wing will be prepared. In addition, a wind tunnel test (funding tbc) in S2MA will be performed in order to improve of surface default criteria to transonic conditions and to develop a specific instrumentation for unsteady transition measurement.

The activities under “Extended laminarity” task will be a continuation of those planned in 2018.

*Technology Stream A-3: High Speed Airframe*

With respect to “Multidisciplinary wing for high and low speed”, the PDR of the Wing Root Box demonstrator will be mid-2018. It will be followed by the detailed design of one specific panel with the CDR mid-2019. This panel will then be manufactured starting mid-2019. With respect to the Moveable demonstrator, the CDR is planned Q2 2019. The tooling will start mid-2019. Demonstrator final assembly and tests will be carried out starting 2020.

The activities related to “Tailored front fuselage” will be focused on optimizing cockpit windshields for large diameter business aircrafts as continuation of the activities planned in 2018.

With respect to “Innovative shapes & structure”, the Cargo door demonstrator CDR is planned end of 2018; in 2019, tooling and some part manufacture and assembly will take
Delivery of tooling is planned for the end of 2019. In addition, the study of thermomechanical compatibility between a composite WRB and a metallic CWB will be pursued.

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

With respect to “Smart Mobile Control Surfaces”, the development of the mixed thermal ice protection will continue as well as the ultra-low power IPS using piezo electric technology. In addition, the development of the integration of the EWIPS on a slat to produce a demonstrator for ground IWTT will continue. Finally, the synthesis of the target applications for movables will be finalized. Two concepts will be selected for further development to TRL 4-5. A full size design of the concepts will be started in order to provide a detailed definition. Activities on “Active load control” will consist for BJ applications in the preparation of gust load alleviation demonstrator based on full flight simulator and flight tests. Flutter control will also be studied and applied to a business jet test case. System architecture specificities for gust and flutter control will also be studied. With respect to LPA applications, techniques for robust/adaptive active flutter control law design and its demonstration on a theoretical aeroelastic model will be developed. In addition, strategies for gust load alleviation and active flutter control will be further developed and applied.

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

With respect to “Ergonomic Flexible Cabin”, on Human Centred Cabin, in 2019, the concepts developed in 2018 will be implemented as physical mock-ups for the three topics defined in 2018 above. On “Immersive Cabin Services”, for 2019, no activities are planned. The 2019 activities related to “Office Centred Cabin” will be to finalise the detail design development of the innovative layout (CDR planed in July 2019). The manufacturing of the full size mock-up will start mid 2019 with a delivery target for test mid-2020. In addition, the innovative concept decided in 2018 will be studied.

**B – High Versatility Cost Efficient**

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

With respect to “Wing for lift & incremental mission shaft integration”, manufacturing of all flight parts will start for delivery of the wing to IADP FRC 2.2. The acoustics of RACER will be further refined and, the acoustics emissions and the noise carpet for the relevant certification flight conditions assessed. Under “Optimised composite structures”, the Detail design of the wing box will culminate with the CDR. Further automation technology development will continue, refining the down-selected technologies toward the 7M demo. Virtual testing, advanced bonding technology and optical fiber SHM of bond-line will be further developed. With respect to “More efficient Wing technologies”, the 2 Winglet components for flight, for FTB#2 Step 1 flight campaign, will be delivered as well as the LH component for FTB#2 Wing Step 2 configuration, for static Test. Activities under “Flow & shape control” will be focused to be ready for CDR in 2019 for Step2 for FTB#2 flight test campaign. In addition, different kinematic and actuation concepts will be assessed. Finally, in the detailed design phase the analysis is extended to the wing profiles that are deformed by aerodynamic pressure and by actuation forces.

**Technology Stream B-2: Optimized high lift configurations**
With respect to “High wing / large Turboprop nacelle configuration”, the installation will be designed and the nacelle prototype manufactured with the integration of the system designed within the PIPS project. The validation of the system and installation will be started and performed.

Under “High lift wing”, the activity will be focused on having a CDR by Q1 of 2019. The Manufacturing of the OoA composite wing will be completed by Mid-2019 to perform the Full Scale Static Tests of the Wing and to have the 2 components to be integrated in the FTB#2 wing configuration for Step 2 Flight Test Campaign. In addition, the 2 Multifunctional flap components for flight will be delivered, for FTB#2 Step 1 flight campaign, by Q1-Q2 of 2019.

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

With respect to “Advanced integration of system in nacelle”, the activities defined in 2018 will be continued.

Under “All electrical wing”, EMAs activities for aileron and spoiler will be focused on closing a CDR. The embedded antenna in the Fuselage Fairing activities will also be focused on closing the CDR. HVDC (High Voltage Direct Current) will be focused on closing a CDR by end of 2019. The integration of ice protection based into the Leading Edge will be conducted; the installation will be designed and the wing prototype manufactured with the integration of the system designed in INDUCTICE project. The validation of the system and installation will be started and performed. In addition, upscaling of the heating device from coupon level to subcomponent level to show the applicability of the system to realistic airframe structures and to fulfil CS25 requirements will be performed. In addition, the control system concept will be implemented with all subcomponents; the system will be adapted to results of the numerical shape simulations and the actuation and control system will be integrated into the demonstrator section to be tested.

With respect to “Advanced integrated cockpit”, activities on innovative materials for regional cockpit structures elements will be focused on closing a CDR; while those on innovative SHMS will be focused also on closing a CDR. In addition, the completion characterization of panels for EMC and Lightning Strike will be carried out. Preparation and execution of the EMC, Lightning Strikes and Bird Strikes on the Structural Cockpit of Regional FTB#2 will be completed. Ergonomic cockpit activities will be focused on the validation of the design of the Interior lay-up. With respect to LPA cockpit structures elements, activities will be oriented on four axes: multifunctional composite, functional coating, automatized inspection technologies from manufacturing to in service, and, repair process for structural composite components. Finally, with respect to FRC related activities, a CPD model of the side shell parts, will be used to perform the out programming of the discrete AFP tow structure and corresponding robot toolpaths.

Under “More affordable small A/C manufacturing”, the investigation phase of Effective joining methods of metal-composite hybrid structures will be followed by manufacturing of ground demonstrators and their EMC+RLC testing. In addition, the advanced sheet metal demonstrator, more complex than aileron, will be produced for verification of jig-less manufacturing approach. Produced demonstrator (subassembly) will be embedded into the parent structure (plane). Finally, results evaluation of selected manufacturing technologies will be performed. Preparation of the test programs and start of the ground tests of some selected elements of the airplane is also planned.
With respect to “Assembly of Fast Rotorcraft airframe”, the activity will be a continuation of the one started in 2018.

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

With respect to “Rotor-less Tail for Fast Rotorcraft”, all the manufacturing activities will be developed, finishing with the delivery of the Test Articles and Flyable single parts of the Rotorless Tail for FRC, focused on Structural Test Campaign. Under “Pressurized Fuselage for Fast Rotorcraft”, the NGCTR-TD rear fuselage design modification will be completed to accept new tail ready to CDR level. The concept for Rear Fuselage tail module relating to the future aircraft to PDR level will be developed. Structural aspects of the nacelle will be completed ready for CDR.

“More affordable composite fuselage” activities will consist in Completion of manufacturing of Level 3 fuselage sub-components, Structural testing of Level 3 fuselage sub-components, Development of automated manufacturing, as well as assessment of tests results of technologies suitable for composite fuselage. In addition, manufacturing and testing of 5 structural items including SHM technologies resulting in final validation of SHM technologies under operational load and environmental conditions will be performed. Finally, for Design-Against-Distortion for metallic structure, the exploitation of the result by applying it to use case(s) in the Component Research of CleanSky2 will be performed. For composites, integration of the simulation with topology optimisation will continue. The final tasks of developing convertors for CAD to Design Optimisation and Optimisation result to CAD will also be completed, allowing exploitation of the results by applying it to use case(s) in the Component Research of CleanSky2.

With respect to “Affordable low weight, human centered cabin”, definition of the interface control drawings with respect to the primary structural elements for the major cabin interiors items will be developed. Down-selection for the proposed interiors technologies will also be performed based on the small/medium scale test results. In addition, Human model simulations will be carried out for user’s evaluation assessment; design of major cabin items and full-scale test bench will be developed.

**C – Eco-Design**

**C-1: Eco-Design TA Link**

Same activities as for 2018.

**C-2: Eco-Design for Airframe**

With respect to “Technology Development”, roadmaps established at the end of 2017 will be reassessed at the end of 2018, and eventually updated. Technology Development will then be continued in 2019. LCA data collection for technologies will also be continued in order to be stored in the CS-AED database created in Clean Sky / EDA. Initial discussions on demonstrator definition will be initiated.

Under “Life Cycle Assessment”, the LCA flow logic will specify the procedure of data to be collected for the various technologies in the single SPD parts of CS2 and the quantification of environmental impacts (e.g. global warming potential, acidification) but also single emissions (e.g. CO2, NOx) by various eco-statements.

Finally, under “Demonstration”, in 2019, activity on the two demonstrators: Composite Aircraft Wheel, Hybrid Seating Structure, will continue.
C-3: New materials and manufacturing

The following activities are planned:
- Future leakage identification system: final conclusion with all results obtained during 2018 with demonstrator.
- Integration of testing systems on DMU: implementation and validation of final demonstrator with automatization of GTI and warning of change from GTR.
- Automated testing technologies: development and validation of model solution of data Analytics from Data system.
- HMI in productive environments: development and validation of new HW for HMI Test System.
- Innovative manufacturing and functional testing of aerostructures: continuation of the study of the set of technology.

Major milestones planned for 2019:
A-3 Composite Wing Root Box Demonstrator Panel CDR
A-4 IWTT CDR
A-4 Gust WTT CDR
B-1 Wing Box CDR
B-4 Down-selection for the innovative cabin architecture solutions

Major deliverables planned for 2019:
A-3 Moveable demonstrator CDR
A-4 IWTT for the Slat demonstrator
B-1 CDR RACER’s Wing
B-1 Winglet Morphing flight components for FTB#2 Step 1
B-2 OoA Composite Wing Box delivery for FTB#2 Step 2 Wing
ITD Engines

Multi-annual overview and strategic planning

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

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

- Ultra-High Propulsive Efficiency (UHPE) demonstrator addressing Short / Medium Range aircraft market, 2014-2023: design, development and ground test of a propulsion system demonstrator to validate the low pressure modules and nacelle technology bricks;
- Business aviation/short-range regional Turboprop Demonstrator, 2014-2020: design, development and ground testing of a new turboprop engine demonstrator in the 2000 thermal horse power range;
- Advanced Geared Engine Configuration, 2015-2020: design, development and ground testing of new compression system rigs and an expansion system demonstrator to validate key enablers to reduce CO\textsubscript{2} emissions, noise and engine mass;
- Very High Bypass Ratio (VHBR) Middle of Market Turbofan technology, 2014-2018: development and demonstration of technologies to deliver validated power plant systems matured for implementation in full engine systems;
- VHBR Large Turbofan demonstrator, 2014-2021: design, development, ground and flight test of an engine to demonstrate key technologies for large engines;
- The Small Aero-Engine Demonstration projects related to Small air Transport (SAT) will focus on small fixed-wing aircraft in the general aviation domain and their power-plant solutions, spanning from piston/diesel engines to small turboprop engines.
- Eco Design: Considering several demonstrator components this Eco Design work package has been outlined as a comprehensive work package concentrating on relevant engine manufacturing technologies. As a link to Eco Design TA the LCI data on all technologies in scope will be provided for Eco Design Analysis.

Description of main activities for the year 2018

WP2 – Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range aircraft

In 2018, system module studies related to the integrated drive system [IDS], including transmission and gearbox concepts will be continued based on the significant progress achieved by the multidisciplinary task force during summer 2017. An integration loop aiming at generating functional data for design for a transmission system in a representative engine environment will be realized in the first half of 2018.
These maturation studies will lead to the definition of a transmission system test rig which is part of the reinforced risk mitigation plan prior to the demonstrator test which was defined in 2017.

Activities on the UHPE engine demonstrator design will continue in preparation of the Preliminary Design Review (PDR) scheduled in 2019.

**WP3 – Business Aviation / Short Range Regional TP Demonstrator**
The sub-modules of the demonstrator are expected to be delivered during 2018. In particular, the power & accessory gear box (PAGB) should be delivered and the tests should start on the PAGB partial test rig. This advanced partial test rig is also planned to be delivered in 2018.

