ANNEX to GB decision no CAJU-GB-Writ proc 2023-01-Second Amended Work Programme and Budget 2022-2023

CLEAN AVIATION
JOINT UNDERTAKING

SECOND AMENDED WORK PROGRAMME and BUDGET 2022-2023

In accordance with the Council Regulation (EU) No Council Regulation (EU) No 2085/2021 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe and with Article 31 of the Financial Rules of the Clean Aviation JU.
The work programme is made publicly available after its adoption by the Governing Board.

Co-funded by the European Union

Table of Contents

1 INTRODUCTION

1.1 Mission statement of the Clean Aviation Joint Undertaking

The Clean Aviation JU will develop disruptive new aircraft technologies to support the European Green Deal, and climate neutrality by 2050. These technologies will deliver net greenhouse gas (GHG) reductions of no less than 30%, compared to 2020 state-of-the-art. The technological and industrial readiness will allow the deployment of new aircraft incorporating these technologies no later than 2035, enabling 75% of the world's civil aviation fleet to be replaced by 2050. The aircraft developed will enable net CO_2 reductions of up to 90% when combined with the effect of sustainable 'drop-in' fuels, or zero CO_2 emissions in flight when using hydrogen as energy source.

Clean Aviation's aeronautics-related research and innovation activities, focusing on breakthrough technology initiatives, will contribute to the global sustainable competitiveness of the European aviation industry. Our efforts will ensure that aviation remains a safe and secure, reliable, cost-effective and efficient means of passenger and freight transportation while successfully transitioning to climate neutrality. European aviation research and innovation capacity will be strengthened through the partnership, enabling new and ambitious global standards to be set.

1.2 Background and link with the Strategic Research and Innovation Agenda

Europe needs to accelerate and enhance its efforts to achieve the ambitious goals set out in the Paris Agreement. The European Green Deal is a cornerstone policy of the European Union; and it sets out the path to achieving Europe's leading contribution. It includes the first European Climate Law, enshrining the 2050 climate neutrality objective in legislation. At the same time, the Industrial Strategy for Europe lays out in clear terms the importance of industrial leadership in making the transformation to a green and digital Europe fit for the future.

The European aviation sector will need to contribute to these priorities. This will involve transformational change to aircraft entering into operation, including their propulsion, on-board systems and structures, and potentially the fuel or energy source used. Disruptive innovation to enable this transformation will need to be coupled with appropriate measures and policies that allow for the timely introduction of infrastructures, the required ramp-up in availability of renewable energy and the production of hydrogen and 'sustainable aviation fuels'. The common challenge is to lead the way toward a climate neutral aviation system and set new global standards for safe, reliable, affordable and clean air transport.

The journey to a climate-neutral aviation system is well beyond the capability and investment capacity of the private sector alone. Equally, no single country in Europe has the financial, technological and industrial capability to affect the transformation. The European additionality is evident. An institutionalised European Partnership for Clean Aviation under Horizon Europe constitutes the only approach that can pull together the required resources and commitments, and adequately reduce the industrial risk for transformative research and innovation [R&I]. This approach will secure the long-term industrial commitments needed for long innovation cycles. It will ensure that research activities of industry are aligned with the Union's policy priorities. It will build Europe's leadership in innovation and technology, and deliver jobs and economic growth throughout the transition to a climate-neutral Europe by 2050. It can offer future generations the promise of continued, affordable and equal access to air travel, with all of its social and economic benefits, and contribute to the UN's Sustainable Development Goals.

The Clean Aviation Partnership's **Strategic Research and Innovation Agenda** [SRIA] sets out the way to achieve the overall vision, in terms of timescales and magnitude of impact. This integrated research roadmap includes the required upstream 'exploratory' research that is essential to finding tomorrow's pathways to mature technologies, ready to be incorporated into further new and disruptive innovations.
The Clean Aviation trajectory defines two clear horizons towards climate neutrality by 2050:

- 2030: demonstrating and introducing low-emissions aircraft concepts exploiting the research results of Clean Aviation, making accelerated use of sustainable fuels and optimised 'green' operations, so these innovations can be offered to airlines and operators by 2030 for an entry into service [EIS] in the 2030-2035 timeframe;
- 2050: climate-neutral aviation, by exploiting future technologies matured beyond the Clean Aviation phase coupled with full deployment of sustainable aviation fuels and alternative energy carriers.

1.3 Strategy for the implementation of the programme

The high-level objectives (HLO) as set in the Council Regulation (EU) 2021/2085[1] have been laid down in the vision and the overall ambition of the SRIA (see previous chapter). These have subsequently been translated into an executable Technology Roadmap that has served as the basis for the work programme, with topics including technical requirements, critical milestones, expected decision gates, and targets that will allow for the selection and execution of clearly defined research actions, contributing to the achievement of the programme's high-level objectives.

The **Clean Aviation programme** is built on three key *thrusts*, each with targeted R&I and demonstration efforts driving the energy efficiency and the emissions reduction of future aircraft. Each thrust will develop technologies and enablers, leverage essential knowledge and capabilities, and de-risk the identified technologies and solutions, where further maturation, validation and demonstration is required to maximise impact (see chapter 2.2.2 "*Scientific priorities, challenges and expected impact*"):

- Hybrid electric regional aircraft
- Ultra-efficient short/short-medium range aircraft
- Disruptive technologies to enable hydrogen-powered aircraft

The implementation of the Clean Aviation work programme is divided into two phases:

- The **first phase of the programme (Phase 1: 2022 - 2025)** is dedicated to identifying high-potential disruptive aircraft concept(s) by assessing a broad set of potentially relevant configurations. This includes the development and maturation of the contributing technologies and key enablers supported by demonstration and validation to allow a down-selection of most promising technology options and integrated solutions.
- The **second phase of the programme (Phase 2: 2026-2031)**, which will largely depend on the outcome of the first phase, will focus on the most promising aircraft architectures and the integration of the selected best candidate technologies to form aircraft concepts. Key elements of this phase will be large-scale integrated aircraft component/system tests and large-scale flying demonstrator platforms to validate and demonstrate the performance of the key technologies and the targeted aircraft at realistic sizes and operational conditions.

[1] Council Regulation (EU) 2021/2085 of 19 November 2021, Official Journal: OJ L 427, 30.11.2021, p. 17–119

The Clean Aviation Joint Undertaking (CAJU) will identify those technical solutions with the highest impact in terms of climate combined with the best chance of evolving into sustainable product and service innovations, including the demonstration of new ambitious technology solutions and climate-neutral aircraft concepts, via competitive calls for proposals, open to all interested stakeholders willing to commit, contribute and collaborate in the partnership. This approach will allow for long-term allocation of budget through multi-annual grant agreements in line with the open calls and the CAJU financial rules on multi-annual commitments. The CAJU's Work Programme will identify and govern the calls, topics and related R&I actions.

To compensate for the delayed launch of the Clean Aviation programme, the agreed strategy is to launch two calls for proposals in Phase 1: a large call in 2022 and a smaller call in 2023, covering all available funding currently foreseen for Phase 1, and addressing a number of challenges considered as having the highest priority in order to secure the required impact of the programme. This will kick-start the implementation of the programme as well as securing the required long-term commitment from stakeholders to deliver the necessary resources and execute the research activity.

In Phase 2, complementary calls for proposals will be launched in order to allow for tailored and time-limited contributions from partners (in particular from SMEs), towards the integration and build-up of demonstrator hardware as well as for analysis, simulation, testing and validation activities.

Calls for additional associated members may be launched over the life of the programme to ensure the consortia have the appropriate configurations and skillsets needed to maximise results and impact.

Clean Aviation Joint Undertaking will also build on important earlier research carried out under previous Framework Programmes on R&I (such as under the Clean Sky and Clean Sky 2 programmes) and on the experience gained from managing these.

2 WORK PROGRAMME 2022-2023

2.1 Executive summary

The following work programme (and its accompanying budget plan) sets out the main highlights and scientific priorities of the technical activities to be covered across the ambitious research and innovation programme funded by the European Union budget over the period 2022 and 2023. It also includes relevant administrative and legal details and aspects regarding the establishment of the Clean Aviation Joint Undertaking (CAJU). At the start ofCAJU, the joint efforts of the private and public members, together with the JU programme office, were required for the successful start of this ambitious and challenging programme.

In 2022 the CAJU launched its first open call for proposals in the first quarter, so that the signature of the grant agreements could be completed and the technical activities in all three thrusts of the programme could start before the end of the year. A high-level overview of the topics and further information about the first call are available in chapter 2.2.4 and the full and detailed topic descriptions can be found in Annex 4.1.

The call opening of the second open call is foreseen in early 2023. The high-level summary of the topics is provided in Chapter 3.2.4.

In addition to the calls for proposals the JU will launch on open Calls for Expression of Interest (CEI) within the 2022-2023 period, see chapter 2.4.2.

The call for expression of interest will address interested private stakeholders to become an Associated Members of the Joint Undertaking. Successful applicants will be those who can demonstrate strategic and long-term commitment to the programme and who can perform core tasks and bring key capabilities to implement the programme through the research actions in which they may be or may become involved.

2.2 Message from the Executive Director

Dear Readers,

It is my great pleasure to present the first Clean Aviation work programme for the period spanning 2022 and 2023.

The Clean Aviation Joint Undertaking was launched on December 1st, 2021 and I would now like to take this opportunity to welcome our Members and to introduce Rosalinde van der Vlies, the European Commission's Director for Clean Planet as Chair, and Sabine Klauke, CTO of Airbus, as Co-Chair of the Clean Aviation Joint Undertaking Governing Board.

Clean Aviation will play a decisive role in supporting the European Union's objective to reach climate-neutrality by 2050 and meet the pressing societal expectation to act upon climate change and protect

our planet. The partnership will develop, mature and demonstrate the disruptive and impactful technologies we need to secure climate-neutral aviation within a very tight deadline.

I encourage all aviation stakeholders to take a look at our mission and vision, and to apply for our Calls for Proposals. No idea is too big, or too small, if it has the potential to bring us closer to our goal. We will also be making joint Calls in order to forge synergies between our Joint Undertaking and other complementary European initiatives, such as the Clean Hydrogen Joint Undertaking and the Batt4EU batteries partnership. Additionally, calls for expression of interest for the selection of additional Associated Members will be launched.

The Clean Aviation Joint Undertaking is not starting from scratch. It builds on the success and achievements of the Clean Sky and Clean Sky 2 Joint Undertaking to date. Projects funded by the Clean Sky 2 Joint Undertaking will continue to run until 2024. We have more than 34 flagship demonstrators, more than 100 other demonstrators contributing to those flagship demonstrators, and more than 1000 technologies in our innovation pipeline.

Some highlights to look forward to over the course of the Clean Aviation work programme include the first flights of our two Fast Rotorcraft concept demonstrators, RACER and Next Gen Civil Tilt Rotor. These innovative designs will prove that fast, multipurpose rotorcraft are feasible using cutting-edge sustainable technologies. Other innovations to watch include the Multi-Functional Fuselage Demonstrator, the UltraFan propulsion concept, and the electrical Environmental Control System, all of which will complete final tests over this period.

To find out more about Clean Sky's innovative technologies, you can read our Results Stories. I advise you to sign up to our E-news to stay informed about the latest developments, particularly related to the Clean Aviation Programme – from results to calls to upcoming events.
I hope that you enjoy reading about our planned flight path for 2022-2023.

Axel Krein

Executive Director

2.3 Operational activities of Clean Aviation JU

2.3.1 Scientific priorities, challenges and expected impact

The mission of the Clean Aviation Partnership is to develop disruptive new aircraft technology to pave the way towards the EU's ambition of climate neutrality by 2050. The JU will develop and demonstrate technologies that deliver net greenhouse gas (GHG) reductions of no less than 30%, compared to 2020 state-of-the-art technology. The technological and industrial readiness achieved will allow the entry into (commercial) service of new aircraft capable of these reductions by no later than 2035, enabling 75% of the world's civil aviation fleet to be replaced by 2050.

When combined with the effect of sustainable low- or zero-carbon fuels the aircraft developed as a consequence of the CAJU research and innovation will enable net CO_2 reductions of 86-90%. The Clean Aviation Joint Undertaking will as such contribute significantly towards the ambitious environmental impact mitigation goals of the European Green Deal and Regulation (EU) 2021/1119 of the European Parliament and of the Council ('European Climate Law'), that is to say a 55% emissions reduction by 2030 compared to 1990 levels, and climate neutrality at the latest by 2050 in line with the Paris Agreement adopted under the United Nations Framework Convention on Climate Change[2].

The following specific high-level objectives are defined in the Council Regulation 2021/2085 as adopted by the European Council on November 19, 2021:

(a) to integrate and demonstrate disruptive aircraft technological innovations able ***to decrease net emissions of greenhouse gases by no less than 30% by 2030, compared to 2020 state-of-the-art technology***, while paving the ground towards climate-neutral aviation by 2050;

(b) to ensure that the technological and the potential industrial readiness of innovations can support the launch of disruptive new products and services by 2035, with the aim of replacing 75% of the operating fleet by 2050 and developing an innovative, reliable, safe and cost-effective European aviation system that is able to meet the objective of climate neutrality at the latest by 2050;

(c) to ***expand and foster integration of the climate-neutral aviation research and innovation value chains***, including academia, research organisations, industry and SMEs, also by benefiting from exploiting synergies with other national and European related programmes and by supporting the uptake of industry-related skills across the value chain.

The Strategic Research and Innovation Agenda [SRIA] was adopted in December 2021. It sets out the way to achieve these specific objectives and the overall vision, in terms of timescales and magnitude of impact. The partnership will also build upon the important technological progress that was made under the Clean Sky and Clean Sky 2 programmes to achieve these objectives and secure the targeted impact. The Clean Aviation trajectory towards climate neutrality by 2050 defines two clear horizons:

- 2030: demonstrating and introducing low-emissions aircraft concepts exploiting the research results of Clean Aviation, making accelerated use of sustainable fuels and optimised 'green' operations, so these innovations can be offered to airlines and operators by 2030 for an entry into service [EIS] in the 2030-2035 timeframe;

[2] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law') (OJ L 243, 9.7.2021, p. 1).

- **2050**: climate-neutral aviation, by exploiting future technologies matured beyond the Clean Aviation phase coupled with full deployment of sustainable aviation fuels and alternative energy carriers such as hydrogen.

Three key "***thrusts***" for the R&I efforts have been identified that will drive the energy efficiency and the emissions reductions of future aircraft:

- **Hybrid electric and full electric architectures** – driving research into novel (hybrid) electrical power architectures and their integration; and maturing technologies towards the demonstration of novel configurations, on-board energy concepts and flight control.
- **Ultra-efficient aircraft architectures** – to address the short, medium and long-range needs with innovative aircraft architectures making use of highly integrated, ultra-efficient thermal propulsion systems and providing disruptive improvements in fuel efficiency. This will be essential for the transition to low/zero emission energy sources (synthetic fuels, non-drop-in fuels such as hydrogen), which will be more energy intensive to produce, more expensive, and only available in limited quantities.
- **Disruptive technologies to enable hydrogen-powered aircraft** – to enable aircraft and engines to exploit the potential of hydrogen as a non-drop-in alternative zero carbon fuel, in particular liquid hydrogen.

The corresponding performance targets for the main aircraft categories have been defined in the SRIA as summarised in Table 1.

Aircraft Class	Key technologies and architectures to be validated at aircraft level in roadmaps	Earliest EIS Feasibility	Fuel burn reduction (technology based) [1]	Emissions reduction (net – i.e. including fuel effect) [2]	Current share of air transport system emissions
Regional Aircraft	Hybrid-electric, distributed propulsion coupled with highly efficient aircraft configuration	~2035	-50%	-90%	~5%
Short-Medium Range Commercial Aircraft	Advanced ultra-efficient aircraft configuration and ultra-efficient gas turbine engines, ultra-high bypass (possibly open rotor)	~2035	-30%	-86%	~50%

[1] Improvement targets are defined as fuel burn reduction compared to 2020 state-of-the-art aircraft available for order/delivery

[2] Assumes full use of SAF at a state-of-the-art level of net 80% carbon footprint, (or where applicable zero-carbon electric energy)

Table 1. Clean Aviation aircraft category targets (source: Clean Aviation SRIA)

The impact of Clean Aviation technologies on other aircraft segments via scaling and transfer of technology is as summarised in Table 2.

Aircraft Class	Key technologies and architectures to be validated at aircraft level in roadmaps	Earliest EIS Feasibility	Fuel burn reduction (technology based) [1]	Emissions reduction (net – i.e. including fuel effect) [2]	Current share of air transport system emissions
Long Range Commercial Aircraft & Business Aviation	Advanced ultra-efficient aircraft configuration, ultra-efficient propulsion using drop-in SAF with optimised airframe integration, hybrid auxiliary power unit [APU]	~2040	-30%	-86%	~45%
General Aviation Commuter & Rotorcraft	Hybrid-electric and bi-fuel concepts Full electric concepts utilising hydrogen fuel cell based propulsion (augmented with advanced battery technology energy storage)	~2030+	N/A	-87 to 100%	~1%

[1] Improvement targets are defined as fuel burn reduction compared to 2020 state-of-the-art aircraft available for order/delivery

[2] Assumes full use of SAF at a state-of-the-art level of net 80% carbon footprint, (or where applicable zero-carbon electric energy)

Table 2. Clean Aviation potential scaling and transfer benefits to other aircraft categories (source: Clean Aviation SRIA).

The following sections present the Clean Aviation programme high-level scope of work and the main scientific priorities and challenges to be addressed through the Grant Agreements for Members to be established during the period 2022-2023 in the following sections:

- Disruptive technologies for an ultra-efficient short and medium-range aircraft (SMR)
- Disruptive technologies for a Hybrid Electric Regional Aircraft (HER)
- Disruptive technologies to enable hydrogen-powered Aircraft (H2)

2.3.1.1 Disruptive technologies for an ultra-efficient short and medium-range aircraft (SMR)

The mid-2030s will bring a new generation of large aircraft platforms aiming towards sustainable climate-neutral flight. While hybrid/electric energy architectures and ultra-efficient aircraft designs will pave the way towards climate-neutral aviation on <1000km routes, aircraft for classical short- and medium-range distances rely on ultra-efficient thermal energy-based propulsion technologies using sustainable drop-in and non-drop-in fuels to enable climate-neutral flight. The novel aircraft and propulsion concepts will enable low source noise and low noise flight procedures. Due to the nature of close cooperation with other key stakeholders and actors in the European aeronautical community, the technology developments and demonstrations of this part of the research programme will yield additional value through direct spin-offs and cross-activities in neighbouring sectors like business jets and regional aircraft. Some specific developments and limited ground tests will be required to maximise impact.

The research and technology roadmap for the aircraft concept is built on demonstrators, addressing all key technologies to design and develop the next generation of climate-neutral aircraft. Several highly promising technology developments have been started in national or European programmes such as the EcoPulse and BLADE project, as well as initiatives that are exploiting advanced propulsion concepts like open rotor and advanced laminar flow, etc. The first phase of the programme will aim to select, mature and qualify 'best athlete' technologies to exploit their full potential integrated into an ultra-low emission single aisle, short/medium range aircraft.

The roadmap aims to improve the energy efficiency of a new generation of short/medium-range aircraft by 30%. This will happen by 2035 thanks to a combination of disruptive technologies related to the airframe with ultra-efficient propulsion systems and their integration. The roadmap also includes an option for the demonstration and validation of an even more disruptive concept using hydrogen as a non-drop-in fuel, subject to a sufficiently mature capability provided by the Clean Aviation H_2 technology development programme.

The roadmap of this development and demonstration programme goes well beyond the integration of an improved propulsion concept into 'any' short/medium range aircraft. It results in a holistic aircraft suite-solution for a future green, eco-efficient, economically viable and competitive large number serial product that will create momentum and achieve targeted impact at European and global scale. Within this context, four thrusts are key constituents of the 'Green Short/Mid-Range Aircraft' development and demonstration roadmap.

The technical roadmap to develop, mature and demonstrate all technologies needed for next generation climate-neutral short- and medium-range aircraft follows a validation and verification 'V&V' approach, the main elements of which are displayed below.

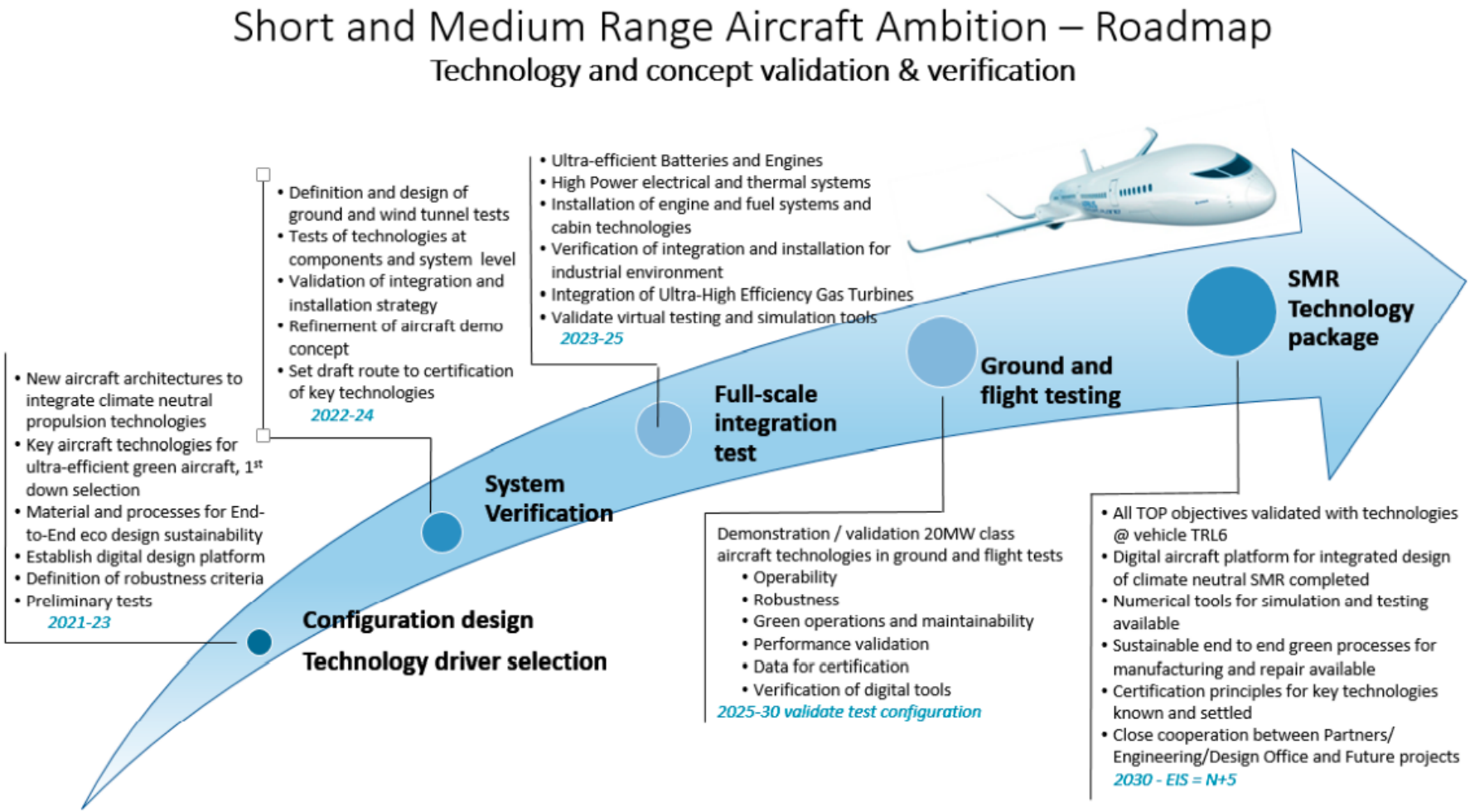


Figure 1: Ambition to demonstrate the climate-neutral short and medium range aircraft.

.

Co-funded by the European Union

The roadmap to develop, mature and demonstrate this vehicle is composed of two programme phases.

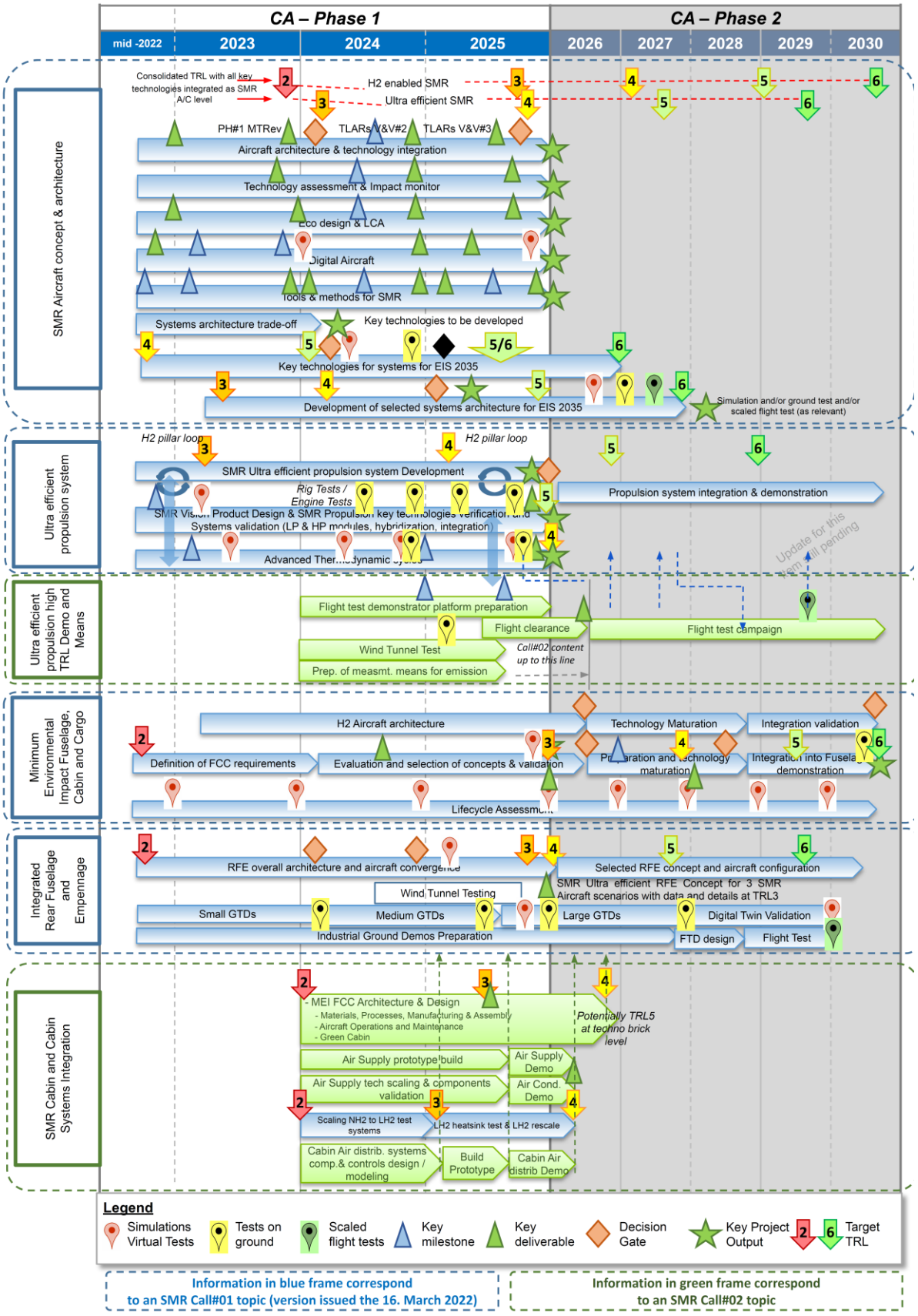
The **first phase of the programme** will be based on the distinct specification of top-level aircraft requirements that are framing the boundaries of a 'technology work space' for candidate technologies and concepts. This phase will involve finalising the conceptual design and the preliminary design characteristics of the targeted demonstration aircraft by selecting the best configuration. This will be based on holistic multidisciplinary numerical simulations, research and development of critical components, materials and processes, technologies and the associated integrated ground tests, such as high-Reynolds-number (flight condition) wind tunnel tests, functional bench tests (including virtual testing) and full-scale sub-component integration tests and flight tests. A digital aircraft platform will be established during phase 1, and the best combinations of phase 1 technologies for the target concept aircraft at mission and fleet level will be assessed via a complementary technology and concept aircraft evaluation platform.

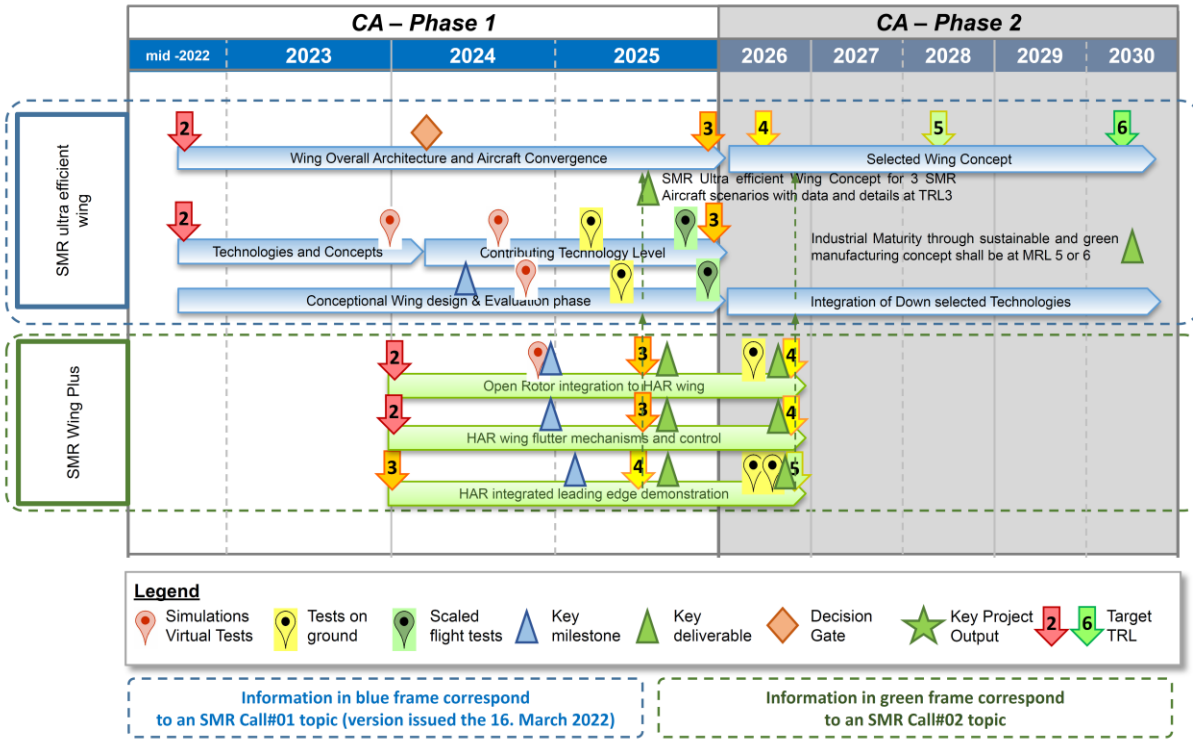
The **second phase of the programme** will focus on validating and integrating selected best candidate technologies to form a single aircraft concept, which will be the result of the activities in phase 1. Key elements of the second phase will be large-scale integrated aircraft component tests and a large-scale flying demonstrator platform to validate the performance of key technologies for the targeted aircraft at realistic sizes under operational conditions.

The ambition to develop an ultra-low-emission single aisle aircraft requires rethinking the overall aircraft architecture, tackling and integrating essentially all major components efficiently.

The Gantt chart on the next page outlines the expected activities and critical milestones in accordance to SMR global schedule and architectural aircraft level activities.

SMR Thrust Consolidated Roadmap Gantt Chart




CA – Phase 1
CA – Phase 2
mid -2022
2023
2024
2025
2026
2027
2028
2029
2030
SMR ultra efficient wing
SMR Wing Plus
Wing Overall Architecture and Aircraft Convergence
Selected Wing Concept
SMR Ultra efficient Wing Concept for 3 SMR Aircraft scenarios with data and details at TRL3
Technologies and Concepts
Contributing Technology Level
Industrial Maturity through sustainable and green manufacturing concept shall be at MRL 5 or 6
Conceptional Wing design & Evaluation phase
Integration of Down selected Technologies
Open Rotor integration to HAR wing
HAR wing flutter mechanisms and control
HAR integrated leading edge demonstration
Legend
Simulations Virtual Tests
Tests on ground
Scaled flight tests
Key milestone
Key deliverable
Decision Gate
Key Project Output
Target TRL
Information in blue frame correspond to an SMR Call#01 topic (version issued the 16. March 2022)
Information in green frame correspond to an SMR Call#02 topic

2.3.1.2 Disruptive technologies for a Hybrid Electric Regional Aircraft (HER)

Environmental concerns, more stringent regulations and higher market demand will profoundly change short range and regional aviation up to distances of 1000 km.
Operators and passengers expect regional and inter-urban aviation to bring new, innovative approaches to aircraft and air transport operations that match increased needs and fulfil growing expectations for better environmental and operative efficiency, new services, larger networks, optimised frequency and new business opportunities at a reasonable overall cost.
Regional aviation has an important role in this segment of air mobility. Regional aircraft-operated routes and connections account for over 12% of world ASK (available seat kilometres). Roughly, regional aircraft currently serve 38% of world city pairs, perform about 40% of the total departures and around 36% of the total flown hours. In terms of regional connectivity, 36% of existing airports are relying exclusively on regional turboprop-operated services. Regional and commuter aircraft can be the launch pad for new low or zero-emissions technology and bring enhanced networks, increase frequency of flights, and boost convenience for passengers while drastically reducing environmental and climate impact. The propulsion innovations studied in this section and globally in Clean Aviation may open up new business scenarios.

The final demonstration is a regional aircraft with technologies ready for entry into service by 2035, incorporating product-viable solutions for technologies, integration, infrastructure, and certification. The aircraft will include hybrid-electric propulsion supported by 100% drop-in fuels or hydrogen (whether fuel cells or H_2 burning as the thermal power source) to reach up to 90% lower emissions while being fully compliant with ICAO noise rules.

Vision 2030 and following

By mid-2030, mobility of people and goods is expected to undergo progressive changes, especially over distances of less than 500 km (inter-urban regional connections). Innovations and technologies related to propulsion, the optimisation of different fuel types and airframe characteristics will reach higher levels of maturity, becoming available for regional air transport as well as other present and future air vehicles operating within similar distances.
Air vehicles operating in this range (including regional aircraft with a capacity of up to 100 seats) will be the first to benefit from an air transport system that will adopt hybrid-electric propulsion technologies and associated complementary solutions for reducing the environmental footprint of aviation, towards climate neutrality. Air vehicles operating on shorter distances or on less travelled routes will also benefit from electric propulsion solutions tested on regional aircraft testbeds, by sharing the development of power modules and making use of different approaches to air vehicle integration.
Regional air transport is a laboratory for other domains in Clean Aviation. The vision for 2030+ is to demonstrate innovative and disruptive technologies, enabling new aircraft performance levels, and opening up new business models. This approach will consider future societal demands in terms of people and goods transport, as well as environmental and system constraints such as short field length capabilities, cockpit workload, simplified operations, quick turn-around times, dense air traffic, and small airport infrastructures.

