Clean Sky 2 Development Plan

Document n°

CS-GB-2016-06-29 CS2DP Part A++

Date 29th June 2016

The undersigned, Ric Parker, Chairman of the Governing Board, on behalf of the Governing Board hereby adopts the above referenced document.

Done in Brussels on 29th June 2016

Ric Parker

Chairman of the Governing Board

Clean Sky 2 Joint Undertaking

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CS2 DEVELOPMENT PLAN

Revision History Table		
Version n°	***Issue Date***	***Reason for change***
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1. Introduction to this Document

1.1 Clean Sky 2 Development Plan Scope, Purpose and Contents

This document defines the Clean Sky 2 Programme's [CS2] main objectives and key performance targets, towards environmental impact and energy efficiency; industrial leadership, and Europe's need for sustainable and competitive mobility. The document lays out the structure of the CS2 Programme, the main activities and their schedule (including milestones); key risks and their mitigation; its forecast budget to completion and the way this will be managed.

In particular, it defines:

- The key technologies and their maturity to be reached at the end of the Programme;
- The relevant demonstrators and the associated development and cost schedules;
- The benefits projected in terms of mobility, competiveness and environmental impact,
- Technical interrelationships and interdependencies between Programme elements

1.2 Interrelationships and Links with other Clean Sky Documents

The CS2DP is linked to the following other documents:

- Council Regulation (EC) No 558/2014 of 6 May 2014, setting up the Clean Sky 2 JU
- The CLEAN SKY 2 Joint Technical Proposal CS-GB-2015-03-16 – v5
- The Clean Sky Management Manual [CSMM].

The CS2DP is an input to the following documents:

- Grant Agreements for Members (GAM) for each IADP, ITD and TA,
- The Grant Agreements for Partners (GAP),
- Clean Sky JU Work Plan, which must be consistent with the CS2DP
- Annual Budget Plans (ABP) (and their amendments)

2. H2020 and the Strategic Context

As recognized in July 2013, progress towards the Europe 2020 objective of investing 3% of GDP in R&D has been slow, in particular in terms of private investment levels. The launch of the European Plan for Growth and Investment, coinciding with the re-launch of the Joint Technology Initiatives [JTIs] under the Horizon 2020 Framework Programme for Research and Innovation [H2020] aims to address this with assertive and focused action.

The European Aeronautics sector accounts for nearly half of the world’’s fleet in operation or on order. It is of paramount importance to the EU economy, meeting society’’s needs by ensuring:

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

Strong and continued growth in demand for air travel [likely to increase 4- or 5-fold towards 2050] raises important environmental and socio-economic challenges; but it also brings opportunity for significant economic growth and value creation in Europe: not just in the aeronautics sector, but through an important leverage effect via the global *aviation* sector. Research and innovation has been and remains core to EU competitiveness and sustainable value creation. The long-term public-private investment made by the European Union and its Aeronautics Sector has made the industry globally competitive, allowing it to drive the innovation agenda in many areas, including environmental performance. But the new challenges identified in ACARE SRIA for 2050 highlight the need for more accelerated innovation and for more far-reaching solutions. A continuation of the Clean Sky JTI as launched under FP7 and nearing completion provides the best assurance that new concepts can be validated and the market adoption of step-change solutions can be accelerated. Clean Sky 2 will deliver major gains within the key pillars defined in H2020:

- Creating resource efficient transport that respects the environment.
- Ensuring safe and seamless mobility.
- Building industrial leadership in Europe.

By pursuing joint European research on breakthrough innovations and demonstrating new vehicle configurations in flight, Clean Sky 2 will facilitate the development and accelerated introduction of game-changing innovations. As such, it will significantly contribute to Europe’’s Innovation Union.
A particularly powerful and new aspect of the H2020 approach embedded in CS2 is the extraction and exploitation of synergies with Regional and National research funding, through the effective alignment of CS2 activities with complementing activity benefiting from the European Structural and Investment Funds (ESIF) via the competent authorities and aligned with Regional ““Smart Specialization Strategies”” [RIS[3] – National/Regional Research and Innovation Strategies for Smart Specialisation]]. This will deliver the innovation and growth needed as well as drive further investment well beyond the technical scope of CS2 itself.

3. The Rationale for Clean Sky 2

The Horizon 2020 period will be decisive for delivering the innovations defining this century’s fleet and its environmental footprint. Clean Sky 2 results will be applicable to 75% of the world fleet needing replacement up to 2050, and Clean Sky 2 technology will be able to address aviation emissions totalling over 70% of the worldwide civil air fleet.

Mastering the full aeronautics research and innovation chain is a prerequisite to sustaining global competitiveness. The Clean Sky 2 JU has become the most important instrument to address the key aeronautics research themes defined in the ACARE SRIA and to ensure they are progressed towards and advanced maturity [e.g. up to the demonstration of integrated complex systems], in parallel with ATM research in SESAR. The set-up as JTI has proven to be the most effective way to ensure all relevant European stakeholders (including academia, research organizations and SMEs) cooperate in developing the most promising technologies towards future industrial application. Clean Sky 2 is already engaging and aligning all stakeholders in the European value chain, triggering research investments from public and private sector players, and permitting the pooling and aligning of required capacities and capabilities from across Europe. With the introduction of Memoranda of Understanding in 2015 and the alignment of thematic agendas and processes CS2, is already showing promising additionality and synergy with ESIF funding in several of Europe’s regions and Member States.

Clean Sky 2 builds on the essential work of Clean Sky. Close alignment between the two ensures a seamless transition and anchors the gains that can be reached in impacts and societal benefit. Based on the technology readiness level (TRL) demonstrated at the end of Clean Sky, several technologies will be ready for potential development and deployment. Others will need to be matured further within a research environment, and will require a higher level of system integration and further validation under CS2. More importantly, given the extremely long development and product life-cycles in aeronautics, and the levels of investment and financial risk going well beyond the private sector’s autonomous capability, the long term stability in research agenda and funding through an instrument such as CS2 is essential in addressing long-term goals as set out in the renewed SRIA where it has been patently stated that evolutionary technology development and incremental performance improvements will no longer suffice. The PPP approach creates the best conditions to give the required confidence to market players to invest in break-through innovation. The inclusive approach, an “open to the world” philosophy embracing all eligible and relevant participations, coupled with the active pursuit of synergies [such as with e.g. ESIF funding mechanisms and selective international cooperation] will also allow the Clean Sky 2 Programme to exploit synergies between Clean Sky technologies and those matured outside Clean Sky with potential complementarity. Innovations from Clean Sky 2 will drive major advances in the next generation of aircraft by mastering the technologies and the risks, in time to meet the market window to replace the current fleet.

The economic context

On average, 12% of aeronautic sector revenues, representing almost €7 bn per year for civil aeronautics alone, are reinvested in Research and Development (R&D) and this supports around 20% of aerospace jobs. The industry accounts for approximately 3% of EU workforce, generates roughly €220 bn of the European GDP per year, and contributes positively to the EU''s trade balance with over 60% of its products exported. Every Euro invested in aeronautics R&D creates an equivalent amount in value in the economy year in, year out, for several decades thereafter.

Meeting society''s requirements

Aviation is and will remain a vital enabler of our economy and society. As stated, air traffic is forecast to grow by 4% to 5% per year in the next decades leading to a 4- to 5--fold increase in traffic by 2050. This poses major environmental, societal and economic challenges that can only be tackled through an intense and sustained cooperation between public authorities, industry, research organisations, academia and SMEs.

The renewed ACARE SRIA was completed in 2012, with ambitious goals for a sustainable and competitive aviation sector. These include a 75% reduction in CO_2 emissions, a 90% reduction in NO_X and 65% in perceived noise by 2050 compared to 2000 levels, and 4 hour door-to-door journey for 90% of European travellers. These substantial emissions reductions and mobility goals require radically new aircraft technology inserted into new aircraft configurations. Building on the substantial gains made in Clean Sky, Clean Sky 2 aims at meeting the overall high-level goals with respect to energy efficiency and environmental performance shown in the following:

High Level Objectives for Clean Sky 2

The overall socio-economic and environmental benefits of Clean Sky 2 will go well beyond the impact of Clean Sky. With increasing demand for air travel the market opportunity is larger and the environmental need greater than when Clean Sky first commenced. The CS2 Programme builds on the first CS Programme, but will also drive towards more ambitious goals and importantly: extend its reach [including longer-term and lower-TRL actions], and expand its horizon into the mid-term of the renewed ACARE SRIA, in order to:

- Accelerate the progress towards the ACARE SRIA goals for 2020-2050;
- Enable a technological leap in the face of emerging competitors;
- Justify the early replacement of aircraft that have yet to enter service and accelerate the adoption of new technology into the global fleet.

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 CO_2 emissions by 20 to 30 % compared to 'state-of-the-art' aircraft entering into service as from 2014;

(ii) reducing aircraft NO_x and noise emissions by 20 to 30 % compared to 'state-of-the-art' aircraft entering into service as from 2014.

High Level Objectives for Clean Sky 2 as set out in the Regulation

The Clean Sky 2 socio-economic and environmental benefit

The Programme aims to accelerate the introduction of new technology in the 2025-2035 timeframe. By 2050, 75% of the world’s fleet now in service (or on order) will be replaced by aircraft that can deploy Clean Sky 2 technologies. Based on the same methodology as applied in the Clean Sky economic case in 2007 the market opportunity related to these programmes is estimated at ~€2000 Bn. The direct economic benefit is estimated at ~€350-€400bn and the associated spill-over is of the order of € 400bn. These figures are additive with respect to the Economic Value Added expected from Clean Sky. As a result of the higher growth now forecast, the environmental case for continuing the Clean Sky with the CS2 Programme is even more compelling. CS2 technologies will bring a potential saving of 4bn tonnes CO_2 through Clean Sky 2 from roughly 2025 through to 2050 in addition to approximately 3bn tons achievable as a consequence of Clean Sky.

The importance of public-private partnership

Clean Sky 2 will focus and allow the coordination of aviation stakeholders’ initiatives and investments at a European scale. It will give the necessary stability and stimulus to the aviation sector stakeholders to introduce game-changing innovations at a scale and in a timeframe otherwise unachievable. Clean Sky 2 will reduce the high commercial risk that is associated with research activity in the aeronautics sector and which is beyond the capacity of private industry. As Public-Private Partnership it will attract strong private investment on the pre-requisite that this is complemented with the same amount of public funding.

The spill-over effects of the aeronautical industry

Aeronautical technologies are a proven catalyst for innovation and spill-over into many other sectors. The main reasons are the severe performance, environmental, weight, safety requirements any aeronautical products must comply with, as well as the necessity of a “system” vision and the management of complexity. As a consequence, historically after an aeronautical application, with the contribution of large investments, skills and efforts to meet the severe requirements, a technology is extended to another field allowing it to achieve a competitive advantage and stay on the technology leading edge. Aeronautics has been the first-user promoter of many new technologies or processes which later spread over many other application fields.

4. Overview of the Clean Sky 2 Programme

4.1. Clean Sky programme structure

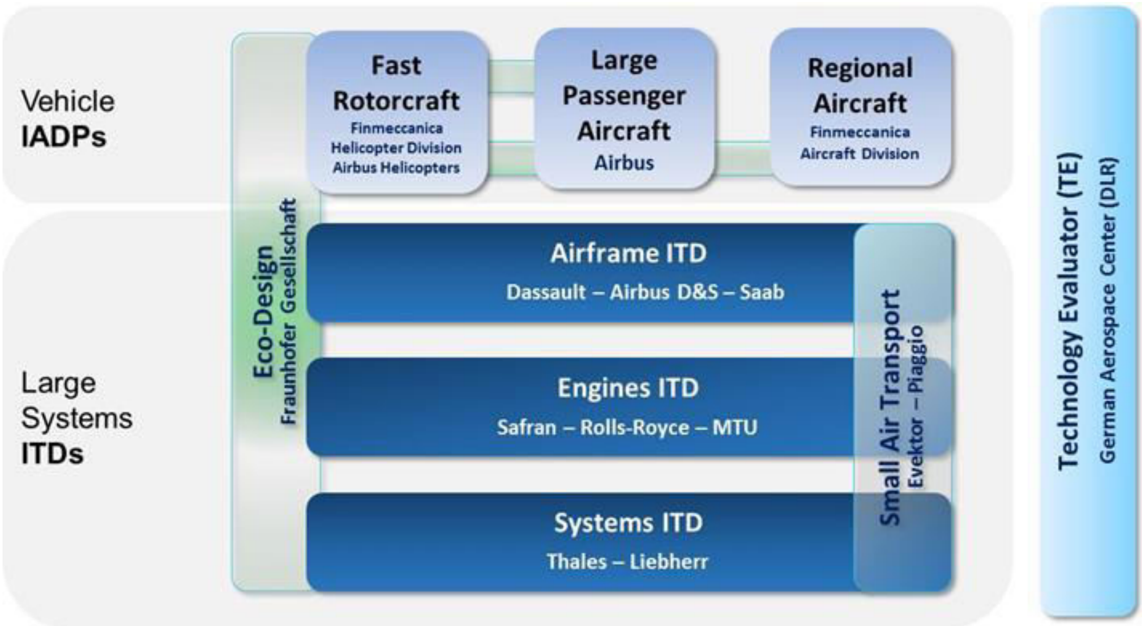
The technological advances made in Clean Sky need to be integrated into complete aircraft to render the next generation of air vehicles more efficient and reduce emissions and noise. In addition, new vehicle configurations will have to be evaluated with flight demonstrators as they will be essential to fulfil the ambitious objectives of renewed ACARE SRIA.