Key objective of the activities in 2018 is the completion of the ICD Rig tests. The concept phase of the 2-spool compressor rig will continue and the concept phase of the Engine Demonstrator will be closed with its preliminary design review.

In order to mature the compression and expansion system technologies for system rig or engine demonstration, a number of complementary test activities will be performed in the technology projects.

**WP5 – VHBR – Middle of Market Technology**
2018 will see ongoing rig design and test effort from the WP leader, core Partners and Call for Proposal organisations in low speed fan/pressure systems, high pressure turbines, 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 power gearbox test programme is progressing and additional work building on the initial power rig and attitude rig work will be continued in WP5.

**WP6 – VHBR – Large Turbofan Demonstrator**
Work will continue on the test campaign for the Advance 3 engine. This will also include detailed analysis of the results from the programme that will be fed into the CS2 Technology Evaluator. For the VHBR programme (UltraFan®) work continues to support the design and definition of key sub-systems, components including those from the two main core partners. This phase of the programme will see detailed work on the design of the power gearbox for the demonstrator and also the detailed definition of the test programme.

**WP7 – Light weight and efficient Jet-fuel reciprocating engine:**
As well as in 2017, the activities in 2018 will be mainly performed by the CfP partners, with the support of the WP leader. For the sub-WP4, it will concern essentially in testing for the 6-cylinder engine, firstly on the engine and propeller test benches for performances & dynamic validation (Q4 2017 – Q1 2018), before being sent to the sub-WP5 partner for installation and ground tests on the aircraft. The sub-WP1/2 will conclude early 2018 by the end of testing phases and the validation, whereas sub WP3/6 will focus on finalizing the design and launch manufacturing of prototypes.

**WP8 - Reliable and more efficient operation of small turbine engines**
2018 will be mainly focused on the development of the Virtual Engine model (Loop#2 with Piaggio), assessing Technology Evaluator CTQs such as noise and NOX/CO2 emissions, and
on the design of the All-additive combustor. The findings from the tests performed in 2016 and 2017, such as the FANN combustor and compressor test, will be incorporated in the evaluation of the different technologies at system level against the project objectives.

**WP9 – ECO Design**

The WP9 activities for 2018 and 2019 are conditional to a funding approval at Programme level by the end of 2017. The Eco-Design link to Big Impact technologies will provide the ability to fully quantify the actual eco-benefit (or eco-penalties) of the technologies in scope throughout the life cycle of the product. For 2018 the start of the technical activities is foreseen focussing on process development in the particular sub-work packages. With regard to the Eco Design analysis the scope of the LCA assessment as well as the interfaces for submission of LCI data to the ECO Design Hybrid Platform will be detailed. All activities will be accompanied by the initiation, management and support of various CfP projects. Eco Design will define the goal and scope of work for the LCA assessment.

**Major Milestones planned for 2018**

- Preliminary Design Review for IDS module - Technical audit report to be delivered (WP2)
- PAGB Module delivered (WP3)
- Engine Demo. Test Concept Review (WP4)
- Enablers to UltraFan® Stage 1 Exit (WP5)
- UltraFan® Stage 1 Exit (WP6)
- Endurance Test Readiness Review (WP7)
- Report out for advanced compressor (WP8)

**Major Deliverables planned for 2018**

- Preliminary Design Review datapackage for IDS test vehicle (WP2)
- PAGB Acceptance Test Report (WP3)
- ICD Rig tests Post Test Review (WP4)
- Enablers to UltraFan® Stage 1 Summary (WP5)
- UltraFan® Stage 1 Summary (WP6)
- Ground Demonstrator Test Results (WP7)
- Low Noise Propeller System Design (WP8)

**Description of main activities for the year 2019**

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

In 2019 the Preliminary Design Review (PDR) of UHPE demonstrator shall be performed. The UHPE demonstrator will be able to take full benefit of the learnings from modules rig tests and from transmission system test vehicle design. A full set of functional data associated to finalized specification will be generated for the modules to enable the modules’ Preliminary Design Review (PDR). In the second half of 2019, detailed design of the modules will be conducted. Material of long lead time parts will be done.
WP3 – Business Aviation / Short Range Regional TP Demonstrator
Following the delivery of the propeller, nacelle and engine parts, the IPPS demonstrator will be built in 2019. It is planned to light the demonstrator in 2019. In parallel, the partial tests for an upgraded compressor test module will be prepared.

Key objective of the activities in 2019 is the completion of the detail design for the Engine Demonstrator and the major part of the detail design for the 2 Spool Compressor Rig, as well as hardware procurement and test preparation of the entire programme. In order to mature the compression and expansion system technologies for system rig or engine demonstration, a number of complementary test activities will be performed in the technology projects.

WP5 – VHBR – Middle of Market Technology
The rig test programme in WP5 will be progressing well with key rigs around the turbines (HP and IP) and oil/air systems (from core partners) expected to be fully commissioned and delivering results.

WP6 – VHBR – Large Turbofan Demonstrator
The VHBR (UltraFan®) programme will be nearing testing in 2019 and the main focus of the programme will be around test schedule definition, instrumentation and tooling for the build of the test vehicles. The WP Leader efforts will be mainly focused on the management of collaborative partners due to the limited remaining budget.

WP7 – Light weight and efficient Jet-fuel reciprocating engine
As well as in 2017 & 2018, the activities in 2019 will be mainly performed by the CfP partners, with the support of the WP leader. As the sub-WPs on core engine, turbocharger & 6-cylinder architecture (1/2/4) will be finalized in 2018, 2019 will focus on the 3 others sub-WPs (3/5/6), with the manufacturing & validation tests for propeller and control system, and the permit-to-fly preparation for the aircraft equipped with the 6-cylinder engine.

WP8 - Reliable and more efficient operation of small turbine engines
2019 will be mainly focused on the final evaluation of the high level objectives by means of the Virtual Engine model (Loop 3 with Piaggio), including the all-additive combustor technology, developed in synergy with the CfP launched in Wave#6.

WP9 – ECO Design
The Eco-Design link to the ITD Engines will set up the ability to fully quantify the actual eco-benefit (or eco-penalties) of the technologies in scope within the ITD, and throughout the life cycle of the related aero-engine concepts. In 2019 the technical activities will be continued focusing on process development in the particular sub-work packages. With regard to the Eco-Design analysis first sets of Life Cycle Impact [LCI] Data will be provided to the Eco-Design TA Hybrid Platform. All activities will be supported by various CfP projects which will see their initiation, management and execution from 2018..

Major Milestones planned for 2019
• Preliminary design review (WP2)
• First Engine Propeller To Test (FEPTT) (WP3)
• 2 Spool Compr. Rig Preliminary Design Review (WP4)
• Enablers to UltraFan® PDR (WP5)
• UltraFan® PDR (WP6)
• Application to Permit-to-Fly (WP7)
• Final Exploitation Plan (WP8)

Major Deliverables planned for 2019
• Preliminary Design Review report meeting (WP2)
• Preliminary IPPS Test Report following FEPTT (WP3)
• Engine Demo. Critical Design Documentation (WP4)
• UltraFan® PDR Summary Review (WP5)
• UltraFan® PDR Summary Review (WP6)
• Permit-to-Fly documentation (WP7)
• Final Evaluation report (WP8)
ITD Systems

Systems play a central role in aircraft operation, flight optimisation, and air transport safety at different levels as they enabling optimised trajectories, new aircraft configurations and improved performance-weight-ratios. The 2018-2019 period will see the maturation of many topics while some others will be ramped-up. Systems ITD’s scope include virtually all major aircraft systems, ranging from cockpit and avionics to landing gears. It includes as well environmental control systems, wing ice protection and electrical power generation, distribution and conversion. Furthermore flight control systems and actuation is addressed for small, regional and large aircraft alike. A joint focus of all activities is set on the increasing electrification of the systems to enable the future more-electric or full-electric aircraft. Additional work is done to create environmentally friendly technologies in particular in the area of material and processes. Many CfP partners are integrated and support the activities. A very relevant number of core partners joined the Systems ITD addressing even more technologies as for example an aircraft systems simulation framework, power electronics, electrical brakes and cockpit solutions specifically for small air transportation. In 2018, the integration of many new Core partners will lead to the activation of the WP2 about cabin and cargo technologies completing the set-up of the Systems ITD. The majority of the planned technology developments will be extensively ground or flight tested in order to reach a high level of technology readiness.

Description of main activities for the year 2018

WP1 Extended Cockpit
Most of the building blocks of the cockpit in the domains of large tactile displays, new control devices, Communication, Navigation and Surveillance functions, Flight Management and Enhanced Vision will reach a maturity level of TRL4 to TRL5 depending on the progress made in the underlying technologies. A first instance of a system level demonstrator will be available by end of year 2018, with an initial scope focusing on Flight management, Cockpit Display system and flight control.

WP2 Cabin & Cargo Systems
Activities in this WP will start in January 2018. An optimized Cabin & Cargo system and communication architecture will be defined based on the evaluation of cabin processes and operations (see list of deliverable below). Alignment to the architecture by all WP2 partners will be guaranteed through a dedicated gate review (see list of milestone here below). The baseline for standardization on power management and communication interfaces will be identified. The development of all WP2 technology bricks will be initiated (connected seat, connected trolley & galley, modular cabin power converter, new WWS reusing grey water, halon-free fire suppression system interfacing with an OBIGGS). The underlying TRL roadmap will be defined. In anticipation of demonstration activities, the demonstration strategy and the corresponding planning will be set up.

WP3 Innovative Electrical Wing
Set-up and testing of Smart Integrated Wing Demonstrator will go into its Phase 2 incorporating components developed in research activity carried out outside of Clean Sky 2.
Wing architecture studies will deliver first assessment results. Technology bricks in particular for hydraulic power packs will be maturated and readied for an equipment demonstration in LPA IADP.

Innovative electrical flight control components for regional A/C will progress and nearly complete the assembly phase.

Preliminary design of Smart Active Inceptors will be adjusted according to the airframer specification allowing the start of the detailed design phase in 2018 – both, for mechanical and electronical sub-assemblies.

WP4 Landing Gear System
2018 work will consist in manufacturing and performing first tests on sub elements prototypes needed in the future Electrified Landing Gear Systems. (i.e.: Testing, demonstration, verification of MLG, GATs 2nd generation and Short TAT equipment. Integration/maintenance study and TRL5 testing for Nose Landing Gear Local Hydraulic system will be completed. Low-complex composite brace will be finalised in the manufacturing during the period and testing will be prepared.

For Electrical Braking a concept phase and a preliminary design will be conducted. For the Sensor Systems the following work will be performed: Delivery of optimised sensor for NLG & MLG; mechanical integration design pack; safety & reliability assessment, provision of fibre optic interrogator and prototype fibre optic processing unit to NLR for system functional testing; start of environmental & system tests.

WP5 Electrical Chain
Activities on HVDC power will cover specifications for electrical network architecture and distribution technologies bricks, preparation of tests for the Power Management Center commutation matrix, components modelling validation and optimization of rules for Electrical harnesses installation according to rapid protection technology. Work on Digital GCU will increase the TRL level managing the control of AC and DC networks. Refinements of FW functionalities will allow reaching TRL5. On rotating starter-generator(SG), activities will focus on the development of bricks to be integrated in SG demonstrator. The Core Partner activity on Energy Storage will be initiated.

Integration test for Enhanced Distribution Center Unit will start. Technologies to enable a high-density electrical cabinet such as health monitoring and protection solutions will reach TRL4. The Core Partner project THRUST launched mid 2017 focuses on development of commutation matrix and technology improvements to enable HVDC components specifications. The development of full-scale power electronics (45 KW, multi-use capabilities and modularity) will lead to a first HW prototype to support the SW activities as well as THRUST and EECS demonstration. The control will be developed and tested. In parallel, development tests will be performed on the HW. Additional Technology bricks, such as SiC or Cooling, will be further developed to reach TRL5 in 2019.

WP6 Major Loads
Development of the AECS will be performed starting with air treatment and air sensors laboratory tests (Target TRL4). An advanced ventilation cabin mock up and an Energy Management function will be designed.
For eECS activities, a system PDR will be carried out, and Liebherr will start the detailed design phase. Airbus will contribute to the eECS integration strategy definition and implementation.

For the pack of the Vapor Cycle System, preliminary design activities will start while first prototype tests for air quality monitoring and air filtering will be performed. The optimized architecture of electrical Wing Ice protection as well as the ice accretion rate function will be validated through small IWT test campaign to reach TRL4. An additional activity planned in the period is the development of the Primary Function Ice Detection System. A lab prototype of the Airborne Interferometric Ice sensor will be validated to reach TRL3.