Rationale and approach

In order to identify the most efficient aircraft architecture, different propulsion and aircraft configurations will be assessed in trade-offs (i.e. turbo-electric distributed vs. parallel/serial hybridisation of the propulsion system. Different levels of hybridisation and different primary energy sources will be explored including options for a thermal engine or potentially a fuel cell as part of the hybrid (or full-electric) configuration. In parallel, technologies and solutions that are able to shorten

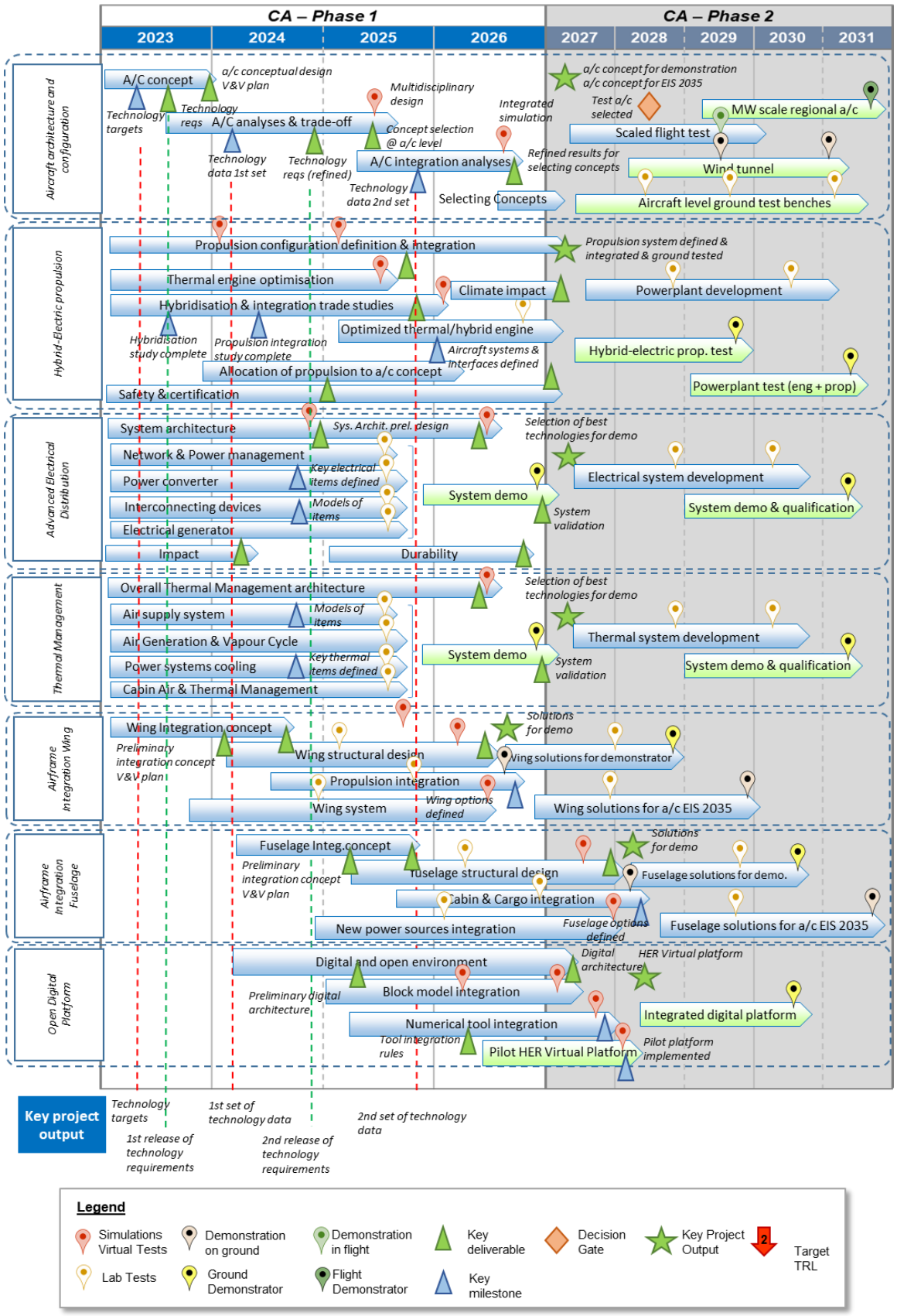
time-to-market and affordability will be pursued. The development of regulations and new infrastructure to support such disruptive aircraft configurations is a key complementary issue to be addressed in order to realise the market potential.

Complexity and design activities

As with any radical change in the dominant design of complex systems and the introduction of disruptive technologies, the metrics to assess product performance across the life cycle can radically change, introducing new parameters not considered before. The integration activities of the hybrid-electric regional platform will involve several interdependent areas of research.
In a first phase (up to 2025) the building blocks and different integration options will be studied back-to-back for their potential and integration perspective to identify the most promising architectures.
A second phase will further mature the technologies selected for the demonstrator and deliver suitable final solutions ready for integration. This second phase will also mature some technologies not ready for the demonstrator but valuable for actual aircraft integration in 2030.

The Gantt chart on the next page outlines the expected activities and critical milestones in accordance to HER global schedule and architectural aircraft level activities.

HER Thrust Consolidated Roadmap Gantt Chart



2.3.1.3 Disruptive technologies to enable hydrogen-powered aircraft (HPA)

Sustainable Aviation Fuels (SAF) are categorised into *net carbon-neutral* drop-in fuels such as synthetic or bio-fuels, and non-drop-in fuels such as hydrogen. Burning drop-in fuels results in low or net-zero CO_2 emissions whilst burning zero-carbon hydrogen results in CO_2-free emissions.
Future renewable electrical energy production (photovoltaic, wind power etc.) will allow 'green' hydrogen to be produced at scale, thereby eliminating upstream carbon emissions and creating an extremely attractive energy storage option.

For heavy transport in particular, hydrogen is likely to be a promising option in reducing greenhouse gas emissions where the lower energy density (hence lower range), high initial costs, and slow recharging performance of batteries are major disadvantages. Because the transport segment makes up about one-third of all CO_2 emissions in the EU, its decarbonisation represents a key element in achieving the energy transition. Hydrogen-powered air transport can be a promising solution to limit this climate impact. But considering the challenging fluid properties and impact on the overall aircraft system currently optimised for conventional fuel, a high research effort is required to introduce this technology onto the market.

The advantages are clear: hydrogen as an on-board fuel or energy will allow for the complete elimination of CO_2 emissions in flight, and along the entire energy life cycle if produced from renewable sources. Its usage in fuel cells allows for zero-emission propulsion (including NOx and particles). When burnt in a turbine engine, very low particle emissions can be expected, as well as reduced NOx emissions, provided that the combustion system is optimised. However, when using hydrogen for combustion, more water vapour is produced. Considering all non-CO_2 emissions at flight altitudes, the use of hydrogen in a thermal (combustion) engine will lead to different emissions compared to 'drop-in' fuel alternatives and consequently the full climatological impact will need to be assessed carefully.
Nevertheless, to develop hydrogen-powered commercial aircraft, several technological challenges need to be overcome before its full potential can be exploited. Among these topics, some elements are still at a very low maturity level and will need significant development, maturation and demonstration in order to be ready for integration in future aircraft. One key aspect in which aviation will require a highly specific approach is the fact that hydrogen's energy density, while very high with respect to mass and as such with a promising potential for flight, is very low with respect to its volume when in gaseous form. For large commercial air transport applications, it is therefore widely expected that only liquid hydrogen systems will prove viable. Liquefying and storing 'LH2' presents unique challenges as a temperature of -253°C needs to be maintained 'in the tank'. The resulting effect on tanks, fuel/distribution systems, refuelling and on the overall system design, as well as on reliability and safety elements present major research and development challenges. In parallel to the efforts needed to develop the necessary on-board technologies, the availability of hydrogen, its distribution and the necessary recharging/refuelling infrastructure, together with renewable production, will be key for the overall success of this approach.

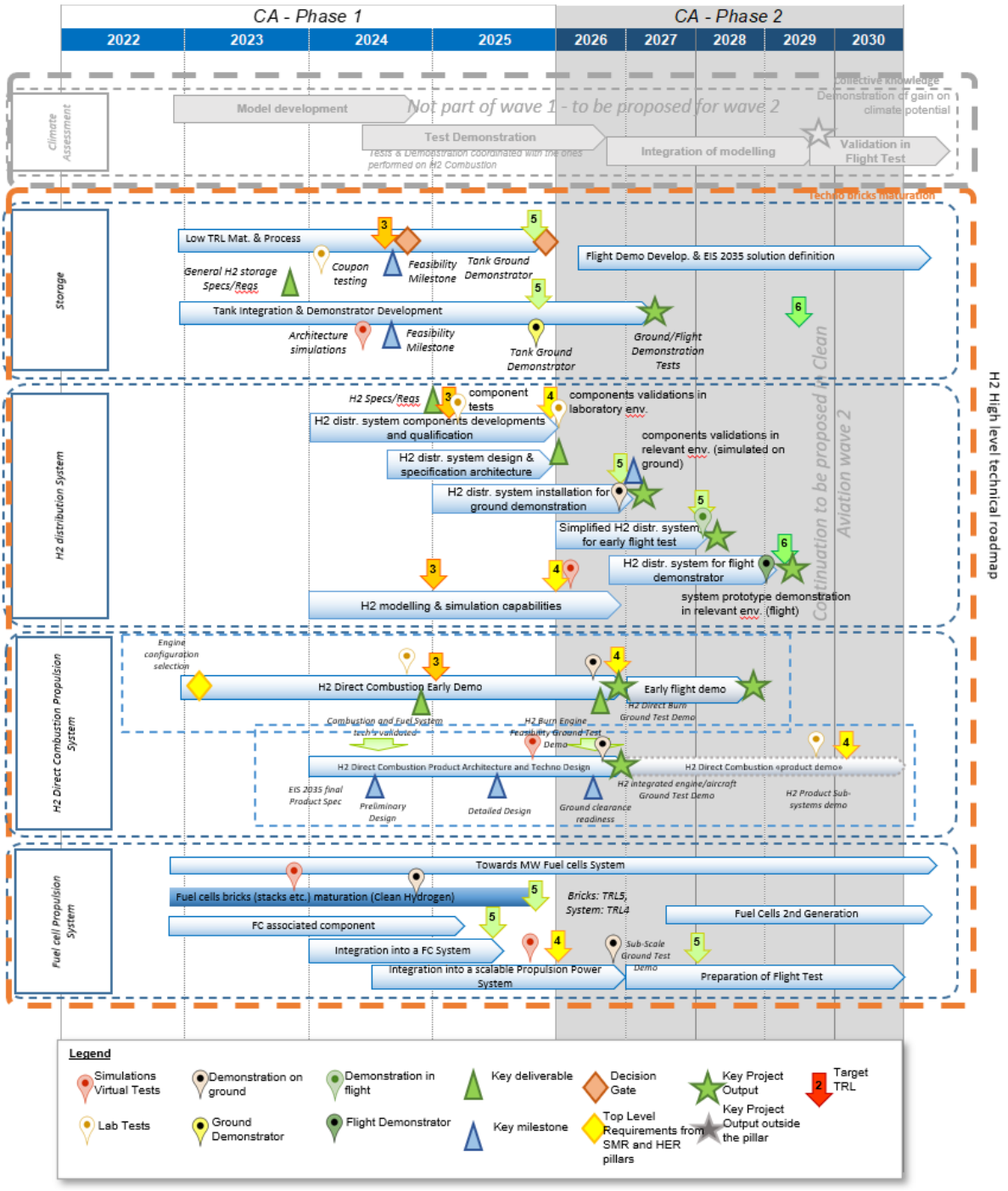
As such, Clean Aviation aims to mature and demonstrate all relevant systems ready to be integrated into future aircraft: liquid hydrogen storage on-board, fuel distribution systems, fuel-cell-based propulsion drive trains or direct combustion of hydrogen into turboprop or turbofan engines. This comprises the selection and validation of the most suitable concepts, materials and designs to provide the required performance, lifetime, costs, and safety. Beyond that, the integration of these systems into the aircraft platform requires a deep understanding of operational, maintenance, and certification aspects.

To ensure the impact of clean hydrogen propulsion, the high-level requirements of potential aircraft platforms will be considered from the beginning. Systems will be scalable for different propulsion architectures (fuel cell or use in gas turbines, also referred to as H2-burn architectures) as well as aircraft sizes (commuter, regional, and short/medium range). Subsequently, early deployment may take place through the application of a hydrogen fuel cell for hybrid electric commuter or small regional aircraft in the next decade.

Building on this, radical short and medium range aircraft will benefit from storage and feed system architectures used to exploit hydrogen direct burn propulsion systems, paving the way for larger and longer range applications.
Clean Aviation will lay the foundations for the future clean hydrogen aircraft propulsion architecture.

The Gantt chart on the next page outlines the expected activities and critical milestones in accordance to HPA/H_2 thrust global schedule and architectural aircraft level activities.

HPA Thrust Consolidated Roadmap Gantt Chart



2.3.2 Objectives, risk management and performance monitoring

The **general objectives of the Clean Aviation** Joint Undertaking as defined in art. 57 of the Single Basic Act (SBA)[3] are the following:
(a) to contribute to reducing the ecological footprint of aviation by accelerating the development of climate-neutral aviation technologies for earliest possible deployment, therefore significantly contributing to the achievement of the general goals of the European Green Deal, in particular in relation to the Union-wide net greenhouse gas emissions reduction target of at least 55% by 2030, compared to 1990 levels, and to a pathway towards reaching climate neutrality at the latest by 2050;
(b) to ensure that aeronautics-related research and innovation activities, with a particular focus on breakthrough technology initiatives, contribute to the global sustainable competitiveness of the Union aviation industry, and to ensure that climate-neutral aviation technologies meet the relevant aviation safety and security requirements, and that aviation remains a secure, reliable, cost-effective and efficient means of passenger and freight transportation;
(c) to advance the European aviation research and innovation capacity.

The **operations objectives for both programmes** (Clean Sky 2 and Clean Aviation) are:

- To execute the calls, evaluation, grant implementation and indirect actions as defined for the two-year period covered by this work programme;
- To ensure that the scientific priorities are adequately incorporated in the two Programmes' operational activities and in the grant agreements;
- Implement an effective and efficient management and governance of the programmes (including for Clean Aviation design of the related business processes);
- Execute at least 90% of the budget as well as the relevant milestones and deliverables;
- Ensure a high level of technical integrity in the execution of the programmes, including a maximum relevance of research actions performed towards the programmes' objectives;
- Achieve a high level of process integrity at all levels of the programme implementation, including the calls and their resulting selection of JU Members and other participants.

The **specific objectives** for the legacy Clean Sky 2 programme for the period 2022-2023 are:

- ⇨ To execute the technical content as defined for the two-year period and ensure this is adequately incorporated in the Clean Sky 2 Development Plan (CS2DP) and the grant agreements;
- ⇨ To determine in the course of 2022-2023 the definitive configuration of the programme's major demonstrators and technology development themes, based on robust risk and progress reviews based on the baseline set in the CS2DP; where necessary diverting resources to safeguard the achievement of the programme's High-Level Objectives [HLOs] to start delivering the first results;
- ⇨ To implement solutions for leveraging Clean Sky 2 funding with structural funds;
- ⇨ To implement an appropriate and agreed approach for each transverse area that allows for the transversal coordination to be executed and technical synergies to be extracted;
- ⇨ To finalise and implement the impact assessment strategy and reference framework for the Technology Evaluator (including the selection of and the performance levels of reference aircraft against which the progress in CS2 will be monitored); to finalise the assessment criteria and evaluation schedule for the Technology Evaluator (TE) for each technical area. To complete the selection of its key participants; to conduct within the timeframe of the Work Plan the second TE assessment of CS2.

[3] Council Regulation (EU) No 2085 2021 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe (hereinafter "Single Basic Act" or "SBA") OJ L 42717.

Clean Sky 2 Demonstrators and Technology streams

Theme	Demonstration area	Demonstrator / Technology stream in Programme Area						Contribution*			Funding	Funding
		LPA	REG	FRC	AIR	ENG	SYS	E	M	C	RoM	RoM m€
Breakthroughs in Propulsion Efficiency (incl. Propulsion-Airframe Integration)	Advanced Engine/Airframe Architectures	✈			✈			✈		✈	532.3	93.9
	Ultra-high Bypass and High Propulsive Efficiency Geared Turbofans	✈			✈	✈		✈		✈		354.0
	Hybrid Electric Propulsion	✈						✈	✈	✈		27.9
	Boundary Layer Ingestion	✈						✈		✈		14.2
	Small Aircraft, Regional and Business Aviation Turboprop					✈		✈	✈	✈		42.3
Advances in Wings, Aerodynamics and Flight Dynamics	Advanced Laminar Flow Technologies	✈			✈			✈		✈	180.0	98.2
	Regional Aircraft Wing Optimization		✈		✈			✈	✈	✈		81.7
Innovative Structural / Functional Design - and Production System	Advanced Manufacturing		✈		✈			✈		✈	178.183	29.2
	Cabin & Fuselage	✈	✈		✈			✈	✈	✈		136.3
	Innovative Solutions for Business Jets				✈				✈	✈		12.7
Next Generation Cockpit Systems and Aircraft Operations	Cockpit & Avionics	✈	✈				✈	✈	✈	✈	158.578	146.6
	Advanced MRO	✈							✈	✈		12.0
Novel Aircraft Configurations and Capabilities	Next-Generation Civil Tiltrotor			✈	✈				✈	✈	222.563	109.5
	RACER Compound Helicopter			✈	✈				✈	✈		110.1
	Regional Innovative Configuration		✈					✈	✈	✈		2.9
Aircraft Non-Propulsive Energy and Control Systems	Electrical Systems		✈		✈		✈	✈		✈	157.985	109.3
	Landing Systems		✈				✈	✈		✈		32.2
	Non-Propulsive Energy Optimization for Large Aircraft	✈						✈		✈		14.5
	Low Power WIPS		✈					✈		✈		2.1
Optimal Cabin and Passenger Environment	Environmental Control System		✈				✈	✈	✈		58.9929	20.8
	Innovative Cabin Passenger/Payload Systems	✈	✈		✈		✈	✈	✈	✈		38.2
Eco-Design		✈	✈	✈	✈	✈	✈	✈		✈	39.1	39.1
Enabling & Long-Term Technologies		✈	✈	✈	✈	✈	✈	✈	✈	✈	136.5	136.5

**Contribution as E: Environment, M: Mobility, C: Competitiveness*

For the Clean Aviation programme, the mechanisms for monitoring the implementation of the programme and the impact of its results on the environmental objectives will be developed during the course of 2022. As compared to the two previous programmes in the aviation sector (Clean Sky and Clean Sky 2), the JU will consider in the evaluation of the impact of the Clean Aviation programme also the potential market uptake of the research results.

The **specific objectives of the Clean Aviation Joint Undertaking** are the following:
(a) to integrate and demonstrate disruptive aircraft technological innovations able to decrease net emissions of greenhouse gases by no less than 30% by 2030, compared to 2020 state-of-the-art technology, while paving the ground towards climate-neutral aviation by 2050;
(b) to ensure that the technological and the potential industrial readiness of innovations can support the launch of disruptive new products and services by 2035, with the aim of replacing 75% of the operating fleet by 2050 and developing an innovative, reliable, safe and cost-effective European aviation system that is able to meet the objective of climate neutrality at the latest by 2050;
(c) to expand and foster integration of the climate-neutral aviation research and innovations value chains, including academia, research organisations, industry and SMEs, also by benefiting from exploiting synergies with other national and European related programmes and by supporting the uptake of industry-related skills across the value chain.

The **operations related objectives of Clean Aviation Joint Undertaking** for the Clean Aviation programme for the period 2022-2023 are:

- Develop an appropriate approach for the transversal coordination and identification of synergies within the CA programme, with other Horizon Europe R&I actions including the other partnerships, and with a view to national and regional programmes;
- Launch the first two calls for proposals for selecting the projects and participants of the CA programme and sign the related grant agreements;
- Launch a further call for expression of interest for Associate Membership of the JU based upon the results of the first call for proposals;

- Implement the impact assessment strategy and reference framework for the CA programme.

Risk management

The following two tables present the summaries of the most significant risks to be noted for the execution of (A) the Clean Sky 2 programme and (B) the Clean Aviation Programme, relevant for the Work Programme 2022-2023.

The risks have been defined through the risk assessment exercise performed by the JU's management and coordinated by the Internal Audit Officer. The assessment has integrated the outcome of the dedicated risk management process carried out continuously at the level of the System and Platform Demonstrators (SPDs) in the Annual Reviews, the Steering Committees and in the quarterly reporting of SPD leaders.

None of the risks assessed by the JU management and described here below are considered to present a critical residual risk level, taking into account the mitigating actions implemented and/or planned.

(A) Risk assessment table for the Clean Sky 2 programme

Risk Description	Impact (H/M/L)	Likelihood (H/M/L)	Impact Category*	Mitigation plan	Residual risk
Implementation of activities as defined in the CS2DP: Implementation of the CS2 Development plan may be hampered due to: • Change of priorities of private Members and reduction of leverage effect of EU funding:Strategic or technical priorities within industrial companies may result in a lack of resources available for Clean Sky CS2, delays in the completion of the activities and/or a need to revise programme content. • Delays in execution of grants: Technical setbacks, delays in execution of grants and business continuity risk in one or several IADPs / ITDs / TAs may result in underachievement of milestones and deliverables and/or a significant over / under-spending of annual budget. • Lack of funding linked to technical difficulties or lack of robustness of resources / financial planning versus demonstration objectives: Planning for cost and effort for complex, large ground and flight demonstrators (10-year programme) may lack maturity and/or accuracy, leading to delayed completion of technical activities or reduced scope of activities.	H	M	Operational Reputational	The residual risk remains at the same level as last year (High) IADPs/ITDs/TAs GAMs were extended to cover the full program in line with the CS2DP 2021 update aimed to confirm the ambition of the remaining demonstrations. The reassessment performed of the key risks provided evidence of some risk reduction on the way to meet the HLGs. However, due to the entering in the final phase with key demonstration still worth to be achieved, the risk level is confirmed as High. Mitigation actions: Continue to maintain an early warning capability through quarterly reports, the Annual and Intermediate Progress Reviews and where necessary alert the Governing Board. Monitor technical execution through timely execution of milestones and deliverables. Assess technical difficulties during ad-hoc or regular reviews and propose a mitigation plan to promptly fix the technical issues. Each IADP/ITD/TA to continue to deploy a detailed risk management and “through to completion” plan with critical path management, budget and risks, allowing due assessment and revision opportunities. Seek for funding opportunities through other instruments (national level or other EU initiatives) or increase the level of additional activities required to meet the programme objectives. Risks reported during the ARM and summarised in the Top 10 by IADPs/ITDs/TAs at Q2 show a positive trend with a series of High risks reduced. A series of residual risks are assessed at Medium after mitigation	High

Risk Description	Impact (H/M/L)	Likelihood (H/M/L)	Impact Category*	Mitigation plan	Residual risk
				expecting some impact on key demonstrators within some case margins for further mitigation. CS2DP is at large confirmed. Closely follow-up of main achievements, ground and flight demonstrators through monitoring of critical milestones will continue.	
Achievement of high-level goals CS2 **Execution of the technical activities in Clean Sky 2 may not result in the achievement of the High-Level Goals [HLGs] as stated in the Regulation**	High	High	Operational	This risk has been assessed as medium in the previous year. After integrating a new contingency situation to take into account NO_X the risk is considered High. Most of Annual review meetings 2022 confirmed progress on technology developments and expected environmental improvements for key demonstrators/technologies in IADPs/ITDs/TAs to contribute to CS2 high level goals. No specific risk raised by TE as part of Q2. However, the Technology Evaluator ARM of 12/13 Oct regarding progress of the different aircraft concepts revealed the following: Introduction of technologies aiming to higher OPR in engines contributing to CO2 reduction seems instead to increase the level of NOx emissions. The JU needs to continue monitoring the situation in view of the 2nd TE assessment in order to better understand the situation before defining the aircraft engine architecture to be modelled. Inherent and residual risk level moved to high. Regarding qualitative goals of the Regulation [e.g. competitiveness and mobility] evidence to quantify these goals is provided through periodic assessments with the TE. In parallel to the TE actions, the socio economic study was performed and final report issued in September, providing ample information on the impact of CS2 programme on socio-economic objectives.	High

Risk Description	Impact (H/M/L)	Likelihood (H/M/L)	Impact Category*	Mitigation plan	Residual risk
Market uptake of research results: The maturity of certain demonstrators at programme completion maybe lower than expected (delays, Covid-19 impact, technical or financial difficulties) hampering the timely exploitation of results. Covid-19 impact on market demand: The Covid-19 crisis has delayed the scenarios for new product introduction, due to its impact on the airlines and the adverse consequences on passenger demand. The situation is not expected to be fully recovered before 2024-25. As a consequence, the situation has delayed the introduction of new technologies onto new aircraft to enter into service by 2025-2030.	H	M	Operational	The residual risk level is unchanged as compared to last year (High). Mitigating actions: Continue to maintain an early warning capability through quarterly reports, the Annual and Intermediate Progress Reviews and where necessary alert the Governing Board to confirm at large the programme ambition. Continue to better describe exploitation path to new products stemming from CS2 research and align to Clean Aviation. Socio-economic impact study was in the meantime released confirming CS2 exploitation opportunities.	High

(B) Risk assessment table for the Clean Aviation programme

Risk description	Impact	Likelihood	Impact Category	Mitigation plan	Residual risk
Specific budget execution 2023: Forecasts for the 2023 budget have been made under the assumption of a Pre-financing (PF) rate of 70% equal to the H2020 rate. Instead, for the 1st HE Call of CAJU, it has been agreed subsequently to reduce the PF rate to 40%, which generates a surplus in payment appropriations (PA) of €200 m. Consequently, the PA execution rate for the CA budget in 2023 may be very low.	High	Medium	Financial	The mitigation measure in place is to introduce a first reporting period after 6 months (June 2023) which can allow an expedited interim payment to beneficiaries on the condition that the relevant projects are on track.	High

Risk description	Impact	Likelihood	Impact Category	Mitigation plan	Residual risk
Achievement of HLOs with a view to adequacy of funding: **The funding budget of €1.7 bn in the SBA is inadequate for the achievement of the HLOs as stated therein.** **The SRIA as currently defined could deliver the HLOs but is estimated to require €2.5 bn in public funding.** **As a result, a potential reduction in scope of activities or of funding rates for the programme's activities may both endanger the achievement of the HLOs.**	High	High	Operational	. Streamlining the SRIA and related WP, combined with the transfer of activities deemed critical for the achievement of the HLGs to national programmes. Rescoping where activities may be of less critical importance for the primary (climate/environmental) objectives will also be undertaken. The potential use of the UK HMG Guarantee for UK-based participants in the CAJU actions may partially bridge the gap between the original SRIA scope and its underlying assumptions and the current situation with a likely 3rd Country status for the 1st Call.	High
Funding of activities related to Associated Countries: **Late or failing agreement for admitting third countries to the EU programs, in particular the UK, may reduce technical contribution through key capabilities OR delay the implementation of activities, necessary to execute the program and to achieve the key objectives.**	Medium	High	Operational	**Status as of October 2022:** The UK entities participating in projects selected in Call 1 is foreseen to be financed by the UK government while their participation to the project is maintained. Limited guidelines to implement this approach have been developed so far on both sides (EU and UK). Specific contingency measures have been requested in the 1st month of the grant preparation: - confirmation of the UK participation in projects with funding from the UK government; - the implementation of a liability regime by consortia; - the swap of coordinator for projects which were due to be coordinated by a UK based entity. While the participation of the UK entities is considered secure from a financial standpoint, the implementation of the proposed mechanism may lead to delays. The swap of coordinator within certain projects and consortia may lead to some increased risks in the project execution. Therefore, the residual risk level is maintained at high.	High

Risk description	Impact	Likelihood	Impact Category	Mitigation plan	Residual risk
Adequacy of the SRIA/Roadmap: SRIA/Roadmap based plans may not be successful in securing achievement of CA HLOs. The [revised] SRIA scope and roadmaps may not adequately cover the required research portfolio and/or the timeframes needed to secure the achievement of the HLOs within the timeline set in the SBA.	2	3	Reputational, operational	For mitigation, it is critical to perform the down-selection of the topics (which need to have clear links to the HLOs) and to get the related Work Packages approved. In addition, this will be complemented by the following measures: - by setting conditions in the topics (such as transfer of results, linkage of projects, etc.); - by defining smart objectives in the topic descriptions; - by requiring the provision of data and reporting in the topic descriptions to enable project and impact monitoring.	High
Open Calls set-up: The Open Calls set-up, as described in the SBA, may lead to difficulties in ensuring a coherent programmatic approach to research and to the flow of research outcomes between projects. This may endanger achievement of the HLOs, which are at integrated 'aircraft' level and require integration and consolidation from disparate consortia, all of them	High	High	Operational	Participants will be encouraged to enter into Cooperation Agreements that specify the modalities for collaboration between projects contributing to common goals at thrust and programme level including IP protection for sharing research outcomes between projects. The situation will be reviewed after the first 6 months since the launch of the projects and corrective action undertaken where necessary.	High

Risk description	Impact	Likelihood	Impact Category	Mitigation plan	Residual risk
with individual IP agreements and pursuing individual commercial interests. The absence of agreement ahead of the launch of the topics and the absence of approach already proposed by OEMs puts at risk the implementation of projects in an integrated manner (IP issues, A/C concept view)					
Financial risks for HE programme: The impact of the unexpected inflation and economic crisis on production costs may lead to serious under performance in project execution due to significantly insufficient financial provisions for CAJU beneficiaries.	High	Medium	Financial	- Discuss with Commission potential mitigation measures, in particular increase of budget (from Commission and other funding sources); - Redefine programme objectives and scope; - JU to monitor closely and assess together with private members the potential gap in funding. The risk has the potential to become critical in future, but is currently out of control of the JU.	High
Synergies with national and regional programmes: Establishing mechanisms and agreeing practical measures such as work division, to create and leverage synergies with national and regional programmes may prove difficult	High	High	Operational	For synergies with national programmes, a "roundtable" platform for discussion and alignment is foreseen, which should include the most relevant and significant MS programmes. A planned CSA from the Commission aims to support the identification of the most important synergies and programmes. The JU will take stock of which other initiatives need to be taken, including the use of the SRG and TC whose tasks include obligations to seek and facilitate areas of synergies. A CSA for supporting the development of (continued and/or new) synergy approaches with regional authorities (related to	High

Risk description	Impact	Likelihood	Impact Category	Mitigation plan	Residual risk
				ERDF/ESIF) was launched in the CAJU 1st Call and is now under grant preparation. The JU will engage with the support of the Commission with funding bodies at regional and national levels in line with the potential for contributing R&I funds and relevant outputs from projects funded therewith via the established mechanism of commonly agreed Memoranda of Understanding and Memoranda of Cooperation.	
Migration to SUMMA by end of 2022 - impact on financial management and programme execution	High	medium	Financial/Operational	The JU is in close contact with Directorate-General (DG) for Budget and the Directorate-General for Research and Innovation to monitor the progress. The JU has started to organise trainings and coaching sessions. Fallback solution in case the development is not mature enough or bugs are identified, with critical impact on the JU's accounting and payment processes: the launch of SUMMA will be postponed and/or the use of SUMMA will be reversed and ABAC will be continued. The residual risk is seen at medium, provided that the tests to be made until the actual launch confirm the functioning of the main modalities needed for executing the payments. If test outcomes indicate a lack of robustness, the significance of the risk will be raised to High or Critical.	Medium

Performance monitoring

The JU has implemented various tools to monitor the achievement of targets by using several sets of indicators for the execution of the H2020 programme in terms of productivity, achievements, planning and risks of the operations:

- Quarterly Reports of the ITD/IADPs, which provide information on resource consumption, achievements and the resulting forecasts for level of project implementation;
- Steering Committees at ITD/IADP level with the involvement of the CS2 project officers;
- Annual Reviews of the ITD/IADP's performance organised by the JU with the involvement of independent experts;
- Monitoring information is summarised and reported regularly to the Governing Board.

Concerning the Clean Aviation programme in 2023, the JU will deploy a new programme management tool to ensure the proper monitoring of grants, the monitoring of the performance at programme level and the associated reporting obligations. This tool will allow all participants in projects to share a common approach enforced across the programme and it will allow to gain in efficiency as compared to the former programmes. The tool will also provide support to project coordinators to implement their projects and to link their information with the EU Commission tool (SYGMA) in force to implement the grants.
The new programme management tool, called PLANEs (Programme impLemention ANd Execution System), will aim at monitoring the progress per projects (resources planning and execution, deliverables and milestones) and their performance against performance targets by using several sets of indicators in terms of resource, achievements, planning and risks of the operations among others. This information will serve to report both to the Technical Committee and the Governing Board.
The tool will serve as a basis to discuss progress and results during regular meetings organised at project level, such as:

- Project Management Committees and Steering Committees where each project consortium will discuss the project results and next steps, with the participation of the CAJU Project Officer;
- Annual Reviews of the project performance organised by the JU with the involvement of independent experts.

The programme governance structure is under elaboration and will be revised in the course of 2023 to include an ad-hoc approach proposed to implement the performance monitoring as defined in the work programme.

Key Performance Indicators for monitoring are maintained at various levels covering performance on the levels of the two programmes of the CAJU and in the context of the impact monitoring of the CA programme.

In the following sections, the most significant KPIs are summarised with their targets, as far as available. They concern monitoring performance of:

- CAJU finance and budget;
- CAJU Resources (including synergies within Horizon Europe and with National and Regional programmes);
- CA Programme execution;
- CA Programme outcome;
- CA Programme impact.

The following sections also include the high-level environmental objectives for the CS2 programme and the related KPIs for the CS2 programme execution.

Clean Aviation JU financial/budget performance:

KPI name	Definition	Unit of Measurement	Baseline	2023 Target	Target at Programme end
Time To Grant (TTG)	Number of GAs signed within target (i.e. Time To Grant (TTG) < 243 calendar days measured from call deadline to signature of grants) Express number as % of total GAs signed.	%	First year level	90% of grants signed with TTG < 243 days	90% of grants signed with TTG < 243 days
Time To Pay (TTP) Operational budget	% payments made on time: -pre-financing (max 30 days) -interim payment (max 90 days) -final payment (max 90 days)	%	First year level	 - 98% - 98% - 98%	 - 98% - 98% - 98%
Time to Pay (TTP) Administrative budget	% payments made on time (max 30 days)	%	First year level	98%	98%
Budget Execution	- % CA (=Commitment Appropriation) to total budget - % PA (=Payment Appropriation) to total budget (Distinguish between Total, Operational, Administrative)	% %	First year level	Total: CA: 100%; PA: 90% Operational: CA: 100%; PA: 90% Administrative: CA: 100%; PA: 90%	Total: CA: 100%; PA: 95% Operational: CA: 100%; PA: 95% Administrative: CA: 100%; PA: 95%
Residual error rate[4]	% residual error on H2020 programme	%	First year level	<2%	<2%
Ex-post audit coverage[5]	Percentage of operational expenses covered by ex-post audits on H2020 programme.	%	First year level	15%*	15%*

[4] The Horizon Europe KPIs and metrics will be defined during the course of 2023 within the CAJU audit strategy.
[5] The Horizon Europe KPIs and metrics will be defined during the course of 2023 within the CAJU audit strategy.

				*(accumulated from programme start till 2023)	*(accumulated till from programme start till programme)

Clean Aviation JU Resources:

KPI name	Definition	Unit of Measurement	Baseline	2023 Target	Target at Programme end
In-kind contribution	Total amount of funds leveraged through Art. 187 initiatives, including additional activities. (IKC=IKOP+IKAA)	€	First year level	1.5 x (EU funding assigned in year 2023)	at least 2400 million
Synergies within Horizon Europe	1. **Ex ante:** N. of CAJU topics (and associated total EU funding) promoting synergies with other HE PPPs. 2. **Ex post**: N. of resulting CAJU projects (and associated total EU funding) that demonstrate tangible synergies with actions in other HE PPPs. 3. **Ex ante**: N. of topics from other PPPs or parts of HE WP (and associated total EU funding) promoting synergies with CAJU or relevant aviation applications. 4. **Ex post**: N. of projects from other PPPs or parts of HE WP with recognised synergies with CAJU and developing complementary technologies with relevant aviation applications aligned with CAJU aims/goals (indicate associated EU funding, highlighting EU funding received by CAJU members.)	- / €	First year level	1. 55 MEUR 2. TBD 3. 120 MEUR 4. TBD	1. TBD 2. TBD 3. TBD 4. TBD
Synergies with National/Regional programmes	1. Ex ante: funding volume from National / Regional programmes* allocated to support CAJU objectives (e.g. via MoU/MoC).	- / €	First year level	1. TBD 2. TBD	1. TBD 2. TBD

	2. Ex post: funding volume from National / Regional programmes* invested in projects contributing to CAJU objectives. *(Including Recovery and Resilience Facility and RIS3, ERDF, and other cohesion policy funds)				

Clean Aviation Programme execution

KPI name	Definition	Unit of Measurement	Baseline	2023 Target	Target at Programme end
Share of projects and EU financial contribution allocated to Innovation Actions (IAs)	% of IA and related EU financial contribution	%	First year level	>90%	>90%
Call topics success rate	Percentage of topics resulting in signature of GA	%	First year level	>90%	>90%
WP execution: deliverables delivered versus plan	% of deliverables available versus planned	%	First year level	> 80%	> 90%
WP execution: milestones achieved versus plan	% of milestones achieved versus planned	%	First year level	> 80%	> 90%

KPI name	Definition	Unit of Measurement	Baseline	2023 Target	Target at Programme end
Events organized by the JU	Number of events organized by the JU	-	First year level	3	TBD
Info days participated by the JU	Number of Info Days participated by the JU	-	First year level	5	TBD
Speaking opportunities at events	Number of speaking opportunities at relevant events	-	First year level	30	TBD
Website & news articles	-Number of website visits and page views -Number of news articles	-	First year level	>250 000 visits >900 000 page views >60	TBD
Number of CAJU publications	- Number of CAJU publications	-	First year level	TBD	TBD
Social Media	LinkedIn / Twitter 1. -number of new followers 2. -number of posts / tweets 3. -number of impressions 4. -number of views	-	First year level	Twitter 1. 300 2. 300 3. 500 4. 80000 LinkedIn 1. 2000 2. 200 3. 500 000 4. 13 000	TBD
Newsletter subscriptions	Number of new subscriptions to the CAJU newsletter	-	First year level	1000 per year	TBD

Clean Aviation Programme Outcome

Outcome KPIs are defined to monitor projects results and outputs.