Evidence is mounting that conventional aircraft configurations are approaching intrinsic performance limits, as the integration of the most recent technologies are showing diminishing returns. Therefore, the need today is even greater for industry to develop materially different, substantially more environmentally friendly vehicles to meet market needs, and ensure their efficient integration at the air transport system level.

Clean Sky 2 will continue to use the Integrated Technology Demonstrators (ITDs) mechanism when appropriate. Its objective-driven agenda to support real market requirements providing the necessary flexibility is well suited to the needs of the major integrator companies. The new Programme will also focus on reinforcing interactions between demonstrations of improved systems for a better integration into viable full vehicle architectures. The Clean Sky 2 structure will involve demonstrations and simulations of several systems jointly at the full vehicle level through Innovative Aircraft Demonstrator Platforms (IADPs).

A number of key areas will be coordinated across the ITDs and IADPs through Transverse Activities where additional benefit can be brought to the Programme through increased coherence, common tools and methods, and shared know-how in areas of common interest.

As in Clean Sky, a dedicated monitoring function - the Technology Evaluator (TE) will be incorporated in Clean Sky 2.



Clean Sky Programme Logic and Set-up

4.2. Introduction to the IADP, ITD and TA instruments in CS2

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

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

Three IADPs are defined in the CS2 Programme:

- **Large Passenger Aircraft [LPA]** covering large commercial aircraft applications for short/medium and long range air transport needs
- **Regional Aircraft [REG]** focusing on the next generation of approx. 90-seat capacity regional turboprop powered aircraft enabling high efficiency/reliability regional connections
- **Fast Rotorcraft [FRC]** aiming at new configurations bridging the gap between conventional helicopters and utility / commuter fixed wing aircraft: both in speed and range/productivity.

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

- **Airframe ITD [AIR]** comprising topics affecting the global vehicle-level design;
- **Engines ITD [ENG]** for all propulsion and power plant solutions;
- **Systems ITD [SYS]** comprising on board systems, equipment and flight management.

The Transverse Activities [TAs] enable important synergies to be realized where common challenges exist across IADPs and/or ITDs; or where co-ordination across the IADPs and ITDs allows a cogent and coherent approach to common technical challenges. TAs do not form a separate IADP or ITD in themselves, but coordinate and synergize technical activity that resides as an integral part of the other IADPs and ITDs. A dedicated budget, mainly addressed to technology development, and driven by excellence toward the TA objectives, while simultaneously supporting the industrial, competitiveness and societal leadership of the Programme Participants in the actions of the SPDs, is reserved for these activities to be performed inside the concerned IADPs and ITDs. Transverse Leaders are nominated and coordinate each TA. Currently two Transverse Activities are agreed for Clean Sky 2 and are specified in the Statutes for the JTI:

- **ECO-Design TA [ECO]:** Key materials, processes and resources impact in an ""ecolonomic"" frame, considering also life cycle optimization of the technologies, components and vehicles.
- **Small Air Transport TA [SAT]:** airframe, engines and systems technologies for small aircraft, extracting synergies where feasible with the other segments.

An independent Technology and [Socio-Economic] Impact Evaluation is an essential task within the CS2JU and will be continued in CS2 via the **Technology Evaluator**. Environmental Impact Assessments currently focused on noise and emissions will be continued, and expanded where relevant for the evaluation of the Programme''s progress. Other impacts, such as on Mobility or on Industrial Leadership of Clean Sky 2 concepts will be assessed. The TE will also perform evaluations on innovative *long term* [low TRL] aircraft configurations where beneficial to the Programme''s content.

4.3. Transition and coordination from Clean Sky 1 to Clean Sky 2

In 2016 the Clean Sky programme [CS1] is in its last year of technical operations, whereas CS2 [launched mid-2014] ramped up significantly in 2015 and will reach cruise speed in the 2016-17 Work Plan period. The two years of superposition of CS2 activities during the heavy demonstrator-focused final phase of CS1 require close monitoring with respect to the achievability of the planned CS2 ramp-up, and conversely with respect to any potential impact on the CS1 demonstration schedule. As a consequence, a phased approach has been taken to the start-up of CS2 projects with the programmatic and thematic logic on one hand, and the achievability and resource availability on the other determining the phase-in of activities. *Launch Reviews* are held for each major technology stream or key demonstrator project in CS2 to validate the maturity of the planning, assess risk management and the availability of resources prior to any major ramp-up in activity in the 2016-17.
In very broad terms, in the first 4 years Clean Sky developed and validated technologies up to [roughly] TRL4. From there on a selection of the most promising and mutually compatible technologies are subsequently taken to TRL5/6 system level demonstration. In some cases, Clean Sky ITDs will bring a number of high-potential - but less mature - technologies up to TRL4 through a focused effort during the 2014-17 CS1 – CS2 transition period. These will not be matured beyond TRL4 within Clean Sky but are candidates for continuation in Clean Sky 2.

Clean Sky 2 IADPs use results from CS1 ITDs as a start towards integration studies in the 2014-2017 timeframe. CS1 and CS2 ITD outputs form key inputs into the configuration and content of IADP demonstration strategies. The architecture and configuration trade-off studies in CS2 IADPs are launched as soon as the specifications and interfaces of components and subsystems to be integrated can be frozen. Consequently, activities within CS1 ITDs can be completed according to their own work plan at the latest in 2016 while new activities are launched within CS2 ITDs and IADPs according to a staggered schedule over the 2014-2016 period.

Finally, it should be noted that a relatively smaller but significant share of CS2 activity is geared towards the longer term [>2035] SRIA agenda and is aimed at making the first important steps towards the SRIA's goals for 2050. These activities represent important new "Streams" within the CS2 ITDs and the Large Passenger Aircraft IADP [LPA] as well as Regional Aircraft IADP [REG], where a dual set of maturity horizons and performance gains are targeted.

4.4. Clean Sky 2 Programmatic Implementation / Execution to Date

As the Clean Sky 2 Programme ramps up during the first two years of operations, the key objectives are linked to the detailed definition of the demonstrators and main technology streams, the scheduling and execution of calls for core partners and calls for proposals, refinement of the Technology Roadmaps, the environmental benefits assessment, and the control of expenditures.

Programme Implementation Objectives [2015 - 2017]	Achievement per end 2015 [and Comments]
Select the Programme's Core Partners as planned in four Calls for Core Partners;	On track: the master schedule for Core Partner selection having a series of calls or "waves" spread across 2014/15/16.
Refresh / refine the technical content of the programme in the course of the accession of the core partners, and ensure this is adequately incorporated in CS2 *Development Plan* and the Grant Agreements.	All 1st Wave Core Partners have been absorbed in GAMs. Final JTP v5 was "frozen" in April 2015 and further updates now follow via the CS2 Development Plan.
Further refine the Demonstration Programme: adjusting schedule, scope and definition of demonstrators where needed in course of core partner accession;	This objective is due for completion on the closing of all Core Partner Waves [end 2016]. Accession of the 1st Wave completed and grant implementation of the 2nd Wave progressing.
Conduct *Launch Reviews* for all technical activity commencing in the 2015-2017 period, to test the level of definition, preparation and resourcing.	>80% of the Launch Reviews successfully conducted; final reviews in 1st half of 2016 for areas with a low activity and a ramp-up in 2nd half 2016 . All others held in 2015.
Implement solutions for leveraging Clean Sky 2 funding with Structural Funds;	8 MoUs signed as of Early 2016, and in two cases an ESIF funded project is linked to and will have synergies with CS2 Programme actions.
Define and implement an appropriate model for SAT and ECO Transverse Areas that allows for the transversal coordination to be executed and technical synergies to be extracted;	SAT fully implemented. For ECO the progress has been slower with the content generation and governance model not sufficiently converged between the TA and SPDs.
Define the reference framework for the TE (including performance levels of reference aircraft against which the progress in CS2 will be monitored);	The governance principles of the TE were adopted by GB decision in Dec. 2015, with an update provided on the overall scope of TE evaluations and the "drumbeat" of assessments. First technical activity foreseen in 2016.
To ensure a time-to-grant [TTG] no greater than 8 months for the Calls for Proposal;	Not yet achieved. TTG at 8 months in the 1st CfP was 0%, however 63% at 9 months. Major IT system led to at least 6 weeks unavoidable

	delay. Nonetheless this performance is under close scrutiny for improvement in the 2nd and further CfP calls.

To execute >90% of the budget and of the relevant milestones and deliverables;	**Budget execution approached 75%, with a commendable ramp-up in the final quarter of 2015 when the Core Partners from „Wave 1" became operational. Milestone and Deliverable performance was in line with budget execution.**
To ensure a high level of technical and process integrity in the execution of the Programme, including the Calls and their resulting selection of CS2 participants; and a maximum relevance of research actions performed towards the Programme's goals: thus ensuring a strong positive perception of the Programme throughout the mid-term assessment.	Strong ramp up of the programme in terms of calls launched and participants The first two CfP calls were each record size for the JU in terms of topic numbers, value and with a healthy over-subscription of applicants [between 4- to 5-fold]. 100% track record to date of successfully implementing selected Core Partners is commendable.

4.5. Synergies with Other European, National and Regional Programmes

Via regular interaction with the Commission in the Work Plan preparation, the JU will ensure that activities conducted within the ITDs/IADPs and launched via Calls do not present redundancies with FP7 projects and upcoming H2020 projects.

The coherence and complementarity with National Programmes in the Member States will be checked via the States Representatives Group and, when appropriate, directly with Agencies in charge of any programme which may provide inputs for the execution of the Clean Sky activities.

The Europe 2020 strategy towards smart, sustainable and inclusive growth will make significant progress by building upon the synergy between the cohesion policy (ESIF) and the excellence objectives of Horizon 2020. The fostering of synergies between the two policy instruments aims at maximizing the quantity and quality of investments, and thus ensuring a higher impact of the funds.
As such a key area of potential synergy and complementarity exists between CS2 and ESIF related research and innovation activities. To this end the JU has an instrumentarium for ensuring opportunities for the enhancement of aeronautics research activity and accelerated progress towards the CS2 high-level objectives, while simultaneously addressing the objectives of regional funding [or national] bodies responsible for executing the cohesion policy.
Article 20 of the Horizon 2020 Regulation and Article 37 of the H2020 Rules for Participation encourage synergies between Horizon 2020 and other European Union funds, such as ESIF and the Clean Sky 2 Joint Undertaking (CSJU) is called by its founding Council Regulation n° 558/2014 of 6th of May 2014 to develop close interactions with ESIF to underpin smart specialization efforts in the field of activities covered by the CSJU.

To this effect, the CSJU encourages synergies with ESIF by allowing complementary activities to be proposed by the applicants to CSJU calls and by amplification of the scope, addition of parallel activities or continuation of CSJU co-funded project/activities through ESIF in synergy with the Clean Sky 2 Programme and its technology roadmap. The CSJU encourages the use of ESIF also to build and enhance local capabilities and skills in the fields related to the Programme to enhance the level of European competitiveness of stakeholders in the area.

In view of the above, the CSJU has launched an action plan on synergies and is developing close interactions with interested Member States and Regions in Europe to discuss strategies and possible cooperation via a tailored made approach and incorporating modalities depending on the level of interest and commitment which a Region may decide to engage with. The aim of such cooperation is to strengthen the R&I innovation capacity and the European dimension of the Regions in aeronautics, to identify areas of technical cooperation which could complement the Programme and support its overall objectives; and to globally achieve a leverage effect from synergies between ESIF and the Clean Sky funding. While keeping well separate the funding processes and rules of each competent authority, the purpose is to identify and apply mechanisms for ensuring complementarity and synergies through ESIF in the most relevant research and innovation projects from a certain MS or Region in view of maximizing its impact via the JTI framework of CSJU projects.