For Other Loads, motors activities will start by Thales.

For integrated demonstration and validation activities, V&V plan according to the EECS TRL road map will be consolidated by Airbus and Liebherr. Some CfP to support the AVANT test bench set-up will be launched.

WP7 Small Air Transport Activities
Technologies for small air transport aircraft systems will be further maturated during the period. This includes Electro Mechanical actuation for flight control surfaces, for landing gear actuation, braking, electrical generation and distribution, de-icing, SESAR compatible cockpit.

Crash test of lightweight, crashworthy passenger seats is planned to validate performed FE analysis. Furthermore the advanced and parametric simulations will be performed in order to take advantages of FEA modelling.

The work of CfP partners on passenger comfort technologies will be completed in 2018. The results in acoustic and thermal insulation and climate comfort will be prepared towards a TRL6.

WP 100.1 Power Electronics and Electrical Drives
The EMINEO project will continue to work on the portfolio of topics about power electronics, network architectures, electrical drives and machines. Eight topics will be completed and five new topics will be started during the 2018/2019 period.

WP 100.2 Product Life Cycle Optimization: ECO Design
In 2018, research activities on green coating systems, high performance composites and additive manufacturing will continue. Furthermore, some tests will be performed on innovative light alloys (high temperature aluminum alloys and TiAl alloys).

Further partner calls on ECO topics will be launched to support activities on EBM technology, hybrid materials and innovative light alloys.

The collaboration started with Eco Design TA will carry on and be reinforced to secure completion of the work package objectives.

WP 100.3 Model Tools and Simulation
The software core environment TRL5 prototype will be deployed. Main activities will include data management integration, advanced capabilities regarding management and IP protection of exchanged data, automated workflow, report generation, enhanced DESYRE integration by standard API and proposals for potential extensions to standards.

The initial integration of a central data management system into the MISSION framework
will take place. Furthermore, an open test automation interface and tool will be integrated. Activities related to the development of health monitoring and fault detection methodologies will be initiated.

Modelling and optimization activities at aircraft level will complete the development of the power platform. Further modelling efforts will be dedicated to the definition and initial development of the thermal platform. In addition, progresses of the methodologies for aircraft-to-system integration are expected.

Modelling and optimization activities at system level will complete the design and optimization platforms for landing gear and actuation systems, with particular attention to methodologies for aircraft-to-system integration. Further efforts will focus on the preliminary development of the electrical architecture and thermal architecture design platforms. In addition, engine models will be developed.

Ongoing collaborations with Systems members will contribute to improve environment capabilities.

Major Milestones planned for 2018
- First version of system cockpit demonstration (WP1)
- Gate review n°1 – alignment to architecture (WP2)
- Smart Active Inceptors final system PDR (WP3)
- GATS Manufacturing Review (WP4)
- TRL5 of Full Digital Generator Control Unit (WP5)
- EWIPS TRL 4 maturity gate (WP6)
- Construction of demonstrator with noise and thermal insulation for testing in optimal flight regime (WP7)
- Completion of DT#10 (WP100.1)
- EMA and EHA modelling and design environment developed, validated and demonstrated (WP100.3)

Major Deliverables planned for 2018
- Extended Cockpit Validation Plan (WP1)
- Future cabin and cargo architecture definition – initial version (WP2)
- More electrical wing architectures assessment report (WP3)
- NLG and MLG sensors (WP4)
- EDCU technology demonstrator test plan (WP5)
- EECS architecture for large aircraft - PDR Report for eECS demonstrator (WP6)
- EPGS High Level Requirements (WP7)
- Update on Demonstrator Topics' Progress (WP100.1)
- Software core environment TRL 5 prototype deployed (WP100.3)

Description of main activities for the year 2019

WP1 Extended Cockpit
Additional functions are integrated in the cockpit virtual system bench, according to the TRL maturation of each building block. Candidates for integration in 2019 are in the surveillance and navigation domain.
Some functions will also be flight tested, e.g. for Enhanced Vision Systems.
WP2 Cabin & Cargo Systems
Activities in 2019 will focus on the development of the WP2 technology bricks up to TRL4 and standardization. For each TRL level, TRL reviews will be organized according to the TRL roadmap. Baseline activities from 2018 on standardization will feed into a standardization plan (see deliverable here below) with yearly standardization reviews (see milestone here below). Definition and specification of communication interfaces will be finalized and targeted interaction with identified standardization bodies will be initiated.

WP3 Innovative Electrical Wing
Detailed Design and Modelling activities for Smart Active Inceptors will be completed with a Critical Design Review leading to the start of sub-assemblies manufacturing. Assembly of EMA flight control components for regional A/C will be finalised in 2019. Integration and safety tests will be conducted to support the first flight test in Regional IADP in 2020.
Phase 2 of the Smart Integrated Wing demonstrator with its components will continue. Wing architecture studies are planned to deliver first assessment results. Progress will be realized on Endurance testing of EHA pump technology.

WP4 Landing Gear System
Green Autonomous Taxiing System will focus on the integration of the sub elements at a System level and the demonstration and validation of System performance (GATS 2nd generation and MLG).
Local Hydraulic System for NLG will be prepared for integration on Airbus rig. For Electrical Braking detailed design will be closed. The low-complex composite structure demonstrator will be supported as needed for TRL6 demonstration with Airbus in LPA IADP. Concept studies for more-complex composite parts for landing gears will be closed as well as the following preliminary design phase.
Works on LG sensor systems include: Completion of environmental and system testing, system integration on flight test aircraft, flight testing, final reporting.

WP5 Electrical Chain
Work on HVDC include test of Power Management Center commutation matrix on PROVEN test bench, validation of models automatic adaptation algorithms and Electrical harnesses installation topology optimization studies based upon improved installation rules. Technologies for the rotating Starter-Generator will be further matured. The development of DC-DC converter, initiated 2017, will progress in order to reach a TRL4 level in 2019.
The Enhanced Distribution Center Unit will be tested at system level leveraging High Voltage technology bricks developed outside CS2. The technologies development will reach TRL5 in the period.
THRUST activities will focus on commutation matrix test and HVDC components design. The full-scale development will be pursued and Power Electronic Modules will be delivered to allow the start of pre-integration tests and to support WP6 activities. Technology Bricks development will be finalised reaching TRL5.
WP6 Major Loads
Laboratory testing of air treatment and sensors will be completed. System and control logic will be validated and all developed technologies shall be demonstrated for TRL4 and a 1% fuel savings as an intermediate step toward the 2% final objective. Manufacturing of the advanced ventilation mock-up will begin.
For the eECS and VaCS demonstrators the system and components CDR will be carried out leading to the launch of manufacturing and the preparation of the test campaign.
The development of sensors for ozone and VOCs air quality monitoring in the cabin will be performed and the second prototype will be delivered for testing in Liebherr facilities.
For the air filter a demonstrator will be optimized and tested in full scale environment.
Full scale IWT tests will be validating the performance of EWIPS and its advanced control benefits in all Icing conditions. TRL5 maturity will be assessed for EWIPS and TRL6 for PFIDS.
AiIS flight test demonstrator will be matured towards TRL4.
For integrated demonstration, cooling system integration into AVANT test bench and eECS integration tests will be performed.

WP7 Small Air Transport Activities
Technologies will in general reach TRL4 in this period. In particular Electro Mechanical actuation for flight control surfaces, for landing gear actuation, and braking will be addressed. Electrical generation and distribution, de-icing, SESAR compatible cockpit, and lightweight, crashworthy passenger seats are other areas of research work.
Modified passenger seats will undergo a crash test in order to validate developed methodology.
In the field of passenger comfort, technologies for acoustic and thermal insulation and for acclimatisation comfort will reach TRL6.

WP 100.1 Power Electronics and Electrical Drives
The EMINEO project will continue to work on the portfolio of topics about power electronics, network architectures, electrical drives and machines. Eight topics will be finished and five other topics will be started during the 2018/2019 period.

WP 100.2 Product Life Cycle Optimization: ECO Design
In 2019, research activities on green coating systems, high performance composites and additive manufacturing will continue. End of life processes study will start for composite materials.
Further partner calls on ECO topics will be launched.
The started collaboration with Eco Design TA will carry on and be reinforced to secure funding and completion of the work package objectives.

WP 100.3 Model Tools and Simulation
The software core environment functionalities will be improved by integrating users’ feedback. The second integration phase of the data management system will take place. Further implementation of SiL simulations and feasibility analysis of virtual testing methods is planned.
Activities in model based algorithms and controls deliver the specification of the different systems controls and management functions. In addition, activities related to health
monitoring and fault detection will progress. The automatic test generation & coverage tool will be completed.

Modelling and optimization activities at aircraft level will focus on the thermal platform. Progresses in the development of methodologies for aircraft-to-system integration and support to design decision are expected.

Modelling and optimization activities at system level will complete the design and optimization platforms for wing, electrical and thermal architectures, with particular attention to methodologies for aircraft-to-system integration. In addition, engine models will be integrated with design platforms at system and aircraft level. On-going collaborations with Systems members will contribute to improve environment capabilities.

**Major Milestones planned for 2019**

- Extended Cockpit TRL4 (WP1)
- Standardisation review n°2 (WP2)
- Electro-motor-pump bricks available (WP3)
- Short TAT TRL 4 Review (WP4)
- TRL5 of Power Electronic Module technology bricks (WP5)
- Adaptive ECS system leveraging existing technologies and components at TRL 4 (system) (WP6)
- Computing Node Detail Design Review (WP7)
- Completion of 3 out of four demonstrator topics in Network Architectures section of the programme (WP100.1)
- Automatic test generation environment complete (WP100.3)

**Major Deliverables planned for 2019**

- Standardisation plan (WP2)
- Delivery of Spoiler/Aileron EMA for Regional A/C to testing (WP3)
- DDR Review results for EMA braking (WP4)
- Electrical network conversion final test description (WP5)
- EWIPS TRL 5 maturity report (WP6)
- Seat Demonstrator No.2 – Test Evaluation Results (WP7)
- Update on Demonstrator Topics' Progression (WP100.1)
- Aircraft thermal models for each target platform: Combined aircraft models integrating power layers (WP100.3)
Small Air Transport Transverse Activity

Small Air Transport play a central role in representing 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. The key areas, already identified at the start of the programme 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.

Starting from the activities performed in the previous period on the different technologies at level of ITD’s on the different technologies, preliminary studies of integration shall be performed. The level of maturity of this integration shall be more shifted to the second part of the next period when a significant number of partners will be on board. This integration shall be performed at level of the reference aircraft for SAT that is the 19 seat. So a tuning of the ITD’s technologies must be implemented to get from existing platform to 19 seat.

As reference the existing platforms are:

<table>
<thead>
<tr>
<th>Vehicle models</th>
<th>Reference vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-seater</td>
<td>2014 technology (existing ref. EV55)</td>
</tr>
<tr>
<td>19-seater</td>
<td>2014 technology (generic ref.)</td>
</tr>
<tr>
<td>Business Turboprop</td>
<td>2014 technology (existing ref. P180)</td>
</tr>
</tbody>
</table>

Hereafter is an overview of the technologies that shall be integrated according to the incoming information from ITDs:

- Affordable health monitoring systems
- Electrical Power Generation and Distribution
- Electrical LG architecture
- Electrical Low power de-ice system
- Fly by wire
- Affordable avionics system
- Increased safety by increasing comfort in cabin

The SAT TA in *Clean Sky 2* will address technologies at integration level through the following actions:

- Work on specific topics and technologies to design and develop individual items, equipment and systems and demonstrate them in local test benches and integrated demonstrators (up to TRL5).
- Customization, integration and maturation of these individual systems and equipment in SAT. 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 either during development or operational use.
The main activities for 2018-2019 divided for WP are:

- **WP 1 Management**: Within the different sub-packages general Management activities of the SAT and support to ITD’s for the coordination of the ITD will be performed.
- **WP 2 Aircraft Configuration**
- **WP 3 Advanced Integration of System and Engine in small a/c**: Integration studies by iterative loops with ITD’s for all the technologies.

**Major Milestones planned for 2018**

- Annual Report (WP1)
- PDR - Integration on P180 /from previous GAM) (WP3)
- CDR - Integration on P180 /from previous GAM) (WP3)

**Major Deliverables planned for 2018**

- Annual Report (WP1)
- PDR - Integration on P180 /from previous GAM) (WP3)

Activity for 2019 is the continuation of the ones already in place in 2018.