KPI name	Definition	Unit of Measurement	Baseline	2023 Target	Target at Programme end
Technology Readiness Levels	number of critical technologies that reached: TRL4 TRL5 TRL6 VS total critical technologies pursued in CAJU. - SMR | HER	%	compared to 2020 state-of-the-art	TRL4: N/A[6] | N/A TRL5: N/A | N/A TRL6: N/A | N/A	TRL4: TBD | TBD TRL5: TBD | TBD TRL6: TBD | TBD
Net[7] GHG emissions[8] reduction potential	Net GHG emission reduction* potential of targeted aircraft concepts - SMR | HER * (measured per Available Seat Kilometre (ASK) on a typical mission)	%	compared to 2020 state-of-the-art	N/A | N/A	>30% | >30% (>2035)
CO_2 emissions reduction potential	CO_2 emission reduction* potential of targeted aircraft concepts	%	compared to 2020	N/A | N/A	>30% | >50% (>2035)

[6] Not Available

[7] "Net" accounts for the use of SAF as drop-in aviation fuel produced on the basis of direct air carbon capture and green H2 production.

[8] GHG emissions are hereby estimated only accounting for the "tank-to-wake" GHG emissions, i.e. emissions released into the atmosphere by the aircraft burning fuel from the tank. The "well-to-tank" GHG emissions, i.e. emissions released into the atmosphere from the production, processing and delivery of a fuel or energy vector, are not accounted for.

KPI name	Definition	Unit of Measurement	Baseline	2023 Target	Target at Programme end
	- SMR | HER * (measured per Available Seat Kilometre (ASK) on a typical mission)		state-of-the-art		
Availability of draft certification requirements and critical means of compliance	Available draft certification requirements and critical means of compliance per project for critical Clean Aviation technologies. (Targets set as average across projects)	%	compared to 2020 state-of-the-art	N/A* *Assessment made at end phase 1 (2026) and end of phase 2 (2030). Not every year.	90%
Patent applications	Number of patent applications	-	First year level	N/A (Patent applications are expected after 4 to 5 years from the project launch)	340
Peer reviewed scientific publications	Number of peer-reviewed scientific publications - Share of peer reviewed scientific publications published in open access	- %	First year level	N/A* (*Low number of publications in the first 1-2 years of the programme is expected. On average 40-50 per year in the following years.)	350

KPI name	Definition	Unit of Measurement	Baseline	2023 Target	Target at Programme end
Project dissemination and Communication activities	Number of project dissemination activities other than peer-reviewed scientific publications. For example: Technical papers / Conference proceedings, thesis, books, conference participations, other dissemination activities, such as technical presentations at event/conferences, workshops/training organised. Number of project communication activities. For example: press releases, publications, exhibitions, social media, websites, communication campaigns	-	First year level	N/A* (*Low number of dissemination activities in the first 1-2 years of the programme is expected. On average 50-60 per year in the following years.) N/A* (*Low number of communication activities expected in the first 1-2 years of the programme. On average 50 per year in the following years.)	600 TBD

Clean Aviation Programme Impact

Impact KPIs are defined to monitor the impact of projects' results. Reporting on these KPIs is carried through dedicated external studies and/or from inputs arising from the impact monitoring results carried out by the European Commission.

KPI name	Definition	Unit of Measurement	Baseline	2023 Target	Target at Programme end
Net[9] GHG emissions[10] reduction at fleet level by 2050	Net[11] GHG emissions reduction at CAJU fleet* level by 2050 (cumulative) expressed as % of GHG emissions by 2050 (cumulative) assuming fleet level composed by 2020 state of the art aircraft** available in the market. *(CAJU fleet = CAJU SMR fleet + CAJU REG fleet) **(fleet = 2020 state-of-the-art SMR fleet + 2020 state-of-the-art REG fleet)	%	compared to 2020 state-of-the-art	N/A (Impact expected after 2035)	N/A (>2035) To be estimated at programme end, including assumption on fleet renewal rate and market share
Market deployment of CA solutions	Likelihood of exploitation with EIS2035 based on - achieved performance targets - achieved technology maturity - industrialisation systems available, - certification in place, - sufficient SAF/H2 availability, - infrastructure & regulation in place - market opportunities: Two aircraft platforms are differentiated: SMR I HER	%	compared to 2020 state-of-the-art	N/A | N/A	N/A (>2035) Launch of new products by 2030, delivery by 2035 to be estimated at programme end.

[9] "Net" accounts for the use of SAF as drop-in aviation fuel produced on the basis of direct air carbon capture and green H2 production.

[10] GHG emissions are hereby estimated only accounting for the "tank-to-wake" GHG emissions, i.e. emissions released into the atmosphere by the aircraft burning fuel from the tank. The "well-to-tank" GHG emissions, i.e. emissions released into the atmosphere from the production, processing and delivery of a fuel or energy vector, are not accounted for.

[11] "Net" accounts for the use of SAF as drop-in aviation fuel produced on the basis of direct air carbon capture and green H2 production.

KPI name	Definition	Unit of Measurement	Baseline	2023 Target	Target at Programme end
Socio economic benefits	1. Leverage Factor: net economic value of CAJU innovations vs EU funding. (The leverage factor quantifies the “return on investments”) 2. Number of jobs (i.e. jobs direct, indirect, induced and tourism catalytic) supported by aviation in Europe in 2050.	- -	Clean Sky 2 Socio Economic Study 2022	N/A* * assessments foreseen in 2026 and 2030	1. Leverage Factor>3 2. TBD * assessments foreseen in 2026 and 2030

Impact Monitoring Framework of the Clean Aviation programme

Clean Aviation aims to integrate and demonstrate disruptive aircraft technological innovations to decrease net emissions of greenhouse gases by no less than 30% by 2030, compared to 2020 state-of-the-art technology while paving the ground towards climate-neutral aviation by 2050. The Council Regulation (EU) 2021/2085 assigned the additional task to the JU, of monitoring and assessing the technological progress towards the achievement of its objectives, in line with the Strategic Research and Innovation Agenda (SRIA) and the three thrusts.

This task, ensured by the Executive Director under the direct supervision of the Governing Board, covers the monitoring and assessment of the Clean Aviation Work Programme activities emanating from the calls for proposals that will implement the Strategic Research and Innovation Agenda, towards achieving the general and specific objectives of Clean Aviation.

The independent impact monitoring of aviation research and innovation in general, will be carried out under the responsibility of the European Commission within its collaborative research programme in order to contribute to the definition and impact assessments of future EU aviation policies, to support the EU position in ICAO, and to communicate the impact of EU aviation research and relevant policies. All necessary agreed information (data exchange) and interaction to this task will emanate from the impact monitoring tasks implemented in the Clean Aviation programme.

The aircraft integrators, supported by the propulsion and system suppliers and their participants in projects (RTOs, academia and SMEs) are responsible for providing aircraft performance predictions, including the environmental impact at aircraft level against the Council Regulation (EU) 2021/2085 objectives. They will integrate all the results stemming from different projects contributing to an aircraft concept (in one report) and provide visualisations of the cumulated programme impacts as compared to the objectives set in the SRIA, including interdependencies between technical, operational, and environmental dimensions. The report will also consolidate the expected impact from SRIA-relevant projects that arise from other relevant European Partnerships. Expected impact from synergies with other EU, national or regional initiatives (including missions) should also be explored.

This task will follow a well-developed intervention logic with clear objectives and targeted impacts, measurable expected outcomes, deliverables and milestones within a defined timeframe, as well as adequate resources and portfolio of activities to match these. It is based on the schematic process illustrated in Figure 2.

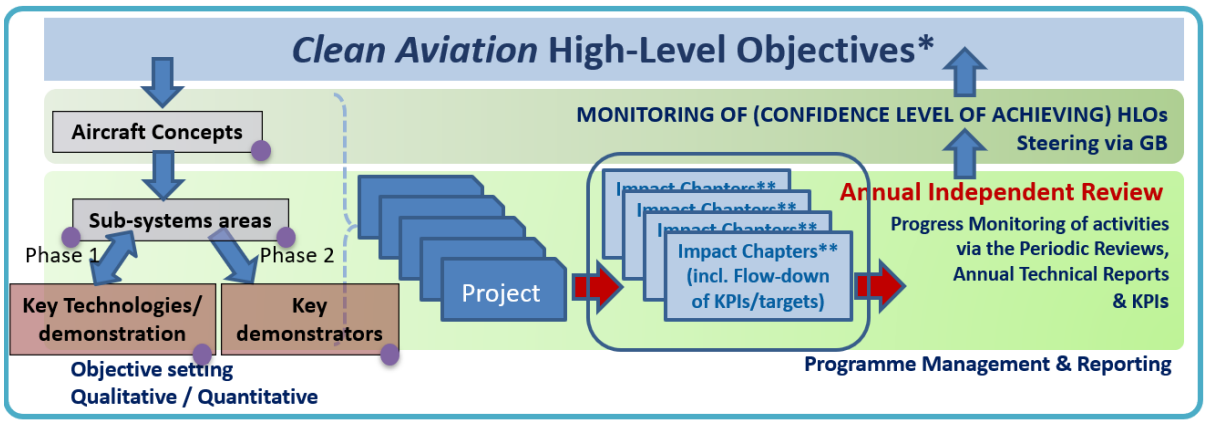


Figure 2. Schematic principles of the CAJU Impact Monitoring Framework.

Both a qualitative and quantitative objective setting will be performed through the definition and selection of relevant aircraft concepts/configurations, versus a well-defined baseline (state-of-the-art 2020 reference aircraft) for comparable top-level aircraft requirements.

These overall aircraft concepts will allow for a breakdown of the objectives into key subsystem areas (propulsion system, wing, fuselage, etc.) and finally key technologies and demonstrators. This breakdown will enable the identification of the relevant Key Performance Indicators (KPIs) at each level, likely to undergo an iterative process during Phase 1 of the programme, until convergence before the start of Phase 2. The KPIs will be defined using SMART criteria: Specific, Measurable, Attainable, Relevant, and Time-bound.

At aircraft concept level, the high-level objective, as stated in the Council Regulation (EU) 2021/2085, towards achieving at least 30% GHG net emissions reduction versus the State-of-the-Art 2020 will be translated into emissions and fuel burn reduction targets and/or aircraft energy efficiency targets when new fuels such as hydrogen are considered. This will allow to align/reconcile the objectives defined in the SRIA (in terms of CO_2 emission targets per aircraft concepts or technologies - without any effect of sustainable aviation fuel) with those defined in the Regulation (in terms of net GHG emissions) once getting further scientific knowledge and inputs.
At key subsystem area level, those KPIs will translate into specific target performance parameters required to realise a given concept, such as tailpipe emissions, efficiency and power density of an engine or any power train configuration, aerodynamic (lift and drag, etc.) and weight/structural performance of a wing configuration, as non-exhaustive examples.
In order to ensure measurable outcomes, each project will provide a specific deliverable to the aircraft concept owners on a yearly basis, as well as a final impact/performance assessment at completion, including a TRL assessment.

Aircraft concept projects (aircraft integrators) will perform a consolidated assessment of the performance and maturity progress based on the individual technology assessments stemming from the different linked projects contributing to an aircraft concept. They will also report on a yearly basis for the relevant aircraft concepts envisaged. At aircraft concept level, this reporting will be complemented on a biennial basis by a detailed overall aircraft level performance simulation and related assessment with appropriate high-fidelity tools.

This information flow will be complemented by the well-established Programme Management and Reporting activities, such as the Annual and Periodic Reviews by independent experts and the Annual Activity Report with the Programme KPIs.
The CAJU will follow up these tasks and the associated deliverables in the frame of the Work Programme activities. The Executive Director will ensure the programme's monitoring and assessment of the progress compared to relevant impact indicators and the Joint Undertaking's specific objectives, under the supervision of the Governing Board and in coordination with advisory bodies where relevant, and in accordance with monitoring and evaluation principles set out in the Council Regulation (EU) 2021/2085.

The report(s) will be submitted to the Technical Committee to propose, for deliberation and final decision by the Governing Board, revisions or optimisation of the technical scope of the programme in order to align the work programme and the objectives of the Clean Aviation Joint Undertaking with Horizon Europe overall and other European partnerships' related work programmes.

Horizon Europe Key Impact Pathways

The Horizon Europe Regulation provides for a definition of **impact areas** to monitor results against **Key Impact Pathways[12] (KIPs)**. Due to the current very early stage of the programme, there will be no sufficient projects results available in 2023 to report against KIPs, except for "Number of peer-reviewed scientific publications resulting from the Programme" which has been included among the KPIs for monitoring the Clean Aviation Programme Outcome.

High-Level Environmental Objectives for the Clean Sky 2 programme:

Key Performance Indicator	Definition/Responding to Question	Target
Reduction of aircraft CO_2 emissions	reduce aircraft CO_2 emissions compared to "state-of-the-art" aircraft entering into service as from 2014	*> 20 to 30%*
Reduction of aircraft NOx emissions	reduce aircraft NO_x emissions compared to "state-of-the-art" aircraft entering into service as from 2014	*> 20 to 30%*
Reduction of aircraft noise emissions	reduce aircraft noise emissions levels per operation compared to "state-of-the-art" aircraft entering into service as from 2014	*> 20 to 30%*

[12] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0695&from=EN

Key Performance Indicators for the execution of the Clean Sky 2 programme:

Key Performance Indicator	Definition/Responding to Question	Target
Demonstration activities	Number of demonstration activities	*>90* *the KPI is referring to the demonstrators and key technologies as defined in the different SPDs*
SME participation	Share of EU financial contribution going to SMEs (enabling & industrial tech and Part III of Horizon 2020)	*10%** *(Including GAMs and GAPs contribution [GAPs: >25%])*
Dissemination activities	Number of dissemination activities (conferences, workshops, press releases, publications, exhibitions, trainings, social media, websites, communication campaigns).	*At least 100/year*

2.4 Calls

The Clean Aviation Joint Undertaking (CAJU) is set up for a period ending on 31 December 2031 and it can launch calls until 31 December 2027 (in duly justified cases this can be extended to 31 December 2028 and based on availability of remaining budget stemming from the MFF 2021-2027).

The following open calls are launched as part of the Clean Aviation Work Programme 2022-2023:

- Calls for Proposals for
  - Innovation Actions (IAs);
  - Coordination and Support Actions (CSAs);
- Calls for Expression of Interest
  - to become an Associated Member of the CAJU;

2.4.1 Calls for Proposals

The Clean Aviation Calls for Proposals are open. Members as well as non-members of the Joint Undertaking (JU) can equally participate to these calls.
The Clean Aviation Work Programme is divided into two phases:

- Phase 1 (2022-2025): maturation of technologies and key enablers;
- Phase 2 (2026-2031): integration of those technologies focusing on breakthrough demonstrators.

The Work Programme 2022-2023 covers the execution of Phase 1 through the launch of two Calls for Proposals and the subsequent evaluation, selection and funding of Innovation Actions covering the activities needed in the aforementioned thrusts, as well as of Coordination and Support Actions covering activities in support of the Clean Aviation programme.

The proposed strategy is to launch a large call in the first quarter of 2022 (Call #1), and a smaller call in the first quarter of 2023 (Call #2), covering all available funding of Phase 1 (i.e. €809.635 million). The call planning is presented in Table 1 and Table 2.

Table 1. Calls for Proposals – Innovation Actions - planning 2022-2023

Calls for Proposals – Innovation Actions - planning 2022-2023		
SUBJECT	ESTIMATED EU FUNDING (in million EUR)	SCHEDULE (estimated launch)
Call 1	654 (total value of grants signed)[13]	Launched on 23 March 2022
Call 2	137	Q1-2023
Total	791	

Table 2. Calls for Proposals – Coordination and Support Actions[14] - planning 2022-2023

Calls for Proposals – Coordination and Support Actions - planning 2022-2023		
SUBJECT	ESTIMATED EU FUNDING (in million EUR)	SCHEDULE (estimated launch)
Call 1	0.72 (total value of grant signed)	Launched 23 March 2022
Call 2	0.75	Q1 2023
TOTAL	1.47	

Innovation Actions

Call 1 and Call 2 will address a number of challenges considered to be the highest technological priorities in order to achieve impact, in-line with the High-Level Objectives laid out in the Single Basic Act (SBA)[15]. These priorities have been determined on the basis of the Clean Aviation SRIA and of the detailed Strategic Roadmaps defined by the stakeholders for each *thrust*, as summarised in Table 3.
In line with the rationale and priorities described above, the funding available in phase 1 is foreseen to be allocated across different topics for Call 1 and Call 2 as presented in **Error! Reference source not found.** and 5. Topic descriptions are laid down in Annex 4.1 and Annex 4.2.

Table 3. Proposed priorities for each Thrust for Phase 1

Thrust	Rationale / Priorities for Phase 1
H2	➢ Support the development of key enabling technologies (fuel cells, stacks, tanks, fuel distribution, propulsion) in coordination with Clean Hydrogen Joint Undertaking and critical to a hydrogen-based propulsion system; ➢ Performance and reliability consistent with the requirements expected by the HER and SMR ambitions, for subsequent uptake and integration at the level of these aircraft; ➢ H2 thrust supporting Early Ground Demo (in Phase 1) and flight tests (in Phase 2), which are major contributors to the H2 climate assessment.
HER	➢ Priority given in Call #1 to start critical activities contributing to GHG reduction and most challenging technologies with high risk; ➢ Hybrid-electric propulsion is compatible with H2 Burn and Hydrogen Fuel Cell propulsion technologies. Therefore, strong interactions will exist between the HER activity and H2 and disruptive propulsion technology streams in the H2 and SMR thrusts.
SMR	➢ Priority given to develop in parallel key technologies for an ultra-efficient SMR and H2-fuel capability and to achieve high technical and industrial maturity at same pace. ➢ Proposed setup ensuring a close alignment of R&I activities for key technologies at aircraft integrated level;

[13] €735 million (total value of grants as launched)
[14] Subject to confirmation by the European Commission
[15] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CONSIL:ST_12156_2021_INIT&qid=1646380000738&from=EN

Table 4. Call#1 – Year 2022 – Innovation Actions - Total indicative funding 735M€

Hydrogen Powered Aircraft (H2)	
Topic ID / Funding	**Topic Title / Abstract**
HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-01	Direct Combustion of Hydrogen in Aero engines
Call#1 - 115M€ Up to 2 projects expected	Conversion of a Regional or SMR donor aero engine (i.e. turboprop or turbofan) to Hydrogen Direct Combustion up to Engine Ground Test and Permit to Fly. TRL5 achieved at the level of hydrogen direct combustion by end of Phase 1.
HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-02	Multi- Megawatt (MW) Fuel Cell Propulsion System for Hydrogen-Powered Aircraft
Call#1 - 50M€ Up to 2 projects expected	Design, Development and Component Optimisation of a Full Electric Large Scale Multi-MW (~3MW) Fuel Cell HIPS (Hydrogen Integrated Propulsion System) for Regional Aircraft Applications up to system/sub-system validation at TRL 4 or higher by end of Phase 1.
HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-03	Large Scale Lightweight Liquid Hydrogen Integral Storage Solutions
Call#1 - 10M€ 1 project expected	Development and Ground Test of Large Scale Ultra lightweight LH2 Integral Tanks of ~150kg LH2 capacity with a gravimetric index of 35% @TRL4 or higher by end of Phase 1, aiming at large integral tanks (600kg H2, gravimetric index >45%) for regional and SMR applications.
HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-04	Near Term Disruptive Technologies for Hydrogen-Powered Aircraft
Call#1 - 7M€ Up to 2 projects expected	Ground Test of a Small Scale (~500kW) Fuel Cell HIPS (Hydrogen Integrated Propulsion System) based on state of the art components targeting identification of failure modes by full "virtual flight test". Complete drive train system iron bird including propulsive and non-propulsive loads @TRL5. Flight Test of a Small Scale LH2 Integral Tank (100kg LH2, G.I.25%) to investigate in-flight behaviour (sloshing, boil-off, thermo-mechanical behaviour, etc.) @TRL5 by end of Phase 1.
Total Call#1: 182M€	
Hybrid Electric Regional Aircraft (HER)	
Topic ID / Funding	**Topic Title / Abstract**
HORIZON-JU-CLEAN-AVIATION-2022-01-HER-01	Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft
Call#1 - 75M€ Up to 2 projects expected	Development and ground test of a hybrid-electric propulsion system with a target of at least 30% GHG emissions reduction at overall propulsion system level in 2030. TRL4 or higher at propulsion system level to be achieved at project completion.
HORIZON-JU-CLEAN-AVIATION-2022-01-HER-02	Thermal Management Solutions for Hybrid Electric Regional Aircraft
Call#1 - 40M€ 1 project expected	Development of novel thermal management concept(s) for hybrid electric aircraft including all relevant key enabling technologies and components matured to TRL5 at system level at project completion.
HORIZON-JU-CLEAN-AVIATION-2022-01-HER-03	Electrical Distribution Solutions for Hybrid-electric Regional Aircraft
Call#1 - 40M€ 1 project expected	Development of advanced electrical distribution concept(s) for hybrid electric aircraft including all relevant key enabling technologies and components matured to TRL5 at system level at project completion.
HORIZON-JU-CLEAN-AVIATION-2022-01-HER-04	Innovative Wing Design for Hybrid-Electric Regional Aircraft

Call#1 – 20M€ 1 project expected	Design of an innovative and more efficient wing with relevant technology bricks matured to TRL5 at wing system level at project completion, duly supported by ground tests.
Total Call#1: 175M€	

Short & Medium Range Aircraft (SMR)

Topic ID / Funding	Topic Title / Abstract
HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft
Call#1 – 175 M€ Up to 3 projects expected	Development and ground test demonstration of Ultra Efficient Propulsion Systems based on ducted or unducted engine architectures, as well as core engine and combustion technologies, including advanced thermodynamic cycles and hybridisation technologies targeting ultra-efficient propulsion systems with a fuel burn reduction of minimum 20% compared to 2020 state-of-the-art. TRL 5 at ducted or unducted engine architectures system level and TRL4 at core engine / combustion technologies level at project completion.
HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-02	Ultra Performance Wing for Short and Short-medium Range Aircraft
Call#1 – 55 M€ Up to 2 projects expected	Design and development of ultra-efficient wing for the targeted SR/SMR aircraft concepts including 'wet' (for SAF-fuelled concepts) and 'dry' (hydrogen-fuelled concepts) configurations, exploiting advanced aerodynamic technologies. Maturation at TRL4 or higher via ground and scaled-flight tests demonstration by project completion.
HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-03	Advanced Low Weight Integrated Fuselage and Empennage for Short Range and Short-Medium Range Aircraft
Call#2 – 40 M€ 1 project expected	Design of an innovative and more efficient fuselage and empennage for the targeted SR/SMR aircraft concepts using hydrogen as a fuel, with relevant technology bricks matured to TRL 4 at fuselage system level and TRL 4 at empennage system level at project completion, duly supported by virtual and ground tests.
Total Call#1: 270M€	

Transversal Topics

Topic ID / Funding	Topic Title / Abstract
HORIZON-JU-CLEAN-AVIATION-2022-01-TRA-01	Aircraft architectures & technology integration for aircraft concepts ranging from regional to short-medium range applications
Call#1 – 90 M€ Up to 3 projects expected	Definition and detailed design studies of aircraft concepts and architectures targeting entry into service (EIS) by 2035. The configurations studied will aim at reducing fuel burn by at least 30% for SR/SMR aircraft and by 50% for regional aircraft compared to 2020 state-of-the-art, seeking 100% SAF drop-in fuel compatibility. For concepts based on the use of hydrogen as the fuel or energy source, the configurations studied will aim at no less than 15% reduction in aircraft energy demand compared to 2020 state-of-the-art. The design shall include the complete architecture layout (in terms of aircraft aerodynamic/structural configuration and propulsive/non-propulsive system architecture) up to a validated down-selected concept at project completion (including numerical simulations and wind tunnel tests where relevant).
HORIZON-JU-CLEAN-AVIATION-2022-01-TRA-02	Novel Certification Methods and Means of Compliance for Disruptive Technologies
Call#1 – 18 M€ 1 project expected	Development of processes and methods to prepare the future certification framework, based on the analysis of risks and gaps of existing regulations, and implemented on a set of critical challenges representative of disruptive technologies and architectures. Investigation and development of new means of compliance for aviation safety, security and environmental protection based on virtual testing, digital platforms and Model Based System's Engineering (MBSE).
Total Call#1: 108M€	

Table 5. Call#2 – Year 2023 – Innovation Actions – Total indicative funding: 137M€

Hydrogen Powered Aircraft (H2)	
Topic ID / Funding	**Topic Title / Abstract**
HORIZON-JU-CLEAN-AVIATION-2023-02-HPA-01	Hydrogen fuel system for direct burn engine ground test execution and flight test preparation
Call#2 – 20M€ 1 project expected	Development, manufacturing, and delivery of all engine fuel system equipment for the wet rig tests at TRL5 and ground test campaign at TRL6. Finalisation of flight test demonstrator components on aircraft fuel system side and flight test preparation up to flight clearance.
HORIZON-JU-CLEAN-AVIATION-2023-02-HPA-02	Aircraft Liquid Hydrogen Fuel Distribution System Technologies for Direct Burn Applications
Call#2 - 10M€ 1 project expected	Design and development of the aircraft liquid hydrogen fuel distribution system components for Hydrogen Direct Burn Propulsion Systems (modelling & simulation, up to ground demonstration of full functional system at TRL6 by end of Phase 1).
HORIZON-JU-CLEAN-AVIATION-2023-02-HPA-03	Multi-MW Fuel Cell Propulsion System for Hydrogen-Powered Aircraft
Call#2 - 35M€ 1 project expected	Design & Integration Optimisation of a Full Electric Large Scale Multi-MW (~3MW) Fuel Cell HIPS (Hydrogen Integrated Propulsion System) based on an aviation-grade Fuel Cell for Regional Aircraft Applications up to system/sub-system validation at TRL4 by end of Phase 1.
Total Call#2: 65 M€	
Hybrid Electric Regional Aircraft (HER)	
Topic ID / Funding	**Topic Title / Abstract**
HORIZON-JU-CLEAN-AVIATION-2023-02-HER-01	Innovative Fuselage/Empennage Design for Hybrid-Electric Regional Aircraft
Call#2 - 25M€ 1 project expected	Design of an innovative fuselage with relevant technology bricks matured to TRL 5 at major component/assembly or system level at project completion, duly supported by ground tests.
HORIZON-JU-CLEAN-AVIATION-2023-02-HER-02	Open Digital Platform for Hybrid-Electric Regional Aircraft Design
Call#2 - 7M€ 1 project expected	Development of an open and transferable digital platform architecture, combining MBSE, PLM and SDM technologies, with a software maturity comparable with TRL 5 at system level and validated by a pilot case at project completion
Total Call#2: 32M€	
Short & Medium Range Aircraft (SMR)	
Topic ID / Funding	**Topic Title / Abstract**
HORIZON-JU-CLEAN-AVIATION-2023-02-SMR-01	High-TRL Flight Demonstration Means for Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft
Call#2 – 20 M€ 1 project expected	Delivery of an ultra-advanced flight test demonstrator platform at project completion enabling full-scale flight tests of novel ultra-efficient ducted or unducted geared engine architectures for Short and Short Medium Range. Preparation of Flight tests to be later performed in Phase 2 of the Clean Aviation Programme to demonstrate TRL6 at propulsion system level at programme end.

HORIZON-JU-CLEAN-AVIATION-2023-02-SMR-02	Ultra Performance Wing Technologies and Integration for Short and Short-medium Range Aircraft
Call#2 – 13 M€ 1 project expected	Design of ultra-efficient 'dry' wing for the targeted SR/SMR aircraft concept exploiting non-drop-in fuels such as hydrogen, including optimized solutions for unducted engine integration, aerodynamic optimisation and flutter management. Maturation at TRL4 or higher via ground and scaled-flight tests demonstration by project completion.
HORIZON-JU-CLEAN-AVIATION-2023-02-SMR-03	Advanced Cabin and Cabin Systems Integration for Short Range and Short-Medium Range for Hydrogen-Powered Aircraft
Call#2 - 7M€ 1 project expected	Cabin and cabin systems design and development for safe and optimum integration of hydrogen equipment and components and corresponding fuselage design for hydrogen-powered SR/SMR aircraft up to TRL4 or higher.
Total Call#2: 40M€	

Coordination and Support Actions

Within the WP 2022-23, the JU intends to launch two call topics as a Coordination and Support Actions[16] (CSA) supporting both the Strategic Development Unit and the Programmes Unit.

The Call 1 CSA aims to establish a network between European aeronautical states and regions with the Clean Aviation Joint Undertaking, in order to develop further the synergies between the Clean Aviation programme and other related national and regional initiatives. The Call 2 CSA will address the Impact Monitoring Framework and the Programme Strategy in general. The CSA topics foreseen in Calls 1 and 2 are presented in Table . The topic descriptions are included in Annex 4.1 and Annex 4.2.

Table 6. Coordination and Support Actions

Call#1 – Year 2022 - Total indicative funding 0.72M€[17]

Coordination and Support Actions	
Topic ID / Funding	**Topic Title / Abstract**
HORIZON-JU-CLEAN-AVIATION-2022-01-CSA-01	Developing a European Clean Aviation Regional Ecosystem (ECARE)
Call#1 – 0.72M€ 1 project expected	Establish a networking platform that will facilitate the interaction between the national and regional stakeholders (including clusters); support and coordinate the national and regional activities with the Clean Aviation programme; and identify specific measures aimed at increasing the involvement of SMEs and other stakeholders in the Clean Aviation programme.
Total Call #1: 0.72M€	

Call#2 – Year 2023 - Total indicative funding 0.75M€[18]

Coordination and Support Actions	
Topic ID / Funding	**Topic Title / Abstract**
HORIZON-JU-CLEAN-AVIATION-2023-02-CSA-01	**Aviation Climate and Technology Impact Monitoring Methodology**
Call#2 – 0.75 M€ 1 project expected	Development of a Climate and Aircraft Technology Impact Monitoring Methodology based on a state-of-the-art review and analysis of aviation climate impact assessment methodologies (including metrics) and a worldwide survey of open source emerging disruptive aircraft concepts and technologies, and the targeted/expected performance gains claimed. This topic should provide the JU and its members with support to get a preliminary assessment of the expected impact of projects and the definition of interfaces with the impact monitoring under the call HORIZON-CL5-2024-D5-01-09: "Impact monitoring of EU Aviation R&I".
Total Call #2: 0.75M€	

[16] Subject to confirmation by the European Commission

[17] Subject to confirmation by the European Commission

[18] Subject to confirmation by the European Commission

Call publication and evaluation of IAs and CSAs

The detailed description of the calls for proposals will be announced at the time of the publication of the call on EU 'Funding & Tender opportunities' portal and JU website.

The legal entities and consortia selected through the open calls will carry out objective-driven research activities aiming at developing new knowledge, new technologies and/or solutions contributing to the high-level goals of the Clean Aviation programme. Applicant legal entities and consortia will be selected on the basis of eligibility criteria, evaluation criteria and thresholds set out in calls launched via the EU 'Funding & Tender opportunities' portal.
The calls will be subject to independent evaluation and will follow the Horizon Europe rules on calls for proposals with the exception of the derogation and specificities set out in subchapter 2.4.3. Upon selection, the applicants will sign a Grant Agreement with the JU. For more information on the call management rules and evaluation process please see subchapter 2.4.3 and the General Annexes to the HE Work Programme and the specific call/topic conditions.
The calls will include *inter alia*:

- a call identifier;
- a description of the objectives, priority and strategic orientation of the call;
- specific topic descriptions, indicating the areas or fields where the applicant is requested to bring new knowledge, new technologies or solutions;
- types of actions;
- indicative timetable;
- indicative funding (broken down per work area/topic as relevant, or budget-to-scope allocation);
- applicable funding rate per call topic;
- expected EU contribution per project;
- indicative project duration;
- indicative number of selected projects per call topic;
- expected duration and time schedule;
- the competences required to run the action (expertise and skills, capabilities and track record) and to deal with risks associated to the activity (both at project and applicant level);
- the requirements related to the operational capacity (level of competences, level of technical capabilities, availability and capacities of specific resources, track record etc.);
- any specific legal, intellectual property and liability aspects in line with the provisions of the JU model Grant Agreement, Consortium Agreement, Membership Agreement and Cooperation Agreement.

2.4.2 Calls for Expression of Interest

The Clean Aviation will launch open Calls for Expression of Interest (CEI) as indicated in
Table 4

- to become an Associated Member of the Joint Undertaking (JU) (see subchapter 2.4.3);

Table 4. Call for Expression of Interest - planning 2022-2023

Call for Expression of Interest - planning 2022-2023		
SUBJECT	ESTIMATED EU FUNDING (in million EUR)	SCHEDULE (estimated launch)
CEI to become Associated Member of the JU	Not applicable	First half of 2023

2.4.3 Conditions and management of the calls

In accordance with the SBA, the CAJU may operate via the following types of calls mechanisms:

- calls for proposals;
- joint calls with other European Partnerships;
- calls for expression of interest for the selection of associated members.

Applicable legal basis:

Calls for proposals:
In accordance with Article 5.2 (a) of the SBA the CAJU shall provide financial support, mainly in the form of grants, to research and innovation indirect actions, selected following open, transparent and competitive calls except in duly justified cases specified in their work programme in order to set additional conditions requiring e.g. the participation of Members of the Joint Undertaking or their constituent or affiliated entities.

Joint calls with other European Partnerships:
In accordance with Article 5.2 (b) the CAJU shall develop close cooperation and ensure coordination with other European partnerships, including by dedicating, where appropriate, a part of the Joint Undertaking's budget to joint calls.

Calls for expression of interest for the selection of Associated Members:
In accordance with Article 7 of the SBA, the CAJU shall launch open and transparent calls for expression of interest to select Associated Members subject to the provisions of Article 7 and to a decision of the Governing Board.

In accordance with Article 57.2 of the SBA Associated Members may be selected by the Governing Board during the first six (6) months following the establishment of CAJU from a list drawn up after an open call for expression of interest launched by the Commission prior to its establishment.

Description of the calls:

Call for proposals
The call for proposals process will be conducted in line with Horizon Europe rules and by analogy to the applicable guidance documents for calls for proposals under Horizon Europe.

The description of the process for the submission of proposals, the evaluation procedure and any specificity related to the call for proposals framework will be set out and described in the CAJU rules for submission, evaluation, selection, award and review procedures of the Calls for Proposals which pursuant to SBA Council Regulation (EU) 2021/2085 of 19 November 2021 require the approval by the Governing Board and will be published on the Clean Aviation JU website and on the Funding & Tenders opportunities portal:
https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home

The calls for proposals will be managed in compliance with the present section of the CAJU Work Programme and the General Annexes to the HE Work Programme (https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2023-2024/wp-13-general-annexes_horizon-2023-2024_en.pdf), complemented by the specific conditions of the call, if any.

Applicants to the calls which are non-members of the JU will not become members of the JU and will not be expected to contribute to the administrative costs of the JU. Similarly, they will not participate in the governance of the CAJU nor the Technical Committee.

Joint calls with other European Partnerships

To expand and foster integration of the climate-neutral aviation research and innovations value chains, the CAJU can launch a joint call with other European Partnerships.

In the case of a joint call for proposals, the applicants shall fulfil the eligibility requirements specified in section B of the General Annexes to the HE Work Programme.

The selection and evaluation of proposals will be carried out in line with the procedure established jointly by funding authorities in line with the applicable HE rules for participation. Such procedures shall involve a balanced group of experts appointed by each party.

Calls for expression of interest for the selection of Associated Members:

In accordance with article 57 of the Single Basic Act (SBA), the members of the CAJU other than the Union shall be:

- the Founding Members;
- the Associated Members to be selected in accordance with article 7 of the SBA subject to a decision of the Governing Board, or to be selected by the Governing Board in accordance with Article 57(2) of the SBA during the first six months following the establishment of CAJU from a list drawn up after an open call for expression of interest launched by the Commission prior to its establishment.

Only the pre-established Founding Members listed in Annex I of the SBA and their affiliated entities and the Associated Members selected based on Article 7 and 57.2 and their affiliated entities may become “Members other than the Union” of the CAJU in the meaning of Article 2.1 of the SBA.

Applicants wishing to become Associated Members in the Clean Aviation Programme shall submit applications to the call for expression of interest (CEI) to be launched by the CAJU in line with Article 7 of the SBA.

The organisations will be assessed and selected by the CAJU in line with Article 7.2 of the SBA following an evaluation process with the assistance of independent experts based on their documented key knowledge, experience and added value, key competences and capabilities, expected level of technical contribution to the CAJU objectives and “SRIA” High Level Objectives and their long-term financial and in-kind contribution to the JU.

The organisations shall sign a “Letter of Commitment” (LoC) as required in Article 6.2 of the SBA by which they agree in being jointly committed to the in-kind requirement set in Article 6.3 of the SBA (jointly with the Founding Members and Associated Members). The selected organizations will be proposed for selection to the Governing Board in accordance with Article 7.3 of the SBA.