With the purpose of identifying potential interested actors, the CSJU is developing a mapping of MS and Regions with an interest in engaging into cooperation with the CSJU based on their Smart Specializations and other information available through other sources (such as the CSJU State Representative Group, the RIS[3] platform, the European Commission (DG RTD and DG REGIO), the EACP and the EC supported AirTN Network action). Click here for more information.
The mapping performed to date by the CSJU already demonstrates that many Smart Specializations (RIS[3]) and Operational Programmes 2014-2020 include aeronautics or areas correlated to the Clean Sky Programme (air transport, mobility, materials, composites, engines, manufactures, CO_2 reduction etc.) as thematic areas/priorities for ESIF funding. It is notable that the interest raised comes not only from the more classic ""aeronautics Regions"" in Europe but also of Regions considering this as a potential to increase their capabilities in R&I in cross cutting areas with possible market uptake in aeronautics and European level of cooperation and competitiveness of their stakeholders.
At the time of the release of this Development the following Clean Sky Regional MoUs were in place:

- Midi-Pyrénées Region (FR) in February 2015
- Andalucía (ES) in July 2015
- Cataluña (ES) in August 2015
- Romania (at National level) in July 2015
- Campania (IT) in October 2015
- Flevoland (NL) in November 2015
- Östergötland (SE) in November 2015
- Västra Götaland (SE) in November 2015
- Czech Republic (at National level) in March 2016

Further bilateral institutional contacts with a number of MS and Regions should enable approximately 15 MoUs to be in place by 2016, and an overall coverage of 20-25 regions could be foreseen. The CJU will continue developing the pilot-phase across 2016-2017 with these Member States and Regions in view of launching projects in 2016 and beyond, and monitoring the synergies achieved.

4.6. Clean Sky 2 – SESAR & SESAR2020 Coordination

Clean Sky 2 is focused on aircraft-based and aircraft performance-driving technology development culminating in demonstration-based validation. Yet it is obvious that the full benefit of these technologies will only be achieved if they are compliant with and can be fully integrated in overall future Air Transport system defined by SESAR / SESAR2020; NextGen and similar initiatives. The compatibility of Clean Sky 2 work with the overall principles and concepts of operations of SESAR / SESAR2020 [and through these European initiatives with the overall global air transport system] is a key objective to be met in CS2. Cooperation, compatibility and consistency between activities and developments in Clean Sky 2 (especially for flight procedures and Extended Cockpit where direct implementation of SESAR / SESAR2020 regulations will be performed) and the objectives of SESAR / SESAR2020 (in terms of Concepts of Operation and ATM rules) is crucial for the success of both programmes.

Clean Sky 2 will implement a key interface in the Systems ITD in the form of a dedicated WP to exchange technical content and feedback with a mirror WP in SESAR/SESAR 2020. In addition the JU-to-JU interface pioneered in Clean Sky will be strengthened; as can be witnessed by the conclusion of the Memorandum of Cooperation signed between the two Joint Undertakings in December 2015.

The purpose of this Memorandum of Cooperation) (““MoC””) is to establish a cooperative framework between the Parties that contributes to the sustainable development of the European air transport system through an effective implementation of some areas of their respective Programmes. The scope of this framework includes the following objectives:

- Sharing [where feasible] of respective scope of activities and coordination in relevant aviation domains within each JU’’s development, validation and demonstration activities, while mitigating against identified gaps or unnecessary overlap between work programmes;
- Exchanging information about the calls to be launched by each Party and topics related to avionics / ATM / environmental aspects
- Pursuing consistency between work programmes with regard to the definition of the performance targets, in particular regarding environmental targets;
- Exchanging periodically on the progress achieved in their respective Project programmes;
- Coordinating and implementing relevant activities at the aviation, aeronautics and air transport level and agreeing joint communication actions where relevant and feasible.

The two JUs will implement this MoC through a CSJU/SESAR JU Steering Committee in which each Party are equally represented and Co-Chaired by the Parties Executive Directors. Ad-hoc Working Groups may be formed to fulfil the purpose of this MoC and enable interfacing between SESAR JU relevant projects and the CS2 projects in areas such as, but not limited to:

- Avionics and ATM/CNS infrastructure and services;
- Mission and Business Trajectory Management (‘’’’MBTM’’’’);
- Assessing the SES performance targets (in particular the environmental target of 10% for CO_2 reduction associated to ATM/ATC) and the complementarity between both Jus’’ activities.

Upon the request of either Party, the Parties may jointly implement dedicated common reviews and organize common meetings with the participation of respective industries. The Parties may also establish coordination on possible cooperation on topics in respect of liaising with other EU bodies.

4.7. Clean Sky 2 – EASA Coordination

Starting from a revised policy on research by EASA leading to intensified contacts, a workshop with Clean Sky Members' and JU officials was held with EASA representatives to discuss potential involvement of EASA in CS activities. It has now been decided that a specific joint panel will be developed, involving both DG RTD and DG MOVE, and appropriate members of CSJU and EASA (and SESAR when applicable).

The scope foreseen will be to understand the potential impact on the evolution of standards and the certification of component and system for the application to future aircraft or equipment. The starting point will be:

- the outcome of the CS activities in FP7 and related demonstrators and achievements;
- the status of technologies developed and their TRL,
- the results of other EC collaborative and coordination programmes, and
- the content of the CS2DP and the list of technologies to be developed during the [CS2] work programme;

Contributions by EASA need to be defined such that these will be consistent and compatible with the H2020 rules as well as with the EC criteria for the funding of agencies and use of public money.

For the JU members, the possibility to use the TAC approach (Technical Advisory Contract) is considered feasible, allowing the CS member to directly contract EASA for supporting activities and be covered as eligible costs. With the new EASA regulations, a higher level of involvement than TAC is possible, if justified by the need. Still to be defined if the formal involvement of EASA as subcontractor following tenders is feasible and required.

At coordination level, periodic meetings between Directors are to be held on a quarterly basis, while Technical Coordination meetings and dedicated workshops on different areas are planned on a monthly basis starting at beginning of 2016.

The areas for joint thematic workshops and involvement of representatives of each Party to other initiatives are the following:

- Environmental impact and noise;
- More electric aircraft and hybrid propulsion;
- Icing;
- Composites and Structural Health Monitoring;
- Modelling for Certification;
- Additive Manufacturing;
- Rotorcraft Operations;
- Safety-related items, like Cabin Air Quality;

Also with EASA, as with SESAR: the exchange of information about the calls for proposals and topics of potential interests and synergy will be activated by both Parties.

5. Membership and Participation

5.1. The Clean Sky 2 Programme Set-up

Membership of the Clean Sky 2 JU involved in the CS2 Programme is comprised of:

- The European Commission representing the Union and ensuring EU public policy;
- Leaders as defined in the Statutes and committed to achieve the full research and demonstrator activity of the Programme;
- Core-Partners as selected through the Calls for Core Partners and duly accepted by the Governing Board of the CS2JU upon successful selection and negotiation, who bring a further substantial long-term commitment towards the Programme.

As ***Members****, Leaders* and *Core Partners* are jointly responsible for the execution of the overall Programme, meeting the High-Level Objectives, and providing the in-kind contributions in order to meet the minimum level to be brought to the Programme by the Members as set in the Regulation.

Core-Partners are selected through open and competitive calls planned over the first years of the Programme, guaranteeing a transparent selection of the best membership and strategic participation. As Members of the JU in the meaning of the Clean Sky 2 Regulation, Core Partners are expected to make long-term commitments and contribute to the implementation of the Programme over its lifetime: bringing key competences and technical contributions, and significant in kind resources and investment.
Core Partners contribute to the global management of the technology streams and demonstrators and as such also may manage activities of Partners selected via Calls for Proposals.
Core Partners join the ITD/IADP Steering Committees in which they are active, contributing to its governance. Core Partners are also represented at Governing Board level via a process of co-opting and rotation at ITD/IADP level.
Leaders’ and Core Partners’ participation and contributions are governed through the Grant Agreements for Members [GAMs] managed by the JU and setting out the actions over the full period of the Programme, via extendable and renewable multi-annual GAMs that closely align with the CS2JU’s Work Plans.

Partners participate in the Programme in specific projects with a well-defined and limited scope and commitment defined in topics launched in Calls for Proposals [CfP]. Partners are selected through these calls launched in a regular and phased approach over the H2020 funding period [2014 – 2020]. Partners’ participation is governed through dedicated Grant Agreements for Partners [GAPs]: complementary grants structured to complement the Members’ contributions and activities and jointly managed by the JU and *Topic Managers* appointed by the Members.

Partners’ activities are monitored and managed by the JU in close collaboration with Topic Manager in order to ensure the alignment of actions and the convergence of technical activity towards the Programme’s goals.

The funding repartition of the CS2 Programme is set out in the Regulation and is as follows:

- Up to 40% of Clean Sky 2’s available funding of 1716m€ [net of Running Costs] is ring-fenced for its 16 leaders and their Affiliates;
- Up to 30% of the Programme’s funding is available for Core Partners and
- At least 30% will be awarded via Calls for Proposals and Calls for Tenders.

The 60% thus defined as to be awarded via the Calls for Core Partners and Calls for Proposals represents over €1 billion, making it alone over 25% greater than the total budget of the first Clean Sky Programme and just over five times the call funding volume of Clean Sky. With this substantial amount of funding open to competition, Clean Sky 2 will foster wide participation where SMEs, research organisations and academia interact directly with key industry stakeholders. The different call mechanisms and the related breadth of the call topics and technical scope of the CS2 programme will provide opportunity for the vast bulk of the aeronautics industry in the European Research Area to participate, and also allow for space for newcomers, including important opportunities for “cross-over” participants from outside the sector. Getting capable new firms involved in the aeronautics sector can make an important contribution to the competitiveness of the sector and to the European economy.

Noting there are roughly 600 participants in the original Clean Sky Programme, for Clean Sky 2 we expect 800 - 1000. That is ample evidence of a dynamic and open system operating in the JU and with all stakeholders.

5.2. Clean Sky 2 Participation – Progress to Date

Summary of Call results to date – Calls for Core Partners

With Clean Sky 2 now operating for just under two years, three of the four Core Partner Calls that are foreseen for the Programme have been launched.

The first Call has been fully implemented:

- 29 published topics, of which 26 successful with an expected lifetime funding value of €233m;
- Adoption of new Members June and Sept. 2015;
- Accession of 75 new Members representing 13 Member States to the appropriate Grant Agreement for Members in Aug. thru Nov. 2015.

The second Call for Core is now underway in terms of technical negotiation and the accession of Members, with an expected start date of new Core from June 2016. Key facts and figures:

- 17 published topics [all successful] with an expected lifetime funding value of €102m;
- Adoption of new Members expected from May 2016;
- Accession to the appropriate Grant Agreement for Members expected from June 2016.

A third Call for Core Partners was launched in October 2015. Its key metrics follow here below:

- 22 published topics, of which 17 successful with an expected lifetime funding value of €83m
- Closing date Feb. 2016;
- Evaluation completed in April 2016;
- Adoption of the ranking lists by the Governing Board expected by May 2016;
- Start of technical activity from Q4 2016.

Cumulative position of the Calls for Core Partners:
By mid-2016 the three Calls for Core Partners launched will have ““locked in”” just over 80% of the expected Core Partner activity and funding over the life of the programme. A fourth and final Call for Core Partners is foreseen by the end of 2016, and this should complete the selection process for the Clean Sky 2 Core Partners and for the membership, on time with respect to the planning made at the Programme’’s start. The fourth and final Call for Core Partners is expected to contain roughly another 10% of the Core Partner funding, which will allow for flexibility in the downstream management of the Programme in bi- or multi-annual work plans and GAMs.

The three Calls for Core Partners will have already led to the Membership of Clean Sky 2 JU via the CS2 Programme spanning 20 countries: 18 Member States and two countries associated to H2020 [Turkey and Israel].

When disregarding multiple winning applications leading to participation as Core Partner via more than one call and/or in more than one IADP/ITD, the net number of Members acceding to the programme on the basis of Calls for Core Partners Waves 1-3 is expected to be 125 [this number subject to the GB approval of the accession of top-ranked applicants and the approval of the Core Partner Wave 3 ranking lists and subsequent accession to the membership.]

Summary of Call results to date – Calls for Proposals

In the first two years since the Programme''s commencement three Calls for Proposals were successfully launched and closed, with the evaluations completed. A fourth Call for Proposals is under preparation and will be launched within this timeframe subject to GB approval.