**Major Milestones planned for 2019**

- Annual Report (WP1)
- PDR - Integration on P180 /from previous GAM) (WP3)

**Major Deliverables planned for 2019**

- Annual Report (WP1)
- CDR - Integration on P180 /from previous GAM) (WP3)
Eco Design Transverse Activity

Multi-annual overview and strategic planning

Eco Design TA will continue in 2018-19 in its effort to coordinate and support the CS2 activities in ITDs/IADPs focused to ensure a significantly reduced ecological impact of future air vehicles and their processes over their product life cycle contributing to a more sustainable aviation and competitive European aviation industry.

Description of main activities for the year 2018

Eco Design TA will continue to work at two axis level, technology and ecological assessment, to demonstrate and promote excellence toward the integration of the most promising technologies for materials, processes and resources innovations in new aeronautical products design to contribute to important aspects as:
- More efficient production
- Waste reduction, reuse and recycling
- Hazardous substances reduction
- Reduced material use
- Components life extension

The Eco Design Coordination Committee will continue to steer the Eco Design activities performed in the different SPDs toward the action objectives ensuring the proper level of interaction. It will also define a set of agreed criteria to help the selection of Eco Design TA projects.

Candidate Eco Design activity from ITDs/IADPs intended to be performed in the period, including the launch of new call topics, will be then screened and assessed on a competitive basis through a selection process clearly highlighting the in scope character, benefit and impact for the transversal action.

The selected ITDs/IADPs projects will be implemented with the action leader supporting leaders and partners in coordinate, monitoring and measuring their progress toward the ecolonomic goals also with the mean of promoting workshops on specific themes of interest (i.e. composites recycling and reuse, additive manufacturing) aimed to joint collaborative approach and to ensure synergies. The Eco Design coordination framework and tasks have to be reassessed accordingly to ensure a proper level of cooperation and efficiency.

The principles of an extended aeronautical data base will be developed to help to quantify the environmental benefits of the most promising technologies and orientate the research in the Eco Design theme. Data base management principles have also to be discussed and agreed for a proper cooperation. The necessity to have a common tool to enhance the Eco Design guidance will also be assessed.

Major Milestones planned for 2018
- Workshop on Joint Themes
- Data Base Management Principles
• SPDs Eco Design Activity 2nd Assessment

Major Deliverables planned for 2018
• Updated Technology List for Eco design activities in SPDs
• Progress report for the Eco Design Technologies and monitoring

Description of main activities for the year 2019

Eco Design TA will continue the 2018 action toward ecolonomic guidance and monitoring of ITDs/IADPs relevant activity. In scope projects will be monitored, candidate activity screened and assessed for Eco Design relevance. Aeronautical data base will be expanded through data collected in the period on an the agreed set of technologies. First Eco Design relevant results will be assessed and new activity promoted or redirected. A proper communication of Eco Design TA progress and first key achievements could be also ensured.

Major Milestones planned for 2019
• Workshop on Joint Themes
• Eco statements review
• SPDs Eco Design Activity Assessment

Major Deliverables planned for 2019
• Updated Technology List for Eco design activities in SPDs
• Progress report for the Eco Design Technologies and monitoring
• Dissemination and Communication Plan
Technology Evaluator
Multi-annual overview and strategic planning

A Technology and Impact Evaluation infrastructure is and remains an essential element within the Clean Sky JTI. Cross-positioned within the Clean Sky 2 programme, the Technology Evaluator (TE) is a dedicated evaluation platform. It has the key role of assessing the environmental impact of the technologies developed in Clean Sky 2 and their level of success towards defined environmental (Noise, CO2, NOx) benefits and targets and where appropriate covering also societal impacts like e.g. mobility.

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 when appropriate selected ITD outputs into concept aircraft and modelling long term TE concept aircraft;
- Impact Assessments at Airport and Air Transport System level using IADPs and TEs concept aircraft / rotorcraft.

For the 2018 to 2019 period the main objective will be to prepare the 1st full assessment in 2020. The following milestones will contribute to this:

- Definition of additional calls; Conclusion of grant agreements and/or Tender contracts and Start-up of activity of participants joining the TE via calls during 2018 and 2019
- Coordination and interaction with SPDs to update Clean Sky 2 TEs integrated planning
- Delivery of CS2 Clean Sky concept aircraft models from SPDs to the TE

In the frame of the MoC with EASA, TE2 will support the preparation of next edition of the EASA European Aviation Environmental Reports (EAER), aimed at next CAEP in 2019.

The core objective of the EAER is to publish reliable and objective information, accessible to all, to inform discussions on how to address the environmental challenges that the aviation sector faces. It has a wide target audience including policy makers, industry stakeholders and the general public.

Description of main activities for the year 2018

In 2018 the following work packages will be covered:

WP0 TE management
- Administrative management
- Technical management
- Call preparation

WP1 TE scope and set up
- Regular update of the integrated planning
- Further specification of metrics and assessments to express Clean Sky 2 benefits
- Exchanges with the JU executive team (partly also with external experts) on the possibility to assess climate impact and local air quality plus on the option to consider non Clean Sky vehicles in the forecasts and scenarios
WP2 TE Interfacing with SPDs and transversal activities
- Regular meetings and interfacing (physical/teleconference) with all SPDs to discuss status of SPD inputs, update of TE requirements and work plan.

WP3 TE integration at Mission level (incl. mission level modelling)
- Workshops with experts to enable a “Light projection” for mainliner and regional aircraft in terms of the Clean Sky 2 SPD environmental (emissions, noise) goals until Mid-2018: Comparison of goals for mainliner and regional CS2 concept aircraft and “best flown 2014 aircraft”
- Collection of Mission level outputs from SPDs and interaction
- CFP 07 mission level topic management

WP4 TE airport impact assessment
- Airport level Assessment: airport selection scheme, selection criteria and selected airports
- Generation of heliport rotorcraft traffic scenarios
- Generation of airport level airport flight schedules
- CFP 05 Airport level Topic management

WP5 TE ATS impact assessment
- A projection based on specific objective for CO₂, NOₓ and Noise at conceptual model level. An overall projection for CO2 and NOx will be assembled for the fleet level based on forecasts worked out by DLR
- ATS level assessment: fleet & movement forecast (up to 2035) and flight schedules
- 1st results ATS aircraft fleet environmental impact (new reference aircraft)
- Generation of Rotorcraft traffic scenarios
- Future fleet mix and CS vehicle share as input for the “Light Projection”
- CFP 05 ATS level topic management
- CFP 07 call topic management support (ATS part)

Major milestones planned for 2018
- Reception of SPD projections in achieving the CO2, NOx and Noise objectives of the regulation (on concept model level)
- Reception of SPD concept aircraft models v1

Major deliverables planned for 2018
- TE integrated planning new version
- Mission level report
- Mission level activity regarding workshop results on “light projection”
- Airport level report
- ATS level activity regarding “ATS part on light projection” including fleet level projection for CO2 and NOx
- ATS level report

Description of main activities for the year 2019

In 2019 the following work packages will be covered:
WP0 TE management
- Administrative management
- Technical management
- Call preparation

WP1 TE scope and set up
- Regular update of the integrated planning

WP2 TE Interfacing with SPDs and transversal activities
- Regular meetings and interfacing (physical/teleconf) with all SPDs to discuss status of SPD inputs, update of TE requirements and work plan.

WP3 TE integration at Mission level (incl. mission level modelling)
Collection of Mission level outputs from SPDs and interaction
- CFP 07 mission level topic management

WP4 TE airport impact assessment
- Airport level Assessment: simulation of airport traffic scenarios and start of environmental impact
- 1st results for heliport rotorcraft traffic scenarios environmental impact
- CFP 05 Airport level Topic management

WP5 TE ATS impact assessment
- ATS level assessment: 2050 scenarios and flight schedules
- 1st results ATS aircraft fleet environmental impact (concept aircraft) and connectivity
- 1st results for Rotorcraft fleet traffic scenarios environmental and mobility/productivity impact
- CFP 05 ATS level topic management

Major milestones planned for 2019
No milestones planned

Major deliverables planned for 2019
- TE integrated planning new version
- Mission level report
- Airport level report
- ATS level report

Synergies with the European Structural and Investment Fund (ESIF)

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

Synergy does not imply replacing the private contribution to be brought in the CS2JU action by ESIF or combining them for the same cost item in a project although a CS2JU project can benefit from additional funding from ESIF at national or regional level for complementary or additional activities not covered by the CS2JU grant. Synergy means to expand the scope and impact of a CS2JU project through ESIF funds in terms of scientific excellence and contribution to the Clean Sky 2 programme objectives.

In the framework of its calls, the CS2JU encourages the submission of proposals containing a separate and clearly identified Work Package (ESIF WP) that is independently funded or eligible for funding through ESIF under the applicable national/regional funding scheme/call. Activities proposed under the ESIF WP, where applicable, should be of complementary nature to the core scope of the Call topic, should contribute to the overall objectives of the Clean Sky 2 programme but are or may be exclusively funded through ESIF. In the context of the calls for proposals, the complementary activities will be assessed by the JU strictly outside the call for proposal framework, its evaluation and applicable rules.

The CS2JU encourages also synergies with ESIF also by amplification of the scope, parallel activities or continuation of a CS2JU co-funded project through ESIF in synergy with the programme and by stimulating the use of ESIF to build capacity and capabilities in the fields related to the programme.
3.2.3. Calls for proposals and calls for tenders

Calls for proposals – Partners

The Partners selected through calls for proposals will carry out objective driven research activities aiming at developing new knowledge, new technologies and/or solutions that will bring a contribution to the high-level goals of the Clean Sky 2 programme, and complement actions developed and executed in the IADP/ITDs/TAs. Partners will be selected on the basis of topics launched through the calls for proposals (CfP) via the EU Participant Portal. The topics will define the scope, goals, objectives and estimated duration of the activities to be performed by the successful applicant upon being selected as a partner. Topic descriptions will be laid down in the call text and will include, where appropriate, any special conditions related to the topic and/or specific requirements related to operational capacity required, Consortium or Implementation Agreement conditions, or prerequisite conditions to be met such as capacities needed to be compliant with the topic’s objectives and specifications.

Calls for proposals will follow the H2020 Rules for Participation, with special conditions laid down in this work plan under 3.3. The proposals submitted in the context of the calls will be subject to independent evaluation governed by the rules set out in section 3.3 of this work plan and published with the topics on the Participant Portal. Upon selection, the partners will sign a grant agreement for partners with the JU and their contribution may be made available to either demonstrator activities in the IADPs/ITDs/TAs, or to a set of technological research activities which are performed by one or several CS2 members in the frame of the grant agreement[s] for members. The partners' activities may be performed under the technical monitoring of a private member acting in the call process and grant implementation as Topic Manager.

In cases where the performance of actions by partners may contribute to the Clean Sky 2 high-level objectives and provide benefit to a broad stakeholder base, beyond one IADP/ITD or TA, Research and Innovation Action topics may be launched outside the complementary framework within one IADP/ITD/TA and the actions and results made available under conditions specified in topic special conditions as laid down in the call text.

Additionally, the JU may launch topics for Coordination and Support Actions (CSAs) with the aim of supporting the goals of the programme at large. For any CSAs proposed by the JU and agreed for launch through the Governing Board, the general conditions and rules of H2020 shall apply.

Technical implementation of the partner’s actions within an IADP/ITD/TA - access rights between private members and partners

The contribution of partners to the objectives of an IADP/ITD/TA and in so doing to the activities of the private member[s] will require a close cooperation between the member[s]
and the Partner selected by the JU to execute the work and implement the action under the grant agreement for partners.

When assigned as Topic Manager in a topic 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/TA 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\(^1\), where applicable, or to negotiate and sign an Implementation Agreement with the private member who 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 exploitation of results. Specific provisions will be laid down in the respective model grant agreement for members and model grant agreement for partners\(^2\).

### Calls for tenders

The CS2JU is entitled to launch calls for tenders as part of its operations and within the operational budget allocated under Article 16 of the Statutes. The CS2JU is planning to launch in 2018-2019 few operational calls for tenders to request the provision of services to support the CS2JU in the performance of its activities.