It should be noted that the organizations established in countries for which an Association Agreement to the Horizon Europe has not been concluded by the date of the selection by the Governing Board, may not be selected for membership of the CAJU.
The selected organisations will have a strategic and long-term commitment to the Programme and will perform core tasks and bring key capabilities to implement the Programme through the research actions in which they are involved.

The Members other than the Union and their affiliated entities shall contribute to the efficient implementation of the SRIA / CA Programme, in accordance with the objectives and requirements set out in the SBA.

The Members will be eligible to apply to the open calls for proposals and joint calls (where applicable) and may become grants beneficiaries of the CAJU following the evaluation, selection process and signature of a grant agreement.

In accordance with art. 59 the SBA, the Founding Members and Associated Members shall bring an amount of in-kind contribution to operational activities 'IKOP' at the level of the indirect actions and an amount of in-kind contribution to additional activities 'IKAA' both at the level of the indirect actions and at the level of the Programme to be able to collectively ensure the minimum level of in-kind contribution (IKC) (€2.4 bn) set under Article 61 of the SBA.

Specific conditions will apply as appropriate at the level of the calls for proposals to ensure implementation of the objectives set under the SBA.

Calls management rules:

The CAJU calls for proposals are managed in accordance with the following rules:

Part A (Admissibility) of the General Annexes to Horizon Europe Work Programme https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2021-2022/wp-13-general-annexes_horizon-2021-2022_en.pdf shall apply to the calls for proposals, with the following modification below:

Page limits

Unless provided otherwise in the specific call conditions, the limit for a full application is 120 pages (except for 'Coordination and support' actions, where the limit is 30 pages).

Part B (Eligibility) of the General Annexes to the Horizon Europe Work Programme shall apply to the calls for proposals with the following derogation, additional conditions, modifications or non-applications introduced below:

Eligibility and consortium composition:

Unless otherwise provided for in the CAJU Work Programme and the specific topic conditions, legal entities forming a consortium are eligible to participate in actions provided that the consortium includes:

- at least one independent legal entity established in a Member State;

- at least two other independent legal entities, each established in different Member States or Associated Countries.

Derogation on eligibility: Pursuant to Article 72 of the SBA Regulation, where it is duly justified in the description of relevant topics in the CAJU Work Programme, a single legal entity established in a Member State or Associated Country or consortia not meeting the condition laid down in Article 22(2) of the Horizon Europe Regulation shall be eligible to participate in indirect actions funded by the Clean Aviation Joint Undertaking.

In accordance with Article 22(6) of the Regulation (EU) 2021/695 establishing Horizon Europe, where appropriate and duly justified, the Work Programme may provide for eligibility criteria, in addition to those set out in paragraphs 2 to 5 of the same Article, to take into account specific policy requirements or the nature and objectives of the action, including the number of legal entities, the type of legal entity and the place of establishment.

Additional specific cases:

Founding members – means the Member(s) other than the Union listed in Annex 1 to the SBA having officially confirmed and accepted its commitment to the CAJU as required under articles 6(3) and 59(1)(b) of the SBA by means of the Letter of Commitment.

Associate members- any legal entity established in a member state, in a country associated to the Horizon Europe Programme or in an international organisation that accedes to the CAJU by signing a Letter of Commitment in accordance with articles 6(3) and 7 of the SBA and subject to approval in accordance with those articles.

Members' affiliated entities - the affiliated entities to the Members other than the Union involved in the technical programme implementation and relevant grant agreements.

Contributing Partners- means any country, international organisation or legal entity other than a member, or a constituent entity of a member or an affiliated entity of either, that supports the objectives of a joint undertaking in its specific area of research and whose application has been approved in accordance with Article 9 of the SBA.

Partner (beneficiary non-member): entities which participate in the action as beneficiary by signing the grant agreement, but without the rights and obligations of the Members other than the Union.

Entities eligible for funding

To be eligible for funding, applicants must be established in one of the eligible countries, i.e.:

- the Member States of the European Union, including their outermost regions
- the Overseas Countries and Territories (OCTs) linked to the Member States

- non-EU countries eligible for funding: countries associated to Horizon Europe[19]

Considering the Union's interest to retain, in principle, relations with the countries associated to Horizon 2020, most third countries associated to Horizon 2020 are expected to be associated to Horizon Europe with an intention to secure uninterrupted continuity between Horizon 2020 and Horizon Europe. In addition, other third countries can also become associated to Horizon Europe during the programme. For the purposes of the eligibility conditions and the evaluation process, applicants established in Horizon 2020 Associated Countries or in other third countries negotiating association to Horizon Europe will be treated as entities established in an Associated Country. The entities will be eligible for Union funding only if the Horizon Europe association agreement with the third country concerned will be signed and applicable by the time of signature of the grant agreement. If not, the entity will not be eligible for Union funding and may participate to the action as "Associated Partner" status under the Horizon Europe model GA with its own financial resources or its costs may be directly funded by its relevant national authorities.

If the legal entity was pre-selected as possible Member other than the Union, following the signature of the HE association agreement, a Letter of Commitment may be signed in line with Article 6(3) of the SBA and its Member status may be accepted by the Governing Board and the entity may provide financial and in-kind contribution to the CAJU from the start of its technical activities in line with Article 10 of the SBA (private contribution matching the EU contribution as increased by third countries appropriations allocated to the CAJU) and Article 11(1) of the SBA (forms of in-kind contribution).

- low- and middle-income countries[20]

NB: Legal entities established in Russia, Belarus, or in non-government controlled territories of Ukraine — Given the illegal invasion of Ukraine by Russia and the involvement of Belarus, there is currently no appropriate context allowing the implementation of the actions foreseen in this programme with legal entities established in Russia, Belarus, or in non-government controlled territories of Ukraine. Therefore, even where such entities are not subject to EU restrictive measures, such legal entities are not eligible to participate in any capacity. This includes participation as beneficiaries, affiliated entities, associated partners, third parties giving in-kind contributions, subcontractors or recipients of financial support to third parties (if any). Exceptions may be granted on a case-by-case basis for justified reasons.

Eligible activities

The following activities are the only eligible for grants under Horizon Europe Clean Aviation Programme[21]:

- Research and innovation actions (RIA)
- Innovation actions (IA)
- Coordination and support actions (CSA)

[19] Please see the Horizon Europe Programme Guide on the Portal for up-to-date information on the current list and on the position for Associated Countries https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf

[20] See the Horizon Europe Programme Guide on the Portal for a complete list of these countries. https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf

[21] For a full description of these activities, please consult the Horizon Europe Work Programme 2023/2024 General Annexes, Part B.

Security — EU-classified and sensitive information

Not applicable.

Part C (Financial and operational capacity and exclusion) of the General Annexes to the Horizon Europe Work Programme shall apply, with the following additional conditions:

Grants may be awarded only to participants that can demonstrate sufficient financial capacity to perform their activity throughout the duration of the action. Organisations participating in several projects must have sufficient capacity to implement all these projects.

The financial capacity check will be done on the basis of the documents uploaded in the Participant Register during the grant preparation stage (e.g. profit and loss account and balance sheet, business plan, audit report produced by an approved external auditor, certifying the accounts for the last closed financial year, etc.) as well as during the entire duration of grant on the basis of a risk assessment performed, as appropriate, by the granting authority.

Part D (Award Criteria) of the General Annexes to Horizon Europe Work Programme shall apply complemented by the following additional conditions and non-applications:

Award criteria

If admissible and eligible, the proposals will be evaluated and ranked against the following award criteria, depending on the type of action:

	Excellence (The following aspects will be taken into account, to the extent that the proposed work corresponds to the description in the work programme)	**Impact**	**Quality and efficiency of the implementation**
Research and innovation actions (RIA) **Innovation actions (IA)**	- Relevance vs the SRIA/topic objectives (maturity targets and performance targets/ breakdown with respect to the topics/SRIA objectives); - Clarity and pertinence of the project's objectives	- Credibility of the pathways to achieve the expected outcomes and impacts specified in the SBA specific objectives, work programme, topic description and the SRIA, (quantitative measurement/assessment and performance monitoring strategy) and the likely scale and significance of the	- Quality and effectiveness of the proposed project work plan, assessment of risks, decision making process and appropriateness of the effort assigned to work packages, and the resources overall; List of major / key milestones and deliverables in the proposal representative of the actual progress

	(definition of SMART objectives) and the extent to which the proposed work is ambitious and goes beyond the state of the art; - Soundness of the proposed overall methodology, including the underlying concepts, models, assumptions, inter-disciplinary approaches, appropriate consideration of the gender dimension in research and innovation content, and the quality of open science practices, including sharing and management of research outputs and engagement of citizens, civil society and end-users where appropriate; - High level of innovation (disruptive concepts) and associated performance objectives.	contributions from the project; - Suitability and quality of the measures to maximize expected outcomes and impacts, as set out in the dissemination and exploitation plan, including communication activities; - The section on exploitation shall demonstrate a credible plan for a potential market uptake of the proposed technologies towards EIS by no later than 2035 consistent with envisaged maturity objective of the proposal (TRL objectives); - Evidence of the downstream exploitation of the results brought by applicants' participation in the programme (industrial strategy of the consortium as a whole describing the possible supply chain approach, the envisaged knowledge transfer if any and the industrial capabilities and objectives of participants…) and contribution to the European Green Deal objectives and European competitiveness; - Identification of existing synergies with Programmes (EU, national, regional) contributing to the activities and identification of additional work areas where synergies would be needed.	and intermediate results and consistent with final targets/objectives sought in the topic; - Soundness and appropriateness of the financial plan and budget in line with the topics' indicative value (best value for money and appropriateness of the use of resources per WPs and participants); - Capacity and role of each participant, and the extent to which the consortium as a whole brings together the necessary expertise to meet the objectives and to mitigate technical risks; - Match of technical capabilities (including expertise necessary to bring new disruptive ideas necessary at the start of later) and skills with the Topic Area and congruent with the programme objectives embodied in the topic; - Ability to involve supply chain and into an equal or higher tier industrial organisation; - Ability to ensure an adequate level of in-kind contribution to the CAJU as defined in the calls/topics.
Coordination and support	- Clarity and pertinence of the project's objectives; - Quality of the proposed coordination	- Credibility of the pathways to achieve the expected outcomes and impacts specified in the SBA specific objectives, work programme, topic description and the SRIA,	- Quality and effectiveness of the proposed project work plan, assessment of risks, decision making process and appropriateness of the effort assigned to work

	and/or support measures, including soundness of methodology.	(quantitative measurement/assessment– i.e. smart objectives, performance breakdown and monitoring strategy) and the likely scale and significance of the contributions from the project. - Suitability and quality of the measures to maximise expected outcomes and impacts, as set out in the dissemination and exploitation plan, including communication activities.	packages, and the resources overall; - Capacity and role of each participant, and the extent to which the consortium as a whole brings together the necessary expertise.

In order to protect the European competitiveness of the aeronautic sector and in view of ensuring a projects portfolio consistency to meet the CAJU objectives and SRIA goals, in accordance with Articles 32 and 39 of the Regulation (EU) 2021/695 establishing HE, the exploitation plan shall describe the European exploitation of the results generated in the programme. The JU will make appropriate checks concerning the exploitation of results during project implementation and the reporting phase. Article 16.4 of the Horizon Europe MGA[22] and *Annex 5* shall apply by default to all CAJU grant agreements.

In this respect, unless stated otherwise in the specific call conditions, beneficiaries are required up to 10 years after the end of the action inform the granting authority if the results could reasonably be expected to contribute to European or international standards (see 'Specific rules for JU actions' of Annex 5 of the MGA).

The granting authority may, up to 10 years after the end of the action, in accordance with Article 16.4 of the MGA, object to a transfer of ownership or to the exclusive licensing of results. If no exploitation takes place within one year after the period set out in Article 4, the beneficiary must use the Horizon Results Platform and/or the CAJU membership to find interested parties to exploit those results. If justified on the basis of a request of the beneficiary, this obligation may be waived.

Scores and weighing

Evaluation scores will be awarded for the criteria, and not for the different aspects listed in the table. For full applications, each criterion will be scored out of 5 (half-marks are possible). The threshold for individual criteria will be 3. The overall threshold, applying to the sum of the three individual scores, will be 10.

To determine the ranking for 'Innovation actions', the score for 'Impact' will be given a weight of 1.5.

[22] Horizon Europe (HORIZON), Euratom Research and Training Programme (EURATOM), General Model Grant Agreement, EIC Accelerator Contract (HE MGA — Multi & Mono), Version 1.1, 15 April 2022

Proposals that pass the individual threshold and the overall threshold will be considered for selection and possible funding subject to the evaluation and selection process described in the CAJU rules for submission, evaluation, selection and review and subject to the decision of the Governing Board on the approval of the ranking list in line with Article 11 a) of the SBA.

Two-stage calls

Not applicable.

Part E (Documents) of the General Annexes to the Horizon Europe Work Programme shall apply.

Part F (Procedure) of the General Annexes to the Horizon Europe Work Programme shall apply, with the following additional conditions and non-applications:

Calls will be subject to a single-stage submission procedure.

For those proposals that have passed the applicable scoring thresholds, the CAJU will rank them according to the evaluation scores and their contribution to the achievement of the specific objectives of the CAJU, including the constitution of a consistent portfolio of projects to ensure implementation and the alignment with the SRIA objectives.

In accordance with Article 29.2 of the Regulation (EU) 2021/695 establishing HE, the evaluation committee may also propose adjustments to the proposals insofar as those adjustments are needed for ensuring the consistency of the portfolio approach. Those adjustments shall be in conformity with the conditions for participation and comply with the principle of equal treatment.

For proposals with the same score within a single budget envelope within the same topic a method to establish the priority order will be determined, taking into consideration the objectives of the specific topic and the proposal contribution to the SRIA and the SRIA High-Level Objectives. In the absence of special arrangements in the specific call conditions, the following method will apply:

For each group of proposals under the same topic with the same score, starting with the group achieving the highest score and continuing in descending order:

1) Proposals that address aspects of the topic that have not otherwise been covered by more highly ranked proposals will be considered to have the highest priority.

2) The proposals identified under 1), if any, will themselves be prioritised according to the scores they have been awarded for 'Excellence'. When these scores are equal, priority will be based on scores for 'Impact'. In the case of 'Innovation actions', priority will be given to the score for 'Impact', followed by that for 'Excellence' in line with the impact driven approach of the CAJU.

3) If necessary, any further prioritisation will be based on the participation of newcomers, SMEs and/or geographical diversity, defined as the number of EU Member States or Associated Countries represented in the proposal, not otherwise receiving funds from projects higher up the ranking list (and if equal in number, then by budget).

4) If necessary, the gender balance among the personnel named in the proposal who will be primarily responsible for carrying out the research and/or innovation activities, and who are included in the researchers table in the proposal, will be used as a factor for prioritisation.

5) If a distinction still cannot be made, the panel may decide to further prioritise by considering other factors related to the objectives of the call, or to Horizon Europe in general. These may

include, for example, enhancing the quality of the project portfolio through synergies between projects or, where relevant and feasible, involving SMEs. These factors will be documented in the panel report.

Budget flexibility is described in Part F of the General Annexes to the Horizon Europe Work Programme which shall apply *mutatis mutandis* to the actions covered in this Work Programme.

In case of total funding request exceeding the call funding value and for the sake of budget optimization the following criteria shall be used in the following order of priority:

1) Select the proposals having highest score in each topic provided that it has met or exceeded the applicable evaluation thresholds for minimum scores, in order to ensure a balanced portfolio of actions, and to ensure that the programme's intended scope of research actions is maintained.

2) Select the proposal(s) having the highest score of the second ranked proposal(s) of the topics of the call indicating the possible funding of up to two (2) proposals. Where there are two or more proposals from different topics having equal total score, the proposal having the highest score in "Impact" shall be selected; if still equal, the proposal having highest score in "Excellence" shall be selected in line with the impact driven approach of the CAJU.

3) Select the proposal(s) having the highest score of the third ranked proposal(s) of the topics of the call indicating the possible funding of up to three proposals. Where there are two or more proposals from different topics having equal total score, the proposal having the highest score in "Impact" shall be selected; if still equal, the proposal having highest score in "Excellence" shall be selected in line with the impact driven approach of the CAJU.

Part G (Legal and financial set-up of the grant agreements) of the General Annexes to the Horizon Europe Work Programme - shall apply with the following additional conditions and non-applications:

Provisions concerning project implementation

–

– Intellectual Property Rights (IPR), background and results, access rights and rights of use *(Article 16 and Annex 5 of the MGA).* In addition to the standard provisions, the following specific provisions in the model grant agreement (MGA) will apply to all grants awarded under this Work Programme:

- If applicable under the call/topic – in accordance with Articles 3 and 7 of the MGA a beneficiary must — under the conditions set out in *Annex 5 of the MGA* — give access to its background and its results to the beneficiary selected to implement the linked action under the call for proposal for the purpose of implementing the action concerned;

- If requested by the granting authority, beneficiaries must grant non-exclusive licenses to their results – for a limited period of time specified in the request and on fair and reasonable

conditions – to legal entities that need the results to address the public emergency. These legal entities must commit to rapidly and broadly exploiting the resulting products and services on fair and reasonable conditions. This provision will apply up to 4 years after the end of the action;

- Unless stated otherwise in the specific call conditions, beneficiaries must, up to 10 years (see *Annex 5* of the MGA) after the end of the action, inform the granting authority if the results could reasonably be expected to contribute to European or international standards;

- The granting authority may, up to 10 years after the end of the action, in accordance with Article 16.4 of the MGA and *Annex 5*, object to a transfer of ownership or to the exclusive licensing of results. If no exploitation takes place within one year after the period set out in Article 4, the beneficiary must use the Horizon Results Platform and/or the JU membership to find interested parties to exploit those results. If justified on the basis of a request of the beneficiary, this obligation may be waived;

- Participants in projects selected under a call topic will be required to conclude a Cooperation Agreement with the participants implementing the projects selected under other relevant topics.

Founding and Associated Members must also ensure the compliance with the Membership Agreement including contributions from non-Members, inter alia via the conclusion of a suitable Consortium Agreement [CA] governing the project and its consortium.

If applicable under the call/topic and if requested by the granting authority in the interests of the Programme, a beneficiary must grant access to its results to any other beneficiaries identified in the request, if it is deemed necessary by the CAJU for the further development or demonstration of the relevant technologies essential to the achievement of the SBA objectives and Programme's High-Level Objectives. Such access does not extend to beneficiaries' ''Background'' and must be granted within one month thereafter on a royalty free basis subject of the written agreement of the Parties.

Based on Article 71 of the SBA, the European Union Aviation Safety Agency (EASA) will be participating under the CAJU's grant agreements as a third party giving in-kind contributions to the action (Art. 9.2 MGA[23]) or as a beneficiary (Art.7 MGA). In both cases, the provisions regarding fees and charges set out in Regulation (EU) 2018/1139 of the European Parliament and of the Council[24] apply.
That participation of the EASA in the projects founded by the CAJU is crucial to accelerate market uptake, by facilitating the certification process of resulting products and services as required by Regulation (EU) 2018/1139.

Part H (Specific conditions for actions implementing pre-commercial procurement or procurement of innovative solutions) of the General Annexes to the Horizon Europe Work Programme are not applicable.

[23] EASA will directly charge its fees and charges to the relevant beneficiaries/parties for which the certification activities and services will be provided in the sense of the SBA. The concerned beneficiary(ies) may charge these amounts in the CAJU's projects as 'actual direct costs' (i.e. purchase costs) under Article 6.2.C.3 of MGA 'Other goods, works and services' budget category. See also Article 6.2.C. of MGA.
[24] Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91 (Text with EEA relevance.), OJ L 212, 22.8.2018, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018R1139

2.4.4 Calls for tenders and other actions

The CAJU does not plan to launch any operational call for tenders in 2022-2023.

The call(s) for tenders is/are expected to assist the Clean Aviation programme with tackling socio-economic and environmental challenges and also ensuring the smooth uptake and further development of the green technologies generated under the Clean Sky 2 research programme. The services that will be procured through this type of operational call(s) for tenders will gather data for use by the CAJU which will be integrated into the action implemented under the grant agreements.
The call(s) for tenders concern enabling IT systems and modelling that directly support the Programme Office and the JU in creating and maintaining a capability to [1] store and manage data related to assessments; [2] enable assessments not linked to the actions in the grant agreements for members and their major demonstrator projects but more broadly aimed at stimulating technology progress; and [3] to provide to the JU a communication / visualisation tool in its role as Programme Office and Public-private partnership (PPP) body. They are not, as such, activities that support one private member's activities within a grant agreement but represent services supporting the JU in the performance of its statutory tasks and membership at large, including the tasks of the Executive Director and the Board respectively in proposing and agreeing actions to optimise the programme's benefits and results as well as to increase impact, as laid down in the Single Basic Act. They will contribute to the assessment of the environmental impact of the technologies developed in Clean Sky 2 and Clean Aviation and their level of success towards well-defined environmental and societal benefits and targets. The foreseen administrative calls for tenders are listed under section 2.5.2.

2.4.5 Follow-up activities linked to past calls: monitoring, evaluation and impact assessment

The following chapter presents the Clean Sky 2 Programme high-level scope of work and the main scientific priorities and challenges that will be performed by the ITDs, IADPs and TAs through the Grant Agreements for Members during the period 2022-2023[1].

These activities are complemented and supported by actions executed by Partners selected in Calls for Proposals throughout the 2014-2020 period.

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

IADP Large Passenger Aircraft

1. Multi-annual overview and strategic planning

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

[1] The list of deliverables and milestones presented in this chapter is provisional and may be updated at the stage of the preparation and signature of the grant agreement for the members.

Platform 1: Advanced Engine and Aircraft Configurations

The major objective of Platform 1 is to provide a development environment for the integration of the most fuel-efficient propulsion concepts into compatible airframe configurations and concepts targeting next-generation aircraft.

Overall, the propulsion concepts considered in Platform 1 range from Open Rotor engine architectures to advanced Ultra-High Bypass Ratio (UHBR) turbofans up to "hybrid" propulsion concepts (combination of combustion- and electric-based components) for different levels of electrification of the power plant.

For all these aforementioned propulsion concepts, design opportunities will be investigated to further increase the propulsive and airframe efficiency. Examples for this are the application of Boundary Layer Ingestion (BLI) design or by exploring the potential of distributing the thrust generating part of the power plant over the aircraft.

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

To avoid detrimental effects on overall aircraft performance when integrating UHBR engines on airframe, Platform 1 is developing and demonstrating integrated flow control techniques applied at the wing-pylon interface, an area which is prone to interference effects between wing and engine. Another important flow control activity in the reporting period is the maturation of the Hybrid Laminar Flow Control technology (HLFC) applied on tails and wing for skin-friction drag reduction. Scaled flight-testing will be further matured and applied to demonstrate a down-selected radical aircraft configuration.

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

Platform 2: Innovative Physical Integration Cabin – System – Structure

Platform 2 aims to develop, mature, and demonstrate an entirely new, advanced fuselage structural concept in alignment towards next-generation cabin-cargo architectures, including relevant aircraft systems. To account for the substantially different test requirements, the large-scale demonstration will be based on two individual major demonstrators. A Multi-Functional Fuselage Demonstrator (MFFD) made of thermoplastic composites will be developed, manufactured and tested with a focus on industrial manufacturing including pre-installation and modularisation. Within the innovative Fuselage, Cabin/Cargo and System demonstrator modules/components will be integrated to validate multi-ATA technologies and their industrial processes. A Cabin and Cargo demonstrator will be dedicated to integrating and testing the next generation of large passenger aircraft cabin and cargo. A number of smaller test rigs and component demonstrators are part of the programme. The target is to accomplish technology readiness level up to 6, for a certain number of technologies.

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

The IADP LPA Platform's three main objectives are: on one hand to bring innovative and disruptive cockpit operations to a high maturity level through appropriate demonstrators, functions and

technologies for Large Aircraft, Regional Aircraft and Business Jets; and to also demonstrate an end-to-end service as well as value-driven maintenance functions and tools suite.

For each one of the three cockpit demonstrations, the following enhancements are targeted:

- safety enhancement through resilience to pilot skills evolution, error-tolerant automation, improved situational awareness, human monitoring;
- robust operations, reduced operational costs thanks to easier flight crew tasks, reduced workload, with optimised allocations between human and system;
- European aeronautical industry competitiveness enhancement via evolutionary cockpit design, low costs and fast upgradability, a "shared resources platform" concept, applicative cockpit, reduced lead- time, design for security.

The technologies are developed and evaluated on the ground or in flight, either under the frame of demonstration bricks or integrated demonstrators.
In 2022 and 2023, the IADP LPA Platform 3 Work Plan will focus on finalising the development, integration and tests of the cockpit functions for the Large Aircraft Disruptive Cockpit demonstrator and finalising the last Business Jet additional enhanced cockpit functions integration and tests.

In early 2022, the Regional Aircraft Active Cockpit demonstrator project finished with a final demonstration.

The end-to-end maintenance demonstrator ADVANCE was fully completed in 2020.

2. Description of main activities for the year 2022

Platform 1: Advanced Engine and Aircraft Configurations

Stream engine design and integration N+1:
In 2022, the activity will focus on performing the FETT for the Ultrafan Engine, further maturing the techno-bricks in D10 up to TRL4, securing hardware delivery for SA^{2}FIR like the DAS (Data Acquisition System) and continuing the adaptation of the DNW Wind Tunnel Test.
In D12[25], the first ground test campaign for active vibration controls for modes identification will be completed. Finally, the Non-Propulsive Energy activity will be focused on the auxiliary power unit assembly and delivery to the ground demo bench. XDC will support the UHBR engine evaluation as well as the wind tunnel experiments by integrating high-resolution micro-electromechanical (MEMS) sensors in the Wind Tunnel model to mature this technology.

Stream engine design and integration N+2:
The main target in 2022 is to deliver the ORAS (Open Rotor and Stator) recommendation dossier for the selection of aircraft architecture with support from SAFRAN regarding the various techno-bricks developed in D16.

Stream laminarity:
In D04, the activity will focus mainly on delivering a segment of fully functional HLFC Horizontal Tail Plane (HTP) and on performing tests up until TRL6, whereas in D06 the target will be to conduct a

[25] Demonstrator reference codes are explained on the next page.

ground based demonstrator Critical Design Review (CDR), prepare the wind tunnel testing at ONERA facilities, and prepare and complete the F2 wind tunnel test.
In D05, the activities will be focused on maturing solutions-type sealants to ensure flush junction between parts as well as fasteners masking activities through experimentation.

Stream radical aircraft configuration:
The main activities will be focused around the Scale Flight Demonstrator (D03) mission flight test (moved from 2021 to 2022) and analysis in order to reach TRL5. Regarding Distributed Electric Propulsion (D08), the objective is to perform the manufacturing of the modified parts followed by the assembly of the demonstrator in summer 2022.The wind tunnel tests in DNW took place in Q4 2022. For D02 the activity will focus on delivering the Rear End Assembly Industrial Demonstrator. Finally, for D09, the remaining activities will focus on capitalisation/dissemination of test bench results and read-across with regard to the different techno-bricks that could be re-used for micro-hybridisation.

Major milestones planned for 2022:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Milestones
LPA-01-D01 - Enablers for Integrated Open Rotor Design	Short-medium range (SMR) aircraft architecture selection
LPA-01-D02 - Advanced Rear-End	Rear fuselage upper shell demonstrator delivered
LPA-01-D03 - Scaled Flight Testing	None (planned in WP 2020-21)
LPA-01-D04 - HLFC on Tails Large Scale Ground Based Demonstrator	TRL6 on selected manufacturing technologies and project closure
LPA-01-D05 - Natural Laminar Flow Demonstrator for HTP Bizjets	Tests completed on flush junction between parts and fastener masking works
LPA-01-D06 – Ground Based Demonstrator HLFC Wing	Low-speed wind tunnel test at F2 completed and high-speed wind tunnel test at S1Ma started
LPA-01-XDC - Cross Demonstrator Capabilities	Demonstration of MEMS integration into wind tunnel models successfully performed
LPA-01-D08 - Radical Configuration Flight Test Demonstrator	DEP-SFD wind tunnel test campaign completed
LPA-01-D09 - Hybrid Electric Ground Test Bench	N/A
LPA-01-D10 - UltraFan Flight Test Demonstration	TRL4
LPA-01-D11 - Active Flow Control Flight Test Demonstration	TRL3
LPA-01-D12 - Flight Test Demonstration of Active Vibration Control Technologies / Noise Prediction Methods for Rear-Mounted Engines	Intermediate tests
LPA-01-D13 - UHBR SMR Integration	Delivery of various hardware for the SA²FIR rig (DAS, ACS, Cowlings)
LPA-01-D14 - Boundary Layer Ingestion	N/A
LPA-01-D15 - Non Propulsive Energy	End of ground demonstrator APU tests campaign
LPA-01-D16 - Common Technology Bricks for Future Engines	Low pressure turbine demonstrator preliminary design review

Major deliverables planned for 2022:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
LPA-01-D01 - Enablers for Integrated Open Rotor Design	Dossier for SMR aircraft architecture selection

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
LPA-01-D02 - Advanced Rear-End	Rear fuselage upper shell demonstrator delivered
LPA-01-D03 - Scaled Flight Testing	None (planned in WP 2020-21)
LPA-01-D04 - HLFC on Tails Large Scale Ground Based Demonstrator	TRL6 report of selected technologies
LPA-01-D05 - Natural Laminar Flow Demonstrator for HTP Bizjets	Report on flush junction between parts and fastener masking activities
LPA-01-D06 – Ground Based Demonstrator HLFC Wing	Frozen structural concept for ground based demonstrator (inputs for TRL4)
LPA-01-XDC - Cross Demonstrator Capabilities	MEMS integration into wind tunnel models
LPA-01-D08 - Radical Configuration Flight Test Demonstrator	Distributed electric propulsion SFD wind tunnel test analysis
LPA-01-D09 - Hybrid Electric Ground Test Bench	Progress report on thermal management technological bricks and capitalisation dossier
LPA-01-D10 - UltraFan Flight Test Demonstration	Dossier ready for TRL4
LPA-01-D11 - Active Flow Control Flight Test Demonstration	Dossier ready for TRL3
LPA-01-D12 - Flight Test Demonstration of Active Vibration Control Technologies / Noise Prediction Methods for Rear-Mounted Engines	Intermediate tests report
LPA-01-D13 - UHBR SMR Integration	Critical Design Review DNW-LLF - installation for the L/S acoustic wind tunnel testing
LPA-01-D14 - Boundary Layer Ingestion	N/A
LPA-01-D15 - Non Propulsive Energy	Ground demo APU assembly to test
LPA-01-D16 - Common Technology Bricks for Future Engines	Low pressure turbine demo preliminary design

Platform 2: Innovative Physical Integration Cabin – System – Structure

With respect to the Multi-Functional Fuselage Demonstrator (MFFD), the main focus will be on the manufacturing of the demonstrator with priority sub-assemblies and major components. Testing of small- and medium-size test articles will help to gather material data and further develop innovative production techniques like automated forming and thermoplastic welding, including the needed welding equipment. Highlights of the manufacturing demonstration and thus of several single technology bricks will be the production of all representative thermoplastic parts up to their integration into full-scale fuselage shells (one upper half and one lower half), leading finally to a fully automated plant system to assemble these partly pre-equipped shells to a fuselage barrel. The set-up of a so-called digital twin (full representation of material properties and demonstrator features in a digital model) has to be part of the design activities.

Within the Next Generation Cabin & Cargo Functions demonstrators, the design of an innovative passenger service unit (PSU) will continue. By combining the enabler technologies developed in 2016-2019, a first PSU prototype shall be manufactured and integrated for subsequent validation testing leading to TRL4 by the end of the project in 2022.

For the Crown Module further large installation tests shall be conducted. In parallel, system function tests will be performed on the integrated technical enabler, e.g. a new air system, power/data backbone and Universal Cabin Interface (UCI) integration.

For the fuel cell powered energy optimised cabin (EOC), the first ground demo test shall be conducted. The main focus will be on the design and manufacturing of the MULTI-STACK demonstrator, which will allow Safran Power Units to mitigate major risks linked with multi-stack technologies.

The Printed Electrics project shall complete its concept demonstrator of the multi modular printer, showing the production of printed electrics circuits. On the software side, the customisation front-end and generation of electrical layouts shall be demonstrated.
During 2022 in work package 2.4, in order to complete technologies needed to support industrial activities related to Platform 2 demonstrators, development on Structural Health Monitoring (SHM), Fatigue Digital Twin (FDT) and simulation work to understand material behavior will be performed.

Major milestones planned for 2022:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Milestones
LPA-02-D1: Next Generation Fuselage, Cabin and Systems Integration	• Handover of fuselage shells to final assembly (MCA)
LPA-02-D2: Next Generation Cabin & Cargo Functions	• MPSU TRL4 review • EOC N CELLMAX TRL4 • Platform concept TRL5

Major deliverables planned for 2022:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
LPA-02-D1: Next Generation Fuselage, Cabin and Systems Integration	• Lower shell assembly • Upper shell assembly
LPA-02-D2: Next Generation Cabin & Cargo Functions	• MPSU TRL4 report • EOC N CELLMAX TRL4 report • Platform concept TRL5 report

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

Activities related to the Large Aircraft Disruptive Cockpit Demonstrator

The development of the cockpit avionics functions and technologies will progress towards the delivery of hardware and software prototypes developed in Platform 3 work packages by the Core Partners and CfP Partners. Functions developed within the framework of the ITD Systems that were adapted for integration in the Large Aircraft disruptive cockpit demonstrator (a.k.a DISCO Bench) will be delivered by Thales.

The overall strategy and roadmap for the verification and validation of the integration of systems will be delivered up until the end of CS2 by the different contributors. This will be updated in collaboration with the main Leaders, Core Partners and Partner contributors.

The Proof of Compliance for the Integrated Systems Management function will demonstrate its capability to interface with smart systems (e.g. fuel system) and alleviate the crew workload in case of system failure (e.g. fuel leak).

The integration of the new issues of the Cockpit Tactile Displays and FMS on DISCO Bench will continue. Provided by Thales from the Systems ITD, this will enable them to be evaluated functionally and operationally. The robustness of the LIDAR sensor for icing conditions flight tests will be assessed as well as the GPAHRS (Ground Positioning Attitude and Heading Reference System) sensor, which will be tested in flight. The image base landing performance will be tested. The Disco Bench will be upgraded with a speech-to-text engine. The validation and verification strategy for massive testing will be created.

Activities related to the Regional Aircraft Active cockpit demonstrator

In 2022, to finalise and close the project, the Leader (CASA) will host the Annual Review Meeting and propose a demonstration on the Regional Aircraft Cockpit Simulator.

The activities related to ground and flight test demonstration for business jet
These activities will focus on: approach stabilisation assistant (AStA) maturation which will reach TRL5 in 2022; pilot state monitoring (PSM) additional functionality development which will enrich the initial PSM functional perimeter with new states, sensors and mitigation strategies, and cockpit utility management system (CUMS – UBBICK demonstrator) finalisation with enhanced functionalities in particular for resource configuration.

With regards to the End-to-End Maintenance demonstrator, the project was successfully closed in 2020, no more activity foreseen until end of 2023.

Major milestones planned for 2022:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Milestones
LPA-03-D1 Disruptive Cockpit	• ATN/IPS Router TRL5 assessment (Aeronautical Telecommunications Network (ATN) using the Internet Protocol Suite (IPS)) • TRL5 assessment of SDR (Software Definition Radio) based on satcom • IMBALS (Image Based Landing Solutions) TRL5 assessment
LPA-03-D2 Regional Active Cockpit	None (planned in WP 2020-2021)
LPA-03-D3 Business Jets Demonstrator	• AStA (Approach Stabilisation Assistant) TRL5 review • Pilot State Monitoring – Presence, sleep and drowsiness detection – TRL6

Major Deliverables planned for 2022:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
LPA-03-D1 Disruptive Cockpit	• DISCO (Disruptive Cockpit) System Bench validation report • Honeywell new navigation sensors and hybridisation flight test realisation (GPAHRS – Global Positioning and Attitude and Heading Reference System and LiDAR – Light Detection And Ranging)
LPA-03-D2 Regional Active Cockpit	None (planned in WP 2020-2021)
LPA-03-D3 Business Jets Demonstrator	• RDPC (Remote Data Power Controller) TRL6 demonstration dossier • Functions and solutions for easier flight and man-machine efficiency for Business Jets – synthesis of 2022 activities

3. Description of main activities for the year 2023

Platform 1: Advanced Engine and Aircraft Configurations

Stream engine design and integration N+1:
On D10 the activity will focus on completing the delivery of the various hardware (nacelle and inlet) for ground and flight tests for the Ultrafan Engine, further maturing the techno-bricks up to TRL5, delivering the full (D13) hardware to DNW and completing the mandatory SA²FIR tests before the end of 2023. TRL6 of D12 (active vibrations controls) shall be completed. XDC will finalise the micro-electromechanical system (MEMS) development and corresponding signal processing and will establish a workshop to distribute and communicate the developed tools and experimental means. Finally, the Non-Propulsive Energy activity (D15) will be focused on the ground demo power sharing bench test completion.