Details follow below for the first of these calls:

- Call comprised of 53 published topics with an indicative topic value of €48m
- Adoption of the ranking lists by the Governing Board July 2015;
- Technical activity of first Partners from December 2015.

The 2nd Call for Proposals was launched in 2015, with key figures and milestones as set out below:

- Call comprised of 64 published topics with an indicative topic value of nearly €58m
- Adoption of the ranking lists by the Governing Board March 2016;
- Kick-off of Grant Preparation phase: March 2016;
- Deadline for 8 month Time to Grant [TTG]: July 2016.

The 3rd Call for Proposals was launched in 2016, with key figures and milestones as set out below:

- Call comprised of 60 published topics with an indicative topic value of nearly €56m
- Closing date June 2016;
- Evaluation planned July 2016;
- Adoption of the ranking lists by the Governing Board is expected July 2016;
- Kick-off of Grant Preparation phase: September 2016;
- Deadline for 8 month Time to Grant [TTG]: Q1 2017.

Summary of the participations of the CS2 Programme Leaders and their Affiliates

Overleaf the participation of the 16 CS2 Leaders as defined in Annex 1 of the Statutes is summarized in table format

Leaders“ participation areas

	Finmeccanica SpA (Helicopter Division)[1]	AgustaWestland Limited	Airbus SAS	Airbus Defence and Space SA[2]	Airbus Helicopters	Finmeccanica SpA (Aircraft Division)[3]	Dassault Aviation SA	Deutches Zentrum fuer Luft- und Raumfahrt e.V. (DLR)	Evektor, spol. s.r.o	Fraunhofer-Gesellschaft zur Foerderung der Angewandten	Liebherr-Aerospace Lindenberg GmbH	MTU Aero Engines AG	Piaggio Aero Industries SPA	Rolls-Royce Plc	SAAB Aktiebolag	Safran S.A.	Thales Avionics SAS
IADP Large Passenger Aircraft			L	PL			PL			PL	PL			PL			PL
IADP Regional Aircraft				PL		L											
IADP Fast Rotorcraft	L	L			L												
ITD Airframe	PL	PL	PL	L	PL	PL	L		PL	PL			PL		L		
ITD Engines			PL									L	PL	L		L	
ITD Systems			PL	PL			PL		PL		L		PL		PL	PL	L
Small Air Transport (SAT)									L				L				
ECO Design 2										L							
Technology Evaluator 2								L									

Legend

L Leader as defined by the Statutes

PL Participating Leader as identified in the Grant Agreement for Members [GAM]

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1 ex Agusta Westland SpA

2 ex EADS-CASA

3 ex Alenia Aermacchi SpA

6. Clean Sky 2 Programme Content

Overleaf the Clean Sky 2 Programme thematic content is shown

6.1. Clean Sky 2 Technology and Demonstration Activities

Summary of the Clean Sky 2 Technology and Demonstration Activities:

Theme	Demonstration area	Demonstrator / Technology stream in Programme Area						Contribution*			Funding
		LPA	REG	FRC	AIR	ENG	SYS	E	M	C	RoM m€
Breakthroughs in Propulsion Efficiency (incl. Propulsion-Airframe Integration)	CROR	✈			✈			✈		✈	143.5
	Ultra-high Bypass and High Propulsive Geared Fans	✈				✈		✈		✈	292.9
	Hybrid Electric Propulsion	✈						✈	✈		10.4
	Small Aircraft, Regional and Business Aviation Turboprop					✈		✈	✈	✈	39.4
Advances in Wings, Aerodynamics and Flight Dynamics	Advanced Laminar Flow Technologies	✈			✈			✈		✈	96.3
	Regional Aircraft Wing Optimization		✈		✈			✈	✈	✈	114.8
Innovative Structural / Functional Design - and Production System	Advanced Manufacturing		✈		✈			✈		✈	35.9
	Cabin & Fuselage	✈	✈		✈			✈	✈	✈	197.9
	Innovative Solutions for Business Jets				✈				✈	✈	10.9
Next Generation Cockpit Systems and Aircraft Operations	Cockpit & Avionics	✈	✈				✈	✈	✈	✈	158.8
	Advanced MRO	✈							✈	✈	12.3
Novel Aircraft Configurations and Capabilities	Next-Generation Civil Tiltrotor			✈	✈				✈	✈	110.3
	LifeRCraft Compound Helicopter			✈	✈				✈	✈	109.4
Aircraft Non-Propulsive Energy and Control Systems	Electrical Systems		✈		✈		✈	✈		✈	111.3
	Landing Systems		✈				✈	✈		✈	34.8
Optimal Cabin and Passenger Environment	Environmental Control System		✈				✈	✈	✈		17.9
	Innovative Cabin Passenger/Payload Systems	✈	✈		✈		✈	✈	✈	✈	19.7
Eco-Design		✈	✈	✈	✈	✈	✈	✈		✈	39
Long-term Technologies		✈	✈	✈	✈	✈	✈	✈	✈	✈	116.0
											1671.5

**E – Environment, M – Mobility, C - Competitiveness*

Note 1: Long-term technologies are themselves aligned with the major thematic research and technology development areas as shown; nonetheless they are shown as a separate line item in order to indicate their RoM value and share of activity in the Programme.

Note 2: the balance between indicated figures and the overall expected Programme value of 1716m€ is comprised of a number of ancillary activities, the main contributor being management cost.

Detailed overview with the Demonstrator / Technology Streams:

Theme	Demonstration Area	Programme Area [IADP/ITD/TA]						Demonstrator / Technology Stream	Contribution*			Funding
		LPA	REG	FRC	AIR	ENG	SYS		E	M	C	RoM m€
Breakthroughs in Propulsion Efficiency (incl. Propulsion-Airframe Integration)	**CROR**	✈			✈			UHBR and CROR configuration	✈		✈	**143.5**
								CROR demo engine flight test demo	✈		✈	
								Advanced engine integration driven fuselage ground demo	✈		✈	
	Ultra-high Bypass and High Propulsive Geared Fans	✈				✈		Ultra High By-pass Ratio engine	✈		✈	**292.9**
								VHBR – Middle of Market Technology	✈		✈	
								VHBR – Large Turbofan Demonstrator UltraFan™	✈		✈	
								UltraFan Flight Test Demonstration	✈		✈	
								Validation of scaled flight testing	✈		✈	
								Radical Configuration Flight Test Demonstrator	✈		✈	
								Advanced Geared Engine Configuration	✈		✈	
	Hybrid Electric Propulsion	✈						Hybrid Electric Ground Test Bench	✈	✈		**10.4**
	Small Aircraft, Regional and Business Aviation Turboprop					✈		Business aviation / short range Regional Turboprop Demonstrator	✈	✈	✈	**39.4**
								Small Aircraft Engine Demonstrator	✈	✈	✈	
								Small Aircraft Turbine Engine	✈	✈	✈	
Advances in Wings, Aerodynamics and Flight Dynamics	**Advanced Laminar Flow Technologies**	✈			✈			Applications for business jets / regional aircraft: Natural Laminar Flow (NLF) smart integrated wing Laminar Nacelle for Business Jets Leading edge/Wingbox Advanced Laminarity NLF demonstrator for HTP bizjets NLF LE/Wingbox GBD	✈			**96.3**
								Applications for large passenger aircraft: HLFC on tails large scale ground-based demonstrator Ground-based demonstrator HLFC wing HLFC on tails flight test operation Active flow control flight test demonstrator	✈			
	Regional Aircraft Wing		✈		✈			Full Manufacturing & Test			✈	**114.8**
								Component manufacturing and testing			✈	

Advances in Wings, Aerodynamics and Flight Dynamics	Optimization Regional Aircraft Wing Optimization		✈		✈			Innovative Flight Control System with EMAs for Aileron and for Winglet/Wingtip		✈	✈	
								Load Control/Load Alleviation System			✈	
								Demonstrator Power Controller			✈	
								Flying Test Bed#1 (FTB1): Innovative Wing Innovative Flight Control System including EMA for Winglet/Wing	✈	✈	✈	
								Flying Test Bed#2 (FTB2): High Lift Advanced Turboprop On-ground Structural Rig FTB#2 Wing On-ground Actuation Rig FTB#2 Wing On-ground Structural Cockpit FTB#2		✈	✈	
								Code validation demonstration			✈	
								Smart control surfaces			✈	
								Demonstrator Fixed Leading Edge			✈	
								High lift wing			✈	
								Morphing Leading Edge Demonstrator			✈	
								Novel Control			✈	
								Virtual high lift demonstrator			✈	
								Moveables			✈	
Innovative Structural / Functional Design - and Production System	Advanced Manufacturing		✈		✈			Advanced multifuntional CFRP for regional aircraft fuselage	✈		✈	35.9
								Nacelle Systems Demonstrator	✈		✈	
								Aileron Demonstrator		✈	✈	
								Aileron, fuselage panel jigless assembly	✈		✈	
								Cockpit segment, engine nacelle demonstrators			✈	
								Coupons and subscale components	✈		✈	
								Joints metal - composite	✈		✈	
								Thermoplastic secondary structures	✈		✈	
	Cabin & Fuselage	✈	✈		✈			Advanced integrated Structures		✈	✈	197.9
								Regional Aircraft Fuselage Major Components Demonstrator			✈	
								Regional Aircraft Pax Cabin Major Components Demonstrator		✈	✈	
								Low cost material, process, manufacturing, assembling technologies for regional a/c fuselage			✈	
								Affordable and low weight regional aircraft pax cabin	✈		✈	
								Door Demonstrator		✈	✈	
								Next Generation Fuselage, Cabin and Systems Integration	✈	✈	✈	

								Next Generation Cabin & Cargo Functions	✈	✈	✈	
								Next Generation Lower Center Fuselage	✈		✈	
	Innovative Solutions for Business Jets				✈			Half Central Wing Box		✈	✈	**10.9**
								Central Wing Box Panel		✈	✈	
								EWIPS Integration on a business jet flap		✈	✈	
								Low Weight Seat Demonstrator		✈	✈	
								Compostie Wing Root Box		✈	✈	
Next Generation Cockpit Systems and Aircraft Operations	**Cockpit & Avionics**	✈	✈				✈	Flight Test Demonstration on LPA Aircraft		✈	✈	**158.8**
								Enhanced Cockpit Large Aircraft		✈	✈	
								Disruptive Cockpit Large Aircraft		✈	✈	
								Extended Cockpit Demonstrations		✈	✈	
								Enhanced functions and technologies ground and flight tests on Business jet		✈	✈	
								Integrated Cockpit for Small Air Transport		✈	✈	
								For regional aircraft: Fly by Wire Regional Active Cockpit Performance/Health Monitoring linked to SHM and to EMA		✈	✈	
	Advanced MRO	✈						Maintenance Service Operations Enhancement Demonstrator		✈	✈	**12.3**
Novel Aircraft Configurations and Capabilities	**Next-Generation Civil Tiltrotor**			✈	✈			TiltRotor Nose / Cockpit Section		✈	✈	**110.3**
								TiltRotor Cabin Section		✈	✈	
								TiltRotor Tail Section		✈	✈	
								Mock-up of major airframe sections and rotor		✈	✈	
								Tie Down TiltRotor (TDT) Demo		✈	✈	
								NextGenCTR Demonstrator (Ground & Flight)		✈	✈	
								Prop-rotor components and assembly demo		✈	✈	
								NextGenCTR’’s wing assembly - demo		✈	✈	
								Engine-airframe physical integration - demo		✈	✈	
								Fuel system components - demo		✈	✈	
								NextGenCTR’’s drive system components and assembly – demo		✈	✈	
								Intelligent electrical power system and ancillary/ auxiliary components - demo		✈	✈	
								Flight control & actuation systems and components demo		✈	✈	
	LifeRCraft Compound			✈	✈			Wing for incremental lift & transmission shaft integration		✈	✈	**109.4**
								Rotorless Tail		✈	✈	