The calls for tenders are expected to support the Technology Evaluator TA in its activities and analysis across the Clean Sky 2 programme. The services to be procured through this type of operational calls for tenders have an objective to gather data for use by the CS2JU which will be integrated in the next step into the action implemented under TE grant agreement for members. The calls for tenders concern enabling IT systems and modelling that directly support the Programme Office and the JU in creating and maintaining a capability to [1] store and manage data related to assessments; [2] enable assessments not linked to the actions in the grant agreements for members and their major demonstrator projects but more broadly aimed at simulating technology progress; and [3] to provide to the JU a communication / visualization tool in its role as Programme Office and PPP body. They are not, as such, activities that support one private member activities within a grant agreement, but represent services and capabilities supporting the JU in the performance of its Statutory tasks and Membership at large, and the tasks of the Executive Director and the Board respectively in proposing and agreeing actions to optimise the programme’s benefits and results, as laid down in the Statutes. They will contribute to the assessment of the environmental impact of the technologies developed in Clean Sky 2 and their level of success towards well-defined environmental and societal benefits and targets.

\(^1\) In case of TE Calls for Proposals, a TE Coordination Agreement will apply

\(^2\) Under the conditions set out in Articles 25.2 and 25.3 of the H2020 model grant agreement
A summary table is made available below listing an estimate of the operational tenders planned for launch in 2018-2019 and the planned procurement procedure in line with the CS2JU Financial Rules. The detailed description of the tender specifications and of the procedure will be announced at the moment of the publication of the tender documents on TED and CSJU website.

### Call for tenders planning 2018 -2019

<table>
<thead>
<tr>
<th>Indicative value of the contract</th>
<th>Type of procurement procedure</th>
<th>Title of the tender</th>
<th>Launch</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 k€</td>
<td>Article 104.1 (a) of the EU FR(^3)</td>
<td>TE Information System</td>
<td>Q1-Q3 2018</td>
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<tr>
<td><strong>Short description</strong></td>
<td></td>
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<tr>
<td>Procurement to the JU of services aimed at setting up a TE data repository and management system, called the TE-IS, to provide assistance in the extraction of TE data by interactive functionalities and layers and to provide inputs for reporting work.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300k€</td>
<td>Article 104.1 (a) of the FR(^4)</td>
<td>TE Mission level non-proprietary vehicle models</td>
<td>Q1-Q3 2018</td>
</tr>
<tr>
<td><strong>Short description</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment of a set of non-proprietary aircraft models to provide the JU with an open analysis environment to integrate components and assess the impact of their technologies on mission level.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300 k€</td>
<td>Article 104.1 (a) of the FR(^5)</td>
<td>TE Interactive Analysis Environment</td>
<td>Q1-Q3 2018</td>
</tr>
<tr>
<td><strong>Short description</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment of an interactive analysis environment to visually showcase the impact of Clean Sky 2 technologies on mission and ATS level. An appropriate framework needs to be developed that enables a near-real-time evaluation capability.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300 k€</td>
<td>Open tender (Article 104.1 (a) of the FR(^6))</td>
<td>Socio economic assessment of Clean Sky 2</td>
<td>Q1-Q3 2019</td>
</tr>
<tr>
<td><strong>Short description</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This topic focuses on socio economic assessment of Clean Sky 2 programme.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


\(^4\), \(^5\), \(^6\) idem
3.2.4. Call management (planning, evaluation, selection)

Calls for proposals planning 2018-2019

Seventh call for proposals JTI-CS2-2017-CfP07
The seventh Call for Proposals is foreseen to be launched on 8 November 2017. The indicative funding value\(^5\) of this call is 73 M Euro. The Call topics and their full descriptions are appended to this work plan (see Annex III).

Eighth call for proposals JTI-CS2-2018-CfP08
The 8\(^{th}\) call for proposals is foreseen to be launched on 12 April 2018. The indicative funding value\(^6\) of this call is 70 M Euro for the topics launched within the complementary framework of ITD/IADP/TAs. In addition to this envelope, 5 M Euro will be added for the topics to be launched outside of the complementary framework of ITD/IADP/TAs (Thematic Topics). The Call topics and their full descriptions are appended to this work plan (see Annex IV).

Ninth call for proposals JTI-CS2-2018-CfP09
The 9\(^{th}\) call for proposals is foreseen to be launched in Q4 2018. The indicative funding value\(^6\) of this call is 60 M Euro. The Call topics and their brief summaries and indicative values will be appended to further updates to this work plan.

Tenth Call for Proposals JTI-CS2-2019-CfP10
The 10\(^{th}\) call for proposals is foreseen to be launched in Q2 2019. The indicative funding value\(^7\) of this call is 70 M Euro. The Call topics and their brief summaries and indicative values will be appended to further updates to this work plan.

Calls will be open on the Participant Portal for at least three months from opening. Timelines for completion of the evaluation process and of grant agreement preparation will be kept as lean as possible with the aim of completing signature of the grant agreements within applicable time to grant (TTG).

3.2.5. Dissemination and information about projects results

The JU will continue to adopt and exploit the common Horizon 2020 IT systems available in the Commission. Besides continuous monitoring of the dissemination activities related to the projects performed by the members and the partners, during their implementation (according to the applicable periodicity and certainly at the final reporting), the JU (the project officers inside the operational team and one SNE devoted to dissemination activities) will ensure that the requirements of the grant agreements in this regard are met.

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\(^5\) Note: the figures mentioned in the above paragraphs are new commitments and shall be understood as excluding any potential re-launch of topics or re-use of commitment funding from previous calls.

\(^6\), \(^6\), \(^7\) Idem
3.3. Call management rules

The call for proposals process is conducted in line with H2020 rules and applicable guidance documents for calls for proposals. Any specificity in the submission and selection process is set out and described in the Rules for submission, evaluation, selection, award and review procedures for Calls for Proposals which pursuant to CS2JU Regulation n° 558/2014 of 6 May 2014 were approved by the Governing Board and published on the Clean Sky website and on the Participant Portal.

On a practical level, the calls for proposals will make use of the European Commission’s Participant Portal:

The calls for proposals will be managed in compliance with the General Annexes to the Horizon 2020 Work Programme 2018-2020:

Part A (List of countries eligible for funding), part D (Types of action: specific provisions and funding rates), part E (Specific requirements for innovation procurement (PCP/PPI) supported by Horizon 2020 grants), part F (Model rules of contest ROC for prizes), part G (Technology readiness levels TRL), part I (Budget flexibility) and part L (Conditions related to open access to research data) of the General Annexes to the Horizon 2020 Work Programme 2018-2020 shall apply mutatis mutandis.

Part B Standard admissibility conditions and related requirements shall apply mutatis mutandis to the Clean Sky 2 calls for proposals launched within the complementary framework of one IADP/ITD/TA with the following additional conditions introduced below.

According to Article 9(5) of Regulation (EU) No 1290/2013 the annual work plan, where appropriate and duly justified, may provide for additional conditions according to specific policy requirements or to the nature and objectives of the action, including inter alia conditions regarding the number of participants, the type of participant and the place of establishment. The following additional conditions (points 1 and 2) apply to the calls for proposals launched within the complementary framework of one IADP/ITD/TA:

1. 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" in accordance with Article 9.5 of the H2020 Rules for Participation:

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7 European Commission Decision C(2017)7124 of 27 October 2017
The 16 Leaders of JU listed in Annex II to Regulation n° (EU) No 558/2014 and their affiliates\(^8\) may apply to Calls for Proposals only in another IADP/ITD where they are not involved as Members.

The Core partners and their affiliates may apply to calls for proposals only in another IADP/ITD where they are not involved as member.

2. Applicants may apply to calls for proposals if they:
   - officially state whether they are an affiliate\(^9\) to a member of the JU or not;
   - issue a declaration of absence of conflicts of interest\(^10\).

These elements shall determine the admissibility of the proposal. The above criteria and the declarations will be checked by the JU which will determine the admissibility of the proposals. The CS2JU reserves its right to request any supporting document and additional information at any stage of the process.

Calls for proposals launched under Part B of Annex IV: In cases where the performance of actions by partners may contribute to the Clean Sky 2 high-level objectives and provide benefit to a broader stakeholder base beyond one IADP/ITD or TA, Research and Innovation Action topics may be launched outside the complementary framework of one IADP/ITD/TA; for these topics, in order to prevent any conflict of interest, the following "additional conditions" within the meaning of Art 9(5) of the Horizon 2020 Rules for Participation shall apply:

- The 16 Leaders of JU listed in Annex II to Regulation n° (EU) No 558/2014 and their affiliates\(^11\) may not apply to the topics listed in Part B of Annex IV.

Part C Standard eligibility conditions of the General Annexes to the Horizon 2020 Work programme shall apply mutatis mutandis. The following derogation applies to the calls for proposals launched by the CS2JU regarding the minimum conditions for participation: an application to a call for proposal will be considered eligible if it complies with the eligibility conditions set out in the table below, depending on the type of action.

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\(^8\) See the definition under Article 2.1(2) of the H2020 Rules for Participation

\(^9\) See the definition under Article 2.1(2) of the H2020 Rules for Participation

\(^10\) 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.

\(^11\) See the definition under Article 2.1 (2) of the H2020 Rules for Participation
Part H Evaluation rules of the General Annexes to the Horizon 2020 Work programme applies mutatis mutandis, with the following addition:

<table>
<thead>
<tr>
<th>Eligibility conditions&lt;sup&gt;12,13,14&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research &amp; innovation action</strong></td>
</tr>
<tr>
<td><strong>Innovation action</strong></td>
</tr>
<tr>
<td><strong>Coordination and support actions</strong></td>
</tr>
</tbody>
</table>

---

### Award criteria

<table>
<thead>
<tr>
<th>Type of action</th>
<th>Impact</th>
<th>Quality and efficiency of the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and innovation actions (RIA); Innovation actions (IA)</td>
<td>The section on exploitation shall demonstrate a clear commitment to support exploitation of the results brought by their participation in the programme and contribute to European EU competitiveness.</td>
<td>Match of technical capabilities and skills with the Topic Area and congruent with the programme objectives embodied in the topic; Ability to work effectively within a supply chain and into an equal or higher tier industrial organization;</td>
</tr>
</tbody>
</table>

In order to protect the European competitiveness of the aeronautic sector, in accordance with Article 43 RfP, the JU will make appropriate checks concerning the exploitation of results during project implementation and the reporting phase. In this respect, the contractual option of Article 30.3 of the grant agreement (providing that the JU may object to a transfer of ownership or licensing of results to a third party established in a third country not associated to the EU-H2020) shall apply by default to all CS2JU grant agreements.

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<sup>12</sup> The eligibility criteria formulated in Commission notice Nr. 2013/C 205/05 (OJEU C 205 of 19.07.2013, pp.9-11) apply for all actions under this Work Programme, including for third parties that receive financial support under the action (in accordance with Article 137 of the Financial Regulation No 966/2012), notably programme cofund actions.

<sup>13</sup> Natural or legal persons, groups or non-State entities covered by the Council sanctions in force are not eligible to participate in Union programmes. Please see the consolidated list of persons, groups and entities subject to EU financial sanctions, available at [http://eeas.europa.eu/cfsp/sanctions/consol-list_en.htm](http://eeas.europa.eu/cfsp/sanctions/consol-list_en.htm)

<sup>14</sup> Given that the EU does not recognise the illegal annexation of Crimea and Sevastopol, legal persons established in the Autonomous Republic of Crimea or the city of Sevastopol are not eligible to participate in any capacity. This criterion also applies in cases where the action involves financial support given by grant beneficiaries to third parties established in the Autonomous Republic of Crimea or the city of Sevastopol (in accordance with Article 137 of the Financial Regulation No 966/2012). Should the illegal annexation of the Autonomous Republic of Crimea and the City of Sevastopol end, this Work Programme will be revised.

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<sup>15</sup> Platform & Software as a Service
3.4. Support to Operations

3.4.1. Communication and events

Key advocacy and communication activities will include increasing the visibility and reputation of the JU by conveying the members’ and partners’ achievements and successes, as well as by promoting Clean Sky 2 calls. We will sharpen our message, expand our networks and make our brand visible, consistent and reputable, playing its role within the EU policy for research and innovation and H2020 in particular.