Stream engine design and Integration N+2:
The main target in 2023 is to deliver the dossier for ORAS (Open Rotor & Stator) TRL3 with support from SAFRAN with regards to the various techno-bricks developed in D16.

Stream laminarity:
The activity will focus on D06 with the objective of conducting the ground-based demonstrator test until completion and performing the associated TRL4 review. In D05, the activities will be focused on maturing solutions to ensure anti-erosion protection compatible with laminarity requirements through experimentation.

Stream radical aircraft configuration:
With regards to the distributed electric propulsion demo (D08), the main activities will be focused on the qualification ground and flight tests followed by the mission flight tests and data analysis. For the D02 the activity will focus on preparing and performing TRL6 of the rear end structure.

Major milestones planned for 2023:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Milestones
LPA-01-D01 - Enablers for Integrated Open Rotor Design	TRL (Experimental Proof of Concept) for ORAS
LPA-01-D02 - Advanced Rear-End	Rear fuselage demonstrator TRL6 report
LPA-01-D03 - Scaled Flight Testing	N/A
LPA-01-D04 - HLFC on Tails Large Scale Ground Based Demonstrator	N/A
LPA-01-D05 - Natural Laminar Flow demonstrator for HTP bizjets	Tests completed on anti-erosion protections works
LPA-01-D06 – Ground Based Demonstrator HLFC wing	Ground-based demonstrator ready for test and ground-based demonstrator test completed TRL4 review conducted and project closure
LPA-01-XDC - Cross Demonstrator Capabilities	Prototype of MEMS high-frequency pressure sensor available
LPA-01-D08 - Radical Configuration Flight Test Demonstrator	First flight
LPA-01-D09 - Hybrid Electric Ground Test Bench	N/A
LPA-01-D10 - UltraFan Flight Test Demonstration	TRL5
LPA-01-D11 - Active Flow Control Flight Test Demonstration	N/A

Demonstrators/Techno Streams (as shown in CS2DP)	Major Milestones
LPA-01-D12 - Flight Test Demonstration of Active Vibration Control Technologies / Noise Prediction Methods for Rear-Mounted Engines	TRL6 ground tests campaign on active vibration controls
LPA-01-D13 - UHBR SMR Integration	Test readiness review of the SA²FIR Wind Tunnel test @ DNW-LLF
LPA-01-D14 - Boundary Layer Ingestion	N/A
LPA-01-D15 - Non Propulsive Energy	End of power sharing tests for Bizjet (MIC)
LPA-01-D16 - Common Technology Bricks for Future Engines	LPT Demo TRL5 (AVIO)

Major deliverables planned for 2023:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
LPA-01-D01 - Enablers for Integrated Open Rotor Design	Dossier for TRL3 ready
LPA-01-D02 - Advanced Rear-End	Rear fuselage demonstrator TRL6 report
LPA-01-D03 - Scaled Flight Testing	N/A
LPA-01-D04 - HLFC on Tails Large Scale Ground Based Demonstrator	N/A
LPA-01-D05 - Natural Laminar Flow Demonstrator for HTP Bizjets	Report on protection anti-erosion activities
LPA-01-D06 - Ground Based Demonstrator HLFC Wing	Test report Ground Based Demonstrator & TRL4 Review report
LPA-01-XDC - Cross Demonstrator Capabilities	Report on MEMS high frequency pressure sensor prototype development
LPA-01-D08 - Radical Configuration Flight Test Demonstrator	Test and data analysis report
LPA-01-D09 - Hybrid Electric Ground Test Bench	N/A
LPA-01-D10 - UltraFan Flight Test Demonstration	Dossier ready for TRL5
LPA-01-D11 - Active Flow Control Flight Test Demonstration	N/A
LPA-01-D12 - Flight Test Demonstration of Active Vibration Control Technologies / Noise Prediction Methods for Rear-Mounted Engines	TRL6 Dossier and assessments on cabin noise reduction in aircraft environment
LPA-01-D13 - UHBR SMR Integration	Delivery of validated data from the L/S acoustic test at DNW-LLF with SA²FIR
LPA-01-D14 - Boundary Layer Ingestion	N/A
LPA-01-D15 - Non Propulsive Energy	Ground demo power sharing test results for large aircraft (SNE)
LPA-01-D16 - Common Technology Bricks for Future Engines	LPT final configuration assessment (AVIO)

Platform 2: Innovative Physical Integration Cabin – System – Structure

For the Multi-Functional Fuselage Demonstrator (MFFD) the upper and the lower shells will be joined to a full fuselage barrel, which will be located in the ZAL - Centre for Applied Aviation Research, in Hamburg. During 2023 various demonstrations in and on the multifunctional fuselage demonstrator will be performed, including, amongst others, the integration of the cargo door delivered by Saab as well as the integration of the Crown Module. The evaluation of various KPIs supporting the building of the components and the industrial concept of the various manufacturing techniques applied will be performed too. The project will be concluded by the end of 2023 aiming for an overall TRL of 5.

The activities within the Next Generation Cabin & Cargo Functions shall be concluded by integration tests of the developed cabin systems in the Multi-Functional Fuselage Demonstrator. In particular, this applies to the new Crown Module including its integrated systems. The project shall be concluded with a TRL6 based on the integration into the MFFD.

Safran will perform further tests on the fuel-cell system within the Energy-Optimised Cabin (EOC) project. The project will conclude with a TRL4 by end of 2023 with a focus on the multi-stack demonstrator.

The Printed Electrics project will conclude with TRL 6 by the end of 2023, focusing on the safety and reliability test with the Multi-Modular-Printer.

In 2023 the focus of WP2.4 will be mainly on reaching TRL6 for Structural Health Monitoring (SHM), as well as on the Fatigue Digital Twin (FDT). Onera will conclude their activities with the metallic (TRL3) and the composite (TRL4) material modelling by the end of 2023.

Major milestones planned for 2023:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Milestones
LPA-02-D1: Next Generation Fuselage, Cabin and Systems Integration	• MCA completed / barrel delivery to ZAL • Structural health monitoring (SHM) TRL6 review • Fatigue digital twin TRL6 review • Material modelling metallic TRL3 & composite TRL4
LPA-02-D2: Next Generation Cabin & Cargo Functions	• Platform concept TRL6 • EOC Multi-stack TRL4 • Printed electrics TRL6

Major deliverables planned for 2023:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
LPA-02-D1: Next Generation Fuselage, Cabin and Systems Integration	• MFFD TRL5 report • SHM TRL6 report • Fatigue digital twin TRL6 report • Material modelling metallic TRL3 & composite TRL4 report
LPA-02-D2: Next Generation Cabin & Cargo Functions	• Platform concept TRL6 report • EOC Multi-stack TRL4 report • Printed electrics TRL6 report

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

Activities related to the Large Aircraft Disruptive Cockpit Demonstrator

The preparation and evaluation of the maturity of the whole Large Aircraft Disruptive Cockpit (TRL5 expected) will take place, based upon the integration and evaluation of functions and technologies provided by Thales, Honeywell, Airbus and partners.
The demonstration in-flight of the capability of the audio communication manager to alleviate the crew workload when dealing with the management of the radio frequencies involved in audio link communications via modular radio avionics function provided by Honeywell is planned, as well as flight tests of the Li-Fi technology for its TRL6 assessment. The Functional Protocol as well as the GPAHRS and the ATN/IPS are also planned to reach TRL6 maturity in 2023. A Proof of Concept for the massive testing will demonstrate the acquired capability to enhance the robustness of the SPO concept and of the Large Aircraft Disruptive Cockpit.

Activities related to the Regional Aircraft Active Cockpit Demonstrator
No activities foreseen in 2023, the project was finalised early 2022.

The activities related to ground and flight tests demonstration for business jets

Activities will consist of finalising AStA (Approach Stabilisation Assistant) development until TRL6 and Pilot State Monitoring additional functionalities also until TRL6 maturity level.

Major milestones planned for 2023:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Milestones
LPA-03-D1 Disruptive Cockpit	• Functional Protocol TRL6 assessment • ISM (Integrated System Management) TRL4 assessment
LPA-03-D3 Business Jets Demonstrator	• AStA (Approach Stabilisation Assistant) TRL6 review

Major Deliverables planned for 2023:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
LPA-03-D1 Disruptive Cockpit	• PoC (Proof of Concept) Massive Testing • DISCO (Disruptive Cockpit) concept TRL5 review
LPA-03-D3 Business Jets Demonstrator	• PSM (Pilot State Monitoring) project summary and lessons learnt

IADP Regional Aircraft

1. Multi-annual overview and strategic planning

The objective of the Regional Aircraft IADP (REG IADP) is to bring the integration of technologies for regional aircraft to a further level of complexity with respect to the achievements of Clean Sky Green Regional Aircraft ITD.Advanced technologies for regional aircraft are being further developed, integrated and validated at aircraft level, so as to drastically de-risk their integration on future aircraft products. The validation of technologies is progressively achieved through several testing activities as well as through the integration and validation at aircraft level by means of the following major demonstrators:

- Adaptive wing integrated demonstrator: Flying Test Bed #1 (FTB#1) and Outer Wing Box (OWB) on-ground demonstrator;
- Integrated technologies demonstrator: Flying Test Bed #2 (FTB#2);
- Fuselage / cabin integrated demonstrator;
- Iron Bird demonstrator.

With activities performed in the period 2014-2021 all technologies have been down-selected and matured, the design phase has been completed for all the full-scale demonstrators, the manufacturing of their components and their integration achieved good progress. For the FTB#2 the integration phase was already completed and its flight test campaign (the so-called Step 1 in the Work Plan of previous years) is expected to be completed at the end of 2021 and in case of delays, it might potentially be extended in early 2022. During 2022-2023 the demonstration activities of all full-scale demonstrators are planned to be completed. The main high-level objectives pursued in this timeframe are:

- FTB#1: completion of experimental modifications implementation on the demo aircraft, execution of aircraft ground tests, execution of the flight test campaign, TRL6 assessment for technologies validated with this demonstrator;
- OWB: completion of components manufacturing, assembly of the demonstrator, ground tests execution; TRL5 assessment for technologies validated with this demonstrator;
- FTB#2: the flight test campaigns will be analyzed as they are completed, and the main effort of the period will be focused on the on-ground demonstrators: the full-scale structural test and the actuation rig including HVDC (High Voltage and Direct Current) and EMAs (Electromechanical Actuation);
- Fuselage Structural Demonstrator: completion of demonstrator manufacturing and assembly, execution of on-ground structural tests, TRL6 assessment for technologies validated with this demonstrator;
- Pax Cabin Demonstrator: completion of structural barrel manufacturing and assembly, integration/installation of systems and pax cabin interiors items, execution of noise/vibration and comfort/thermal/system ground tests, TRL6 assessment for technologies validated with this demonstrator;
- Iron Bird: completion of integration and of laboratory testing, TRL5 assessment for the technologies validated with this demonstrator.

Furthermore, the studies undertaken during 2019 related to hybrid/electrical regional aircraft configurations will be completed.

2. Description of main activities for the year 2022

WP0 – Management: REG IADP coordination, administration and management, ensuring proper interactions and interfaces with the JU and other SPDs.

WP1 – High Efficiency Regional A/C: Regarding the TP 90pax configuration, all the activities have been completed, and regarding the conventional configuration of the TP 90pax, all the engine and aerodynamic dataset activities and the evaluation report of the Loop 3 cost model have been completed.
With regards to the conventional configuration of the TP 90pax, all the activities of the engine and aerodynamic dataset and the evaluation report of the Loop 3 cost model have been completed.
Studies related to new hybrid / electric propulsion concepts undertaken in 2019 will continue in this period.
In particular, a further regional configuration with Distributed Electrical Propulsion (DEP) will be investigated and wind tunnel tests will be executed on a wing section to evaluate the aerodynamic efficiency of the distributed propulsion over a low-speed performance wing.
In particular, the following main activities will be carried out by Leonardo Aircraft and IRON:

WP2 – Technologies Development

- WP2.1 – Adaptive Electric Wing
  - WPs 2.1.1, 2.1.2, 2.1.3: Activities expected to be completed in 2021;

  - WP 2.1.4: The final assessment of the adaptive wing air vehicle technologies (morphing and load control and alleviation) will be performed;
  - WPs 2.1.5, 2.1.6: Activities completed in 2019.
- WP2.2 – Regional Avionics: Activities completed in 2021.
- WP2.3 – Energy Optimised Regional Aircraft:
  - Wing Ice Protection System (WIPS) TRL5 assessment upon completion of Wind Tunnel Tests (WTT);
  - Electrical Landing Gear System (E-LGS) qualification complete and delivery to Iron Bird.
  - Finalisation of Thermal Management (ThM) technologies laboratory demonstration and test results;
  - Advanced Electrical Power Distribution System (A-EPDS) TRL5 assessment upon completion of testing on the Iron Bird;
  - Hybrid Environmental Control System (H-ECS) model test plan and acceptance test execution;
  - Innovative Propeller WTT results analysis and final assessment.

- WP2.4 – Flight Control System: Contribution to Iron Bird and FTB#1 activities for the aspects related to Flight Control System.

WP3 – Demonstrations

- WP3.1 – Adaptive Wing Integrated Demonstrator (FTB#1 and OWB): Innovative morphing wing devices of future TP90Pax regional aircraft will be experimented in-flight on the FTB#1 demo aircraft. Three experimental configurations will be realised, one introducing the wing load control and alleviation system (LC&AS) with Morphing WingLet (MWL) a second one with Innovative WingTip (IWT), and a third one with Basic WingTip (BWT). Wing ground resonance and strain gauge calibration tests will be performed for each configuration, and then the aircraft ground and flight tests will be executed.

  For the OWB, Liquid Resin Infusion (LRI) upper and lower panels as well as ribs and spars manufacturing and inspections will be completed. The site acceptance test of the assembling cell will be completed. The assembly of the OWB structure will be executed and the instrumentation/installation of the test article on the test rig will start.

- WP3.2 – Fuselage / Cabin Integrated Demonstrator: The Fuselage Structural Demonstrator will be assembled upon reception of sub-structures provided by CfP projects. It will be installed on a test rig, the instrumentation will be completed and the on-ground laboratory tests will start. The manufacturing of Pax Cabin Demonstrator stiffened panels will be completed and the whole structure will be assembled. Cabin and system items will be made available and their integration into the demonstrator will start. The air conditioning system, control system, mechanical support and interfaces will be made ready for the comfort tests.
- WP3.3 – Flight Simulator: No activities will be performed.
- WP3.4 – Iron Bird: AWL and IWT test results will be evaluated for FTB#1 activities prosecution. The last components (E-LGS) are expected to be delivered to the Iron Bird final setup and TP90 Pax E-LGS and A-EPDS test campaigns will be completed.

- WP3.5 – Integrated Technologies Demonstrator Flight Test Bed#2 (FTB#2): The activities will be concentrated on the completion of the Regional FTB#2 flight tests campaign – analysis of results and technology evaluation in a representative operational environment. In addition, the main focus will be the on-ground demonstration of technologies:
  - the full-scale structural test (external outer wing box in composite materials manufactured with out-of-autoclave processes, and innovative assembly technologies). The detailed design of the test will be completed, in particular the design of the interface of the tests specimen and the rig that is crucial for test representativeness.
  - the actuation on-ground rig that includes high voltage direct current technologies to supply electrical power to essential loads: the electromechanical actuators (EMAs) of the control surfaces – aileron and spoilers. In REG IADP, the systems description and the demonstration strategy will be established while maintaining coordination with the AIR and SYS ITDs, essential contributors to the demonstrations.

WP4 – Technologies Development / Demonstrations Results

- WP4.1 – Technology Assessment: Continuation of interactions and interface with the Technology Evaluator (TE). Two aircraft simulation models (TP 90 Pax and TP 130 Pax) delivered to TE in 2021. Starting from 2022 the activities will be focused on the support to TE for the second global assessment.
- WP4.2 – Eco-design Interface: Continuation of interaction, interface and data exchange with ECO TA delivering Life Cycle Inventories (LCI Data) also for the OWB flagship demonstrator.

Major milestones planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones (WP)
REG WP1 - Hybrid/Electrical Regional Aircraft Configuration	Distributed Electrical Propulsion WTT Execution (WP1)
REG D1 - Adaptive Wing Integrated Demonstrator – Flying Test Bed#1 (FTB1)	First flight completion (WP3.1)
REG D1 - Adaptive Wing Integrated Demonstrator – OWB Ground Test	Outer Wing Box demonstrator available (WP3.1)
REG D2 - Integrated Technologies Demonstrator – Flying Test Bed#2 (FTB2)	On-ground actuation rig critical design review achieved (WP3.5)
REG D2 - Integrated Technologies Demonstrator – Flying Test Bed#2 (FTB2)	Delivery of the full-scale structural test specimen (WP3.5)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Structural Demonstration)	Fuselage structural demonstrator test readiness review achieved (WP3.2)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Comfort/Thermal Demonstrations)	Availability of Pax Cabin items manufactured (WP3.2)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Comfort/Thermal Demonstrations)	Test rig for cabin comfort tests available (WP3.2)
REG D4 - Iron Bird	A-EPDS test campaign completion (WP3.4)
REG D4 - Iron Bird	E-LGS test campaign completion (WP3.4)

Major deliverables planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables (WP)
REG WP1 - Hybrid/Electrical Regional Aircraft Configuration	Final report of Hybrid-Electrical Regional Aircraft Configuration "D" (WP1)
REG WP2.3 – IWTT for Low Power Wing Ice Protection System	Analysis of IWT test results and TRL5 Assessment of Low Power Wing Ice Protection System (WP2.3)
REG WP2.3 - WTT Demonstrator for the Innovative Propeller	Analysis of WTT results and TRL5 Assessment of Innovative Propeller (WP2.3)
REG D1 - Adaptive Wing Integrated Demonstrator – Flying Test Bed#1 (FTB1)	Report describing the implementation of experimental modifications on the demo aircraft (WP3.1)
REG D2 - Integrated Technologies Demonstrator – Flying Test Bed#2 (FTB2)	On-ground actuation rig: system description and strategy for demonstration (WP3.5)

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables (WP)
REG D2 - Integrated Technologies Demonstrator – Flying Test Bed#2 (FTB2)	Delivery of the full-scale structural test specimen (WP3.5)
REG D3 - Full scale innovative Fuselage & Pax Cabin demonstrator (Structural demonstration)	Report describing the available fuselage structural demonstrator (WP3.2)
REG D3 - Full scale innovative Fuselage & Pax Cabin demonstrator (Comfort/Thermal demonstrations)	Report on availability of pax cabin items manufactured (WP3.2)
REG D1 - Adaptive Wing Integrated Demonstrator – OWB Ground Demonstrator	Report describing the outer wing box demonstrator lower panel manufactured and inspected (WP3.1)
REG D4 - Iron Bird	Assessment of AWL/IWT Iron Bird test results (WP2.4 and WP3.4)
REG D1 - Adaptive Wing Integrated Demonstrator – OWB Demonstrator	Coordination memo delivering REG LCI Updates to ECO TA (WP4.2)

3. Description of main activities for the year 2023

WP0 – Management: REG IADP coordination, administration and management, ensuring proper interactions and interfaces with the JU and other SPDs.

WP1 – High Efficiency Regional aircraft: Activities expected to be completed in 2022.

WP2 – Technologies:

- WP2.1 – Adaptive Electric Wing
  - WPs 2.1.1, 2.1.2, 2.1.3 activities expected to be completed in 2021;
  - WP 2.1.4 activities expected to be completed in 2022;
  - WPs 2.1.5, 2.1.6 activities completed in 2019.
- WP2.2 – Regional Avionics: Activities completed.
- WP2.3 – Energy Optimised Regional Aircraft: Hybrid ECS & ThM thermal test bench integration and test campaigns will be performed and relevant test reports issued.
- WP2.4 – Innovative Flight Control System: Flight control system TRL will be assessed on the basis of Iron bird and FTB#1 test results. Prognostic and health monitoring (PHM) activities will be completed.

WP3 – Demonstrations:

- WP3.1 – Adaptive Wing Integrated Demonstrator (FTB#1 & OWB):
  The analysis of data will be completed for the three experimental aircraft configurations and the TRL6 assessment final report will be released for the load control and alleviation system using movable wing tip surfaces. In parallel the demo aircraft refurbishment will be performed. Concerning OWB, the static and fatigue tests will be executed. The tests results assessment will be performed and reported including evaluations of data coming from structural health monitoring systems applied on the demonstrator.
- WP3.2 – Fuselage / Cabin Integrated Demonstrator:
  The laboratory structural tests will be executed on the Fuselage Structural Demonstrator. Structural test results will be assessed. The integration of cabin and system items into the Pax Cabin Demonstrator will be completed. Instrumentation and vibro-acoustic tests will be

executed. The Pax Cabin demonstrator will then be instrumented and subjected to comfort tests. Both vibro-acoustic and comfort tests results will be assessed and reported.

- WP3.3 – Flight Simulator: No activities will be performed.
- WP3.4 – Iron Bird: Demonstration activities and the assessment of results will be completed for the part related to TP90Pax configuration.
- WP3.5 – Integrated Technologies Demonstrator (FTB#2): The activities will be concentrated on the completion of the on-ground demonstration technologies:
  - For the full-scale structural test, the test assembly with the wing box, aileron and winglet will be completed in REG IADP and then delivered for the test in AIR ITD;
  - the actuation of the on-ground rig test will be performed in AIR ITD and the REG ITD will be in charge of the system evaluation and verification assessment of the demonstration.

WP4 – Technologies Development / Demonstrations Results

- WP4.1 – Technology Assessment: Final interactions with TE;
- WP4.2 – Eco-design Interface: Final interactions with ECO TA.

Major milestones planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones (WP)
REG D1 - Adaptive Wing Integrated Demonstrator – Outer Wing Box Ground Test	Outer Wing Box demonstrator test readiness review achieved (WP3.1)
REG D1 - Adaptive Wing Integrated Demonstrator – OWB Demonstrator	Outer Wing Box TRL5 achieved (WP3.1)
REG D2 - Integrated Technologies Demonstrator – Flying Test Bed#2 (FTB2)	On-ground actuation rig system test readiness review achieved (WP3.5)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Structural Demonstration)	Fuselage structural demonstrator fatigue tests completed (WP3.2)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Structural Demonstration)	Fuselage structural demonstrator static tests test readiness review achieved (WP3.2)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Structural Demonstration)	Pax cabin demonstrator available (WP3.2)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Comfort/Thermal Demonstrations)	Pax cabin noise and vibration tests completed (WP3.2)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Comfort/Thermal Demonstrations)	Pax cabin demonstrator transfer to FhG facility for thermal test (WP3.2)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Comfort/Thermal Demonstrations)	Pax cabin comfort/thermal/systems tests readiness review achieved (WP3.2)

Major deliverables planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables (WP)
REG D1 - Adaptive Wing Integrated Demonstrator – Flying Test Bed#1 (FTB1)	FCS TRL6 assessment report (WP2.4 and WP3.1)
REG D2 - Integrated Technologies Demonstrator – Flying Test Bed#2 (FTB2)	On-ground actuation rig system evaluation and verification assessment related to TRL5 achievement (WP3.5)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Structural Demonstration)	Fuselage structure TRL6 assessment report (WP3.2)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Comfort/Thermal Demonstrations)	Pax cabin TRL6 assessment report (WP3.2)
REG D1 - Adaptive Wing Integrated Demonstrator – OWB Demonstrator	Outer wing box TRL5 assessment report (WP3.1)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Comfort/Thermal Demonstrations)	Thermal management final report (WP2.3.3)

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables (WP)
REG D3 - Full Scale Innovative Fuselage & Pax Cabin Demonstrator (Comfort/Thermal Demonstrations)	Comfort/thermal testing – synthesis report and recommendations (WP3.2)
REG D4 - Iron Bird	Assessment of E-LGS Iron Bird test results (WP2.3.2 and WP3.4)

IADP Fast Rotorcraft

1. Multi-annual overview and strategic planning

The Fast Rotorcraft IADP of Clean Sky 2 consists of two flight demonstrators, the Next Generation Civil TiltRotor Technology Demonstrator (NGCTR-TD) [leader: Leonardo Helicopters] and the RACER compound helicopter [leader: Airbus Helicopters]. These two fast rotorcraft concepts aim to deliver superior vehicle productivity and performance, and through this bring economic advantage to users.
NGCTR aims to design, build and fly an innovative next generation civil tiltrotor technology demonstrator. The configuration will go beyond current architectures of this type of aircraft and will involve tilting prop-rotors mounted in fixed nacelles at the tips of the wing. The closure of the CDR at aircraft level and the start of the NGCTR Final Assembly are both planned in 2021 and will be completed in 2022. Ground testing and flight testing will be performed in 2023.

The RACER aims to develop and flight-test in a full-scale flightworthy demonstrator, which embodies the new European compound rotorcraft architecture. This architecture combines a lifting rotor with two lateral rotors at the tips of novel box-wings architecture, in pusher configuration. The Critical Design Review, at complete demonstrator level, was held in 2019, as well as some specific technology validation ground tests. The assembly of the technology demonstrator started in 2021 with the fuselage assembly and will be continued until ground testing, the first flight will take place in 2022 and subsequent flight tests in 2023.

2. Description of main activities for the year 2022

Activities relevant to the Next Generation Civil Tiltrotor demonstrator (WP1)
Programme activities will focus on two major objectives. Following the release of aircraft frozen designs at CDR, parts procurement will need to be continuously monitored to enable timely achievement of NGCTR final assembly deadlines. At the same time, components/systems qualification will need to be launched and supervised, together with the engagement and interaction with the Civil Airworthiness Authority for the release of NGCTR Permit to Fly.

- WP 1.1 - NGCTR Demonstrator Management and Coordination: This work package deals with programme management and controls in order to (1) carry out all the tasks needed to co-ordinate, orient, report and plan the NGCTR project specific activities in line with IADP level requirements including Core Partner/Partner coordination and (2) ensure delivery of all documents and information in a timely fashion as required by the FRC IADP in line with the Management Manual. These activities will run continuously for the 2022 period.
- WP 1.2: Air Vehicle Design and Development: This work package deals with NGCTR-TD design and system integration activities that are needed at aircraft and sub-system level. System specifications will be issued allowing test rig requirement definitions and the launch of rig manufacturing, with testing commencing for many key systems. Focus will be placed on the safety case evidence – both

that it is made available and generated by analyses or physical tests to substantiate discussions with the Civil Airworthiness Authority towards the permit to fly approval in 2023.

- WP 1.3: Aircraft Final Assembly: This work package deals with the activities associated with NGCTR-TD build and assembly, coordinated by Industrial Engineering, including the manufacture of jigs, tooling and components, plus the modification of the donor test vehicle to Technology Demonstrator flight standard. Necessary jigs and tools will be manufactured and delivered. Following completion of the donor structure in 2021, NGCTR specific structural modifications will be embodied. Installation kits and sub-system components will be progressively delivered to the manufacturing cell to support the staged assembly process. The tail and wing structures will be delivered and built up as major sub-assemblies prior to joining with the main fuselage.
- WP 1.4 - Aircraft Test and Demonstration: This work package deals with NGCTR-TD ground and flight tests, and includes aircraft instrumentation design and development. In 2022, NGCTR-TD instrumentation will be established along with the preparation of the relevant conformity declarations. A final test matrix will be established and relevant test plans prepared for ground-testing.

Activities relevant to the RACER demonstrator (WP2)

The demonstrator final assembly will continue until its completion in 2022. The major activities in 2022 will be: to assemble the RACER Demonstrator including the required flight test instrumentation; and to collect all necessary evidence (ground tests, analysis, etc.) and documentation to achieve the permit to fly. One of the major tasks is to further investigate extra funding opportunities in order to secure the flight test campaign and reach the targeted maturity level within the Clean 2 Sky programme timeframe.

- WP 2A: RACER Flight Demonstrator Integration: WP2A activities will cover integration follow-up and support of all components and a few sub-systems delivery follow-up. In 2022, the major activity will be the finalisation of the Permit To Fly, which calls for the implementation of major ground testing complemented by simulations. A significant part of 2A's efforts in 2022 will be the follow-up of the few missing flightworthy component deliveries, the follow-up and support of the demonstrator assembly and the performance and support of component and systems tests for the permit to fly.
- WP 2B: RACER Airframe Integration: RACER airframe components (central fuselage, canopy, doors, wings, tail boom) were delivered by Core Partners and Partners and assembled by Airbus Helicopters (AH) in 2021. The finalisation of the wing assembly of the demonstrator will be performed in early 2022. The delivery of three test specimens and associated ground tests are planned to be delivered by 2021, therefore 2022 will be mainly dedicated to finalisation of ground tests and stress substantiation in view of the Permit To Fly. All those FRC 2B demonstrator activities will rely on the successful performance of related AIR ITD activities, namely the flightworthy RACER wings, rotor-less-tail (and associated documentation).
- WP 2C: RACER Dynamic Assembly Integration: The scope of work for RACER Dynamic Assembly in 2022 will be mainly about manufacturing, assembling and subsequent ground tests of major dynamic subsystems. Two flightworthy main gear boxes (cooperation between the FRC WP2 Leader, and the ARTEMIS Core Partner's project) will be delivered in mid-2022 to start the substantiation bench tests and finalise the demonstrator assembly. Flight-cleared propeller gear boxes (Mobility Discovery – a Core Partner's project) will be delivered in 2022, for final assembly and preparation of flight tests. Engines have already been delivered to Airbus Helicopters (AH). Rotor components have been procured and will be assembled by early 2022. Lateral rotors will be delivered at the end of 2021 while testing activities will be running by early 2022 in MT Propeller facility. For the lateral actuator the first item will be delivered by the end of 2021 to start endurance and fatigue testing activities in early 2022 in the AH laboratory.
- WP 2D: RACER On-board Systems Integration: RACER On-Board Systems activities in 2022 will concern integration in the demonstrator and ground tests at demonstrator level. RACER electrical harnesses and bays will be delivered and partly assembled in 2021. Assembly finalisation will take

place in 2022. Following completion of the on-board equipment integration, the power-on and key ground tests will be performed in 2022 on the complete RACER demonstrator.

Transversal Fast Rotorcraft Activities (WP3, WP4 & WP5)

- WP 3: Eco-Design Concept Implementation to Fast Rotorcraft: Within WP3, FRC leaders will implement the Life Cycle Assessment (LCA) relevant to the defined case studies for each demonstrator (RACER and NGCTR), including collection of data from Leaders, Core Partners and active partners as required. Relying on a successful collaboration agreement signed between FRC and ECO TA in 2021, FRC Leaders will complete the review process, collection, and validation of physical data for Life Cycle Inventories (LCI) pertaining to major technology Flagship Demonstrators (FSDs) for RACER and NGCTR. Following the FRC masterplan, shared with ECO TA in 2021, most of the data will be concurrently collected during the final manufacturing activities along 2022 in line with the master plan as shared with ECO.
- WP 4: Technology Evaluator (TE) Methodology for Fast Rotorcraft: In 2022, support will be given to the TE to undertake, at airport and ATS level, rotorcraft refined assessments of environmental (emissions and noise) improvements that may be accrued through replacement of reference technology over the designated time scales, in view of the TE 2nd assessment foreseen in 2023. An assessment of concept technology benefits against the reference models will be developed.
- WP 5: Fast Rotorcraft Project Coordination: The coordinator will act as the prime interface to the Clean Sky 2 Joint Undertaking (CS2JU) for all aspects of the consortium, working closely with the FRC co-leader and other beneficiaries of the consortium. Appropriate representation in Clean Sky 2 Committees will be maintained to ensure coherence across all aspects of the programme. In addition, FRC-specific Steering Committee meetings will be held to ensure communication is maintained and that the consortium has an opportunity to influence necessary aspects of the project.

Major milestones planned for 2022:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Milestones
ET1.2 - Tie Down TiltRotor (TDT) Demo	NGCTR harness installation completion – WP1
ET1.2 - Tie Down TiltRotor (TDT) Demo	Fuel distribution system delivery – WP1
ET1.5 - Wing Assembly	Wing delivery for assembly – WP1
ET2.1 - RACER Flight Demonstrator Integration	Assembled demonstrator power-on
ET2.1 - RACER Flight Demonstrator Integration	Completion of the RACER demo assembly – WP2
ET2.1 - RACER Flight Demonstrator Integration	RACER flight condition approval form signed + Permit To Fly – WP2
ET2.1 - RACER Flight Demonstrator Integration	Racer first flight – WP2
WP3 - Eco Design Concept Implementation	Delivery of LCI data for all flagship demonstrators
WP4 - Technology Evaluator Methodology	Reference aircraft models are defined and adopted for NGCTR-TD and RACER. The first assessment of benefits at technology levels is completed.

Major deliverables planned for 2022:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
ET1.2 - Tie Down TiltRotor (TDT) Demo	Flight Clearance Justification Plan – WP1
ET1.5 - Wing Assembly	NGCTR Wing delivery – Acceptance report – WP1
ET1.4 - Drive System and Components	Transmission Test Rig Completed – report – WP1
ET1.2 - Tie Down TiltRotor (TDT) Demo	Engine set delivered – WP1

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
ET2.1 - RACER Flight Demonstrator Integration	Flight condition approval form – validation note from DGAC – WP2
ET2.1 – RACER Flight Demonstrator Integration	Demonstrator power-on – summary note of first results
ET2.1 - RACER Flight Demonstrator Integration	Assembly of the full-scale demonstrator – summary report for press release – WP2
ET2.1 - RACER Flight Demonstrator Integration	First flight – summary report for press release and/or special event
Eco Design Concept Implementation	Life Cycle Inventories of FRC flagship demonstrators-summary reports on data released – WP3
Technology Evaluator Methodology	FRC Technology Report 2022 (AH/LH separated reports).

3. Description of main activities for 2023

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

Programme activities will focus on the completion of NGCTR assembly and testing to enable the first ground run and flight, along with completion of qualification tasks required for Permit to Fly release.

- WP 1.1: NGCTR Demonstrator Management and Co-ordination: This work package deals with programme management and control to carry out all tasks needed to co-ordinate, orient, report and plan the NGCTR project specific activities.
- WP 1.2: Air Vehicle Design and Development: Design specialists will support the NGCTR final assembly phase to ensure it is correctly accomplished, identifying any possible issues and supporting their resolution. System safety assessments and the aircraft level safety assessments will be concluded. Integral support to ground testing activities will be provided by system specialists and airworthiness will release all the relevant documentation for the first flight Permit to Fly. Specialists will support the generation of the flight testing matrix along with planning an adequate Flight Readiness Review to provide clearance for the first flight and the initial flight activities (Phase 1). Subsequent ground and flight test data will be analysed to validate design loads, system performance and flight characteristics. Rig testing activities will continue in accordance with the test plans, generating data for the relative flight clearance documentation required to request an expanded flight envelope for Permit to Fly beyond first flight and phase 1 testing.
- WP 1.3: Aircraft Final Assembly: NGCTR Final Assembly and testing will be concluded to enable the start of ground run activities and the subsequent first flight, including any adjustment to aircraft configuration and fixes to test faults as required.
- WP 1.4: Aircraft Test and Demonstration: This work package deals with NGCTR ground and flight tests, and includes aircraft instrumentation design and development. NGCTR instrumentation setup definition and integration will be completed. Dedicated instrumentation and telemetry checks will be undertaken to validate real time data monitoring. Ground tests will be performed in accordance with test schedules. Subsequently, after clearance to fly, initial flights will be performed in accordance with the relevant flight test schedules.

Activities relevant to the RACER demonstrator (WP2)

The major activities in 2023 will be the follow-up of the test campaign to cover the defined flight operations envelope towards the achievements of TRL6. At programme management level during 2022, one of the major tasks is to investigate further funding opportunities in order to secure the flight test campaign and reach the targeted maturity level within the Clean 2 Sky programme timeframe.

- WP 2A RACER Flight Demonstrator Integration: Follow-up of the flight test campaign, analysing and gathering flight test results. When relevant, damage of flightworthy parts will be monitored and necessary maintenance actions defined and implemented;
- WP 2B - RACER Airframe Integration: To support the flight test campaign and the analysis of the airframe in-flight measurements. A potential source of activity could also be related to the need for remanufacturing of some parts, depending on the outcomes from the flight test campaign.

- WP 2C: RACER Dynamic Assembly Integration: To support the flight test campaign and the analysis of the dynamic system in-flight measurements; to remanufacture some parts, depending on the outcome from the flight test campaign.
- WP 2D: RACER On-board Systems Integration: To support the flight test campaign and validate the performance of the avionics system during the flights; to remanufacture some parts, troubleshoot on systems, slightly modify software, as well as perform supporting ground tests or flight test analysis.