Novel Aircraft Configurations and Capabilities	**Helicopter**							LifeRCraft doors		✈	✈	
	LifeRCraft Compound Helicopter			✈	✈			General Architecture and Design Demonstrator - Integration and Validation and Verification		✈	✈	
								Airframe structure Wing and tail unit and cockpit doors Landing system Cabin & Mission Equipment		✈	✈	
								Lifting Rotor Lateral Rotors Drive Train Power Plant Actuation System		✈	✈	
								Electrical System Avionics & sensors Flight Control, Guidance & Navigation Systems		✈	✈	
Aircraft Non-Propulsive Energy and Control Systems	**Electrical Systems**		✈		✈		✈	Smart Integrated Wing Demonstrator (incl. Structure Integrated System)			✈	**111.3**
								Innovative Electrical Wing			✈	
								Power Generation	✈		✈	
								EPGD - Electric-Power Generation and Distribution	✈		✈	
								Innovative Electrical Network (IEN) - demo on Copper Bird	✈		✈	
								HVDC Power Management Centre Demonstrator for large A/C			✈	
								Advanced Electrothermal Wing Ice Protection Demonstrator			✈	
								Primary In-Flight Ice Detection Systems			✈	
								De-Ice			✈	
								Next Generation Cooling System Demonstrator	✈		✈	
								Thermal Management Demonstration (Avant Test Rig)			✈	
								Advanced Electrical Power Distribution System			✈	
								Mixed Thermal Ice Protection Demonstrator			✈	
								Ultra Low Power Demonstrator			✈	
	Landing Systems		✈				✈	Advanced Landing Gear Systems	✈		✈	**34.8**
								Electrical Nose Landing Gear System Demonstrators	✈		✈	
								Electrical Rotor Landing Gear System Demonstrator	✈		✈	
								Advanced Landing Gear Sensing & Monitoring System Demonstration	✈		✈	
								EMA and brake LG	✈		✈	

								Electrical Landing Gear Systems	✈		✈	
Optimal Cabin and Passenger Environment	**Environmental Control System**		✈				✈	Next Generation EECS Demonstrator for large A/C	✈	✈		**17.9**
								Next Generation EECS Demonstrator for Regional A/C	✈	✈		
								Advanced Systems integration, E-ECS and Thermal Management	✈	✈		
	Innovative Cabin Passenger/Payload systems	✈	✈		✈		✈	Ergonomic flexible cabin		✈	✈	**19.7**
								Flight test demonstration of active vibration control technologies/noise prediction methods for rear-mounted engines	✈	✈	✈	
								Innovative Cabin and Cargo technologies		✈	✈	
								Human centered cabin design for regional aircraft		✈	✈	
								Comfortable & Safe Cabin for SAT		✈	✈	
								Novel travel experience		✈	✈	
Eco-design		✈	✈	✈	✈	✈	✈		✈		✈	**39**
Long-term Technologies		✈	✈	✈	✈	✈	✈		✈	✈	✈	**116.0**

**E – Environment, M – Mobility, C - Competitiveness*

1671.5

6.3. Key Interfaces & Dependencies

General Overview of Interfaces across ITDs/ IADPs

receiving input \ delivering input	LPA	REG	FRC	AIR	ENG	SYS
LPA		- FTB#2: Flight tests results on pilot monitoring and voice command functions	n/a	- Engine Integration on Rear Fuselage & Novel Certification process - "Extended Laminarity" technologies - Fan design and numerical methods (UHBR Integration), Actuation Concepts, Flow control Systems - Systems/modules delivery - Wing demonstrator component - Technologies and solutions for large passenger transport - Manufacturing processes	- UHBR demonstrator	- Enabling technologies for cockpit, display and avionics - Systems requirements for cabin integration - Variability analysis for technologies / functions to prepare customisation
REG	- Avionic functions & equipment		n/a	- Composite fuselage incl. structural design methodologies and technologies - Low weight, human centered cabin - Ground Demonstration of the Wing including the airframe and the related systems - Demonstrator component & wing substantiation - Manufacturing processes	n/a	- Development of electrical ECS technology (bricks) - Delivery of electrical ECS equipment and solutions - Systems integration for in-flight demonstration activities in Regional FTB#2
FRC	n/a	n/a		- Data exchange throughout the Systems Engineering design and development process - Airworthiness documentation of supplied components - Wing and Tail Unit and Doors flightworthy components - Laminarity technologies - Fuselage components for assembly with the rotorcraft demonstrator - Manufacturing processes	n/a	n/a
AIR	- NLF Smart Integrated Wing & Extended Laminarity - Methods & Requirements (Materials developments) - Configuration and requirements and overall aircraft design & configuration management - CROR engine installation & integration elements - Technology objectives, interfaces & global specifications	- TLAR for Regional Overall Aircraft Design & Configuration - Technology objectives, interfaces & global specifications	- Data exchange throughout the Systems Engineering design and development process - Specifications and interfaces of Wing and Tail Unit and Doors flightworthy components - Feedback on flight demonstration - Configuration and requirements and overall aircraft design & configuration management - Technology objectives, interfaces & global specifications		- Technology maturation learning/results, interfacing/integration constraints	- Development of Electromechanical Actuators to be compliance with the technical requirements specified for All Electrical Wing technologies
ENG	- FTD specifications & economic viability at aircraft level for CROR and UHBR	n/a	n/a	- Requirements, inclusive of integration requirements to electrical systems		n/a
SYS	- NLF Smart Integrated Wing & Extended Laminarity - Next Generation Low Center Fuselage (test case) - Airframers needs and constraints for cockpit technologies	- Electrical ECS requirements - Expected activities Network specifications and test plans - Airframers needs and constraints for cockpit technologies	- Airframers needs and constraints for cockpit technologies	- Electrical ECS requirements Integration requirements to electrical systems - Specification for electrical actuation components for Regional A/C - Requirements for FCS development in Regional FTB#2: EMAs and SHA (aileron, spoiler, winglet and flap)	n/a	

Overview Interfaces - Transverse Area ECO

	receiving output from	delivering input to
	ECO	
LPA	n/a	- Hybrid Laminar Flow Control Large Scale Demonstration - Applied Technologies for Enhanced Aircraft Performance - Demonstration of Radical Aircraft Configurations - Demonstration of Radical Aircraft Configurations - Next Generation Fuselage, Cabin & Systems Integration - Next Generation Cabin and Cargo Functions - Non-specific cross Functions - Enhanced Cockpit - Disruptive Cockpit Demonstration
REG	- Information on LCA needed inputs; Environmental Analysis and assessment of the eco-selected technologies	- Information on eco-relevant technologies from REG WP 4.2 to be used by ECO TA for LCA evaluations
FRC	- Environmental analysis and assessment of the eco-selected technologies and the availability on the hybrid platform (technology pool and datasets).	- Information on eco-relevant technologies (Technology mapping and screening, BOM/BOP relevant information, certain entry criteria on data format, etc.), entering the ED-TA through VEES and linked to the IADP Rotorcraft WP 0.3 Eco-Design concept implementation.
AIR	Details of interface under discussion	Details of interface under discussion
ENG	- Environmental analysis and assessment of the eco-selected technologies and the availability on the hybrid platform (technology pool and datasets).	- Information on eco-relevant technologies (Technology mapping and screening, BOM/BOP relevant information, certain entry criteria on data format, etc.), entering the ED-TA through VEES.
SYS	- Environmental analysis and assessment of the eco-selected technologies and the availability on the hybrid platform (technology pool and datasets).	- Information on eco-relevant technologies (Technology mapping and screening, BOM/BOP relevant information, certain entry criteria on data format, etc.), entering the ED-TA through VEES and linked to the ITD Systems WP100.2 Product Life cycle Optimization: Eco-Design (Materials & Processes, Green Maintenance, End of Life, LCA).

Overview Interfaces - Transverse Area SAT

	receiving output from	delivering input to
	SAT	
AIR	n/a	Data and components/technologies for integration on SAT demonstrators: - Optimized Composite Structures - High Lift Wing - More Affordable Small a/c Manufacturing
ENG	- SAT Requirements & Integration	Data and components/technologies for integration on SAT demonstrators: - Light weight and fuel efficient diesel engines - Reciprocating engine - Reliable and more efficient operation of small turbine engines
SYS	n/a	Data and components/technologies for integration on SAT demonstrators: - Efficient operation of small aircraft with affordable health monitoring systems - More electric/electronic technologies for small aircraft - Fly By Wire architecture for small aircraft - Affordable SESAR operation, modern cockpit and avionic solutions for small aircrafts - Comfortable and safe cabin for small aircraft

6.4. Master Plan

[under preparation and will be included for the next revision]

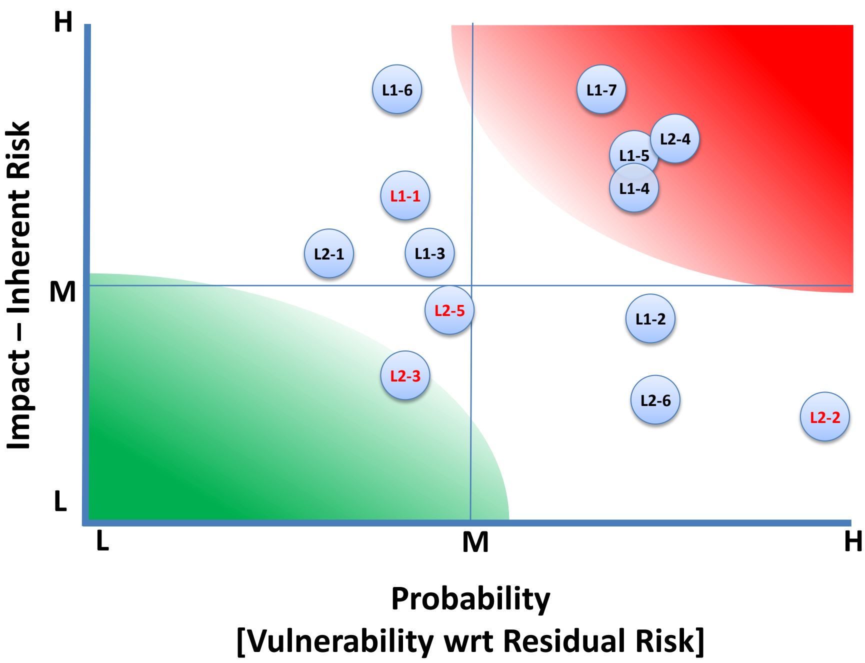
6.5. Overview of Major Risks

Area	Risk #	Risk Description	Likelihood (H/M/L)	Impact (H/M/L)	Impact Category †	Mitigation Plan
TE	**L1-1**	Lack of progress in setting up TE2 [TE under CS2] prevents timely 1st assessment in time for H2020 mid-term	M	M	R/T/S	
ECO	**L1-2**	Lack of agreed TA management / coordination delaying ECO transverse approach	M/H	M	R/T/S	Prompt definition and agreement of Eco coordination committee rules of procedure and launch of a formalized coordination committee plus trilateral meetings with key leaders involved in the action
ECO	**L1-3**	Lack of agreed ECO Roadmap and mechanism for selecting projects and awarding funding delays or prevents ECO progress	M	M	T/S	Prompt definition of a roadmap with leaders together with clear criteria to select the activity worth to be supported by Eco-Design TA
FRC	**L1-4**	NextGenCTR cost forecast far beyond available budget in FRC and AIR and/or funding cuts resulting in significant narrowing of the flight demonstration scope and innovative content	M/H	M/H	T/S/C	- De-scope project activities and focus only on systems that are required to execute flight demonstrator objectives proving TiltRotor architectural technologies - Implement back-up/existing solutions as nominal ones (to the detriment of innovation and system performance)
FRC	**L1-5**	LifeRCraft cost forecast far beyond available budget in FRC and AIR and/or funding cuts resulting in significant narrowing of the flight demonstration scope and innovative content	M/H	M/H	T/S/C	- Abandon any activity not on the critical path of flight demonstrator construction - Take back-up/re-use solutions as nominal ones (to the detriment of innovation and system performance)
LPA	**L1-6**	If CROR FTD plan is delayed, the flight-test phase risks to drop out of CS2 time frame (later than 2023).	M	H	R/T/S	Careful following of CROR economic viability studies, of CROR FTD progress with key milestones scheduled with JU.
LPA	**L1-7**	CROR activities dropped out in case of NO GO decision Mid 2017 based on the Economic viability assessment of the proposed solution.	M/H	H	R/T/S	Focus on UBHR implementation
ECO	**L2-1**	Poor and or incomplete delivery of data from the SPDs to Eco TA. Incomplete database, missing the possibility of fully closing CS1 still open gaps. Link of data to demonstrators and consequently poor LCI and EHP data set not representative of CS efforts.	M	M	T	Workshops and regular Meetings with SPDs and training
REG	**L2-2**	Difficulties in Wind Tunnel execution due to undefined Call for Tender process: Risks in schedule and costs	H	M	C	Find other means to launch 1st WTT campaign. Second ready for tendering process
All SPDs	**L2-3**	The strong interdependencies between IADPs (as provider of requirements and as Integrator) and ITDs (as provider of a/c components,	M	M	T/S/C	Improve coordination and create well-defined interfaces between IADPs and ITDs.