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
- The Clean Sky Communications Network
- Clean Sky management and staff and,
- ACARE, reaching out to policy makers inside ACARE companies

Actions

a) Attract a large variety of excellent participants in Europe to apply for Clean Sky 2 programme

<table>
<thead>
<tr>
<th>TARGET GROUPS:</th>
<th>Potential applicants: Industrial leaders; Large, Small and Medium Enterprises; academia; research centres</th>
</tr>
</thead>
<tbody>
<tr>
<td>MESSAGE:</td>
<td>Benefits of participation in Clean Sky 2 programme</td>
</tr>
<tr>
<td>ACTIONS:</td>
<td>Promotion of Calls:</td>
</tr>
<tr>
<td></td>
<td>• Clean Sky 2 info Days sessions around Call launches</td>
</tr>
<tr>
<td></td>
<td>• Open webinars</td>
</tr>
<tr>
<td></td>
<td>• SRG promotion in each country</td>
</tr>
<tr>
<td></td>
<td>• Clean Sky management and staff participation at events</td>
</tr>
<tr>
<td></td>
<td>• Partnership with SMEs’ European organisations</td>
</tr>
</tbody>
</table>

Clean Sky visibility at key events:
- Paris-Le Bourget in 2019
- Clean Sky Forum in 2018 and 2019
- ILA Berlin and Farnborough Air Show in 2018
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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MESSAGE:</td>
<td>Success of demonstrators in on-going technical projects</td>
</tr>
<tr>
<td>ACTIONS:</td>
<td>• High-level meetings with national and European policy-makers</td>
</tr>
<tr>
<td></td>
<td>• Outreach events at the European Parliament/European Commission, alone or together with the other JUs (e.g. JTI Strasbourg event in October 2017)</td>
</tr>
<tr>
<td></td>
<td>• Targeted meetings/invitations to Demonstrator-related events to representatives of the European Commission, the European Parliament, EU Permanent Representations.</td>
</tr>
</tbody>
</table>

c) **Maximise efficiency and effectiveness of Clean Sky communications efforts**

<table>
<thead>
<tr>
<th>TARGET GROUPS:</th>
<th>ITD leaders’ communications professionals (Communications Network Group); Clean Sky management and staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>MESSAGE:</td>
<td>Maximise internal information and effectively coordinate external actions while aligning messages and timing. Includes press work.</td>
</tr>
<tr>
<td>ACTIONS:</td>
<td>• Align messages to speak with a single voice at events, high-level meetings and when doing media relations. Improve narrative to reach out to various audiences</td>
</tr>
<tr>
<td></td>
<td>• Coordinate communication activities with Communications Network Group</td>
</tr>
<tr>
<td></td>
<td>• Seek regular, high-level media coverage through press work, press releases, and opinion articles in leading and specialised media</td>
</tr>
<tr>
<td></td>
<td>• Conclude contracts with external communication suppliers where more efficient and needed</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>TARGET GROUPS:</th>
<th>CS2 IADP/ITD/TA coordinators; project officers</th>
</tr>
</thead>
<tbody>
<tr>
<td>MESSAGE:</td>
<td>Ex-ante and post-project interaction with communications to optimise visibility, advocacy and influence of Clean Sky</td>
</tr>
<tr>
<td>ACTIONS:</td>
<td>Provide communications guidance and support for their contributions to the website, events, printed and digital publications, as well as press work.</td>
</tr>
</tbody>
</table>
3.4.2. **Procurement and contracts**

For the years 2018-2019 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 2018-2019 a few new calls for tenders are expected to be launched. The tenders planned to be launched are expected to support some core activities mainly in the field of communication for specific events and activities, audit and in the IT field.

A summary table is made available below listing the tenders planned for 2018-2019.

**Procurement planning 2018-2019**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Type of procedure</th>
<th>Value in EUR</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication related activities and events</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean Sky Forum</td>
<td>Specific Contract implementing FWC</td>
<td>max. 60 000</td>
<td>Early 2018</td>
</tr>
<tr>
<td>Clean Sky success stories production</td>
<td>Specific Contract implementing FWC</td>
<td>max. 50 000</td>
<td>2018</td>
</tr>
<tr>
<td>Demonstration Events</td>
<td>Negotiated procedure for low-value contracts</td>
<td>max 30 000</td>
<td>2018</td>
</tr>
<tr>
<td>Conference at ILA Berlin</td>
<td>Specific Contract implementing FWC</td>
<td>max. 10 000</td>
<td>Early 2018</td>
</tr>
<tr>
<td>Stand at ILA Berlin</td>
<td>Specific Contract implementing FWC</td>
<td>max. 110 000</td>
<td>Early 2018</td>
</tr>
<tr>
<td>Media partnerships</td>
<td>Negotiated procedure for low-value contracts</td>
<td>max 25 000</td>
<td>2018</td>
</tr>
<tr>
<td>Events at EP</td>
<td>Specific Contract implementing FWC or Negotiated procedure for low-value contracts</td>
<td>max 20 000</td>
<td>2018</td>
</tr>
<tr>
<td>Strategic Communication</td>
<td>Specific Contracts implementing FWC</td>
<td>aggregated max. value 100 000</td>
<td>2018</td>
</tr>
<tr>
<td>Dedicated aerospace video production and dissemination</td>
<td>Negotiated procedure for low-value contracts</td>
<td>max. 20 000</td>
<td>2018-2019</td>
</tr>
<tr>
<td>CS website</td>
<td>Specific Contract implementing FWC</td>
<td>max. 52 000</td>
<td>2018</td>
</tr>
</tbody>
</table>
### 3.4.3. IT and logistics

A major revision of the Clean Sky IT infrastructure with a new architecture has started in 2017 and the roll-out of that will continue into the period 2018-2019. While primarily driven by a need to replace the servers, backup system, telephone exchange and other core ICT infrastructure (which dates from 2010 & earlier), these changes put in place the foundation for taking advantage of new ways of working. In moving more towards an IaaS model (Infrastructure as a Service), the JU achieves more system availability, more mobile solutions, easy scalability and better cost control with less capital investment. It also positions the JU to move to PaaS* and SaaS* solutions in the future.

These changes are being done in close cooperation with the enlarged JTI family (6) with whom Clean Sky 2 JU is co-located, thereby ensuring consistency and economies of scale.

On the issue of software applications, in 2018-2019 the JU will continue to adopt more common EU systems.

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15 Platform & Software as a Service
3.4.4. JU Executive Team – HR matters

According to the Council Regulation 558/2014, the Staff Regulations of officials of the European Union and the conditions of employment of other servants of the European Union will apply to the staff of the CS2JU and its Executive Director.

In 2018 the JU will manage 9 grant agreements for members of the Clean Sky 2 programme (consisting of approximately 350 financial reports from leaders and core partners and 9 annual technical reports). In addition, the JU will process the signature of GAPs for the 2 calls planned in 2018 and manage the reporting for the GAPs signed in previous years (consisting of approximately 390 financial reports). Out of the 42 positions (TA and CA) currently recruited, 24 positions are involved in the grant management area (excluding senior management tasks).

In accordance with the Governing Board decision adopted on 15 April 2016 regarding the reclassification system, the JU shall perform the annual reclassification exercise for JU staff in 2018 and 2019.

The revised organisational structure of the JU as approved by the Governing Board in July 2017 is shown below. The structure shows the three main units structure and composition in terms of staffing.
3.4.5. Budget and finance

The Clean Sky 2 Joint Undertaking budget for 2018-2019 is summarised below. The administrative costs are based on the available payment appropriations coming from the EU subsidy. The detailed draft budget is set out in section 4.1.

<table>
<thead>
<tr>
<th>Budget 2018</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title 1 - Staff Expenditures</td>
<td>5.105.000</td>
<td>5.105.000</td>
</tr>
<tr>
<td>Title 2 - Infrastructure Expenditures</td>
<td>4.003.363</td>
<td>4.003.363</td>
</tr>
<tr>
<td>Title 3 - CS Operational Expenditures</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Title 4 - CS2 Operational expenditures</td>
<td>285.480.830</td>
<td>330.309.728</td>
</tr>
<tr>
<td>Total Budget</td>
<td>295.673.799</td>
<td>340.502.697</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Budget 2019</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title 1 - Staff Expenditures</td>
<td>5.240.000</td>
<td>5.240.000</td>
</tr>
<tr>
<td>Title 2 - Infrastructure Expenditures</td>
<td>4.275.698</td>
<td>4.275.698</td>
</tr>
<tr>
<td>Title 3 - CS Operational Expenditures</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Title 4 - CS2 Operational expenditures</td>
<td>285.214.572</td>
<td>286.582.295</td>
</tr>
<tr>
<td>Total Budget</td>
<td>294.730.270</td>
<td>296.097.993</td>
</tr>
</tbody>
</table>

3.4.6. Data protection

In 2018-2019, the JU will continue to ensure that personal data are protected and that Regulation (EC) No 45/2001 is complied with, by implementing the following actions:

- The JU Data Protection Officer will allocate time in advising and training the staff in particular in relation to the implementation of the accountability principle and to the follow-up in specific fields of the thematic guidelines issued by the European Data Protection Supervisor;
- The JU will continue to implement the internal procedure for handling internal notifications under Article 25 of Regulation (EC) No 45/2001 related to administrative processing operations by the JU’s staff and, where applicable, to the prior checking notifications to the EDPS under Article 27 of Regulation (EC) No 45/2001.
- The JU will implement the data protection aspects related to the launch and management of the calls for proposals in accordance with the rules and procedures of Horizon 2020. In the light of the latest General Monitoring Report 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, 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 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.

3.5. Governance

The Governance of the Clean Sky 2 Joint Undertaking is ensured by the Governing Board. Other bodies are:
- the Executive Director;
- the Steering Committees;
- the Scientific Committee;
- the States Representatives Group.

The Governing Board (GB) gathers the Commission’s representative, the Industry Leaders [16] and the Core partners [6] representatives, with the Commission holding 50 % of the voting rights. Decisions are taken by a majority of at least 80 % of all votes in its ordinary meetings or by written procedure. The Governing Board has the overall responsibility for the strategic orientation and the operations of the Clean Sky 2 Joint Undertaking and supervises the implementation of its activities. Some of the GB annual tasks as per Article 8 of the CS2JU Statutes include:
- assessment of applications for membership
- adoption of annual budget including the staff establishment plan
- providing guidance to and monitoring the performance of the Executive Director
- adoption of the work plan
- approval of the additional activities plan and providing its opinion on the private members declaration on the in-kind contribution
- approval of the annual activity report, including the corresponding expenditure;
- approval of the calls’ ranking lists produced by a panel of independent experts;

The Executive Director is the legal representative and the chief executive for the day-to-day management of the CS2JU in accordance with the decisions of the Governing Board and in line with Article 10 of the Statutes. The Executive Director is supported by three managers: two Operational Programme Managers and the Head of Administration and Finance. The ITDs/IADPs/TAs Project Officers allows the Executive Director to play its coordination role. The JU’s management acts on the basis of its quality system documents, which are listed in the Quality Manual. Interactions with the ITDs/IADPs/TAs are mainly governed by the CS Management Manual.

The Steering Committees (SC) are responsible for technical decisions taken within each ITD/IADP, specifically for:
- guiding and monitoring the technical functions of its ITD or IADP and taking decisions on behalf of the CS2JU on technical matters specific to the relevant ITD or IADP in line with the grant agreements or decisions;
- reporting to the Executive Director on the basis of defined reporting indicators
- providing all necessary data to the Technology Evaluator
- establishing the detailed annual implementation plans for the ITD or IADP in line with the work plan and proposing the contents of the calls for proposals;
- proposing to the Executive Director changes of the budget allocation within its ITD or IADP.

**Technology Evaluator and other Transverse Activities**

Technology Evaluator, as a Transverse Activity, monitors and assesses the environmental and societal impact of the technological results arising from individual ITDs and IADPs across all Clean Sky activities, specifically quantifying the expected improvements on the overall noise, greenhouse gas and air pollutants emissions from the aviation sector in future scenarios in comparison to baseline scenarios. The Executive Director chairs the TE Coordination meetings.

Eco-Design and Small Air Transport Transverse Activities are in charge of the coordination of their activities in cooperation with ITDs and IADPs.

The **Scientific Committee (SciCo)** is an advisory body to the Governing Board. It will meet at least twice. The Scientific Committee will be consulted on the Work Plans, will advise on Call texts and will participate to interim reviews. Based on the legal framework, the Chair of the Scientific Committee may now participate to the meetings of the Governing Board on issues of specific interest to the Committee.