Transversal Fast Rotorcraft Activities (WP3, WP4 & WP5)

- WP 3: Eco-Design Concept Implementation to Fast Rotorcraft: FRC leaders will complete the Life Cycle Assessment (LCA) relevant to the defined case studies for each demonstrator, including data collected from Leaders, core partners and active partners. FRC Leaders and ECO TA will consolidate the final Eco-Statement on green technologies developed for major FRC Flagship Demonstrators (RACER and NGCTR). The final statement will include an eco-efficiency assessment based on environmental impact results from LCA models including sensitivity and uncertainty analysis, and the functional value in relation to the FSD system performance.
- WP 4: Technology Evaluator Methodology for Fast Rotorcraft: FRC Leaders undertake an in-depth analysis of the results and verification of the fidelity of the models against relevant references. An assessment of concept technology benefits against the reference models will be developed, supported by an agreed methodology capable of measuring achievements' progress. Support will be given to TE-TA in view of a second TE assessment expected by the end of 2023.
- WP 5: Fast Rotorcraft Project Coordination: The coordinator will act as the primary interface to the Clean Sky 2 Joint Undertaking (CS2JU) for all aspects of the consortium task management, working closely with the FRC co-leader and other beneficiaries of the consortium. Appropriate representation in Clean Sky 2 Committees will be maintained to ensure coherence across all aspects of the programme. In addition, FRC-specific Steering Committee meetings will be held to ensure communication is maintained and that the consortium has an opportunity to influence necessary aspects of the project.

Major Milestones planned for 2023:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Milestones
ET1.3 - NGCTR-TD Flying Demonstrator	NGCTR-TD acceptance test procedures – WP1
ET1.3 - NGCTR-TD Flying Demonstrator	Assembled NGCTR – TD power-on – WP1
ET1.3 - NGCTR-TD Flying Demonstrator	NGCTR- TD 1st Flight – WP1
ET2.1 - RACER Flight Demonstrator Integration	High-speed flight domain opening – WP2
ET2.1 - RACER Flight Demonstrator Integration	RACER demonstrator TRL6 achieved – WP2
Eco Design Concept Implementation	Eco-Statements for FRC- flagship demo – WP3
Technology Evaluator Methodology	FRC – Complete set of data, aircraft models are delivered to TE for 2nd assessment – WP4

Major Deliverables planned for 2023:

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
ET1.3 - NGCTR-TD Flying Demonstrator	Assembly of the full-scale demonstrator – summary report for press release – WP1
ET1.3 - NGCTR-TD Flying Demonstrator	NGCTR acceptance test procedures report – WP1

Demonstrators/Techno Streams (as shown in CS2DP)	Major Deliverables
ET1.3 - NGCTR-TD Flying Demonstrator	First Flight – summary report for press release and/or special event
ET2.1 - RACER Flight Demonstrator Integration	RACER flight tests summary note 2023 – WP2
ET2.1 - RACER Flight Demonstrator Integration	RACER TRL6 report – WP2
Eco Design Concept Implementation to FRC	Eco-Statements on FRC Demonstrators – WP3
Technology Evaluator Methodology	FRC Technology Report 2023 contributing to TE 2nd assessment – WP4

ITD Airframe

1. Multi-annual overview and strategic planning

Due to the large scope of technologies and demonstrators undertaken by the Airframe ITD, addressing the full range of aircraft types, the ITD is structured around three major Activity Lines split into Technology Streams (TS) or Work Packages (WP):

- Activity Line A: High Performance and Energy Efficiency (HPE);
- Activity Line B: High Versatility and Cost Efficiency (HVC);
- Activity Line C: Eco-Design (ECO).

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

The high-level HPE objectives for the period 2022-2023 are:

- TS A-1 (Innovative Aircraft Architecture): Novel concepts of engine integration on rear fuselage, especially Boundary Layer Ingestion (BLI), as well as novel aircraft architectures down-selected in 2021 will be further assessed with high-fidelity simulations and Wind Tunnel Tests (WTT). Development or improvement of modelling tools to improve the efficiency of the certification will also be continued.
- TS A-2 (Advanced Laminarity): Investigations on demonstrators and technologies for Natural Laminar Flow (NLF) and Hybrid Laminar Flow Control (HLFC) will be continued for nacelles and airfoils, especially through Wind Tunnel Tests.
- TS A-3 (High Speed Airframe): The activities will be focused on the manufacturing and testing of equipped airframe demonstrators for Large Passenger Aircraft (LPA), i.e. composite flaperon and innovative cargo door, and for Business Jets (BJ), i.e. composite wing root box and anti-icing power-optimised windshields.
- TS A-4 (Novel Control): The activities on design of control for load and flutter control will continue, especially with a gust load alleviation WTT; a scale one BJ slat equipped with an Electrical Wing Ice Protection System (EWIPS) will be tested in a icing Wind Tunnel, and the design of innovative movables will continue to prepare ground testing.
- TS A-5 (Novel Travel Experience): Maturation of the LPA smart galley / crew operations demonstrator will continue. With regards to BJ, the results of the demonstration on the scale one office-centred cabin mock-up performed in late 2021 and early 2022 will be analysed and synthesised.

The high-level HVC objectives for the period 2022-2023 are:

- TS B-1 (Next Generation Optimised Wing) will complete the manufacturing of the demonstrators of new wing concepts and perform the required structural tests for TRL5.
- TS B-2 (Optimised High Lift Configurations) will focus on manufacturing the Out-of-Autoclave (OoA) composite wing and on performing the required structural tests for TRL5.
- TS B-3 (Advanced Integrated Structures) will focus on the achievement of TRL5 for more electrical wing technologies and new cockpit concepts.

- TS B-4 (Advanced Fuselage) will manufacture and perform structural tests up to TRL5 of the innovative concepts for composite centre and rear fuselage demonstrators, as well as cabin interior demonstrators.

The high-level ECO objectives for the period 2022-2023 are:

- TS C-1 (Eco-Design Management and ECO TA Link) will continue to ensure the link between AIR ITD and ECO TA, especially to monitor completion of the Life Cycle Inventory for the five Airframe ITD Eco-Design Flagship Demonstrators (FSD), for which Eco-Statements will be carried out.
- TS C-2 (Eco-Design for Airframe) will perform the detailed design of the FSD parts associated with C-2, to provide necessary inputs to ECO TA to perform the Eco-Statements.
- TS C-3 (New Materials and Manufacturing) was closed in 2021.

2. Description of main activities for 2022

M – Management and Interface

General management activities of the ITD will be performed by the three Co-Leaders, in addition to the coordination of the ITD by the ITD coordinator of the period. This will be complemented by leaders' coordination to support the interfaces with other SPDs (such as REG, LPA, FRC, etc.).

A - High Performance and Energy Efficiency

Technology Stream A-1: Innovative Aircraft Architecture

In WP A-1.1 and A-1.3, respectively, novel concepts of engine integration on rear fuselage, especially BLI, as well as novel aircraft architectures down-selected in 2021 will be further assessed with High-Fidelity simulations and Wind Tunnel Tests (WTT). In WP A-1.4, development or improvement of modelling tools to improve the efficiency of the certification will also be continued for the tasks focused on: Rapid dynamic / crash modelling for safety; Model based integrated systems analyses and synthesis; Prediction of aerodynamic loads at high Reynolds; Cabin thermal modelling with a human thermal model; Ice accretions effects determination by Computational Fluid Dynamics (CFD).

Technology Stream A-2: Advanced Laminarity

Investigations on demonstrators and technologies for Natural Laminar Flow and Hybrid Laminar Flow Control will be continued for airfoils, especially through WTTs. In particular, three WTTs are expected to take place in 2022: Tailored Skin Single Duct (TSSD) real scale leading edge installed on a A320 Vertical Tail Plane; STUNTT WTT for Surface imperfection and Unsteady motion impact on Transition onset; EULOSAMII WTT to test an aircraft mock-up equipped with a laminar high aspect ratio wing capable of various innovative high-lift configurations.

Technology Stream A-3: High Speed Airframe

Activities will be focused on the manufacturing and testing of equipped airframe demonstrators for LPA, i.e. composite flaperon and innovative cargo door, and for BJ, i.e. composite wing root box and anti-icing power-optimised windshields.

Technology Stream A-4: Novel Control

The activities on design of control for load and flutter control will continue, especially with a Gust Load Alleviation (GLA) WTT. A real scale BJ slat equipped with an Electrical Wing Ice Protection System (EWIPS) will be tested in an icing Wind Tunnel, and the design of innovative movables will continue to prepare ground testing.

Technology Stream A-5: Novel Travel Experience

Maturation of the LPA smart galley / crew operations demonstrator will continue. With regards to BJ, the results of the demonstration on the scale one office centred cabin mock-up performed in 2021 will be analysed and synthesised.

B - High Versatility Cost Efficient

Technology Stream B-1: Next Generation Optimised Wing

With respect to RACER's Wing demonstrator, the activities will be focused on the nacelle design convergence with the lateral gear box environment and the completion of the flap design, manufacturing and delivery to FRC IADP for RACER's flight test demo installation. In parallel the preparation and execution of the ground tests of the wings will be completed and the Permit to Fly (PtF) documentation will be released.

With respect to the Small Air Transport (SAT) composite wing, the full-scale integral wing-box demo manufacturing and assembly activities will be finished and tested on ground. Conclusions and recommendations of the technology demonstrated will be prepared. Supporting activities will be carried out for the FTB#2 Step 1 Flight Test Campaign in REG IADP, as well as for the morphing winglet and loads alleviation system. A detailed definition of the on ground FTB#2 actuation wing rig will be frozen within the scope of Step 2 and the preparation and installation of the rig items will be carried out. In addition, the loads alleviation system within the Step 2 scope will be developed to be integrated on the rig.

Technology Stream B-2: Optimised High Lift Configurations

Final validation in the Wind Tunnel Test under icing conditions of loop heat pipe technologies within the BISANCE project will be performed. With respect to FTB#2 Out of Autoclave Composite Wing, the tooling required to manufacture the upper skin in thermoplastic in situ consolidation will be manufactured, as well as the items required at the full scale. This includes the upper skin and lower skin (Liquid Resin Infusion) with the final geometry, delivered to REG IADP for the assembly of the specimen of the full-scale test by the EWIRA REG Core Partner Project. The related test will be prepared and set up.

Technology Stream B-3: Advanced Integrated Structures

With respect to Advanced Integrated Empennages for Regional Aircraft, the representative co-cured multi-rib mid-scale box demonstrator and the mid-scale multi-spar box demonstrator will be manufactured. With respect to more electrical wing technologies, the activities will be focused on the integration of HEPODIS' equipment on the On Ground FTB#2 Actuation Wing Rig, technical support on the EMA's equipment development in SYS ITD and integration on the On Ground FTB#2 Actuation Wing Rig. With respect to Fatigue Digital Twin (FDT), the simulation capability will be developed to derive airframe load sequences using aircraft recorded parameters to produce a first demonstrator. For Structural Health Monitoring (SHM), the capability to detect an extended range of damage configurations will be developed. With respect to the Highly Integrated Cockpit, the pending qualifications tests for bird strikes and noise attenuation will be completed and the results assessed. With respect to SAT manufacturing technologies, the new joining methods will be manufactured and tested on ground.

Technology Stream B-4: Advanced Fuselage

Support to the RACER Assembly Line in FRC IADP will be given as well as support to the Permit to Fly of RACER Flight Test Demo. With respect to the NGCTR Technology Demonstrator, the set-up of the structure testing activities will be prepared and the structure qualification tests initiated. Activities will also focus on the development of out-of-autoclave technology to TRL5 and the production and delivery of the flying tail demonstrator to the NGCTR-TD. Shear ties and frames assembling on full-scale panels will be completed for the Regional Fuselage Demonstrator items. Mechanical and Structural Health Monitoring (SHM) tests of large curved panels and residual strength modules for the SHM/HPC platform will be finalised, as well as manufacturing of smart repair for the large flat panel. Work on the virtual

platform for the smart fuselage will continue. The full-scale major cabin items developed for the regional aircraft interiors will be manufactured and delivered.

C – Eco-Design

Work Package C-1: Eco-Design Management and ECO TA Link

C-1 is connecting the overall Airframe ITD to the Eco-Design Coordination Committee and ECO TA. The activities are mainly related to carefully monitoring the completion of the Life Cycle Inventory (LCI) for the five Airframe ITD Eco-Design Flag Ship Demonstrators (FSD), for which Eco-Statements will be carried out in 2022 and 2023. Additional work planned includes writing synthesis reports and outputs of ECO TA and strengthening the common dissemination activities like technical workshops, conferences and public events.

Work Package C-2: Eco-Design for Airframe

The detailed design of the FSD parts associated with C-2 will be performed, and ground testing of those parts will start. In parallel, the Life Cycle Assessment (LCA) data collection will continue for technologies. Resulting data will be stored in the CS-AED database created in Clean Sky 1 / EDA. Based on this database, Eco-Statements will start to be performed in collaboration with ECO TA for FSDs and their reference parts. This will continue in 2023.

Work Package C-3: New materials and manufacturing

No activities are expected in 2022 since the WP was closed in 2021.

Major milestones planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
D3-4 / TS A-1	Large fuselage BJ configuration WTT completed
D3-7 / TS A-2	Activities on NLF laminar wing synthesis
D1-1 / TS A-3	Door demonstrator synthesis
D3-13 / TS A-4	GAINS tests at CIRA on BJ slat
D2-12 / TS A-5	BJ office centred cabin full scale functional mock-up – synthesis
D1-11/TS B-1	RACER's wing structure tests completed
D1-6/TS B-2	FTB#2 OoA composite wing full scale test readiness review (TRR) completed
D1-8/TS B-3	HVDC and EMAs TRR completed
D1-12/TS B-4	RACER's tail cone Permit to Fly released
D1-16/TS B-4	Regional full scale panels manufacturing completed
TS C-1	LCI delivery reports Q2 and Q4 completed

Major Deliverables planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
D3-4 / TS A-1	Large fuselage Business Jet configuration WTT report
D3-7 / TS A-2	2022 activities on NLF laminar wing synthesis report
D1-1 / TS A-3	Door demonstrator synthesis report
D3-13 / TS A-4	GAINS WTT tests at CIRA on BJ slat report
D2-12 / TS A-5	BJ office centred cabin full scale functional mock-up synthesis report
D1-11/TS B-1	RACER's wing Permit to Fly documentation
D1-6/TS B-2	FTB#2 OoA composite wing full scale demonstrator
D1-10/TS B-3	Concept for multi sensing SHM capability
D1-11/TS B-3	RACER's airframe Permit To Fly documentation

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
D1-15/TS B-4	Final NGCTR technology demonstrator structures qualification test plan
D1-16/TS B-4	Regional full scale panels manufacturing completion report
TS C-1	LCI delivery reports Q2 and Q4

3. Description of main activities for the year 2023

M – Management & Interface

The activities in this work package will be a follow-on of those in 2022.

A - High Performance and Energy Efficiency

Technology Stream A-1: Innovative Aircraft Architecture

In A-1.3, conclusions will be drawn on novel aircraft architecture activities. In WP A-1.4, development or improvement of modelling tools to improve the efficiency of the certification will also be continued for the tasks focused on: rapid dynamic / crash modelling for safety; ice accretion effect determination by CFD; in particular, flight tests with artificial ice shapes will be performed late 2022, beginning of 2023.

Technology Stream A-2: Advanced Laminarity

Investigations on demonstrators and technologies for Natural Laminar Flow and Hybrid Laminar Flow Control will be continued for airfoils through WTT, CFD and analyses. One low speed WTT is expected to take place in 2023 on an aircraft mock-up equipped with a laminar high aspect ratio wing.

Technology Stream A-3: High Speed Airframe

Activities will focus on the testing of equipped airframe demonstrators for LPA, i.e. composite flaperon and innovative cargo door, and for BJ anti-icing power-optimised windshields.

Technology Stream A-4: Novel Control

The activities regarding design of control for load (gust, vibrations) and flutter control will be synthesised, as well as the activities on icing novel systems. The three innovative movable demonstrators will be ground tested, and the results will be analysed and synthesised.

Technology Stream A-5: Novel Travel Experience

The activities on the LPA smart galley / crew operations demonstrator will be synthesised.

B - High Versatility Cost Efficient

Technology Stream B-1: Next Generation Optimised Wing

Supporting activities for the flight test campaign of RACER in FRC IADP will be performed.
On ground FTB#2 actuation wing rig set-up and loads alleviation system for Step 2 scope development will be finished. Validation of full Step 2 system with Electro-Mechanical Actuators (EMAs) will be done on the rig.

Technology Stream B-2: Optimised High Lift Configurations

Finalisation of the FTB#2 Out of Autoclave Composite Wing full scale test will be carried out and conclusions of the results provided.

Technology Stream B-3: Advanced Integrated Structures

In the Advanced Technologies for Empennages, activity will be focused on the multifunctional leading edge and the thermoplastic trailing edge wedge. High Voltage Direct Current (HVDC) and Electro-Mechanical Actuator (EMA) technologies on the On Ground FTB#2 Actuation Wing Rig will be validated. With respect to Fatigue Digital Twin (FDT), the integration and chaining of loads simulation capability and load-to-stress-transfer-function using aircraft recorded parameters will be demonstrated. On structural health monitoring (SHM), multi-sensing capability will be demonstrated.

Technology Stream B-4: Advanced Fuselage

Supporting activities for the flight test campaign of RACER and NGCTR in the FRC IADP will be performed. NGCTR Technology Demonstrator structural tests will be completed, compiling the structures qualification documentation and reviews with airworthiness authority for the Permit to Fly release. Development of the maintenance strategy for smart fuselage, application of manufacturing and testing to full-scale regional fuselage, testing of repaired sub-components as well as the development of an operative cost estimation module will be executed, and related data assessed. In addition, the final assessment of the full-scale major cabin items developed for the regional aircraft interiors will be performed.

C – Eco-Design

Work Package C-1: Eco-Design Management and ECO TA Link

Same activities as for 2022.

Work Package C-2: Eco-Design for Airframe

Ground testing of FSD Parts will be completed, as well as LCA data collection; resulting data will be stored in the CS-AED database created in Clean Sky 1 / EDA. Based on this database, Eco-Statements will be performed in collaboration with ECO TA for FSDs and their reference parts. To achieve that, a Bill of Materials / Bill of Processes (BoM/BoP) will have to be collected for FSDs and their reference parts.

Work Package C-3: New materials and manufacturing

No activities are expected in 2023 since the work package was closed in 2021.

Major milestones planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
D3-5 / TS A-1	Flight tests with artificial ice shapes completed
D3-6 to 12 / TS A-2	Advanced laminarity activities completed
D1-1 / TS A-3	Cargo door demonstrator completed
D3-13-14-15-16 / TS A-4	GAINS assessment completed
D2-7 / TS A-4	MANTA demonstrator on-ground tests completed
D1-5/TS B-1	On-Ground (O/G) FTB#2 Actuation Wing Rig TRR for Step 2 completed
D1-6/TS B-2	FTB#2 OoA Composite Wing full scale test completed
D2-22/TS B-3	Advanced empennage multifunctional leading edge completed.
D1-8/TS B-3	HVDC and EMAs validation on the O/G FTB#2 Actuation Wing Rig for Step 2 completed
D1-15/TS B-4	Completion of NGCTR technology demonstrator structure qualification test

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
D1-16/TS B-4	Validation of the developed design platform with real scale full scale test completed
TS C-1	LCI Delivery Reports Q2 and Q4 released

Major Deliverables planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
D3-5 / TS A-1	Flight tests with artificial ice shapes assessment report
D3-6 to 12 / TS A-2	Advanced laminarity synthesis report
D1-1 / TS A-3	Cargo door demonstrator synthesis report
D3-13-14-15-16 / TS A-4	GAINS synthesis report
D2-7 / TS A-4	MANTA demonstrators on-ground tests synthesis report
D1-5/TS B-1	O/G FTB#2 Actuation Wing Rig Step 2 Validation report
D1-6/TS B-2	FTB#2 OoA Composite Wing Full Scale Test Results report
D1-8/TS B-3	HVDC and EMAs validation report on the O/G FTB#2 Actuation Wing Rig for Step 2
D1-15/TS B-4	NGCTR technology demonstrator flight clearance justification documentation (structures) release
D1-16/TS B-4	Application of SHM/NDI platform to a full-scale regional aircraft fuselage assessment report
AIR-ECO-FSDs/TS C-1	Flagship demonstrator synthesis report 2023
TS C-1	LCI Delivery Reports Q2 and Q4

ITD Engines

1. Multi-annual overview and strategic planning

   In Clean Sky 2, the ENGINES ITD will build on the success of SAGE in CS1 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 engine architectures can be summarised as below:

   - Ultra-High Propulsive Efficiency (UHPE) Demonstrator at TRL 5 addressing short / medium range aircraft market: design, development and ground test of an engine demonstrator to validate the key enabling technologies such as low pressure modules, systems and nacelle modules;
   - Business aviation / short-range regional turboprop demonstrator at TRL 5: design, development and ground testing of a new turboprop engine demonstrator in the 2000 horse-power range;
   - Advanced geared engine technologies at TRL 5: design, development and ground testing of new compression system rigs and an expansion system demonstrator as key enablers for new generation of turbofan engines;
   - Very High Bypass Ratio (VHBR) middle of market turbofan technology at TRL 5: development and demonstration of technologies to deliver selected power plant technology enablers matured for implementation in future engine systems;
   - VHBR Large Turbofan Demonstrator at TRL 5: design, development and ground test demonstration of an engine to assess key technologies (low speed fan, power gear box, enhanced IPT for very high bypass ratio large engines.
   - The small aero-engine projects focus on small fixed-wing aircraft in the general aviation domain including the completed piston/diesel engines demonstrator. Technology development up to TRL 5 of small turboprop engines integrating next generation technologies (e.g. compressor and combustor technologies) for the turboprop market of up to 19-seat aircraft is expected.

- Eco Design will contribute to assessing the impact of a range of selected technologies (i.e. additive manufacturing, composite recycling, high temperature material processes).
- Input to airframer vehicle models for Technology Evaluator assessment will be provided by relevant work packages.

2. Description of main activities for the year 2022

- WP2 – Ultra High Propulsive Efficiency (UHPE) Demonstrator for short / medium range aircraft (Safran Aircraft Engines):
  Firstly, the results of the technology maturation will be analysed to substantiate the review for the engine architecture. It is anticipated that the engine demonstrator will enter a phase of component design, which is necessary to support the architecture choice milestone. Technology maturation will continue, particularly with regards to module testing in preparation for the engine ground demonstration. Additional results will arise during the design phase. In parallel, the full-scale engine ground test demonstrator (GTD) will be consolidated to reduce risk with the lead-time of components;
- WP3 – Business Aviation / Short Range Regional TP Demonstrator: Year 2022 will be dedicated to the completion of the remaining engine and component tests. Then to close the WP3 project, all performed activities will be synthesised into a final report including a SAT evaluation in CS2 Reference aircraft "19 seaters";
- WP 4 – Advanced Geared Engine Configuration (compression/expansion system): The key objective is to complete the testing of the engine demonstrator, and the hardware procurement and assembly of the 2-Spool-Compressor Rig;
- WP5 – VHBR – Middle of Market Technology (Enabler): Following on from the Advance3 engine testing work conducted outside of Clean Sky, the activity will continue on modelling and increasing the understanding of the engine systems, CFD (computational fluid dynamics) of a real bearing chamber will be conducted and key rigs will be designed and manufactured to represent the IP and HP turbines and combustor to generate data supporting the validation of engine models;
- WP6 – VHBR – Large Turbofan Demonstrator: Following on from the manufacturing and assembly of the first UltraFan hardware and engine build, the programme will perform engine testing in line with the Engine Demonstrator Development Plan. Manufacturing hardware delivery for the ICC (Intermediate Compressor Case) and IPT (Intermediate Pressure Turbine) will continue. This will support subsequent engine builds of the programme. Assessments of the engine build process of the IPT module will be documented.
- WP7 – Lightweight and efficient Jet-fuel reciprocating engine: WP7 has completed all technical activities during 2019 and has reported conclusions and achievements during 2020. There are no activities planned during 2022;
- WP8 – Reliable and more efficient operation of small turbine engines: The activity will focus on the aircraft simulation model for the power plant, according to the concept design finalisation of 2021;
- WP9 – ECO Design: In 2022 WP9 will continue to contribute to the assessment of the impact of a range of selected technologies (i.e. additive manufacturing, re-use and recycling of CFRP and advanced engine manufacturing processes). This will allow data on Life Cycle Inventories to be provided, to perform impact analysis according to eco-design standards and Eco-Design TA contribution.

Major milestones planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
ENG 2 - Ultra High Propulsive Efficiency (UHPE) demonstrator for SMR	Ground Test Demonstrator (GTD) architecture review meeting
ENG 3 - Business aviation / short range Regional TP Demonstrator	Delivery of inputs to SAT for environmental impact evaluation
ENG 4 - Adv. Geared Engine configuration	Engine demonstrator test completion
ENG 5 - VHBR – Middle of Market Technology	Bearing chamber experiments review
ENG 6 - VHBR – Large Turbofan Demonstrator	First test campaign of UltraFan demonstrator
ENG 8 - Reliable and More Efficient Operation of Small Turbine Engines	Delivery of aircraft simulation model for power-plant assessment
ENG 2 - Ultra High Propulsive Efficiency (UHPE) Demonstrator for SMR	Ground Test Demonstrator (GTD) architecture review meeting

Major deliverables planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
ENG 2 - Ultra High Propulsive Efficiency (UHPE) demonstrator for SMR	Engine demonstrator design report
ENG 3 - Business aviation / short range Regional TP Demonstrator	Final report
ENG 4 - Adv. Geared Engine technologies	Engine demonstrator test report
ENG 5 - VHBR – Middle of Market Technology	Bearing chamber oil shedding report
ENG 6 - VHBR – Large Turbofan Demonstrator	ICC#2 Test Readiness Report
ENG 8 - Reliable and more efficient operation of small turbine engines	Exploitation plan of technologies developed in Maestro

3. Description of main activities for the year 2023

- WP2 – Ultra High Propulsive Efficiency (UHPE) Demonstrator for Short / Medium Range aircraft (Safran Aircraft Engines): WP2 will start manufacturing and delivering parts for the Engine Ground Test Demonstrator. In parallel, WP2 will work on the test schedule definition, instrumentation and tooling needed to build the test vehicle. The objective will be to assemble the engine demonstrator and launch the test campaign.
- WP3 – Business Aviation / Short Range Regional TP Demonstrator: Project completed.
- WP 4 – Advanced Geared Engine Configuration (compression/expansion system): Key objective is the testing of the 2-Spool-Compressor Rig and the validation of results.
- WP5 – VHBR – Middle of Market Technology (Enabler): The key rig and engine modelling systems developed for the IP Turbine, bearing chamber and HP turbine will conclude and key validation reports on the capability will be completed supporting system and sub-system technology validation and readiness.
- WP6 – VHBR – Large Turbofan Demonstrator: Component manufacturing supporting the engine development programme will continue. The UltraFan engine demonstration programme will also conduct key functional and performance testing of the new engine architecture. Key elements of engine test data will be collected and analysed, including acoustic analysis of the intake. Linked aircraft and flight test readiness activities will be conducted in parallel in the LPA IADP.
- WP7 – Lightweight and efficient Jet-fuel reciprocating engine: WP7 may address any final requests and deliver inputs for finalising the ENG ITD and the Clean Sky 2 programme.
- WP8 - Reliable and more efficient operation of small turbine engines: Work package completed in 2022.
- WP9 – ECO Design: In 2023 WP9 will complete the activity by providing the remaining data for the Life Cycle Inventory and Eco Statements.

Major milestones planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
ENG 2 - Ultra High Propulsive Efficiency (UHPE) demonstrator for SMR	Engine Ground Test Demonstrator (GTD) Design Review
ENG 4 - Adv. Geared Engine technologies	2-Spool Compressor Rig test completion
WP5	HPT rig test run completed
WP6	Acoustic testing completed

Major deliverables planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
ENG 2 - Ultra High Propulsive Efficiency (UHPE) demonstrator for SMR	Engine Ground Demonstrator assembly report
ENG 4 - Adv. Geared Engine technologies	2-Spool Compressor Rig test report
ENG 5 - VHBR – Middle of Market Technology	Final report on HPT rig testing
ENG 6 - VHBR – Large Turbofan Demonstrator	Acoustic test support and analysis

ITD Systems

1. Multi-annual overview and strategic planning

Systems play a central role in aircraft operation, flight optimisation, and air transport safety at different levels as they enable optimised trajectories, new aircraft configurations and improved performance-weight-ratios. The 2022-2023 period will see completion of all remaining topics. Systems ITD's scope includes virtually all of the major aircraft systems, ranging from cockpit and avionics to landing gears. It also includes environmental control systems, wing ice protection and electrical power generation, distribution and conversion. Furthermore, flight control systems and actuation are addressed for small, regional and large aircraft alike. A joint focus of all activities is set on the increasing electrification of systems to enable future more-electric or full-electric aircraft. Additional work is being done to create environmentally friendly technologies, in particular in the area of materials and processes. Many CfP Partners are integrated into the ITD and support the activities. A very relevant number of Core Partners joined the Systems ITD addressing even more technologies – such as, for example, an aircraft systems simulation framework, power electronics, electrical brakes and cockpit solutions specifically for small air transportation. The majority of the planned technology developments will be extensively ground or flight tested in order to reach a high level of technology readiness.

2. Description of main activities for the year 2022

WP1 Extended Cockpit:

- In the field of communications, the objective is an end-to-end demonstration in 2022 of integrated modular communications at TRL5 on representative avionics trial hardware. Related technologies will progress and research on low-profile/drag electronically steerable antennas for in-flight connectivity will be completed;
- Research activities on disruptive flight management solutions will end;
- New efficient production methods for 94 GHz (W-band) waveguide antennas for enhanced vision and awareness will be finalised.

WP2 Cabin & Cargo Systems:

- The objective is to provide the final demonstration at TRL5 of the Integrated Cabin Demonstrator in 2022 as well as the Water & Waste System Demonstrator. The standardisation-related activity in the frame of equipment and systems demonstrator for Cabin & Cargo applications will be another focal point;
- The cabin enabling technologies will be finalised, including separate tests for the connected seat and Internet of Things data management, connected trolley and galley as well as power management;
- The integrated setup of the Cabin Demonstrator will have demonstration sessions of use-cases. Gate reviews for the system TRL5 assessment will follow;
- For the Cargo Demonstrator, the operational Water and Waste System reusing grey water will reach TRL5 and the demonstrations will be carried out and completed;
- The Halon-free Fire Suppression System project was concluded in 2021 at TRL4.

WP3 Innovative Electrical Wing:

- Activities aimed towards large aircraft applications will continue for the Smart Integrated Wing Demonstrator. The definition and completion of testing to collect data for TRL 5 assessment will be finalised;
- Continued support for the Regional IADP flight control through the Innovative Electrical Wing demonstrator. Delivery and maturation of actuation components onto ground test rigs will be performed;
- Completion of hardware for smart active inceptors and preparation for demonstration.

WP4 Landing Gear System:

- Bleeding solution and low-cost pump activities for electro-hydraulic actuators will continue. TRL5 for both a motor sleeve brick, as well as a new wheel that will shorten turn-around-times, will be achieved. In addition, an optimisation loop for new rims will be performed while the final prototype of a new tyre will be produced and tested in order to further increase maturity;
- Work on bricks for optimised main landing gears (MLG) will continue. Final demonstration at TRL5 of the new brake monitoring system will take place. Carbon fibre reinforced plastics (CFRP) MLG structure test articles will be finalised, tested and the project will be completed;
- D5 Green Autonomous Taxing System activities were completed in 2021;
- Electro-hydraulic nose landing gear steering function will be completed.

WP5 Electrical Chain:

- Activities will continue to support the innovative power network demonstrator for large aircraft based on the three pillars: High-Voltage Direct-Current (HVDC) technology maturation; hybridisation/parallel source operation; and disruptive distribution activities;
- Technologies for a disconnection system for the rotating starter-generator will be validated through a test campaign and potential improvements will be implemented. The Generation System, including the digital generator control unit, will contribute to testing. The paralleling of HVDC Generation for Large Aircraft will be studied;
- For the Power Electronic Module (PEM), a VAC filter will be addressed in order to comply with standards. The active rectifier function of the PEM will be improved. The automatic switching function of DC-DC conversion with new middle-point will be tested with regards to eECS. Energy storage will be finalised with the laboratory demonstration test campaign of the battery system;
- The technological maturity of different bricks of innovative electrical harnesses will continue to reach TRL 4 validation.

WP6 Major Loads:

- The focus of activities for the Adaptive Environmental Control System (aECS) is the final testing of advanced components and the completion of advanced system simulations;
- Electrical ECS equipment and system performance tests (including virtual testing and virtual aircraft integration) will be performed to verify the system up to TRL5. The vapor cycle system equipment will reach TRL6 maturity;
- Concerning the electrical hybrid ECS for regional aircrafts, the volumetric compressor will be tested during performance and endurance tests in order to complete TRL4;
- The Electric Wing Ice Protection System test campaign will prepare for a full-scale system performance demonstration. In the framework of the Primary Flight Ice Detection System (PFIDS), both embedded functions will be developed towards TRL5 in order to prepare the flight tests.
- Comprehensive demonstration on the electrical bench will be prepared by integrating further equipment coming from the partners and CfPs. Test activities will focus on hybridisation tests, composed of an HVDC generator and a controllable HVDC battery.

WP7 Small Air Transport Activities:
The following main activities are foreseen to reach TRL5 to support further demonstration in SAT:

- Fly-by-wire rig extension to full capability integrating bus functionality to complete the single axis tests. Integration will start in the demonstrator's second and third axis (elevator and aileron) to support the second phase test campaign in 2023;
- Extend lab test campaign for electrical LV/HV power generation and distribution system;
- Low power de-icing system wind tunnel test results analysis;
- The Electrical Landing Gear Demonstrator will complete its CDR, finalise manufacturing and demonstrator assembly will start to prepare for the test campaign in 2023;
- Demonstration of new SAT seats will be completed;
- Work on Affordable Avionics for SAT will complete several technology bricks and demonstrate them during a second phase of flight testing.

WP 100.1 Power Electronics and Electrical Drives:

- The integration and demonstration of motors and drives into the integrated test rig will be completed. Validation of rig manufacturability and operations via integration of partner projects;
- This involves the experimental validation of reliability models and lifetime consumption prediction of electrical architecture components, which will result in accurate tools able to deliver robust information for the design of such components. The printed circuit board cooling topic is expected to reach completion in early 2022, and will then contribute to the rig, which is due at the end of 2022;
- The characterisation of degradation and the modelling physics of failure for wide band gap devices shall be delivered.

WP 100.2 Product Life Cycle Optimisation: ECO Design: In 2022, research activities will continue on green surface treatments and coatings (especially the testing of ice-phobic materials and research on cobalt free sealing materials), light alloys with improved properties and high T° electro-technology materials (testing of high temperature coils). Data will be collected in view of LCI report production and delivered to the Eco Design Transversal Activity.

WP 100.3 Model Tools and Simulation: Final demonstration of the MISSION framework.