Area	Risk #	Risk Description	Likelihood (H/M/L)	Impact (H/M/L)	Impact Category †	Mitigation Plan
		equipment, systems, and solutions) can cause heavy delays in the overall programme in case of (technical / schedule) problems.				
all SPDs	L2-4	Partners'' contribution to GAMs for activities on the critical path	H	H	T/S/C	a) Preparation phase: assess the appropriateness of proposing a Call for Proposal instead of Sub-contracts – Train Topic Manager(s) and any other necessary participants to grab and absorb all the constraints of the Call for Proposals Mechanism b) Negotiation phase: Involve well trained people from the beginning for both technical and legal aspects and deeply liaise with the JU for specific and difficult cases to find out the best feasible solution c) Implementation phase: Implement specific monitoring and management measures from the start of the project (to be defined with the CSJU on case-by-case basis)
REG	L2-5	Delay in Core Partner and Partner selections: Risks in schedule, resources and costs	M	M	S	Activity transfer from Core Partners and Partners to internal leader and subcontracting
SYS	L2-6	Flight test platform size (full scale E-ECS do not fit into the current A320 pack bay)	M	L/M	T	Alternative flight test platform such as A340

*Risk Layer: L1 corresponds to risk identified on JU Level (and related to the achievement of the strategic objectives), L2 corresponds to risk identified at Programme Level, L3 corresponds to risk identified at SPD Level
†Impact category: R (Reputational for JU); T (Technical Targets), S (Schedule Targets) or C (Cost Targets)

Marci chart



7. Technical Summary

7.1. Large Passenger Aircraft IADP

Large Passenger Aircraft market remains highly competitive, new entrants having means to reach a technology level comparable to legacy US and European airframers support their ambition with both a captive ““home”” market and low costs and pricing. To stay ahead, LPA programme objectives are to further mature technologies tackled in Clean Sky, e.g. the integration of CROR propulsion systems, and to validate other key technologies like hybrid laminarity for the wing, horizontal and vertical tail plane as well as an all-new next generation fuselage cabin and cockpit-navigation. The approach builds on the positive experience in Smart Fixed Wing Aircraft (SFWA) in Clean Sky.
For Clean Sky 2, the Large Passenger Aircraft goal is high-TRL demonstration of the best technologies to accomplish the combined key ACARE goals with respect to the environment, fulfilling future market needs and improving the competitiveness of future products. The setup of the main programme objectives is to further push the value of technologies tackled in Clean Sky, e.g. the integration of CROR propulsion systems, and to add the validation of additional key technologies like hybrid laminar flow for the wing, horizontal and vertical tail plane as well as an all-new next generation fuselage cabin and cockpit-navigation suite validated at integrated level with large scale demonstrators in operational conditions.
Three distinct ‘‘Platforms’’ will be managed in parallel and develop the abovementioned technologies and demonstrators:

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

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

- **Platform 3 “Next Generation Aircraft Systems, Cockpit and Avionics”** has a clear focus to develop and demonstrate a next generation cockpit and navigation suite. Based on the results of a number of research programmes which are currently ongoing or to be started shortly, platform 3 shall allow the Programme to integrate and validate all functions and features which are emerging from individual developments into a disruptive new concept in a major demonstrator suite. With the core of platform 3 being a major ground based demonstrator, selected features and functions will be brought to flight test demonstration when justified. The scope of platform 3 will cover the development of a disruptive cockpit operations concept, a rethinking towards a “Human Centric” based cockpit to operate the aircraft, including innovative functions and Human-Machine interface technologies required to reduce the crew workload, improve situational awareness and support disruptive cockpit operations.
  In addition the development of value-driven end-to-end maintenance service architectures will be investigated, enabling the replacement of scheduled maintenance by efficient on-condition maintenance.

7.2. Regional Aircraft IADP

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

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

- **FTB1 - Innovative Wing and Flight Controls (Regional IADP):** Integration and flight testing of technologies suitable to regional aircraft applications for a new generation wing and advanced flight control systems. Innovative wing related systems and wing structural solutions will also be incorporated where feasible. Aerodynamic enhancements and LC&A features will be considered to complement FTB2, such as: high A/R by means of adaptive/innovative winglets.
- **FTB2 - Flight Demonstration of a high efficient and low noise Wing with Integrated Structural and related Systems solution, including power plant aspects (Regional IADP):** A new wing will be

designed, manufactured and equipped with new structural solutions strongly integrated with advanced low power and high efficient systems such as ice protection, fuel, flight control, engine systems, LE and winglets morphing.

- **Full-scale innovative fuselage and passenger cabin (Regional IADP):** Integration and on-ground testing of a full scale innovative fuselage and passenger cabin including all the on board systems and advanced solutions for increasing passenger comfort and safety. The fuselage will be a full scale demonstration of technologies for composite material, structures and manufacturing aimed to weight and cost reduction and to minimize the environmental impact through eco-design and energy consumption optimization all along the life-cycle (towards a zero-impact).
- **Iron Bird (Regional IADP):** Virtual and Physical ""Iron Birds"" will also be an important part of the Regional A/C Ground Demonstration Programme. These will also be used to integrate, optimize and validate the systems modification of the Flying Test Bed and the results of their simulations and ground testing will be essential to achieve the permit-to-fly.
- **Ground Demonstration of the wing (Airframe ITD),** including the airframe and related systems.
- **Ground Demonstration of the Cockpit (Airframe ITD),** including the structure and related system.
- **Nacelle ground demonstration (Airframe ITD), to be confirmed.**

7.3. Fast Rotorcraft IADP

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

- **Joint activities:**

  These activities cover the methodology for technology evaluation of fast rotorcraft demonstrations and the Eco-Design concept implementation, along with the programme management activities for the Fast Rotorcraft IADP.
  Concerning the methodology for technology evaluation, the activities will allow defining SMART objectives and criteria adapted to the fast rotorcraft missions in line with the general TE approach for Clean Sky 2
  Concerning Eco-Design concept implementation, the activities will allow coordinating approaches and work plans in the two demonstration projects regarding the greening of rotorcraft production processes and ensuring complementarity of case studies. The general Life Cycle Assessment approach will be coordinated with the participants of the Eco-Design TA.

- **The Next-Generation Civil Tiltrotor demonstrator NextGenCTR:**

  NextGenCTR will be dedicated to design, build and fly an innovative Civil Tiltrotor technology demonstrator, the configuration of which will go beyond current architectures of this type of aircraft. NextGenCTR''s demonstration activities will aim at validating its architecture; technologies/systems and operational concepts. Demonstration activities will show significant improvement with respect to current Tiltrotors'' state-of-the-art. The project will also allow to develop substantial R&T activities to increase the know-how about a new platform like a Tiltrotor (not yet certified as a civil aircraft), and to generate a research and innovation volume of activities above a certain critical mass (not available today for Tiltrotors within EU), somewhat comparable to that of well proven conventional helicopter platforms.
  NextGenCTR will continue and further develop what has been initiated in Clean Sky, and launch new activities specific to Clean Sky 2 and NextGenCTR project. In the area of CO2 emissions reduction, NextGenCTR will continue/develop engine installation and flight trajectories

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

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

- **The Compound Rotorcraft demonstrator:**

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

A large scale flightworthy demonstrator embodying the new European compound rotorcraft architecture will be designed, integrated and flight tested. This demonstrator will allow reaching the Technology Readiness Level 6 at whole aircraft level in 2020. The project is based on:

- identified mobility requirements and environmental protection objectives;
- lessons learnt from earlier experimentation with the low scale exploratory aircraft X^3;
- technology progress achieved for rotorcraft subsystems on one side through participation to Clean Sky projects and other research activities at EU or local level;

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

- New rotor blade concepts aiming at improved lifting efficiency and minimizing noise;
- Airframe drag reduction through shape modifications and interference suppression;

- Engine intake loss reduction and muffling;
- Innovative electrical systems e.g. brushless generators, high voltage network, efficient energy storage and conversion, electrical actuation;
- Eco-Design approach, substituting harmful materials and green production techniques;
- *Fly-neighbourly* demonstration of new flight guidance functions and approach;

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

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

7.4. Airframe ITD

Aircraft level objectives on greening, industrial leadership and enhanced mobility, and the fulfilment of future market requirements and contribution to growth cannot be met without strong progress on the airframe. Altogether strong progress towards the 2020 targets will have been obtained when *Clean Sky* is completed (estimated at 75% of the relevant part of the initial ACARE goals, applicable to aircraft with an EIS from 2020/22). However further progress is required on the most complex and challenging requirement on new vehicle integration to fully meet the 2020 objective, and to progress towards the 2050 goals. To make this possible, different directions are proposed. All of these directions of progress will be enabled throughout the foreseen execution of 9 major Technology Streams:

- **Innovative Aircraft Architecture**, to investigate some radical transformations of the aircraft architecture.
  The aim of this Technology Stream is to demonstrate the viability of some most promising advanced aircraft concepts (identifying the key potential showstoppers & exploring relevant solutions, elaborating candidate concepts) and assessing their potentialities.
- **Advanced Laminarity** as a key technological path to further progress on drag reduction, to be applied to major drag contributors: nacelle and wing;
  This Technology Stream aims to increase the Nacelle and Wing Efficiencies by the mean of Extended Laminarity technologies.
- **High Speed Airframe**, to focus on the fuselage & wing step changes enabling better aircraft performances and quality of the delivered mobility service, with reduced fuel consumption and no compromise on overall aircraft capabilities (such as low speed abilities & versatility).
- **Novel Control**, to introduce innovative control systems & strategies to gain in overall aircraft efficiency. The new challenges that could bring step change gains do not lay in the optimisation of the flight control system component performing its duty of controlling the flight, but in opening the perspective of the flight control system as a system contributing to the global architecture optimization. It could contribute to sizing requirements alleviations thanks to a smart control of the flight dynamics.

- **Novel Travel Experience**, to investigate new cabins including layout and passenger oriented equipment and systems as a key enabler of product differentiation, having an immediate & direct physical impact on the traveller, and with a great potential in terms of weight saving & eco-compliance.
- **Next Generation Optimized Wing**, leading to progress in the aero-efficiency and the ground testing of innovative wing structures;

  The challenge is to develop and demonstrate new wing concepts (including architecture) that will bring significant performance improvements (in drag & weight) while improving affordability and enforcing stringent environmental constraints.
- **Optimized High Lift Configurations**, to progress on the aero-efficiency of wing, engine mounting & nacelle integration for aircraft who needs to serve small, local airports thanks to excellent field performances.
- **Advanced Integrated Structures**, to optimize the integration of systems in the airframe along with the validation of important structural advances and to make progress on the production efficiency and manufacturing of structures.
- **Advanced Fuselage** to introduce innovation in fuselage shapes and structures, including cockpit & cabins. New concepts of fuselage are to be introduced to support the future aircrafts and rotorcrafts. More global aero structural optimizations can lead to further improvements in drag & weight in the context of a growing cost & environmental pressure, including emergence of new competitors.

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

- Activity Line 1: Demonstration of airframe technologies focused towards **High Performance & Energy Efficiency (HPE);**
- Activity Line 2: Demonstration of airframe technologies focused toward **High Versatility and Cost Efficiency (HVE).**

7.5. Engines ITD

In Clean Sky the industry leaders committed to build and test seven engine ground demonstrators covering all the civil market. The goals were to validate to TRL 6 a 15% reduction in CO_2 compared to 2000 baseline, a 60% reduction in NOX and a 6dB noise reduction. This is roughly 75% of the ACARE 2020 objectives. Following the worst economic downturn and the consequent changes to market assumptions Clean Sky''s SAGE has adjusted its content to ensure these goals remain achievable. Apart from the consequent delay to the open rotor programme which means that TRL6 is not possible by 2016, the bulk of SAGE objectives remain on track. An open rotor ground demonstrator will run and confirm the CO_2 objective; a lean burn combustion ground demonstrator will run to confirm the NOX objective. A GTF has already run to confirm the CO_2 improvements and noise advantage of such a configuration. An advanced turbo-shaft engine has also run to ensure the environmental goals extend across the whole market while SAGE 3 has run for the first time to validate the cost and weight advantages of an advanced dressings configuration and an advanced low pressure system. The original plans for the open rotor from both Airbus and the engine manufacturers had to be revised and require further work to confirm both the advantages and credibility of this novel concept.

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

- **Open Rotor Flight Test, 2014-2023:** A 2nd version of a Geared Open Rotor demonstrator carrying on *Clean Sky* SAGE 2 achievements and aimed to validate TRL 6 will be tested on ground and then on the Airbus A340 flying test bed (see IADP LPA Programme). From the initial SAGE 2 demonstrator some engine modifications aimed to various improvements, control system update, and engine/aircraft integration activities will be necessary.