The **States Representative Group (SRG)** is an advisory body to the Clean Sky 2 Joint Undertaking. Article 14 of the Council regulation outlines that it will be consulted and, in particular review information and provide opinions on the progress made in the programme of the Clean Sky 2 Joint Undertaking and towards achievement of its targets; updates of strategic orientation; links to Horizon 2020; work plans; involvement of SMEs, monitoring of the Calls for Proposals. It shall also provide information to, and act as an interface with, the Clean Sky 2 Joint Undertaking on the status of relevant national or regional research and innovation programmes and identification of potential areas of cooperation, including deployment of aeronautical technologies; specific measures taken at national or regional level with regard to dissemination events, dedicated technical workshops and communication activities.

It consists of one representative of each EU Member State and of each other country associated to Horizon 2020 programme. It is chaired by one of these representatives. To ensure that the activities are integrated, the Executive Director and the Chairperson of the Governing Board or his representative attend the SRG meetings and the Chair of the SRG attends as an observer at the Governing Board. At least two meetings of the States Representatives Group are foreseen every year. The Chair will participate in Governing Board meetings.
3.6. Internal Control Framework

3.6.1. Financial procedures

Since 2014, the JU has been actively working on the improvement of its financial procedures, as well as the integration of new rules emerging from the H2020 guidance and new specificities compared to FP7. Therefore, the financial procedures and the workflows in place follow the financial rules and the general control framework applicable in the Commission.

Further awareness of beneficiaries on financial and administrative aspects is raised through the development of guidance materials as well as dedicated workshops organized on a regular basis.

For grant agreement with members, the CS2JU has developed an internal IT tool (GMT) for the reporting and validation of costs claims.

For grant agreement with partners, the reporting and validation of costs is done via the EC IT tools. Payments to beneficiaries are executed via the ABAC IT tool (EC accounting system).

3.6.2. Ex-ante and ex-post controls

During 2018-2019, the admin & finance and operational units will continue to work closely together in their day to day activities of initiation, verification and payments of invoices and cost claims, creation of commitments, recovery orders, validation of financial and technical reports and following-up on other financial and administrative aspects of the projects. These activities will be conducted in a timely manner that will be monitored through the defined set KPIs, in particular, the time to pay, the budget and work plan execution. Best practice and highest quality standards will be ensured through the availability of the Manual of Financial Procedures, Clean Sky Management Manual and Quality Manual that are under regular revisions.

For the next two years, the JU will continue to face the additional challenge to perform the ex-ante control while monitoring two programmes in parallel, each having their own financial and operational specificities.

Ex-post controls:
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

3.6.3. Audits

The European Court of Auditors will carry out its annual audit on the JU activities in accordance with the Statutes. The result of this work will be published in its annual report.

The JU will continue to work with the Internal Audit Service of the Commission on areas identified in its Strategic Audit Plan for the JU.

The Internal Audit Capability will perform its work according to the annual audit plan, which is approved by the Governing Board.
4. BUDGET 2018-2019

4.1. Budget information

The years 2018 and 2019 will be challenging in terms of budget monitoring. The JU will follow-up the ramp-up of the CS2 operational activities. Due to some unknown influencing factors such as amounts granted and number of reporting periods, the forecasting of the budget figures is made on certain assumptions taking into account the existing data from past years, as well as budget availability. This may need to be revisited as the real implementation becomes clear.

The budget 2018-2019 presented below contains the following sections:

- **Statement of revenue:** The revenue received from the Commission, from the industrial members and amounts carried over from previous years (unused) as well as bank interests.
  
  The subsidy from the Commission is a sum of the EC plus EFTA Contribution (with EFTA contribution calculated at 2.33% for 2018 and 2019). The 2018 and 2019 Commitments Appropriations provided by the EU Commission are shown with administrative costs included.

- **Statement of expenditure:** The expenditure includes the JU staff expenditure and the infrastructure expenditure (administrative costs) as well as the operational activities under H2020 (Title 4 – CS2 Programme). The unused appropriations are appropriations that are not used in the current year but are shown here for full transparency of the credits available to the JU for future use in accordance with Article 6.5 of the Financial rules.
**Statement of Revenue and Expenditure for the Clean Sky 2 Joint Undertaking for the financial year 2018 - 2019**

### STATEMENT OF REVENUE

<table>
<thead>
<tr>
<th>Title Chapter</th>
<th>Heading</th>
<th>Financial year 2018*</th>
<th>Financial year 2018*</th>
<th>Financial year 2019*</th>
<th>Financial year 2019*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Payment Appropriations</td>
<td>Commitment Appropriations</td>
<td>Payment Appropriations</td>
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<td>331,863,910</td>
<td>289,972,421</td>
<td>289,972,421</td>
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<tr>
<td>2 0</td>
<td>CONTRIBUTION FROM MEMBERS (NON-EC)</td>
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<td>4,554,181</td>
<td>4,757,849</td>
<td>4,757,849</td>
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<tr>
<td>3 0</td>
<td>CARRY OVER FROM PREVIOUS YEAR (executed and estimated)</td>
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<td>4,084,606</td>
<td>0</td>
<td>1,367,723</td>
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<td>5 0</td>
<td>FINANCIAL REVENUES (BANK INTEREST)</td>
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<td>0</td>
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<tr>
<td></td>
<td><strong>TOTAL REVENUE</strong></td>
<td><strong>295,673,799</strong></td>
<td><strong>340,502,697</strong></td>
<td><strong>294,730,270</strong></td>
<td><strong>296,097,993</strong></td>
</tr>
</tbody>
</table>

### STATEMENT OF EXPENDITURE

<table>
<thead>
<tr>
<th>Title Chapter</th>
<th>Heading</th>
<th>Financial year 2018*</th>
<th>Financial year 2018*</th>
<th>Financial year 2019*</th>
<th>Financial year 2019*</th>
</tr>
</thead>
<tbody>
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<td>Payment Appropriations</td>
<td>Commitment Appropriations</td>
<td>Payment Appropriations</td>
</tr>
<tr>
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<td>STAFF EXPENDITURE</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>1 1</td>
<td>STAFF IN ACTIVE EMPLOYMENT</td>
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<td>4,300,000</td>
<td>4,400,000</td>
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</tr>
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<td>300,000</td>
</tr>
<tr>
<td>1 3</td>
<td>MISSIONS AND DUTY TRAVEL</td>
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<td>340,000</td>
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<td>350,000</td>
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<td>SOCIAL MEASURES</td>
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<tr>
<td>1 7</td>
<td>RECEPTIONS AND EVENTS</td>
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<td>70,000</td>
<td>70,000</td>
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<td>5,105,000</td>
<td>5,240,000</td>
<td>5,240,000</td>
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<td>-----------</td>
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</tr>
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<td><strong>2</strong></td>
<td><strong>INFRASTRUCTURE EXPENDITURE</strong></td>
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<td>Payment Appropriations</td>
<td>Commitment Appropriations</td>
<td>Payment Appropriations</td>
</tr>
<tr>
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<td>RENTAL OF BUILDINGS AND ASSOCIATED COSTS</td>
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<td>550,000</td>
<td>570,000</td>
<td>570,000</td>
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<tr>
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<td>INFORMATION TECHNOLOGY PURCHASES</td>
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<td>500,000</td>
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<td>550,000</td>
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<tr>
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<td>MOVABLE PROPERTY AND ASSOCIATED COSTS</td>
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<td>20,000</td>
<td>10,000</td>
<td>10,000</td>
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<tr>
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<td>CURRENT EXPENDITURE FOR RUNNING COSTS</td>
<td>60,000</td>
<td>60,000</td>
<td>65,000</td>
<td>65,000</td>
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<tr>
<td>2 4</td>
<td>POSTAGE AND TELECOMMUNICATIONS</td>
<td>45,000</td>
<td>45,000</td>
<td>50,000</td>
<td>50,000</td>
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<td>2 5</td>
<td>EXPENDITURE ON FORMAL AND OTHER MEETINGS</td>
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<td>300,000</td>
<td>300,000</td>
</tr>
<tr>
<td>2 7</td>
<td>COMMUNICATION ACTIVITIES</td>
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<td>550,000</td>
<td>600,000</td>
<td>600,000</td>
</tr>
<tr>
<td>2 8</td>
<td>EXTERNAL SERVICES AND SUPPORT</td>
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<td>1,000,000</td>
<td>1,000,000</td>
<td>1,000,000</td>
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<tr>
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<td>COSTS ASSOCIATED WITH CALLS</td>
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<td>978,363</td>
<td>1,130,698</td>
<td>1,130,698</td>
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<td><strong>4,003,363</strong></td>
<td><strong>4,275,698</strong></td>
<td><strong>4,275,698</strong></td>
<td></td>
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<tr>
<td><strong>TOTAL ADMINISTRATIVE EXPENDITURE (Title 1 &amp; Title 2)</strong></td>
<td><strong>9,108,363</strong></td>
<td><strong>9,108,363</strong></td>
<td><strong>9,515,698</strong></td>
<td><strong>9,515,698</strong></td>
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<td><strong>TITLE 3 - TOTAL</strong></td>
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<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td></td>
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</tbody>
</table>

| 3 | **OPERATIONAL EXPENDITURE CS** | Commitment Appropriations | Payment Appropriations | Commitment Appropriations | Payment Appropriations |
| 3 0 | SMART FIXED WING AIRCRAFT | 0 | 0 | 0 | 0 |
| 3 1 | GREEN REGIONAL AIRCRAFT | 0 | 0 | 0 | 0 |
| 3 2 | GREEN ROTORCRAFT | 0 | 0 | 0 | 0 |
| 3 3 | SUSTAINABLE AND GREEN ENGINES | 0 | 0 | 0 | 0 |
| 3 4 | SYSTEMS FOR GREEN OPERATIONS | 0 | 0 | 0 | 0 |
| 3 5 | ECO-DESIGN | 0 | 0 | 0 | 0 |
| 3 6 | TECHNOLOGY EVALUATOR | 0 | 0 | 0 | 0 |
| 3 7 | CALLS FOR PROPOSALS | 0 | 0 | 0 | 0 |

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### OPERATIONAL EXPENDITURE CS2

<table>
<thead>
<tr>
<th>4</th>
<th>OPERATIONAL EXPENDITURE CS2</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 0</td>
<td>LARGE PASSENGER AIRCRAFT</td>
<td>39,500,000</td>
<td>55,800,000</td>
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<td>55,450,000</td>
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<td>REGIONAL AIRCRAFT</td>
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<td>15,900,000</td>
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<td>13,700,000</td>
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<tr>
<td>4 2</td>
<td>FAST ROTORCRAFT</td>
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<td>21,750,000</td>
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<td>AIRFRAME</td>
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<td>36,000,000</td>
<td>36,350,000</td>
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<tr>
<td>4 4</td>
<td>ENGINES</td>
<td>32,000,000</td>
<td>43,300,000</td>
<td>35,100,000</td>
<td>38,000,000</td>
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<td>4 5</td>
<td>SYSTEMS</td>
<td>22,000,000</td>
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<td>33,620,000</td>
<td>29,650,000</td>
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<tr>
<td>4 6</td>
<td>TECHNOLOGY EVALUATOR</td>
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<td>400,000</td>
<td>1,100,000</td>
<td>950,000</td>
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<td>4 7</td>
<td>ECO-DESIGN TRANSVERSE ACTIVITY</td>
<td>640,000</td>
<td>800,000</td>
<td>800,000</td>
<td>720,000</td>
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<tr>
<td>4 8</td>
<td>SMALL AIR TRANSPORT TRANSVERSE ACTIVITY</td>
<td>500,000</td>
<td>400,000</td>
<td>550,000</td>
<td>550,000</td>
</tr>
<tr>
<td>4 9</td>
<td>CALLS FOR PROPOSAL / CALLS FOR TENDER</td>
<td>130,000,830</td>
<td>119,109,728</td>
<td>66,094,572</td>
<td>89,462,295</td>
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**TITLE 4 - TOTAL**

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<th>Payment Appropriations</th>
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</thead>
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<tr>
<td>285,480,830</td>
<td>330,309,728</td>
<td>285,214,572</td>
<td>286,582,295</td>
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**TOTAL OPERATIONAL EXPENDITURE (Title 3 & Title 4)**

<table>
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<th>Payment Appropriations</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td>295,673,799</td>
<td>340,502,697</td>
<td>294,730,270</td>
<td>296,097,993</td>
<td></td>
</tr>
</tbody>
</table>

**UNUSED APPROPRIATIONS NOT REQUIRED IN CURRENT YEAR**

<table>
<thead>
<tr>
<th></th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,084,606</td>
<td>1,084,606</td>
<td>0</td>
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<td></td>
</tr>
</tbody>
</table>

**TOTAL BUDGET**

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<th>Payment Appropriations</th>
<th>Commitment Appropriations</th>
<th>Payment Appropriations</th>
</tr>
</thead>
<tbody>
<tr>
<td>295,673,799</td>
<td>340,502,697</td>
<td>294,730,270</td>
<td>296,097,993</td>
<td></td>
</tr>
</tbody>
</table>

* The EU contribution for 2018 is subject to adoption of the draft budget and for 2019 subject to the outcome of the budgetary procedure.