Major milestones planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
D2- Equipment and systems for Cabin & Cargo applications	Cabin & Cargo System demonstration at TRL5
D3 - Smart Integrated Wing	Demonstrator TRL5 Review
D5 - Landing Gear System Technologies	Short turn-around-time TRL5 review
T3 - Digital Development Framework	Final demonstration of MISSION toolchain completed
D10 - Innovative Power Network Demonstrator for Large Aircraft	Demonstrator integration review
D11- Next Generation Electric Environmental Control System (EECS) Demonstrator for Large A/C	System TRL5 review
D14- Electric Wing Ice Protection System (EWIPS)	Full scale EWIPS system ready for ice wind tunnel (IWT) demonstration
D15- Primary In-Flight Ice Detection System	Ice wind tunnel tests and review for super cooled large droplets conditions discriminator function
D16- Thermal Management Demonstration	Intermediate review of integrated air systems model
D18- Fly-by-Wire Demonstrator	Integration to start in the demonstrator second and third axis (Elevator and Aileron) to prepare the second phase test campaign in 2023.
D19- Electric Power Generation and Distribution System (EPGDS) Demonstrator	Lab test completed
D20- Low-Power De-Ice	Wind tunnel test completed
D21- More Electric Aircraft Landing Gear	Demonstrator assembly start
D23- Affordable Future Avionic Solution for SAT	Technology readiness for flight testing in SAT

Major deliverables planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
D2- Equipment and Systems for Cabin & Cargo Applications	Cabin demonstrator & Water & Waste System demonstrator Report
D3- Smart Integrated Wing	Demonstrator final report
D4- Innovative Electrical Wing Demonstrator	Demonstration final report
D5- Landing Gear Brake Monitoring	TRL5 review report
D6- Electrical Nose Landing Gear System	Demonstration final report
D12- Hybrid ECS for regional A/C	TRL4 report
D13- Next Generation Cooling Systems Demonstrators	Centrifugal compressor TRL6 report
D15- Primary In-Flight Ice Detection System	TRL5 review report
D10 - Innovative Power Network Demonstrator for Large Aircraft	Hybridisation of HVDC sources test report
D16- Thermal Management Demonstration	Overall integrated air systems model acceptance report
D18- Fly-by-Wire Demonstrator	Final demonstration TSS
D19- Electric Power Generation and Distribution System (EPGDS)	Low/high voltage final test report
D20- Low Power Hybrid De-Icing System	Final report

3. Description of main activities for the year 2023

- WP1 Extended Cockpit: The integrated modular communications demonstrator will achieve TRL5 with an end-to-end demonstration on representative avionics trial hardware.
- WP2 Cabin & Cargo Systems: Demonstrator completed in 2022.
- WP3 Innovative Electrical Wing: Demonstration completed in 2022.
- WP4 Landing Gear System: Fast bleeding solution, low-cost pump and motor sleeves. TRL6 will be achieved.
- WP5 Electrical Chain:
  - 2023 will be mainly focused on the finalisation of the CfPs and the follow up, support and analysis of the innovative power network demonstrator for large aircraft test campaign;
  - Finalisation of the technological maturity of different bricks of innovative electrical harnesses with TRL 5 validation will be the main milestone.
- WP6 Major Loads:
  - The final demonstration of the Adaptive Environmental Control System will be completed to reach TRL5. Electric Environmental Control System (eECS) testing and modelling activities will be finalised to validate the system up to TRL6. The associated CfPs will be finished. The virtual demonstration of the eECS into the aircraft will be finalised in order to reach TRL5;
  - The results of the Electric Wing Ice Protection System (EWIPS) de-icing campaign will be analysed after testing the full-scale system in the Ice Wind Tunnel. TRL5 will be assessed with an airframer and partners;
  - In the frame of primary-flight-ice-detection systems (PFIDS), both functions, ice crystals detection (IX) and ice accretion rate (IAR), will be finalised towards an objective of TR6 and verified with flight tests on large aircraft (PFIDS) and on rotorcraft (PFIDS RT);
  - The Airframer laboratory team will finalise the integration of equipment coming from partners and CfPs and perform the D10 electrical test bench test campaign.
- WP7 Small Air Transport Activities:
  - The main activities to be closed during 2023 are:
  - Fly-by-wire rig test completion.
  - Electrical Landing Gear Demonstrator test campaign execution.
  - Work on Affordable Avionics for SAT will be completed and closed through final phase of flight testing.
- WP 100.1 Power Electronics and Electrical Drives: Completion of activities about power electronics. Final reporting activities.
- WP 100.2 Product Life Cycle Optimisation: ECO Design: Finalisation of CfP projects including gathering of LCI (Life-Cycle Inventory) data. Collaboration with transversal activity of ECO Design to finalise LCI reporting activity.
- WP 100.3 Model Tools and Simulation: Activity completed. Final reporting activities.

Major milestones planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
D5- System Bricks for Main Landing Gear	Bleeding solution and low cost pump TRL6
D15- Primary In-Flight Ice Detection System	Flight tests and TRL6 review for PFIDS (RT) with IAR and IX functions
D10- Innovative Power Network Demonstrator for Large Aircraft	D10 demonstrator test campaign closure

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
D16- Thermal Management Demonstration	System integration TRL5 review
D16- Adaptive Environmental Control System	Final demonstration at TRL5
T2- ECO Design	LCA activity completed for eECS Flagship Demonstrator
D25- Integrated Modular Communications	End-to-end demonstration of integrated modular communications at TRL5 on representative avionics trial hardware

Major deliverables planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
D9- Innovative Electrical Distribution Systems	Final report
D10- Innovative Power Network Demonstrator for Large Aircraft	D10 demonstrator test report
D11- Next Generation Electric Environmental Control System Demonstrator for Large A/C – WP6	eECS TRL6 report
D14- Electric Wing Ice Protection System (EWIPS)	Architecture TRL5 report
D15- Primary In-Flight Ice Detection System	TRL4 review minutes for App O conditions (SLD) discriminator function
T2- Eco Design	LCA report for eECS Flagship Demonstrator
D21- MEA Landing Gear	MEA Landing Gear final test report

Small Air Transport Transverse Activity

1. Multi-annual overview and strategic planning

Small Air Transport Transverse Activity (SAT TA) plays a central role in representing the research and development (R&D) interests of European manufacturers of small aircraft used for passenger (up to 19 passengers) and cargo transport, belonging to EASA's CS-23 (European Aviation Safety Agency Certification Specifications 23) regulatory base. The key areas, identified at the start of the programme, are:

- multimodality and passenger choice;
- safer and more efficient small aircraft operations;
- lower environmental impact (noise, fuel, energy, pollution);
- revitalisation of the European small aircraft industry.

Starting with the results coming from the different technologies implemented in the different CS2 transversal ITDs (Integrated Technology Demonstrators), integration studies will be performed to deliver the green 19-seat aircraft. In particular, two different green aircraft will be designed.

- One will be available for market entry in 2025. This aircraft will use the technologies developed in several Clean Sky 2 ITDs feeding SAT, matured up to TRL5/6 (Technology Readiness Level).
- One will be available for market entry in 2032. This aircraft will use technologies that will be addressed in the future Clean Aviation Partnership, such as hybrid propulsion, E-STOL (Hybrid-Electric Short Take-Off and Landing) capability etc. This platform is an alternative to the previous one, requiring additional research effort to be carried out in the next EU Framework Programme for Research and Innovation (Horizon Europe),

in order to launch an aircraft as green as possible and with low direct operating costs (DOC) to intercept market demand by using less expensive and greener energy sources.

Hereafter an overview of the technologies that will be integrated into the 2025 green aircraft, according to the incoming information from ITDs:

- new generation turboprop engine with reduced fuel consumption, emissions, noise and maintenance costs for 19-seat aircraft;
- more electric digital systems including:
  - affordable fly-by-wire architecture for small aircraft (CS23 certification rules);
  - more electric systems replacing pneumatic and hydraulic aircraft systems (hybrid de-icing system, landing gear and brakes, high voltage Electrical Power Generation and Distribution System (EPGDS));
  - advanced avionics for small aircraft, to reduce pilot workload, paving single pilot operations for 19 seats.
- affordable airframe structures including:
  - low-cost composite wing box and nacelle using OoA (Out of Autoclave) technology, LRI (Liquid Resin Infusion) and automated deposition process;
  - affordable small aircraft manufacturing of metallic fuselage by means of FSW (Friction Stir Welding) and LMD (Laser Metal Deposition).
- advanced cabin comfort with new materials and more comfortable seats.

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

- work on specific topics and technologies to design and develop individual items, equipment and systems and demonstrate them in local test benches and integrated demonstrators (up to TRL5);
- customisation, integration and maturation of these individual systems and equipment in SAT, which will enable fully integrated demonstrations and the assessment of benefits in representative conditions;
- definition of transverse actions to mature processes and technologies with potential impact either during development or during operational use;
- conceptual studies concerning technologies to be integrated in the 2032 green aircraft.

2. Description of main activities for 2022

The main activities for 2022 divided into work packages (WP) are:

- WP1 Management: This WP will be active along the whole programme run, including overall monitoring of the ITDs' progress, with the main objective to ensure the completion of the research and the validation tasks, respecting deadlines and assigned budget. In addition, WP1 focuses on effective strategies to disseminate, communicate, and exploit project achievements.
- WP2 Aircraft Configuration: In this WP, the Green 19-seats Commuter EIS2025 aircraft simulation model will be provided to the Technology Evaluator (TE) in Q2 2022. In parallel, conceptual studies for the E-STOL Green 19-seats Commuter aircraft configuration EIS2032 (Entry Into Service 2032) will be finalised, considering the introduction of both the hybrid propulsion system and the innovative lift system and the outcomes from thematic calls. The aircraft simulation model of the E-STOL concept will be delivered to TE in Q2 2022, too.
- WP3 Advanced Integration of Airframe, Engine and Systems technologies in small aircraft: This WP aims to develop integration studies of the airframe, engine and system technologies developed in the Airframe, Systems and Engine ITDs, with the main goal being the assembly

and testing of selected demonstrators. In 2022, the CDRs (Critical Design Reviews) of both SAT D1 "A/c Level 0 Iron Bird Demo" and SAT D2 "SHM Demo" will be accomplished, and the ground test campaign of SAT D2 will start. In parallel, the flight test campaign of SAT D3 "Safe and Comfortable Cabin Demo" will be concluded.

Major milestones planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
Green 19-seater EIS2025/E-STOL EIS 2032	Aircraft simulation models sent to TE [Ref. WP2 / M1 - Type: Simulation Model – Due: 30/06/2022]
SAT D1	SAT D1 CDR accomplished. [Ref. WP3 / M2 - Type: Review meeting – Due: 30/11/2022]
SAT D2	SAT D2 CDR accomplished. [Ref. WP3 / M3 - Type: Review meeting – Due: 28/02/2022]
SAT D2	SAT D2 Start of ground test campaign. [Ref. WP3 / M4 - Type: Test campaign – Due: 31/12/2022]
SAT D3	Final flight test campaign start. [Ref. WP3 / M5 - Type: Flight test – Due: 31/08/2022]

Major deliverables planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
Green 19-seater EIS2025/E-STOL EIS2032	2022 Mission Level Assessment for 19 Seats A/C. [Ref. WP2 / D1 - Type: Simulation Model Report – Due: 30/06/2022]
SAT D1	SAT D1 CDR – Minutes of the Meeting [Ref. WP3 / D2 - Type: Report – Due: 30/11/2022]
SAT D2	SAT D2 CDR – Minutes of the Meeting [Ref. WP3 / D3 - Type: Report – Due: 28/02/2022]
SAT D2	SAT D2 Test set-up specification. [Ref. WP3 / D4 - Type: Report – Due: 31/05/2022]
SAT D3	Final flight test campaign specification. [Ref. WP3 / D5 - Type: Flight test – Due: 31/08/2022]

3. Description of main activities for the year 2023

The main activities for 2023 are divided per WP and are as follows:

- WP1 Management: This WP will be active along the whole programme run, including overall monitoring of ITDs' progress, with the main objective of ensuring the completion of the research and validation tasks, respecting deadlines and assigned budget.
  Results from the dissemination and communication strategies as planned in 2022 will be assessed and updated (if necessary) in order to maximise the project's impact.
- WP2 Aircraft Configuration: In this WP, continuous support for TE activities will be granted towards final report delivery, supporting the activities related to the call launched by TE "ATS Level SAT 2035/50 forecast".
- WP3 Advanced Integration of Airframe, Engine and Systems technologies in small aircraft: In 2023, the ground test campaign of both SAT D1 and D2 will be concluded, while the post-processing of SAT D3 will be finalised to assess overall benefits on small aircraft of passenger cabin, structure and avionic technologies.

Major Milestones planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
SAT D1, SAT D2, SAT D3	Final Review Meeting – Project has been positively completed. [Ref. WP1 / M6 - Type: Review Meeting – Due: 30/11/2023]
SAT D1	SAT D1 Start of ground test campaign. [Ref. WP3 / M7 - Type: Test campaign – Due: 30/06/2023]
SAT D1	SAT D1 Ground test campaign closure. [Ref. WP3 / M8 - Type: Test campaign – Due: 30/11/2023]
SAT D2	SAT D2 Ground test campaign closure. [Ref. WP3 / M9 - Type: Test campaign – Due: 30/09/2023]
SAT D3	SAT D3 Flight test campaign closure. [Ref. WP3 / M10 - Type: Test campaign – Due: 30/06/2023]

Major Deliverables planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
SAT D1, SAT D2, SAT D3	Dissemination, Communication and Exploitation Final Report. [Ref. WP1 / D5 - Type: Report – Due: 31/12/2023]
SAT D1	SAT D1 Test requirements specification and test plan. [Ref. WP3 / D6 - Type: Report – Due: 30/06/2023]
SAT D1	SAT D1 Ground test report. [Ref. WP3 / D7 - Type: Report – Due: 31/12/2023]
SAT D2	SAT D2 Ground test report. [Ref. WP3 / D8 - Type: Report – Due: 31/10/2023]
SAT D3	SAT D3 Final report on flight test campaign. [Ref. WP3 / D9 - Type: Report – Due: 31/07/2023]

Eco Design Transverse Activity

1. Multi-annual overview and strategic planning

The Eco Design (ECO) is a Transversal Activity (TA) in the frame of the Clean Sky 2 programme. It focuses on the environmental analysis across the different life cycle phases. The Eco Design Transversal Activity will provide an advanced global Clean Sky Eco Statement layout with the global indicators summary exposition (ground pollution potential, re-use & recycling quota and socio-economic statement) incorporated for a 2010-2020 core environmental improvement reference.

Various Flagship Demonstrators have been selected across all IADPs/ITDs to ensure a proper base of coverage for the Eco Design analysis from technology to demonstrator level.

The main means of Eco Design from a bottom-up point of view are the Materials, Processes and Resources (MPR), guided by reference life cycle inventory analysis, incorporating internationally accepted ISO LCA standards, independent peer reviewed methods and also meaningful extensions for aviation integrated research & development and integration, green business development originally inspired by the EU Integrated Product Policy Innovation, and the responsibility of Life Cycle Thinking in design practice.

The Eco Hybrid Platform virtual demonstrator offers an integrated visualisation of "ecolonomic" improvements of aircraft products and production. This allows the representation of all Eco-Design activities in CS2 and a single point of access to the Eco-Design toolbox for Eco-Statements.
Dissemination of Eco-Design results represents crucial support to the European aircraft industry and is implemented accordingly.

2. Description of main activities for 2022

In 2022, the focus was on the integration of at least 80-90% of the Life Cycle Inventories for all selected Flagship Demonstrators to allow a substantial Eco Design Analysis and the LCA/ES Report deliverables on the base of a fully eligible population, with best practice technology briefs, LCI reference flow charts. From the population, the best athlete modules belonging to the FSDs will be down-selected and delivered to 24 modules to showcase FSD. They will also be transferred to exploitable ISO-category declarations supported by LCA, showing environmental improvement potential (ISO process reviewed, level III declarations ISO 14025 abridged from the FSD Masterplan Demonstration Portfolio). The First LCA and Clean Technology Foresight Bulletins will be issued in 2022 (public) following up ES population maturity and technical highlights, support to visualisation and CS2 communication.
The GPP-Indicators will be finally exploited via white paper (norm format) as solicited to major OEM/ EASA/IATA/EEA new subchapters.
The Eco Hybrid Platform database with tool functionality will be employed for user elaboration and expert maturation.
The Eco Design Symposia / Workshop stream will be continued parallel to the major annual reviews. The cooperation level for dissemination and communication will be extended. This includes conference sessions dedicated to academic interest and industrial needs as done with EASN, contributions to special EU Green Deal scope events, as well as advocacy of successful green manufacturing purposes at various aviation and core CS events.
Apart from singular peer reviewed publications, the ECO TA has a need to produce up to 3 journal publications summarising the achievements of all the FSDs and technologies evaluated with Eco-Statements over 2022-2023.

Major milestones planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
eco-design TA	Workshop for selecting the GPP indicators most relevant for aviation through an agreement with SPDs
ecoDESIGN TA	Major European conference on aircraft recycling
ecoDESIGN TA	ecoDESIGN Symposium
ecoDESIGN TA	Workshop on additive manufacturing
ecoDESIGN TA	Workshop on hazard and regulated substances
ecoDESIGN TA	40% relative environmental commendation improvement (initial first turn)
ecoDESIGN TA	Eco Hybrid Platform User Integration Workshop
ecoDESIGN TA	Exploitation of the GPP-Indicators as a white paper (norm format) as solicited to major OEM/ EASA/ IATA/ EAA new subchapters

Major deliverables planned for 2022:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
ecoDESIGN TA	Q2 LCA/Eco Statement Report 2022
ecoDESIGN TA	Q4 LCA/Eco Statement Report 2022
ecoDESIGN TA	Socio-Economic Derivative
ecoDESIGN TA	LCA & Clean Technology Foresight Bulletins (public)

3. Description of main activities for the year 2022

In 2023, the focus will be on the integration of late deliveries from the Life Cycle Inventories from Flagship Demonstrators to complete the Eco Design Analysis for the global population. LCA/ES Report deliverables will be issued globally. The public LCA and Clean Technology Foresight Bulletins will continue to be issued. A Reference Framework Handbook on the Design for Environment 2020+ will be issued at the end of 2023 referring to the core development phase 2010-2020 for Clean Sky to access the CS Eco Design logic and documentation and to enable answers to query regimes such as under chap. 4.5, ISO14044 as stakeholder back-up to the public final GA reports (2024) expected. The Global KPI as a grand final result will be provided in early 2024 covering a Re-use and Recycling Quota (RRQ), a Ground Pollution Potential Improvement (GPP-Improvement) and the Socio-economic Derivative and advanced global TA Eco-Statement. The Eco Design Symposia / Workshop stream will be continued parallel to the major annual reviews. The accomplishments of PhD students and other further education pursuits within the CS2 consortia and as demonstrated through outreach efforts must be covered by a digest of 100 selected publications attributed to Eco Design. Special achievements will be recognised and will receive awards. Other details will be contained in the multi-annul Grant Agreement. CO_2 productivity equivalent to TE will be provided on a process building on the initial Clean Sky 1 process basis.

Major milestones planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones
ecoDESIGN TA	Workshop on hazard and regulated substances
ecoDESIGN TA	ecoDESIGN Symposium
ecoDESIGN TA	40% relative environmental commendation improvement (second turn, based on late LCI)
ecoDESIGN TA	Workshop on Additive Manufacturing
ecoDESIGN TA	Major journal publications

Major deliverables planned for 2023:

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables
ecoDESIGN TA	Q2 LCA/Eco Statement Report 2023
ecoDESIGN TA	Q4 LCA/Eco Statement Report 2023
ecoDESIGN TA	LCA & Clean Technology Foresight Bulletins (public)
ecoDESIGN TA	Reference Framework Handbook; orientation for final reporting
ecoDESIGN TA	Aviation Eco Statement Document on the base of three Global KPI (deliverable, 2024): RRQ, GPP- improvement, Socio-economic Derivative and advanced global TA Eco Statement
ecoDESIGN TA	Eco Hybrid Platform (Database with tool functionality)
ecoDESIGN TA	CO_2 productivity equivalent to TE

Technology Evaluator

1. Multi-annual overview and strategic planning

A Technology and Impact Evaluation infrastructure is and remains an essential element within the Clean Sky JTI. Cross-positioned within the Clean Sky 2 programme, the Technology Evaluator (TE) is a dedicated evaluation platform. It has the key role of assessing the environmental impact of the technologies developed in Clean Sky 2 and their level of success towards the defined environmental (Noise, CO_2, NOx) benefits and targets, where

appropriate covering also societal impacts like e.g. mobility. The Technology Evaluator consists of three major tasks:

- monitoring of Clean Sky 2 achievements vs. defined environmental and societal objectives;
- evaluation at mission level by integrating (when appropriate) selected ITD outputs into concept aircraft and TE concept aircraft;
- impact assessments at airport and air transport system level using IADPs and TEs concept aircraft / rotorcraft.

For the 2022 to 2023 period the main activity will be to prepare and perform the 2nd complete TE assessment.

2. Description of main activities for the year 2022

The main activity will be to prepare the 2nd TE assessment. This will consist of:

- collection of mission level outputs for emissions and noise for Short Medium Range, Long Range, Regional, Small Air Transport, Business Jet Aircraft and Fast Rotorcraft;
- modelling of TE concept aircraft (Long range ++ and "People Mover");
- airport level assessment for 6 representative airports for noise and emissions outputs;
- air transport system fleet forecast and scenarios with Covid-19 update up to the year 2050;
- involvement in socio-economic impact of air transport CfT project;
- Fast Rotorcraft heliport assessments with respect to noise, emissions and mobility.

Major milestones planned for 2022:

2nd Global TE Assessment	Major Milestones
Mid 2022	Reception of all SPD models and TE concept models for the preparation of the second assessment

Major deliverables planned for 2022:

2nd Global TE Assessment	Major Deliverables
End 2022	Progress report preparation 2nd TE assessment

3. Description of main activities for the year 2022

The main activity will be to complete the 2nd TE assessment. This will consist of:

- finalised mission level outputs for emissions and noise for short / medium range, long range, regional, small air transport, business jet aircraft, fast rotorcraft and TE concept aircraft;
- airport level assessment for noise and emissions outputs in a more aggregated approach for about 50 European airports;
- air transport system level impact emissions assessment of Clean Sky 2 technologies through realistic insertion of concept aircraft into the future fleet;
- Connectivity analysis for specific sub-scenarios;
- Fast rotorcraft fleet assessments with respect to noise, emissions and mobility.

Major milestones planned for 2023:

2nd Global TE Assessment	Major Milestones
End of 2023	all inputs ready for finalisation of 2nd TE assessment report

Major deliverables planned for 2023:

2nd Global TE Assessment	Major Deliverables
End 2023	1st draft 2nd TE assessment report

4. Description of main activities for 2024

- Finalisation of integration of Mission Level, Airport Level and ATS Level assessment results into the 2nd TE Assessment report, including also all TE CfP and CfT project results.
- Preparation for dissemination

Major milestones planned for 2024:

2nd Global TE Assessment	Major Milestones
Mid 2024	2nd TE assessment report ready

Major deliverables planned for 2024:

2nd Global TE Assessment	Major Deliverables
Mid 2024	2nd TE assessment report

2.4.6 Cooperation, synergies and cross-cutting themes and activities

The SBA aims to facilitate the creation of collaboration and synergies between European partnerships, thereby making full use of their interconnections at the organisational level. In this context, Joint Undertakings are called to seek opportunities between Joint Undertakings and other European partnerships and identify the areas in which complementary or joint activities would address the challenges more effectively and efficiently, avoiding overlaps, aligning timing of their activities and ensuring access to results, including by dedicating, where appropriate, a part of the Joint Undertaking's budget to joint calls.

In addition, this Regulation aims to achieve a more effective use of institutionalised European partnerships, in particular by focusing on clear objectives, outcomes and impact that can be achieved, and by ensuring a clear contribution to the related Union policy priorities and policies. To this end, the Regulation facilitates the close collaboration and synergies with other relevant initiatives at national and regional level, as a key to achieving greater scientific, socio-economic and environmental impact and ensuring uptake of results. In this framework, the Clean Aviation Joint Undertaking (CAJU) should benefit from exploiting synergies with other national and European related programmes, in particular with those supporting the deployment and uptake of innovative solutions, training, education and regional development, such as Cohesion Policy Funds, or the national Recovery and Resilience Plans.

For the years 2022-23, the JU is prioritising the development of synergies with the Clean Hydrogen JU and the co-programmed partnership on Batteries (BATT4EU), to ensure that these programmes can respectively deliver hydrogen and batteries technologies meeting the requirements of the targeted hybrid-electric Regional and ultra-efficient Short Medium Range aircraft demonstrators. The CAJU is also going to explore the potential development of synergies with other EU partnerships, in particular Made in Europe, SESAR3 JU, and Key Digital Technologies JU.

In addition, the CAJU is going to establish a networking event between European aeronautical states and regions with the Joint Undertaking, in order to develop further the synergies between the Clean Aviation programme and other related national and regional initiatives. It will invite all interested national and regional authorities, who want to invest in the aviation sector and share the objectives and vision of the Clean Aviation and the European Green Deal (EGD) goals, to express their intention to engage in the programme, through a suitable Memorandum of Cooperation-based approach.
The CAJU will also seek close cooperation with the Coordination and Support Action (CSA) launched under Horizon Europe (WP 2023-2024, Cluster 5, Destination 5), which will support the European Commission in establishing aviation research synergies between the framework programme, the Alliance for Zero Emission Aviation (AZEA) and national/regional R&I aviation programmes.

These activities will increase Clean Aviation Joint Undertaking's impact at national and regional level and contribute to the target for a climate-neutral aviation by 2050.

2.5 Support to Operations

2.5.1 Communication, dissemination and exploitation

2.5.1.1 Communication and events

Key advocacy and communication activities will include increasing the visibility and reputation of the new European Programme for Clean Aviation by communicating on progress so far, including early achievements and successes, in order to attract new members. A strong focus will be put on promoting Clean Aviation calls at the European and national level. We will sharpen our messages to explain objectives and priorities, expand our networks and make our new brand visible, consistent and reputable, highlighting its role within the EU's policy for research and innovation and in particular ,Horizon Europe.

The Clean Aviation Joint Undertaking will rely on multipliers and ambassadors:

- Clean Aviation Joint Undertaking's members: private partners (including large companies, SMEs, research centres and universities) and public entities (European Commission);
- Local multipliers in the Member States, such as States Representative Group, reaching out to potential applicants;
- Clean Aviation project coordinators and participants, who will communicate the successes of Clean Aviation to various national and European audiences;
- The Clean Aviation Communications Network;
- Clean Aviation management and staff.

Actions

a) Attract a large variety of excellent participants across Europe to apply for calls under the Clean Aviation programme

TARGET GROUPS:	**Potential applicants**: Industrial leaders; Large, Small and Medium Enterprises; universities; research centres
MESSAGE:	Benefits of participation in Clean Aviation programme
ACTIONS:	Promotion of Calls: • Clean Aviation 'Info Days' sessions around Call launches, at national, regional and local level • Open webinars • States Representatives Members' promotion in each country • Clean Aviation management and staff participation at events Clean Aviation regular publications quarterly Skyline monthly E- News, as well as thematic publications on key priorities Clean Aviation key events: • Clean Aviation Annual Forum in Brussels in 2022 and 2023 • Participation at ILA Berlin and Farnborough Air Shows in 2022 • Participation at Paris-Le Bourget in 2023 **Clean Aviation's strong support for Members' events**: R&I Days, ICAS Congress, EASN Annual Conference, AED Days, Aerodays, etc. Digital and social media coordination aligned to joint key messages

b) Keep decision-makers aware by demonstrating progress of the Clean Aviation programme

TARGET GROUPS:	Policymakers in the areas of research, innovation, transport, and environment.
MESSAGE:	Successful launch of technical projects, eventually leading to Demonstrators, with Europe-wide participation.
ACTIONS:	• High-level meetings with national and European policymakers • Outreach events at the European Parliament/European Commission, alone or together with the other European Partnerships • Targeted meetings/invitations to Demonstrator-related events to representatives of the European Commission, the European Parliament, EU Permanent Representations.

c) Maximise efficiency and effectiveness of Clean Aviation Joint Undertaking communications efforts

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

d) Internal enabler: Support technology coordinators and CAJU project officers

TARGET GROUPS:	Clean Aviation JU technology coordinators; CAJU project officers.
	Pre- and post-project interaction with communications to optimise visibility, advocacy and influence of Clean Aviation.
ACTIONS:	Provide communications guidance and support for their contributions to the website, events, printed and digital publications, as well as press work with specialised and mainstream press. Provide trainings on how to leverage use of Social Media (LinkedIn) in order to increase reach towards CAJU stakeholders Provide trainings on speaking in public and how to use presentation tools (powerpoint).

2.5.1.2 Dissemination and exploitation

The JU will align to Horizon Europe Programme with regard to Dissemination & Exploitation of project results (D&E). Besides dissemination and exploitation activities performed by the beneficiaries of the grants, internal services of the JU will ensure continuous monitoring, to ensure that the requirements of the grant agreements in this respect are met.
For more information, see below:
https://ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/grant-management/dissemination-of-results_en.htm
https://ec.europa.eu/research/participants/docs/h2020-funding-guide/other/event210609.htm

2.5.2 Procurement and contracts

For the years 2022-2023 the CAJU will assign the necessary funds for the procurement of the required services and supplies in order to sufficiently support its administrative and operational infrastructures., The JU has efficiently simplified the procurement process by establishing multi-annual framework contracts and Service Level Agreements (SLAs) for the supply of goods and services and by joining inter-institutional tender procedures of the European Commission and other Joint Undertakings to reach optimisation of resources.

In 2022-2023 a few new calls for tenders are expected to be launched. The tenders planned to be launched are expected to support some core activities mainly in the field of communication for specific events and activities, audit and in the IT field.

A summary table is made available below listing the tenders planned for 2022-2023.

	PROCUREMENT PLANNING 2022-2023			
N.	SUBJECT	TYPE OF PROCEDURE	VALUE IN EUR	SCHEDULE (estimated launch of a new PP or signature of a SC)
Communication-related activities and events				
1	Communication services	Specific contract implementing FWC – Lot 1- Strategy, editorial, media, press and publications	Max 710 000	Throughout 2022-2023
2	Communication services	Specific contracts implementing FWC – Lot 2 - Digital communication	Max 135 000	Throughout 2022-2023
3	Communication services	Specific contracts implementing FWC – Lot 3 - Events	Max 900 000	Throughout 2022-2023
4	Communication services	Specific Contracts implementing FWC Lot 4 – Web services	Max 190 000	Throughout 2022-2023
5	Media partnerships	Low or mid-value contracts with individual suppliers	Max 100 000	Throughout 2022
6	Stands bookings for ICAS 2022 and Le Bourget 2023	Place orders with individual providers	Max 120 000	Q2/Q3 2022 and Q4 2023/Q1 2024
7	Stands booking for ILA 2024 and Farnborough 2024	Place orders with individual providers	Max 120 000	Q3-4 2023
Others				

8	Audit of the annual accounts of Clean Sky 2 Joint Undertaking for the years ended 31/12/2022 and 31/12/2023	Specific Contract under FWC with reopening of competition	Max 50 000	March 2022
9	Consultancy services in the operational support	Open Tender	Max 5 100 000	2022
		Specific contracts implementing FWC – Lot 2	Max 200 000	Throughout 2022-2023
		Specific contracts implementing FWC – Lot 3	Max 100 000	Throughout 2022-2023
10	Programme Management Tool	Specific contracts implementing FWCs	Max 1 500 000	Throughout 2022-2023
11	Legal support in litigations	Negotiated Procedure	Max 60 000	2022-2023
12	Competency / Learning and Development strategy	Negotiated Procedure	Max 70 000	2022
13	Trainings following the L&D strategy	Negotiated procedures	Max 150 000	2022 - 2023

Back-Office Arrangements				
14	Inter-institutional FWC – Managed IT Services	Open Tender	Max 5 000 000	Q2/Q3 2022
15	Inter-institutional FWC – Data protection (on-line register & legal consultancy services)	Open Tender	Under estimation	2023
16	Inter-institutional FWC – Catering Services	Negotiated Procedure/Open Tender	Under estimation	2023

2.5.3 Other support operations

2.5.3.1 IT and Logistics

The plans for ICT for the next two years are strongly influenced by four main drivers of change:

1. The "new way of working" caused by Covid-19 and its legacy;
2. The continued evolution to cloud computing;
3. The need to adapt to the new Horizon Europe programme;
4. New regulations and compliance requirements.

The legacy of Covid-19 will result in more remote working and on-line meetings, which is a sharp acceleration of a trend that already existed. ICT is a key enabler for this and changes the requirements for provision of hardware, software, services and facilities. The adaptations being planned include more upgrades to audio visual equipment for remote meetings, more software tools for remote working and big changes in the Clean Aviation JU building layout from individual offices to open-plan workspaces suitable for flexible working. When implementing the latter, it is hoped that it will be possible to consolidate the Clean Aviation JU staff onto one floor of the building as well as create a more welcoming environment for visitors which is conducive to collaboration. This will be a big project which will impact all the ICT facilities in the office (WiFi transponders, network and power cabling, workstation equipment, telephony etc.)
The continued evolution to cloud computing fits nicely together with the new way of working and was also a trend already under way. Plans include the provision of more Microsoft O365 services and also facilities such as remote desktop. The rapid scalability of cloud computing will provide more flexibility to meet new objectives and unexpected challenges.
The new Horizon Europe programme will require more integrated tools at programme management level. Circumstances may force a reduction in site visits by Clean Aviation JU staff so remote monitoring will be even more important. So too will be managing the knowledge from the first two programmes to develop into the new programme. To this end, on-line tools will be developed for programme, knowledge and relationship management.
A lot of effort will also be required for regulatory and other compliance issues. These include data protection measures, document management for control of retention periods and cybersecurity requirements (a new regulation on this is likely to come).

2.5.3.2 Data protection

In 2022-2023, the CAJU will continue to ensure compliance with the Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001 and Decision No 1247/2002/EC on Data Protection applicable to EU institutions, agencies and bodies by continuing to implement the following actions:

- ✓ Updating the Data Protection and Legal Notice, all relevant privacy statements and the data protection register to reflect the Clean Aviation partnership;
- ✓ Ensuring the legal transposition of the CS2JU rules on restrictions of data subject rights CS-GB-Written procedure 2020-02 by including it in the Omnibus decision for the CAJU GB adoption on 16 December 2021;

- ✓ Implementing the data protection aspects related to the launch and management of the calls for proposals in accordance with the rules and procedures of Horizon Europe;
- ✓ Negotiating with the EC a MoU defining the roles and responsibilities of the JU and that of the EC (Joint Controllership Arrangement) applicable to Horizon Europe. A MoU applicable to Horizon 2020 was recently finalised in 2021 and signed by all EUIs;
- ✓ Continuing to implement data protection actions present in the CS2 Work Plan, such as:

    - Implementing all data protection mitigation actions necessary to comply with the Microsoft Data Protection Impact Assessment (DPIA);
    - Adopting the Executive Director decisions on both the Data Protection Officer implementing rules, and the JU internal personal data breach rules;
    - Continuing to update internal policies and documents (e.g. contractual clauses) on the data protection aspects and continuing to use its new IT tool - developed and tailor made specifically for the JUs - for keeping records of data processing operations;
    - Cooperating with colleagues from communications, IT, HR and audit in order to regularly monitor compliance of their processing operations, while advising and training the staff, to raise awareness about the risks associated with processing personal data;
    - Following-up in EDPS and DPO network meetings on the EU legal framework for data protection and potential impact on EU Institutions/Agencies/JUs of the data protection package proposal, along with any guidelines and training provided by EDPS/DPO network;
    - Including data protection aspects in the quality manual.

2.5.3.3 Housing

The CAJU considers it important to offer to the staff a pleasant working environment adapted to the new ways of working experienced during the pandemic. In particular, the management wishes to launch a refurbishment in order to have offices suitable for new flexible work scheme, flexible space usage (quiet areas & small meeting areas & bigger meeting spaces). The idea is to encourage teamwork and social interaction. The JU works in cooperation with other Joint Undertakings to have similar working spaces, shared meeting rooms, IT facilities such as videoconference, to encourage exchange also between JUs.

2.5.4 Human Resources

2.5.4.1 HR Management

Although the workload and tasks assigned to the new Joint Undertaking are even more complex, the establishment plan as agreed with the European Commission has foreseen a cut of two SNEs position and one CA position from 2023. The creation of Back Office Arrangements (BOA) required in terms of Article 13 of the SBA, should in principle help in reducing the number of posts since some tasks could be shared with other JUs. The BOA concept has been agreed in the accounting, HR, ICT and administrative procurements domains and the implementation has started in December 2022.
In order to improve the performance of the staff and answer to the new challenges, the JU has outsourced the drafting and implementation of a learning and development strategy more adapted to the specific needs and size of the JU.

2.5.4.2 Strategy for achieving efficiency gains and synergies

The CAJU 2023 Staff Establishment Plan foresees a decrease of 6.9% of the human resources, from a total number of 44 staff members in 2021 to 41 staff members in 2023. Thus, 2023 will be characterised by a considerable reduction in human resources combined with the increased complexity of CAJU projects and the necessity to manage the large and complex legacy from Clean Sky 2 projects, which

will require the JU to pay even more attention to the efficiency and cost-effective management of its resources.

This will be achieved by: (i) reshuffling internal resources, to this end CAJU will keep holding regularly updated resources planning to fulfil upcoming needs in all business areas; (ii) strengthening the collaboration with other Joint Undertakings through arrangements and mechanisms of pooling expertise for specific time-bound tasks.

In 2023, the JUs will continue sharing the human-resource IT tools (e.g., the e-recruitment tool SYSTAL, SYSPER) and an inter JU network of confidential counsellors, this network has been reinforced in 2022 with a publication of a new call and appointment of two additional confidential counsellors.

In addition, CAJU will continue sharing information and best practices with the different JUs through meetings and working groups e.g. the Executive Directors, Heads of Administration, HR officers, IT Officers, Legal. Moreover, further synergies among JUs will also be possible in facility management as several JUs are located in the same building and share joint business continuity planning, managing office spaces and organising procurements of common infrastructure.

2.5.4.3 Staff Establishment Plan

Category and grade	Establishment plan 2022	Establishment plan 2023
AD 16		
AD 15		
AD 14	1	1
AD 13		
AD 12	2	2
AD 11	2	2
AD 10	5	5
AD 9	8	8
AD 8	4	4
AD 7	4	4
AD 6	6	6
AD 5		
Total AD	32	32
AST 8	1	1
AST 7	0	0
AST 6	2	2
AST 5	1	1
AST 4		
AST 3		
Total AST	4	4
TOTAL TA	36	36
CA FG IV	3	3
CA FG III	3	2
CA FG II		
CA FG I		

TOTAL CA	6	5
TOTAL SNEs	2	
TOTAL STAFF (TA + CA+SNEs)	44	41

The JU, with the agreement of the relevant EC services, modified the establishment plan for 2023 by removing a CA GFIII post instead of an AST post. The overall reduction of 3 FTEs is maintained. The practical reason is that a contractual agent left the organisation. This is an exceptional and temporary arrangement until an AST post becomes available that shall then be replaced with a CA FG III position.