- **Ultra High Propulsive Efficiency (UHPE) demonstrator addressing Short / Medium Range aircraft market, 2016-2021:** Design, development and ground test of a propulsion system demonstrator to validate the low pressure modules and nacelle technology bricks necessary to enable an Ultra High By-pass Ratio engine (e.g. advanced low pressure fan, innovative nacelle modules, gearbox, pitch change mechanism if any, high speed power turbine). This ground demonstrator will be built around an existing high pressure core.

- **Business aviation / Short range regional Turboprop Demonstrator, 2015-2020:** Design, development and ground testing of a new turboprop engine demonstrator in the 1800-2000 thermal hp class. The base line core of ARDIDEN3 will be improved specifically for turboprop application (compressor up-date, combustion chamber, power turbine) and then integrated with innovative gear box, new air inlet and innovative propeller.

- **Advanced Geared Engine Configuration (HPC and LPT technology demonstration), 2015-2020:** Design, development and ground testing of a new demonstrator to validate key enablers to reduce CO_2 emissions and noise as well as engine weight. Key elements are: improvement of efficiencies, reduction of parasitic energy flows, innovative lightweight and temperature resistant materials, low pressure turbine and exhaust noises reduction. On compressor side compression system rigs will be build, in which the planned compressor technologies - in particular relevant for interactions between low pressure, high pressure and static structure - can be tested and achieve TRL6.

- **Very High Bypass Ratio (VHBR) Large Turbofan demonstrator, 2014-2021:** Design, development, building, ground testing and flight testing of an engine to demonstrate key technologies on a scale suitable for large engines. An existing engine will provide the core gas generator used for the demonstrator. Key technologies included in this demonstrator will be: integrated low pressure system for a high power very-high bypass ratio engine (fan, compressor, gearbox, LP turbine, VAN), Engine core optimisation and integration, and optimised control systems.

- **Very High Bypass Ratio (VHBR) Middle of Market Turbofan technology, 2014-2021:** Development and demonstration of technologies in each area to deliver validated powerplant systems matured for implementation in full engine systems. Research and demonstration will require the following: behaviour of fans at low speeds and fan pressure ratios and structural technology, aerodynamic and structural design of low pressure turbines for high speed operation, Systems Integration of novel accessory and power gearboxes, optimised power plant integration, Compressor efficiency, and control & electrical power system technology developments.

- **Light weight and efficient jet-fuel reciprocating engine**
  The Small Aero-Engine Demonstration projects related to SAT [Small air Transport] will focus on small fixed-wing aircraft in the general aviation domain, and their power-plant solutions spanning from piston/diesel engines to small turboprop engines. The ITD engine Work Package 7 focuses on piston engines burning jet fuels, in the power range suitable for general aviation, from 5 to 19 seats. These technologies will bring new solutions to replace old gasoline leaded fuel

pistons or small turbines for single and twin engine aircraft. The scope includes the core engine in order to improve the power density, but also the equipment as the turbocharger, the propeller integration and the aircraft installation optimization

- **Reliable and more efficient operation of small turbine engines**
  This area in the Engines ITD will focus on the the reliability and efficiency gains in small turbine engines demonstration project for the business and general aviation such as reference 19 seat aircraft, developing leading edge technologies, design tools and manufacturing technologies for application in both, spiral development programs as well as new engine architectures.

7.6. Systems ITD

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

- Direct contributions to environmental objectives: optimised green trajectories, electrical taxiing, more electrical aircraft approach, and have a direct impact on CO_2 emissions, fuel consumption, perceived noise, air quality, weight gain.
- Enablers for other innovations: for example, bleedless power generation, actuators, are necessary steps for the implementation of innovative engines or new aircraft configurations.
- Enablers for air transport system optimisation: many of the major improvements identified in SESAR, NextGen and Clean Sky for greening, improved mobility or ATS efficiency can only be reached through the development and the integration of on-board systems such as data link, advanced weather systems, trajectory negotiation, and flight management predictive capabilities.
- Smart answers to market demands: systems and equipment have to increase their intrinsic performance to meet new aircraft needs without a corresponding increase in weight and volume: kW/kg, flux/dm3 are key indicators of systems innovation.

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

The Systems ITD in Clean Sky 2 will address these challenges through the following actions:

- Work on specific topics and technologies to design and develop individual equipment and systems and demonstrate them in local test benches and integrated demonstrators (up to TRL 5). The main technological domains to be addressed are cockpit environment and mission management, computing platform and networks, innovative wing systems (WIPS, sensors, and actuators), landing gears and electrical systems. Other contributing activities are foreseen and will be carried on by core partners and partners. The outcome of these developments will be demonstrated systems ready to be customized and integrated in larger settings. An important part of this work will be to identify potential synergies between future aircraft at an early stage to reduce duplication.
- Customisation, integration and maturation of these individual systems and equipment in IADPs demonstrators. This will enable full integrated demonstrations in IADPs and assessment of benefits in representative conditions.

- Transverse actions will also be defined to mature processes and technologies with potential impact on all systems, either during development or operational use. Examples of these transverse actions can be development framework and tools, simulation, incremental certification, integrated maintenance, eco-design etc.

7.7. Small Air Transport (SAT) Transverse Activity

The SAT Initiative proposed in *Clean Sky 2* represents the R&T interests of European manufacturers of small aircraft used for passenger transport (up to 19 passengers) and for cargo transport, belonging to EASA´s CS-23 regulatory base. This includes more than 40 industrial companies (many of which SMEs) accompanied by dozens of research centres and universities. The New Member States industries feature strongly in this market sector. The community covers the full supply chain, i.e. aircraft integrators, engine and systems manufacturers and research organizations.

The approach builds on accomplished or running FP6/FP7 projects. Key areas of societal benefit that will be addressed are:

- Multimodality and passenger choice
- ore safe and more efficient small aircraft operation
- Lower environmental impact (noise, fuel, energy)
- Revitalization of the European small aircraft industry

To date, most key technologies for the future small aircraft have reached an intermediate level of maturity (TRL3-4). They need further research and experimental demonstration to reach a maturity level of TRL5 or TRL6. The aircraft and systems manufacturers involved in SAT propose to develop, validate and integrate key technologies on dedicated ground demonstrators and flying aircraft demonstrators at an ITD level up to TRL6. The activity will be performed within the *Clean Sky 2* ITDs for Airframe, Engines and Systems; with strong co-ordinating and transversally integrating leadership from within a major WP in Airframe ITD.

7.8. Eco-Design Transverse Activity

The Eco-Design Transverse Activity (TA) has the aim to contribute to introduce in ITDs/IADPs activities more valuable eco compliant technologies from a whole product life-cycle perspective and covering the widest range of aeronautical products and systems.
Eco-Design TA will be coordinated and managed by the leader in synergy with ITDs/IADPs development and objectives, with the core of technology development and demonstration residing in the ITDs/IADPs GAMs.
Eco-Design TA will act in helping ITDs/IADPs technology screening through Vehicle Ecological Economic Synergy (VEES) sub-project, mainly regarding the most promising activities worth to be performed toward material, processes and resources innovations and worth to be adopted in future aeronautical products design. The technologies need to include concept toward increased less energy and resources demand, life of components, more recyclability, better re-use, going beyond the conventional ““cradle to grave”” approach and considering emerging aspects coming from future requirements to be met. New bottom-up proposals are also worth to be taken into consideration through dedicated workshops during the project.
Eco-Design analysis (EDAS) sub-project process and tools will then help, basing on master scientific approaches, in the assessment of the benefits toward the definition of more eco-friendly products. Expansion of data base developed in CS1 together with new LCA methodologies and guidelines are worth to be investigated toward a design for environment vision for new aircrafts.

7.9. Technology Evaluator

A Technology and Impact Evaluation (TE) infrastructure remains an essential element within the Clean Sky PPP, and the TE will be reinforced and continued in order to ensure monitoring, assessment, communication, orientation of the JU and IADPs/ITDs/TAs. Impact Assessments, currently focused on noise and emissions, will be expanded and evaluated against the Programme’’s delivered value. Where applicable they will include additional impacts, such as the mobility/connectivity benefits or increased productivity of Clean Sky 2 concepts.

The progress of each demonstration platform (ITDs and IADPs) will be monitored against well-defined environmental (Noise, CO_2, NO_x) and socio-economic (Mobility/Connectivity, Employment, GDP impact) benefits and targets. In the case of full vehicle-level demonstrations as in the IADPs, the core aircraft performance characteristics will be reported by the IADP to the TE under the responsibility of the leading company.

The IADPs will provide verification and validation of the aircraft designs proposed. In the case of the Clean Sky 2 ITDs, the TE will enable an aircraft-level synthesis of results in such a way (via ‘‘concept aircraft’’) that the ITD results can be shown at aircraft level and evaluated within the Airport and Air Transport System alongside IADP results. The TE Impact Evaluator function will reside within the JU. Impact Assessments of Clean Sky 2 outputs will be the responsibility of the TE Impact Evaluator and will focus on aggregate impacts.

Based on lessons learnt in Clean Sky, the following principles will be followed:

- The Progress Monitoring of Clean Sky 2 achievements versus defined environmental and societal objectives will be established via an efficient and effective interfacing between TE and the ITD/IADPs through dedicated work packages (TE WP2 and ITD IADP dedicated WPs).
- The evaluation at Mission Level will be done by integrating ITD outputs into TE concept aircraft / rotorcraft models (including innovative long term aircraft configurations); and in the case of IADPs receiving IADP concept aircraft / rotorcraft models.

The concept aircraft/rotorcraft models will be input for impact assessments at Airport & ATS Levels. The composition and rules of procedure of the governing body of the Technology Evaluator has been adopted by the CS Governing Board in April 2016.

8. Budget to Completion

The proposed total funding available as defined by the Clean Sky 2 Regulation is 1,755 M€ of which 39 M€ corresponds to the contribution towards the Joint Undertaking running costs, leading to a funding available for the Clean Sky 2 operational costs of 1,716 M€.

In accordance with the Statues of Clean Sky 2, Annex I Art. 16, the Union contribution dedicated to operational costs (1,716M€) shall be allocated by SPD on an indicative basis as follows:

IADPs / ITDs	Allocation Regulation - % (Annex III Clean Sky JU Council Regulation)	Allocation Regulation - M€ **(1)**	**TE** 1% IADPs/ITDs values - M€ **(2)**	**ECO** 2% IADPs/ITDs values - M€ **(3)**	**SAT** 4% IADPs/ITDs values - M€ **(4)**	Real allocation - M€ **(5)** = (1) - (2) - (3)- (4)
				Transverse activities		
LPA	32%	548.17	5.48	12.48	21.71	**508.50**
REG	6%	109.63	1.10	2.50	4.34	**101.70**
FRC	12%	200.20	2.00	4.56	7.93	**185.71**
AIR	19%	333.67	3.34	7.60	13.21	**309.52**
ENG	17%	286.00	2.86	6.51	11.33	**265.30**
SYS	14%	238.33	2.38	5.43	9.44	**221.09**
TE						**17.16**
ECO						**39.06**
SAT						**67.95**
TOTAL	**100%**	**1,716**	**17.16**	**39.06**	**67.95**	**1,716.00**
				124.18		

Table 1 - Distribution of Funding: operational budget to completion per SPD CS2 Programme

From original allocation (column (1)) to IADPs/ITDs, 1%, 2% and 4% is retained (columns (2), (3) and (4)) for the Transverse Activities.
The column (5) represents the estimated CS2 funding for the IADPs/ITDs till programme completion – once the TAs activities’’ allocations are deducted.

Following the deduction of the TA % allocations by SPD, the following Table 2 shows the distribution of funding by taking into account the TA allocations where these are applied and incorporated into the SPD GAM envelopes.

IADPs / ITDs / TAs	Allocation - M€ (1)	Distribution ECO (2)	Distribution SAT (3)	Final Allocation - M€ (4) = (1) + (2) + (3)
LPA	**508.50**	**12.48**		**520.98**
REG	**101.70**	**2.50**		**104.20**
FRC	**185.71**	**4.56**		**190.27**
AIR	**301.85**	**7.60**	**24.10**	**333.55**
ENG	**265.25**	**6.51**	**16.55**	**288.31**
SYS	**228.81**	**5.43**	**24.30**	**258.53**
TE	**17.16**	**-**	**-**	**17.16**
ECO	**-**	**-**	**-**	**-**
SAT	**3.00**	**-**	**3.00**	**3.00**
TOTAL	**1,611.98**	**39.06**	**67.95**	**1,716.00**

Table 2 - Indicative Distribution of Funding: operational budget to completion per SPD CS2 Programme (including TAs allocations)

(1) **<u>TE for a total of 17,16m€</u>**: TA TE has its own GAM and will not contribute to any activities within the IADPs/ITDs

<u>(2) **ECO for a total of 39,06m€:**</u> TA ECO GAM final figures and multi-annual overview are not available yet. As a consequence, the total amount (39,06m€) is still redistributed to the IADPs/ITDs within the same proportion as that of Annex III of the Council Regulation (See table 1).