**Note:** In accordance with Articles 13 and 15 of the Financial Rules, the complete details of the Budget 2018-2019 of Clean Sky 2 Joint Undertaking, including the statement of revenue and expenditure for the preceding years 2018-2019 for the Clean Sky programme, the Establishment Plan of the current year and the summary statement of the schedule of payments due in subsequent financial years are published on the CS2JU website.

* The amount of Subsidy from Commission is mentioned as indicative and represents the Clean Sky 2 Joint Undertaking request of contribution to the Commission. The EU contribution for 2018 is subject to adoption of the draft budget and for 2019 subject to the outcome of the budgetary procedure.
4.1.1. Private contribution to the programme and to the JTI objectives

Based on the current information at hand, the minimum estimated in-kind contributions from operational activity are the unfunded 30% of the total eligible costs for the members in 2018/2019. As the funding value (70% funding rate) for members is currently estimated at 216.7m € for 2018, the corresponding unfunded value (remaining 30%) is minimum 92.7m €. In 2019, the funding value (70% funding rate) for members is currently estimated at 196.9m €, and therefore the corresponding unfunded value (remaining 30%) is minimum 84.4m €. In addition to this, the JU expects some members to report further in-kind contributions for these periods and additional activities.

4.2. Staff Establishment Plan 2018

<table>
<thead>
<tr>
<th>Category and grade</th>
<th>Establishment plan 2018</th>
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<tr>
<td>AD 16</td>
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<tr>
<td>AD 15</td>
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<td>AD 6</td>
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<td>AST 2</td>
<td></td>
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<td><strong>Total AST</strong></td>
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<tr>
<td><strong>TOTAL TA</strong></td>
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<tr>
<td>CA FG IV</td>
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<td>CA FG I</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL CA</strong></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td><strong>TOTAL STAFF (TA + CA)</strong></td>
<td><strong>42</strong></td>
</tr>
</tbody>
</table>
5. ANNEXES

5.1. Annex I: Key performance indicators

The current list of KPIs is a combination of the H2020 indicators common to all JUs, indicators monitoring the cross-cutting issues common to JUs, and in addition, specific indicators for CS2JU. In the light of the recent Interim Evaluation Report and the on-going discussions in the Commission regarding the new Internal Control Framework, the below KPIs will be revised during the year 2018.

<p>| TABLE I Horizon 2020 Key Performance Indicators common to all JUs |
|---|---|---|---|
| Key Performance Indicator | Definition/Responding to Question | Target CS2JU |
| <strong>INDUSTRIAL LEADERSHIP</strong> | | |
| 1 | SME - introducing innovations of participating SMEs | Number and % of participating SMEs that have introduced innovations to the company or to the market | No target set |
| 2 | SME - Growth and job creation in participating SMEs | Turnover of company, number of employees | No target set |
| 3 | Patent applications and patents | Number of patent applications by theme; Number of awarded patents by theme (awarded in the area of the JTI) | The target will be defined based on first realistic results. For FP7 projects, CS2JU beneficiaries were not focusing on patenting in the first half of the programme. |
| 4 | Demonstration activities | Number of demonstrators and technology streams | 35 |
| <strong>EVALUATION</strong> | | |
| 6 | Redress after evaluations | Number of redresses requested | &lt;2% of proposals (excluding PP submission related redress requests) |
| <strong>GRANTS</strong> | | |
| 7 | Time to grant (TTG) | Number and % of grants signed within target (eight months) measured from call deadline to signature of grants | 80% |
| <strong>PAYMENTS</strong> | | |
| 8 | Time to pay (TTP) Operational budget | % made on time: - pre-financing (30 days) - interim payment (90 days) -final payment 90days | 95% |</p>
<table>
<thead>
<tr>
<th>Key Performance Indicator</th>
<th>Definition/Responding to Question</th>
<th>Target CS2JU</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR 9 Vacancy rate (%)</td>
<td>% of post not filled in</td>
<td>0%</td>
</tr>
<tr>
<td>JU EFFICIENCY 10 Budget implementation/ execution</td>
<td>1. % CA to annual budget 2. % PA to annual budget</td>
<td>95% in PA</td>
</tr>
<tr>
<td>JU EFFICIENCY 11 Time to pay (TTP) Administrative budget</td>
<td>% made on time (30 days)</td>
<td>&gt; 95%</td>
</tr>
<tr>
<td>TABLE II Indicators for monitoring Horizon 2020 Cross-Cutting Issues common to all JUs (based on Annex III to Council Decision 2013/743/EU)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definition/Responding to Question</td>
<td>Type of Data Required</td>
<td>Target CS2JU</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------------------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>Widening the participation</strong></td>
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<td></td>
</tr>
<tr>
<td>12 Country distribution (EU Member States and Associated countries) - <strong>numbers</strong></td>
<td>Total number of participations by EU-28 Member States and Associated countries</td>
<td>EU 28: 95% Associated: 5%</td>
</tr>
<tr>
<td>13 Country distribution (EU Member States and Associated countries) - <strong>financial contribution</strong></td>
<td>Total financial contribution of EU-28 Member States and Associated countries</td>
<td>EU 28: 95% Associated: 5%</td>
</tr>
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<td><strong>SMEs participation</strong></td>
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<td>14 SME participation -financial contribution</td>
<td>Share of EU financial contribution going to SMEs (Enabling &amp; industrial tech and Part III of Horizon 2020)</td>
<td>13%</td>
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<tr>
<td>15 Gender balance - Program participation</td>
<td>Percentage of women participants in Horizon 2020 projects</td>
<td>No target set</td>
</tr>
<tr>
<td>Gender balance - Project coordinators</td>
<td>Percentage of women project coordinators in Horizon 2020 projects</td>
<td></td>
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<tr>
<td>Gender balance - Advisors and experts</td>
<td>Percentage of women in EC advisory groups, expert groups, evaluation panels, individual experts, etc.</td>
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<tr>
<td><strong>International cooperation</strong></td>
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<tr>
<td>16 Third-country participation</td>
<td>% in numbers and attributed contribution</td>
<td>No target set</td>
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<tr>
<td><strong>Bridging from discovery to market</strong></td>
<td></td>
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<tr>
<td>17 Innovation Actions (IAs)</td>
<td>Share of projects and EU financial contribution allocated to Innovation Actions (IAs)</td>
<td>Leaders: 100% Core partners: 100% partners: 70%</td>
</tr>
<tr>
<td>Demonstration activities within IAs</td>
<td>Within the innovation actions, share of EU financial contribution focussed on demonstration and first-of-a-kind activities</td>
<td>70%</td>
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<tr>
<td>18 Scale of impact of projects (High Technology Readiness Level)</td>
<td>Number of projects addressing TRL8 between (4-6, 5-7)</td>
<td>No target set in the period: TRL objectives can be considered on a longer term in line with the CSDP.</td>
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<tr>
<td>Private sector participation</td>
<td><strong>Definition/Responding to Question</strong></td>
<td><strong>Type of Data Required</strong></td>
</tr>
<tr>
<td>-----------------------------</td>
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<tr>
<td>19</td>
<td>Horizon 2020 beneficiaries from the private for profit sector - number of participants</td>
<td>Percentage of participants from the private for profit sector of the total Horizon 2020 beneficiaries (classified by type of activity and legal status)</td>
</tr>
<tr>
<td></td>
<td>Horizon 2020 beneficiaries from the private for profit sector - financial contribution</td>
<td>Share of EU financial contribution going to private for profit entities (Enabling &amp; industrial tech and Part III of Horizon 2020); classified by type of activity; corresponding EU contribution</td>
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<tr>
<td>20</td>
<td>EU financial contribution for PPP</td>
<td>EU contribution to budget of CS2</td>
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<tr>
<td></td>
<td>Private sector contribution including leverage effect</td>
<td>Total amount of funds leveraged through Art. 187 initiatives, including additional activities, divided by the EU contribution</td>
</tr>
<tr>
<td>21</td>
<td>Dissemination activities</td>
<td>Number of dissemination activities in conferences, workshops, press releases, publications, exhibitions, trainings, social media, web-sites, communication campaigns</td>
</tr>
<tr>
<td>22</td>
<td>Distribution of proposal evaluators by country</td>
<td>% of individual nationalities of proposal evaluators</td>
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<tr>
<td></td>
<td>Distribution of proposal evaluators by type of organisation</td>
<td>% of individual type of organization from which evaluators are stemming</td>
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</table>

<sup>16</sup> CA for the period 2018-2019
<table>
<thead>
<tr>
<th>Participation of RTOs and Universities</th>
<th>Definition/Responding to Question</th>
<th>Type of Data Required</th>
<th>Target CS2JU</th>
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<tr>
<td>23</td>
<td>Participation of Research and Technology Organisations and Universities in PPPs (Art 187 initiatives)</td>
<td>Number of participations of RTOs and of Universities and their share of the total % of budget allocated to RTOs and to Universities</td>
<td>25%</td>
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<td>24</td>
<td>Ethics efficiency</td>
<td>% of proposals not granted because of non-compliance with ethical rules</td>
<td>45 days</td>
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<td>25</td>
<td>Error rates</td>
<td>% of common representative error; % residual error</td>
<td>&lt;2%</td>
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<tr>
<td>26</td>
<td>Implementation of ex-post audit results</td>
<td>Percentage of audit results implemented</td>
<td>100%</td>
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<td>Key Performance Indicator</td>
<td>Objective</td>
<td>Target at the End of Horizon 2021</td>
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<td>--------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
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<tr>
<td><strong>27</strong> Reduce aircraft CO2 emissions</td>
<td>Reduce aircraft CO2 emissions compared to &quot;State-of-the-art&quot; aircraft entering into service as from 2014</td>
<td>&gt; 20 to 30%</td>
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<tr>
<td><strong>28</strong> Reduce aircraft No emissions</td>
<td>Reduce aircraft No emissions compared to &quot;State-of-the-art&quot; aircraft entering into service as from 2014</td>
<td>&gt; 20 to 40%</td>
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<td><strong>29</strong> Reduce aircraft noise emissions</td>
<td>Reduce aircraft noise emissions levels per operation compared to &quot;State-of-the-art&quot; aircraft entering into service as from 2014</td>
<td>20 to 25%</td>
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<tr>
<td><strong>30</strong> Call topics success rate</td>
<td>Percentage of topics resulting in signature of GA</td>
<td>&gt; 90%</td>
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<td><strong>31</strong> WP execution by members - resources</td>
<td>% of resources consumption versus plan (members only)</td>
<td>&gt; 80%</td>
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<tr>
<td><strong>32</strong> WP execution by members - deliverables</td>
<td>% of deliverables available versus plan (members only)</td>
<td>&gt; 80%</td>
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5.2. Annex II: List of private members - beneficiaries of the grant agreements for members

1. **Leaders and Participating Affiliates**

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<th>#</th>
<th>Organization Name</th>
<th>Participation Status</th>
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<th>REG</th>
<th>FRC</th>
<th>AIR</th>
<th>ENG</th>
<th>SYS</th>
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<th>ECO2</th>
<th>TE2</th>
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<td>1</td>
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*CPW03 (3rd batch) "new Member" subject to successful completion of their accession as Members, upon completion of the CPW03 Negotiation Phase expected in by end Q1 2018.
5.3. Annex III: 7th Call for proposals (CfP07): List and Full Description of Topics

See separate annex reference file CS-GB-2017-10-19 Annex III of WP - CFP07

5.4. Annex IV: 8th Call for proposals (CfP08): List and Full Description of Topics

See separate annex reference file CS-GB-2018-04-05 Annex IV of WP - CFP08
6. LIST OF ACRONYMS

ACARE: Advisory Council for Aeronautics Research in Europe
ATM: Air Traffic Management
CA: Commitment Appropriations
CDR: Critical Design Review
CfP: Call for Proposals
CfT: Call for Tender
CROR: Counter Rotating Open Rotor
CS2JU: 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
IADP: Innovative Aircraft Demonstrator Platform
ITD: Integrative Technology Demonstrator
IAO: Internal Audit Officer
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/work plan