(4) **<u>SAT for a total of 67,95m€:</u>** TA SAT GAM is confirmed for a total of 3m€ (till completion). The balance amount (64,95m€) is redistributed to the ITDs in accordance with information received from SAT Leaders.

(5) **<u>A transfer of technical activities for a total of 7,67m€</u>** has been made from AIR to SYS (in total final allocation)- as agreed in the steering committees of both SPDs.

The regulation does not foresee a split for any beneficiary type (i.e. leaders, core partners, partners) inside the projects and actions. However, presently, and based on CS programme experience, the Table 3 below reflects the indicative envelopes of funding as forecast to be allocated to each IADP/ITD/RA and equally indicatively split between leaders, core partners and partners/tenders, following the overall % allocations given in the Regulation. The allocation here (with total 1717.44m€) is the result of "bottom-up" planning – however, it cannot be decided on by the Governing Board as it exceeds the foreseen allocation in the Regulation. The Governing Board adopts the value in the second last column – i.e. Amount for GB decision.

Funding envelope to completion	LPA	REG	FRC	AIR	ENG	SYS	TE	ECO	SAT		Allocation according to Regulation	Amount for GB Decision (June 2016)	Allocation according to Regulation
											of 1.716m €		1716
Leaders & Core-Partners	359.43	72.94	135.85	244.31	211.87	169.65	6.10	0.00	3.00	1203.14		1201.20	
Leaders	**208.44**	**41.68**	**76.11**	**130.60**	**110.03**	**102.53**	**6.10**	**0.00**	**3.00**	**678.49**	**39.54%**	**686.40**	**40.00%**
of which Eco-Design	4.99	1.00	1.82	3.04	2.60	2.17	0.00	0.00	0.00	15.63		15.63	
of which SAT				6.00	1.30	7.95			3.00	18.25		18.25	
Core-Partners	**150.99**	**31.26**	**59.73**	**113.71**	**101.84**	**67.12**	**0.00**	**0.00**	**0.00**	**524.65**	**30.57%**	**514.80**	**30.00%**
of which Eco-Design	3.74	0.75	1.37	2.28	1.95	1.63	0.00	0.00	0.00	11.72		11.72	
of which SAT				12.00	10.05	6.55				28.60		28.60	
Partners*	162.37	31.26	54.40	89.56	76.44	89.20	11.06	0.00	0.00	514.29	29.97%	514.80	30.00%
of which Eco-Design	3.74	0.75	1.37	2.28	1.95	1.63	0.00	0.00	0.00	11.72		11.72	
of which SAT				6.10	5.20	9.80				21.10		21.10	
Total funding to completion (1)	**521.80**	**104.20**	**190.25**	**333.87**	**288.31**	**258.85**	**17.16**	**0.00**	**3.00**	**1,717.44**		**1,716.00**	
										OVER BUDGET			

** Including call for Tenders*

Table 3 - Potential Distribution of Funding: operational budget to completion per SPD Clean Sky 2 Programme - Leaders/Core-Partners/Partners distribution - draft following input transmitted to JU

In addition to the notes presented following table 2:

(1) This table represents the final funding allocation ("Total budget to completion" as presented in table 2 - column (4)) distributed within the Leaders / Core-Partners / Partners (& Call for Tenders) in accordance with the Clean Sky 2 JU Council Regulation Annex I Art. 16:

"- up to 40% shall be allocated to Leaders
- up to 30% shall be allocated to Core Partners
- at least 30% shall be allocated to Partners and calls for tenders
- and taking into consideration the information collected from the different Part C table 3"

(2) The ECO (39,06m€) and SAT (64,95m€) TAs redistributions to SPDs/ITDs which include the Leaders / Core Partners / Partners and calls for tenders funding parts are presented in this table under sections "of which" for a better understanding.

(3) TE and ECO GAM Leaders shares are estimated based on the requirement that maximum Leaders funding cannot exceed 40% of total operational budget.

(4) TE having no planned Core-Partners activities, the balance amount (17,16m€ - 4,10m€(Leaders) = 13,06m€) is allocated to the Partners and Call for Tenders - in accordance with the requirement as mentioned in remark (1) above.

(5) ECO distribution between Leaders / Core Partners / Partners and calls for Tenders is done following the same 40/30/30% proportion.
(6) SAT distribution between Leaders / Core Partners / Partners and calls for Tenders is done in accordance with information received from SAT Leaders
(7) The over-budgetted figures may not be taken as provided to the operational costs at the expense of the running costs. The over-run shall be monitored by the JU and brought in line with the regulation. The amount available from the EC subsidy for running costs remains at 39m €.

N.B.: The Partners'' budget will be kept at JU level and managed with the Members through the statutory responsibilities as was done in the Clean Sky Programme. The budget / forecast cost to completion in this table is based on the assumptions recorded here under and with the aim of tracking the Programme's operational expenditure against the Programme areas and across the beneficiary categories, and is at all times **indicative and for planning purposes only**. The breakdown across beneficiary types will be adjusted to reflect actual Call results and beneficiaries' share of the Programme going forward; and where necessary for planning purposes the assumptions will be revisited to accurately reflect the funding distribution across IADP/ITD/TAs and across beneficiary categories.

The JU will monitor the adequate adherence to the Regulation's requirements and in the interest of keeping the Programme open to newcomers and to the necessary wide variety of beneficiary types. The JU will also safeguard the appropriate balance of Call topics so as to ensure the overall Programme goals (both mid and long term) are achieved.

Annexes

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A. Abbreviations

A/C:	Aircraft
ACARE:	Advisory Council for Aviation Research and Innovation in Europe
AIR:	Airframe (ITD)
ATM:	Air Traffic Management
CS:	Clean Sky Programme
CS2:	Clean Sky 2 Programme
CS2DP:	Clean Sky 2 Development Plan
CSMM:	Clean Sky Management Manual
CDR:	Critical Design Review
CfP:	Call for Proposal
CfT:	Call for Tender
CROR:	Counter Rotating Open Rotor
CSJU (JU):	Clean Sky 2 Joint Undertaking
CSSC:	Clean Sky Scientific Committee
CSTR:	Clean Sky Technology Register
DoW:	Description of Work
ECO:	Eco-Design TA
EDA:	Eco-Design for Airframe
ENG:	Engines (ITD)
Envt:	Environment
ESIF:	European Structural and Investment Funds
FMS:	Flight Management System
FRC:	Fast Rotorcraft (IADP)
GAM:	Grant Agreement for Members
GAP:	Grant Agreement for Partners
GRA:	Green Regional Aircraft (ITD)
GRC:	Green RotorCraft (ITD)
ITD:	Integrated Technology Demonstrator
IADP:	Innovative Aircraft Demonstrator Platform
JTI:	Joint Technology Initiative
JTP:	Joint Technical Programme
JU:	Joint Undertaking
LPA:	Large Passenger Aircraft (IADP)
QPR:	Quarterly Progress Report
MAE:	Management of Aircraft Energy
MMD:	Manufacture, Maintenance & Disposal
PDR:	Preliminary Design Review
RIS3:	Regional Research and Innovation Strategies for Smart Specialisation
SAGE:	Sustainable And Green Engines (ITD)
SAT:	Small Air Transport Transverse Activity
SESAR:	Single European Sky Air Traffic Management Research
SFWA:	Smart Fixed Wing Aircraft (ITD)
SGO:	Systems for Green Operations (ITD)
SRG:	National States Representatives Group
S/S:	Sub-System
SPD:	Systems & Platform Demonstrators
SYS:	Systems (ITD)
TA:	Transversal Activity
TE:	Technology Evaluator
ToP:	Type of Action
WBS:	Work Breakdown Structure

B. Spending Profile over the Lifetime of CS2

CS2DP consolidated figures revision May 2016

PART C Table 3

		TOTAL	2014	2015	2016*	2017*	2018**	2019**	2020	2021	2022	2023	
		1.717,44	**32,42**	**92,25**	**248,95**	**339,18**	**317,55**	**274,46**	**212,44**	**110,56**	**63,11**	**26,51**	
		TOTAL per SPD	**Total per year**										Ratio
LPA		**521,80**	15,58	25,06	54,13	74,67	90,56	97,28	79,17	43,62	29,64	12,09	
	L	208,44	1,49	9,49	15,51	22,86	27,09	35,64	33,55	30,49	22,69	9,62	40%
	CP	150,99	0,00	2,66	18,00	23,59	30,33	30,13	23,72	13,13	6,96	2,47	29%
	P	162,37	14,09	12,91	20,62	28,22	33,14	31,50	21,90	0,00	0,00	0,00	31%
REG		**104,20**	0,28	4,71	14,26	21,93	22,14	18,19	17,02	4,80	0,82	0,05	
	L	41,68	0,23	3,38	6,20	8,94	6,90	5,99	5,87	3,58	0,54	0,05	40%
	CP	31,26	0,05	1,33	6,46	8,26	6,57	4,90	2,19	1,22	0,28	0,00	30%
	P	31,26	0,00	0,00	1,60	4,72	8,67	7,30	8,97				30%
FRC		**190,25**	5,94	14,01	38,68	59,14	21,49	17,19	17,76	10,07	4,03	1,94	
	L	76,11	1,02	6,84	15,16	21,04	7,99	6,89	7,89	5,57	1,78	1,94	40%
	CP	59,73	0,00	0,77	4,67	13,87	13,50	10,29	9,87	4,50	2,25	0,00	31%
	P	54,40	4,92	6,40	18,85	24,23	0,00	0,00	0,00	0,00	0,00	0,00	29%
AIR		**333,87**	1,24	13,32	39,18	59,70	69,00	59,42	45,37	28,36	13,81	4,46	
	L	130,60	1,24	10,95	16,03	19,36	24,27	22,10	16,96	10,98	5,97	2,72	39%
	CP	113,71	0,00	2,08	17,98	23,73	21,58	19,83	15,32	8,94	3,99	0,26	34%
	P	89,56	0,00	0,29	5,17	16,61	23,14	17,48	13,10	8,44	3,85	1,48	27%
ENG		**288,31**	3,37	18,03	57,24	70,14	65,08	41,15	20,83	7,32	3,97	1,19	
	L	107,42	3,37	9,54	28,40	33,40	17,34	10,24	3,53	0,99	0,35	0,27	37%
	CP	99,89	0,00	5,06	18,54	21,97	24,62	17,81	9,62	1,33	0,94	0,00	35%
	P	74,49	0,00	3,42	9,49	13,96	22,31	12,29	6,86	4,18	1,87	0,11	26%
	ECO	6,51	0,00	0,00	0,81	0,81	0,81	0,81	0,81	0,81	0,81	0,81	2%
SYS		**258,85**	0,58	17,12	44,23	51,48	46,75	38,71	29,79	13,91	7,93	2,93	
	L	100,36	0,58	8,99	19,10	21,47	15,94	13,52	11,65	5,08	2,77	1,26	39%
	CP	65,49	0,00	0,15	3,24	9,72	11,40	13,59	11,75	8,83	5,16	1,67	25%
	P	87,57	0,00	7,98	21,89	20,29	19,41	11,60	6,40	0,00	0,00	0,00	34%
	ECO	5,43											
TE		**17,16**	0,00	0,00	0,92	1,74	2,06	2,06	2,06	2,06	2,60	3,67	
	L	6,10			0,36	0,63	0,82	0,82	0,82	0,82	0,67	1,18	36%
	CP	0,00											0%
	P	11,06			0,55	1,11	1,24	1,24	1,24	1,24	1,94	2,49	64%
SAT		**3,00**	0,00	0,00	0,31	0,40	0,47	0,47	0,43	0,43	0,30	0,19	
	L	3,00	0	0	0,31	0,40	0,47	0,47	0,43	0,43	0,30	0,19	100%
	CP	0,00											0%
	P	0,00											0%

* risk of unsustainability of SPDs profile vs JU profile in the area of payment appropriations for 2017: solution under preparation in order to find a solution

** high risk of unsustainability of SPDs profile vs JU profile in the area of commitment and payment appropriations for the years 18 & 19: further analysis needed