2.6 Governance activities

The Governance of the Clean Aviation Joint Undertaking is ensured by the Governing Board. Other bodies are:

- the Executive Director;
- the Technical Committee;
- the European Clean Aviation Scientific Advisory Body;
- the States Representatives Group.

The **Governing Board** (GB) gathers the Commission's representatives [2] and those of the private members [15], with the Commission holding 50% of the voting rights. Decisions are taken by a majority of at least 75% of all votes in its ordinary meetings or by written procedure. The Governing Board has the overall responsibility for the strategic orientation and the operations and supervises the implementation of its activities. Some of the GB annual tasks include:

- assessment of applications for membership;
- adoption of annual budget including the staff establishment plan;
- providing guidance to and monitoring the performance of the Executive Director;
- adoption of the work programme;
- approval of the annual activity report, including the corresponding expenditure;
- approval of the list of actions to be funded etc.;
- adopt by the end of 2023 a plan for the phasing-out of the Joint Undertaking from Horizon Europe funding upon recommendation of the Executive Director.

The **Executive Director** is the legal representative of the Clean Aviation Joint Undertaking. He is the chief executive responsible for the day-to-day management of the Joint Undertaking, in accordance with the decisions of the Governing Board. The Executive Director is in charge of the implementation of the work programme with the support of the Programme Office. The Executive Director is supported by three heads of unit (HoU): Programmes HoU, Strategic Development HoU and the Administration and Finance HoU.

The specific tasks of the Executive Director are further described in Article 19 of the SBA. Following an open and transparent selection procedure Axel Krein was appointed Executive Director of the Clean Sky 2 JU (predecessor of the Clean Aviation JU) on 1 February 2019 for a term of three years. His mandate has been extended for five years until 30 November 2026 by Governing Board decision in accordance with provision in Article 174(11) of the SBA his mandate shall continue in respect to the Clean Aviation JU until the end of his term of office.

The **Technical Committee (TC)** has a key role in developing and maintaining the technical strategy of the programme, and providing key inputs to the Joint Undertaking and its Governing Board in order to optimise the programme's portfolio and maximise its impact. The Technical Committee has the following tasks:

- propose amendments to the Strategic Research and Innovation Agenda (SRIA);
- propose technical priorities and research actions and topics to be included in the work programme;

- provide information on research actions planned or in progress at national, regional or other non-Union levels and maximise possible synergies with Clean Aviation;
- propose revisions of the technical scope of the programme in order to align the work programme with Horizon Europe and other European partnerships' related work programmes;
- make recommendations on maximising the impact in line with the European Green Deal objectives and the potential market uptake of the programme's results.
- The Clean Aviation Technical Committee is composed as follows:
- up to four Commission representatives and Union bodies, as decided by the representatives of the Union in the Governing Board;
- one representative from each member other than the Union;
- one representative of the European Union Aviation Safety Agency (EASA).

The Technical Committee is co-chaired by a representative of the founding members, rotating on a two-yearly basis, and the European Commission. It shall report to the Governing Board and its secretariat shall be provided by the Clean Aviation Joint Undertaking Programme Office.

In order to ensure the development of an integrated technology strategy and roadmap and to coordinate and harmonise the information and inputs to and from the thrust sub-groups and any ad-hoc sub-groups, a Technical Committee Coordination Group (TCCG) is established. Its composition is as follows:

- up to three Members for each thrust sub-group (i.e. SMR, HER, H2);
- one Commission representative in the Technical Committee delegated to this group;
- one EASA representative.

The European Clean Aviation Scientific Advisory Body (SAB) provides independent scientific advice and support to the Clean Aviation Joint Undertaking. The main functions and tasks, composition and procedure for establishing the SAB are briefly described below:

- The SAB provides scientific advice to the Joint Undertaking, in particular on annual work programmes, revisions to the Strategic Research and Innovation Agenda (SRIA), the annual activity report of the JU, any additional activities as well as various other aspects of the Joint Undertaking's tasks, as necessary.
- Collectively the members of the SAB shall have the necessary competences and expertise covering the technical domain in order to make science-based recommendations to the Joint Undertaking, taking into account the climate, environmental and socio-economic impact of such recommendations, as well as the objectives of the Clean Aviation JU.

The members were appointed by the Clean Aviation Governing Board through an open selection process. The Governing Board considered the potential candidates proposed by the Clean Aviation States' Representatives Group. The selection of candidates for membership of the SAB was based on a Call for Expressions of Interest, published on the websites of the Clean Sky 2 Joint Undertaking and that of the Clean Aviation JU, the Official Journal (OJ) of the European Union, as well as in relevant scientific and trade publications.

The SAB shall have no more than 15 permanent members and those members shall not be members of any other body of this Joint Undertaking. A representative of the European Union Aviation Safety Agency (EASA) shall be a permanent member of the SAB.

The Scientific Advisory Body shall carry out, inter alia, the following tasks:

- advise on the scientific priorities to be addressed in the work programmes including the scope of calls for proposals, in line with the SRIA and the Horizon Europe strategic planning;
- advise on the scientific achievements to be described in the annual activity report;
- suggest, in view of the progress of the SRIA and individual actions, corrective measures or re-orientations to the governing board, where necessary;
- provide independent advice and scientific analysis on specific issues as requested by the governing board, in particular as regards developments in adjacent sectors or to support the assessment of applications of potential associated members and contributing partners;
- evaluate the results from technology and innovation actions that are funded by the Joint Undertaking and report to the governing board;
- participate in sector integration committees specifically set up between European partnerships under Horizon Europe to enable synergies;
- cooperate with relevant European aviation stakeholders' fora, such as the Advisory Council for Aeronautics Research in Europe (ACARE);
- hold coordination meetings with the advisory bodies of other relevant Joint Undertakings such as the Single European Sky ATM Research 3 Joint Undertaking, with the aim of promoting synergies and cooperation among relevant Union research and innovation initiatives in aviation and providing advice to that effect to the Clean Aviation Joint Undertaking;
- advise and support the Commission and the Clean Aviation Joint Undertaking on initiatives that promote aviation research in the European education systems, and provide recommendations on aeronautical skills and competences development and updated aeronautical engineering curricula.

The SAB will meet at least twice a year, its assignments and consultations will be organised by the programme office of the Clean Aviation JU, which will provide its secretariat.

The SAB will elect from its members a chairperson at its first meeting, as well as adopt its rules of procedure detailing its internal organisation and cooperation with other JUs' advisory groups and ACARE. These, as well as a list of the members of the SAB, are published on the JU's website.

Opinions and recommendations made by the SAB to the Clean Aviation JU and/or its Governing Board will be published on this website.

The States Representative Group (SRG) will be established for the Clean Aviation Joint Undertaking representing the interests of Member States in Clean Aviation's activities.
The SRG consists of up to two representatives and up to two alternates from each Member State and associated country.
The SRG, as one of the bodies of the Clean Aviation Joint Undertaking, is consulted and, in particular, reviews information and provides opinions on a set of issues such as:

- programme progress of the Clean Aviation Joint Undertaking, achievement of its targets and expected impacts as part of Horizon Europe;
- updating of the Strategic Research and Innovation Agenda;
- draft Work Programme;
- links to Horizon Europe and other European Union, national and, where relevant, regional initiatives, including cohesion policy funds in line with smart specialisation strategies;
- involvement of SMEs, start-ups, higher education institutions, research organisations and measures taken to promote the participation of newcomers;
- actions taken for the dissemination and exploitation of results along the value chain.

The SRG regularly reports to the Clean Aviation Governing Board, and acts as an interface with the Joint Undertaking on a set of important issues, such as:

- synergies with the relevant national or regional research and innovation programmes;
- specific measures taken at national or regional level with regard to dissemination events, dedicated technical workshops and communication activities;
- national or regional policies and initiatives with a view to ensuring complementarities with regard to the Clean Aviation's Strategic Research and Innovation Agenda and annual work programmes.

To ensure synergies with other relevant Joint Undertakings such as the Single European Sky ATM Research 3 Joint Undertaking, the Clean Aviation SRG holds coordination meetings at least twice a year,and provides advice to the Clean Aviation Joint Undertaking on this basis.
The Clean Aviation States Representatives Group also has the following additional tasks:

- propose measures to improve the complementarity between Clean Aviation research and innovation actions and relevant national research programmes (those that contribute to the objectives of the Strategic Research and Innovation Agenda);
- promote specific measures at national or regional level aimed at increasing the involvement of SMEs in Clean Aviation research and innovation;
- promote research and innovation investment from Cohesion Policy funds such as the European Regional Development Funds (ERDF), the Just Transition Funds, and Next Generation EU Funds in the context of the Clean Aviation Joint Undertaking.

2.7 Strategy and plans for the organisational management and internal control systems

The Internal Control Principles as adopted by the Clean Sky 2 Governing Board remain applicable for the CAJU via the GB Omnibus decision of 16 December 2021. The description of specific controls and the related monitoring indicators will be adapted where necessary to the CAJU work environment. The continuous self-assessment by the JU management will continue in 2022, focussing in particular on the new Clean Aviation processes and related risks.

2.7.1 Financial procedures

The financial procedures and the workflows in place follow the financial rules, the general control framework applicable in the Commission and the H2020 rules and guidance.

Clean Aviation JU will continue to apply the same financial framework and control strategies as used by CS2JU, in particular the Financial Rules adopted via the GB Omnibus decision of 16 December 2021.
Reporting and validation of costs will be done via the EC IT tools. Payments will be executed via the ABAC IT tool (EC accounting system).

As stakeholder in the Horizon Europe programme, CAJU will apply a system of internal control in its grant management, which is aligned with the Control Framework developed by the Commission for the implementation of the new programme. In reconciliation with the overall control strategy of the Commission for HE grant management, CAJU will adapt the existing specific internal control system of CS2 JU to the new programme, the most important elements being the CA ex-ante control Guidance, CA project monitoring Strategy, the CA Audit strategy and the CA Antifraud strategy.

CAJU will keep the high quality of its grant management of CS2 projects through continued guidance provided to beneficiaries, in particular in workshops and information sessions on financial and administrative requirements until the end of the CS2 programme.
In addition, the first awareness raising activities for HE participants will be planned and carried out in the year 2022.

2.7.2 Programme management

In 2022, CAJU plans to develop an IT tool that, on top of the common EC tools, will implement efficient programme management and provide a robust source of information, for monitoring and steering the programme implementation. Through interfaces to data available in the EC tools, structured reports will be generated (e.g. Annual Activity Report, Programme Development Plan, etc.). The IT tool will also enhance the efficiency and effectiveness of the grant management, in particular with a view to the multi-year grant agreements.

2.7.3 Ex-ante and ex-post controls

Ex-ante controls:
During 2022-2023, the admin & finance and operational units will continue to work closely together in their day-to-day activities of initiation, verification and payments of invoices and cost claims, creation of commitments, recovery orders, validation of financial and technical reports and following-up on other financial and administrative aspects of the projects. Ex-ante controls will follow a risk-based monitoring approach, which will contribute to further reducing the risk of failing projects and/or loss of funding in the final stage of the CS2 programme.

These activities will be conducted in a timely manner that will be monitored through the defined set of KPIs, in particular, the time to pay, the budget implementation and work programme execution. Best practice and highest quality standards will be ensured through the availability of the CS2 JU Manual of Financial Procedures, the Programme Management Manual and the Quality Manual that are under regular revisions. Where necessary, updates will be performed to incorporate any changes pertaining to the HE processes.

Ex-post controls:
For the execution of the Clean Sky 2 programme, the Ex-post audit (EPA) process represents a significant element of the Internal Control System of the JU. The main objectives of the audits are:
Through the achievement of a number of quantitative targets, ensure the legality and regularity of the validation of cost claims performed by the JU's management;
Provide an adequate indication on the effectiveness of the related ex-ante controls;
Provide the basis for corrective and recovery activities, if necessary.

For Clean Aviation projects, a risk based audit strategy will be developed to be applied earliest in 2023, when the first cost claims on grants can be expected.

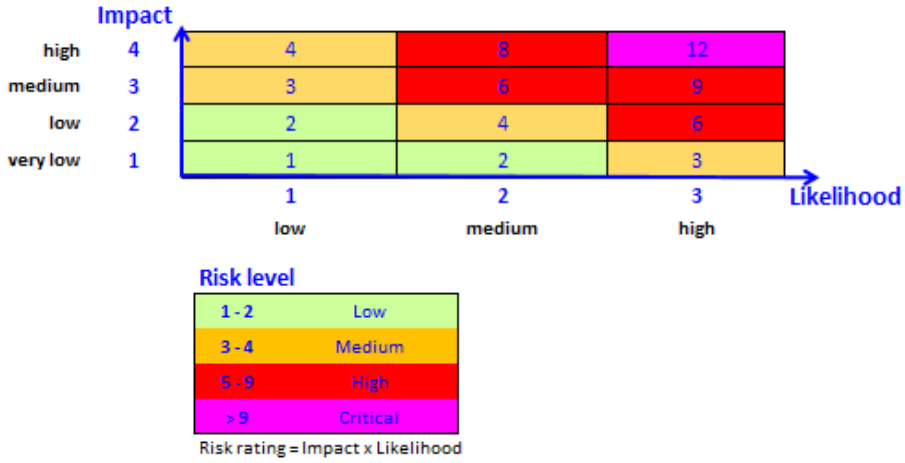
2.7.4 Risk management Strategy

As one major element of its Internal Control Framework, the CAJU applies risk management through a range of dedicated processes covering all areas of the JU's activities.
The risk management strategy of the JU aims at improving the oversight for the JU's Governing Board and management regarding the potential threats for implementing the JU's strategy, including the dedicated process for an independent impact monitoring of the Clean Aviation programme and aviation research and innovation in general.

In addition, risks are considered for driving the JU's performance, leading to a contribution of the risk management process towards **understanding the impact of risks on performance** and improving the setting of performance targets.
Finally, JU risk management also aims at reducing the extent of irregularities and fraud.
The complexity of the JU activities, with the involvement of many stakeholders participating in the execution of the programmes requires assessing and managing risks at the different levels of activity:

- Joint Undertaking organisation level
- CS2 and CA programme level
- ITD/IADP/TA level risks pertaining to the CS2 WP objectives and performances
- Thrusts and technology areas covered by the CA WP objectives and performances

All risks are captured in the global JU Risk Register, which provides for an evaluation of the risk level and description of the mitigating activities. With respect to the methodology used, the JU follows the Impact/Likelihood concept:



The impact is the potential consequence on the achievement of the set objectives, should the potential event materialise. The likelihood reflects the residual impact of the event, taking into account the mitigating actions which are planned or have been taken.
The different types of risks are assessed according to the following criteria:

Impact level	Financial *(measured in % of annual budget; depending on the risk, the reference could be the total JU budget or subcategories [titles, lines])**	Reputational	Operational
4 - Critical	Impact > 10%	Strong reputation or political impact with key stakeholder	Failure would create major disruption to critical activities
3 - High	2% < Impact < 10%	Major reputation or political impact with key stakeholder	Failure would create major disruption to very important activities
2 Medium	1% < Impact < 2%	Some reputation or political impact with key stakeholder	Failure would create some disruption to important activities

Impact level	Financial *(measured in % of annual budget; depending on the risk, the reference could be the total JU budget or subcategories [titles, lines])**	Reputational	Operational
1- Low	0% < Impact 1%	Impact primarily internal	Failure would disrupt minor activities

The outcome of the assessment of risks for the CAJU in the year 2022 is described in subchapter 2.2.2.

2.7.5 Antifraud Strategy

CAJU is a stakeholder of the H2020 and HE programmes and as such covered by the sector specific global Antifraud Strategy (AFS) of the Commission for the entire area of research. The JU will be involved in some of the mitigating actions stemming from this global AFS to reduce the risk of fraud, for instance awareness raising amongst the JU staff.
In line with guidance provided by the European Commission (DG R&I and OLAF), CS2 JU had established its specific Antifraud Strategy, which is reassessed annually following a dedicated fraud risk assessment. CAJU will update the assessment of fraud risks in the context of the CA program but also pertaining to areas other than research and will identify its specific action plan.
As part of the HE Control Strategy, the Commission is establishing Guidelines for risk based ex-ante controls in grant management, which will include specific measures for preventing and detecting fraud and irregularities, applicable also for CAJU. The related IT tools for instance for detecting plagiarism and double funding in H2020 and HE projects will continue to be used by CAJU.
For the prevention and detection of potential conflicts of interest, the JU will continue to apply the multiple already existing processes concerning e.g. the Members of the JU's Governing Board, experts of evaluation procedures, panels for procurement and recruitments.
An overview of the CAJU Antifraud Strategy and related documents, including the guidance for whistle blowers, is provided on the CA website with direct links to OLAF. The section will be updated with new information pertaining to the HE Control Strategy, where necessary.

2.7.6 Audits

The European Court of Auditors will carry out its annual audit on the CAJU activities in accordance with the SBA, covering the expenditure and implementation of the two programmes, Clean Sky 2 and Clean Aviation. The result of this audit will be published in the Court's annual report. The JU will continue to work with the Internal Audit Service of the Commission on areas identified in its Strategic Audit Plan for the JU. For the years 2022 to 2024 a new Audit Plan will be executed by the IAS, based on the results of a risk assessment carried out at the end of the year 2021 for the CAJU. The Internal Audit Capability will perform its work according to the annual audit plan, which will be subject for approval of the CAJU Governing Board.

3 BUDGET 2022-2023

The Budget 2022-2023 presented below is the third amendment to the 2022-2023 budget. It consists of the following modifications with a view to optimising the use of all available funds as well as adopting the initial Budget 2023:

- Revenues:

Inclusion of the expected carry-over (unused payment credits at year-end 2022) to the new financial year 2023 (€70 million); this amount of unused credits is mainly due to delays in the CS2 programme implementation (€41 million) plus a reserve needed to cover payments foreseen for early 2023 until receipt of the first EC installment.

- Expenditures:

CS2 programme operational budget (Title 4): increase by €24.9 million of payment appropriations for the CS2 GAMs payments related to the implementation of activities during 2022 and to be released in 2023.
CA programme operational budget (Title 3): transfer of the foreseen unused payment appropriations of €129.5 million to the unused budget line (Title 5).
This amount was initially forecasted to be paid in 2023 under the assumption that the UK agreement would have been signed in due time and under the assumption of a higher pre-financing rate for Call 1; this surplus will be absorbed during 2024.

The budget 2022-2023 contains the following sections:

- Statement of revenue: The revenue received from the Commission, from the industrial members and amounts carried over from previous years (unused). It covers the estimated private members' contribution to the running costs for Clean Sky 2 and Clean Aviation. For the financial year 2022, the amount of EU contribution includes both the amounts planned for 2021 and 2022 in the financial programming;

- Statement of expenditure: The expenditure includes the JU staff expenditure and the infrastructure expenditure (administrative costs), as well as the operational activities under Horizon Europe (Title 3 – Clean Aviation programme) and H2020 (Title 4 – CS2 Programme). The unused appropriations are appropriations that are not used in the current year but are shown here for full transparency of the credits available to the JU for future use in accordance with Article 6.5 of the Financial Rules[26]. For the financial years 2022 and 2023, they are only related to the CS2 programme.

  NB: In the audit of the financial year 2021, the European Court of Auditors (ECA) issued a preliminary finding related to the non-payment of the employer's contribution to the EU pension's scheme for the JU staff.

- Since JU staff payrolls and related social contributions have always been calculated by the EC PMO services, the JU contacted the Commission (DG Budget) with a view to get its position on this matter.
- According to the Court's position, the potential effect could lead to a correction of up to €2.1 million€ (which might be covered by the accumulated unused financial contributions for administrative costs), while the first interpretation issued by DG Budget would not require retroactive application.

[26] Ref. *CS-GB-Writ. proc. 2019-07 Revised Financial Rules*

- Hence, the JU is awaiting for the final decision as regards to the application of Article 83a(2) of the Staff regulation, in particular for what concerns the retroactivity and the calculation method. At the time of issuing the WP/Budget 2022-2023, the financial impact cannot be quantified with certainty.

STATEMENT OF REVENUE				
Heading	**Financial year 2022 Amendment 2**	**Financial year 2022 Amendment 2**	**Financial year 2023 Amednment 3**	**Financial year 2023 Amednment 3**
	Commitment Appropriations	Payment Appropriations	Commitment Appropriations	Payment Appropriations
SUBSIDY FROM THE COMMISSION	384,227,400	324,976,438	237,289,779	406,953,448
CONTRIBUTION FROM MEMBERS (NON-EC)	4,907,568	4,907,568	5,117,567	5,117,567
CARRY OVER FROM PREVIOUS YEAR (executed and estimated)	19,242,249	82,525,739	24,020,973	70,000,000
FINANCIAL REVENUES (BANK INTEREST)	0	0	0	0
TOTAL REVENUE	**408,377,217**	**412,409,745**	**266,428,319**	**482,071,015**
STATEMENT OF EXPENDITURE				
Heading	**Financial year 2022 Amendment 2**	**Financial year 2022 Amendment 2**	**Financial year 2023 Amednment 3**	**Financial year 2023 Amednment 3**
STAFF EXPENDITURE	Commitment Appropriations	Payment Appropriations	Commitment Appropriations	Payment Appropriations
STAFF IN ACTIVE EMPLOYMENT	5,400,000	5,400,000	4,852,033	4,852,033
MISCELLANEOUS EXPENDITURE ON STAFF	150,000	161,521	82,877	82,877
MISSIONS AND DUTY TRAVEL	210,000	211,329	183,631	183,631
SOCIOMEDICAL INFRASTRUCTURE	90,000	135,285	90,665	90,665
EXTERNAL STAFF SERVICES	600,000	775,313	424,831	424,831
RECEPTIONS AND EVENTS	30,000	30,000	31,097	31,097
TITLE 1 - TOTAL	**6,480,000**	**6,713,448**	**5,665,134**	**5,665,134**
INFRASTRUCTURE EXPENDITURE	Commitment Appropriations	Payment Appropriations	Commitment Appropriations	Payment Appropriations
RENTAL OF BUILDINGS AND ASSOCIATED COSTS	600,000	613,192	624,013	624,013
INFORMATION TECHNOLOGY PURCHASES	426,000	748,516	376,458	376,458
MOVABLE PROPERTY AND ASSOCIATED COSTS	9,000	9,000	7,176	7,176
CURRENT EXPENDITURE FOR RUNNING COSTS	51,000	105,102	46,054	46,054
POSTAGE AND TELECOMMUNICATIONS	45,000	58,463	37,878	37,878
EXPENDITURE ON FORMAL AND OTHER MEETINGS	180,000	182,766	277,166	277,166
COMMUNICATION ACTIVITIES	608,999	1,205,119	580,540	580,540
EXTERNAL SERVICES AND SUPPORT	1,415,137	1,568,580	2,620,716	2,620,716
COSTS ASSOCIATED WITH CALLS	0	0	0	0
TITLE 2 - TOTAL	**3,335,136**	**4,490,737**	**4,570,000**	**4,570,000**
TOTAL ADMINISTRATIVE EXPENDITURE (Title 1 & Title 2)	**9,815,136**	**11,204,185**	**10,235,134**	**10,235,134**

OPERATIONAL EXPENDITURE CLEAN AVIATION	Commitment Appropriations	Payment Appropriations	Commitment Appropriations	Payment Appropriations
SHORT & MEDIUM RANGE AIRCRAFT	139,966,746	64,406,486	85,922,516	89,344,370
HYBRID ELECTRIC REGIONAL AIRCRAFT	90,719,187	41,744,945	55,690,520	57,908,388
HYDROGEN POWERED AIRCRAFT	94,347,955	43,414,742	57,918,141	60,224,723
TRANSVERSAL CERTIFICATION	55,986,699	25,762,594	34,369,007	35,737,748
CSA	373,245	171,751	229,127	238,252
CALL FOR TENDERS	0	0	0	0
EVALUATION EXPERTS	976,000	976,000	1,083,402	1,083,402
OTHERS	0	0	0	0
TITLE 3 - TOTAL	**382,369,832**	**176,476,518**	**235,212,712**	**244,536,882**
OPERATIONAL EXPENDITURE CS2	Commitment Appropriations	Payment Appropriations	Commitment Appropriations	Payment Appropriations
LARGE PASSENGER AIRCRAFT	0	51,505,421	3,101,375	21,412,517
REGIONAL AIRCRAFT	0	9,003,510	711,037	342,128
FAST ROTORCRAFT	0	14,914,210	1,186,394	0
AIRFRAME	0	19,773,405	2,032,977	0
ENGINES	0	22,254,509	2,069,676	0
SYSTEMS	0	17,303,317	0	0
TECHNOLOGY EVALUATOR	0	1,191,749	61,882	1,641,801
ECO-DESIGN TRANSVERSE ACTIVITY	0	1,099,665	55,392	1,022,558
SMALL AIR TRANSPORT TRANSVERSE ACTIVITY	0	412,374	27,403	461,772
CALLS FOR PROPOSAL / CALLS FOR TENDER	60,249	57,562,292	0	27,784,561
TITLE 4 - TOTAL	**60,249**	**195,020,453**	**9,246,136**	**52,665,336**
TOTAL OPERATIONAL EXPENDITURE (Title 3 & Title 4)	**382,430,080**	**371,496,971**	**244,458,848**	**297,202,219**
UNUSED APPROPRIATIONS NOT REQUIRED IN CURRENT YEAR	**16,132,000**	**29,708,589**	**11,734,337**	**174,633,663**
TOTAL BUDGET	**408,377,216**	**412,409,745**	**266,428,319**	**482,071,015**

Multi annual instalments:

According to Art. 29 of SBA, the CAJU will make use of multi annual instalments to cover the calls 1 and 2 of Phase 1 as follows:

Line	Mgt Level	Description		2021	2022	2023	2024	2025	2026	2027	2021-2027	Correction to be applied
01 02 02 52	01	Clean Aviation - support	*EFTA*		*35,568*	*50,067*	*80,646*	*100,628*	*115,374*	*577,091*	*959,373*	
			EFTA incl.	382,000	1,475,568	2,077,067	3,345,646	4,174,628	4,786,374	23,941,091	40,182,373	-959,373
01 02 02 52	02	Clean Aviation - operational	*EFTA*		*3,683,832*	*5,669,712*	*4,629,348*	*9,484,380*	*3,189,832*	*8,694,375*	*35,351,480*	
			EFTA incl.	229,543,000	152,826,832	235,212,712	192,052,348	393,467,380	132,332,832	360,693,375	1,696,128,480	-35,351,480
			Total	**229,925,000**	**154,302,400**	**237,289,779**	**195,397,994**	**397,642,008**	**137,119,206**	**384,634,466**	**1,736,310,853**	**-36,310,853**

Cumul. Operational budget		382,369,832	617,582,544	809,634,892	1,203,102,272	1,335,435,105	1,696,128,480	

		2021	2022	2023	2024				
Multi annual instalment	**Call 1**		382,369,832	150,000,000	124,265,060				656,634,892
	Call 2		0	85,212,712	67,787,288				153,000,000
	Total		**382,369,832**	**235,212,712**	**192,052,348**				**809,634,892**
			0	0	0		% of total HE budget (1.7 b€)		**48%**

The cumulative amount of budgetary commitments in instalments for the period 2022-2024 will amount to EUR 809.634.892. This will represent 48% of the total budget for the programme period, thus below the threshold of 50% set in art. 27 of SBA.

4 ANNEXES

4.1 1st Call for Proposals: List and description of topics

Please refer to separate Annex.

4.2 2nd Call for Proposals: List and description of topics

Please refer to separate Annex.

4.3 IKAA plans

4.3.1 Clean Aviation IKAA plans 2022-2023

The Additional Activities Plan here below is based on the data extracted from the Call 1 proposals currently under grant preparation.

OVERVIEW ESTIMATED IKAA FOR 2022						
Category of the Additional Activities (AA)[2]	Description of the AAs[3]	contribution to JU objectives or KPIs of the JU[4]	Link to specific JU project/ call/topic [5]		Estimated value AA for 2022 (in M€) [6]	of which programme related IKAA
			Topic	Proposal Acronym		
[Support to additional R&I][7]						
	will contribute to achieve the objectives in the following domains:	**will contribute to achieve the following specific objectives (art. 57.2 of SBA):**				
	Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft	(a) to integrate and demonstrate disruptive aircraft technological innovations able to decrease net emissions of greenhouse gases by no less than 30 % by 2030, compared to 2020 state-of-the-art technology, while paving the ground towards climate-neutral aviation by 2050; (b) to ensure that the technological and the potential industrial readiness of innovations can support the launch of disruptive new products and services by 2035, with the aim of replacing 75 % of the operating fleet by 2050 and developing an	HORIZON-JU-CLEAN-AVIATION-2022-01-HER-01	HE-ART	0.000	0.000
	Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-01	AMBER	0.286	0.000
	Thermal Management Solutions for Hybrid Electric Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-02	TheMa4 HERA	1.500	0.000
	Electrical Distribution Solutions for Hybrid-electric Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-03	HECATE	0.000	0.000
	Innovative Wing Design for Hybrid-Electric Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-04	HERWINGT	1.270	0.000
	Direct Combustion of Hydrogen in Aero-engines		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-01	HYDEA	1.131	0.000

Direct Combustion of Hydrogen in Aero-engines	innovative, reliable, safe and cost-effective European aviation system that is able to meet the objective of climate neutrality at the latest by 2050; (c) to expand and foster integration of the climate-neutral aviation research and innovations value chains, including academia, research organisations, industry and SMEs, also by benefiting from exploiting synergies with other national and European related programmes and by supporting the uptake of industry-related skills across the value chain.	HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-01	CAVENDISH	0.000	0.000
Multi- Megawatt (MW) Fuel Cell Propulsion System for Hydrogen-Powered Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-02	NEWBORN	2.466	0.000
Large Scale Lightweight Liquid Hydrogen Integral Storage Solutions		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-03	H2ELIOS	postponed	postponed
Near Term Disruptive Technologies for Hydrogen-Powered Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-04	HyPoTraDe	0.091	0.000
Near Term Disruptive Technologies for Hydrogen-Powered Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-04	fLHYingtank	0.070	0.000
Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	SWITCH	0.000	0.000
Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	OFELIA	39.255	0.000
Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	HEAVEN	0.000	0.000
Ultra Performance Wing for Short and Short-medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-02	UP Wing	6.365	5.750
Advanced Low Weight Integrated Fuselage and Empennage for Short Range and ShortMedium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-03	FASTER-H2	6.939	0.425
Aircraft architectures & technology integration for aircraft concepts ranging from regional to short-medium range applications		HORIZON-JU-CLEAN-AVIATION-2022-01-TRA-01	SMR ACAP	1.725	0.000
Aircraft architectures & technology integration for aircraft concepts ranging from regional to short-medium range applications		HORIZON-JU-CLEAN-AVIATION-2022-01-TRA-01	HERA	0.000	0.000
Novel Certification Methods and Means of Compliance for Disruptive Technologies		HORIZON-JU-CLEAN-AVIATION-2022-01-TRA-02	CONCERTO	3.186	0.000

	Developing a European Clean Aviation Regional Ecosystem (ECARE		HORIZON-JU-CLEAN-AVIATION-2022-01-CSA-01	ECARE	n/a	n/a
				TOTAL	64.285	6.175

[1] One table per year concerned in case of multiannual WP; aggregated amounts per category.

[2] Please detail the scope of AAs (including references to provisions in Part two of the SBA, if possible) e.g.: investments in a new innovative and sustainable production plant or flagship (article 51(1)(a) of the SBA)

[3] Please provide a description of the AAs focusing on expected impact, outcomes and Union added value

[4] To be selected from the SRIA in accordance with the SBA objectives. Please name here the objective or KPI to which the AA is linked.

[5] This column should be fulfilled depending on the existence of such link. Please detail here the topic/call/project (including preceding initiatives) to which the AA is linked, if applicable/available.

[6] Costs incurred by contributors in implementing additional activities less any contribution to those costs from the Union and from the participating states of that joint undertaking

[7] Those general categories of actions in blue are mentioned here to facilitate monitoring and evaluation activities in the future, and only those relevant for the AA mentioned in the AAP should be kept. Please find attached guidance on examples of AA that could be included per category.

IKAA 2022 BREAKDOWN PER COUNTRY	
Country	Estimated value (M€)
Czech Republic	0.500
France	42.501
Germany	15.578
Greece	0.073
Israel	0.110
Italy	0.746
Netherlands	0.345
Slovenia	0.300
Spain	4.132
Total	64.285

OVERVIEW ESTIMATED IKAA FOR 2023						
Category of the Additional Activities (AA)[2]	Description of the AAs[3]	contribution to JU objectives or KPIs of the JU[4]	Link to specific JU project/ call/topic [5]		Estimated value AA for 2023 (in M€) [6]	of which programme related IKAA
			Topic	Proposal Acronym		
[Support to additional R&I][7]						
	will contribute to achieve the objectives in the following domains:	**will contribute to achieve the following specific objectives (Art. 57(2) of SBA):**				
	Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft	(a) to integrate and demonstrate disruptive aircraft technological innovations able to decrease net emissions of greenhouse gases by no less than 30 % by 2030, compared to 2020 state-of-the-art technology, while paving the ground towards climate-neutral aviation by 2050; (b) to ensure that the technological and the potential industrial readiness of innovations can support the launch of disruptive new products and services by 2035, with the aim of replacing 75% of the operating fleet by 2050 and developing an innovative, reliable, safe and cost-effective European aviation system that is able to meet the objective of climate neutrality at the latest by 2050;	HORIZON-JU-CLEAN-AVIATION-2022-01-HER-01	HE-ART	74.519	0.000
	Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-01	AMBER	11.699	0.000
	Thermal Management Solutions for Hybrid-Electric Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-02	TheMa4HERA	13.451	0.000
	Electrical Distribution Solutions for Hybrid-electric Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-03	HECATE	16.611	0.000
	Innovative Wing Design for Hybrid-Electric Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-04	HERWINGT	10.450	0.000
	Direct Combustion of Hydrogen in Aero-engines		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-01	HYDEA	25.516	0.000
	Direct Combustion of Hydrogen in Aero-engines		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-01	CAVENDISH	10.965	0.000
	Multi- Megawatt (MW) Fuel Cell Propulsion System for Hydrogen-Powered Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-02	NEWBORN	9.262	0.000

	Large Scale Lightweight Liquid Hydrogen Integral Storage Solutions	(c) to expand and foster integration of the climate-neutral aviation research and innovations value chains, including academia, research organisations, industry and SMEs, also by benefiting from exploiting synergies with other national and European related programmes and by supporting the uptake of industry-related skills across the value chain.	HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-03	H2ELIOS	postponed	postponed
	Near Term Disruptive Technologies for Hydrogen-Powered Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-04	HyPoTraDe	1.905	0.000
	Near Term Disruptive Technologies for Hydrogen-Powered Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-04	fLHYingtank	0.102	0.000
	Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	SWITCH	29.843	0.000
	Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	OFELIA	103.086	0.000
	Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	HEAVEN	21.610	0.000
	Ultra Performance Wing for Short and Short-medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-02	UP Wing	19.255	5.750
	Advanced Low Weight Integrated Fuselage and Empennage for Short Range and Short Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-03	FASTER-H2	12.591	3.425
	Aircraft architectures & technology integration for aircraft concepts ranging from regional to short-medium range applications		HORIZON-JU-CLEAN-AVIATION-2022-01-TRA-01	SMR ACAP	21.096	0.000
	Aircraft architectures & technology integration for aircraft concepts ranging from regional to short-medium range applications		HORIZON-JU-CLEAN-AVIATION-2022-01-TRA-01	HERA	14.896	0.000
	Novel Certification Methods and Means of Compliance for Disruptive Technologies		HORIZON-JU-CLEAN-AVIATION-2022-01-TRA-02	CONCERTO	8.741	0.000
	Developing a European Clean Aviation Regional Ecosystem		HORIZON-JU-CLEAN-AVIATION-2022-01-CSA-01	ECARE	n/a	n/a
				TOTAL	**405.599**	**9.175**

[1] One table per year concerned in case of multiannual WP; aggregated amounts per category.

[2] Please detail the scope of AAs (including references to provisions in Part two of the SBA, if possible) e.g.: investments in a new innovative and sustainable production plant or flagship (article 51(1)(a) of the SBA).

[3] Please provide a description of the AAs focusing on expected impact, outcomes and Union added value

[4] To be selected from the SRIA in accordance with the SBA objectives. Please name here the objective or KPI to which the AA is linked.

[5] This column should be fulfilled depending on the existence of such link. Please detail here the topic/call/project (including preceding initiatives) to which the AA is linked, if applicable/available.

[6] Costs incurred by contributors in implementing additional activities less any contribution to those costs from the Union and from the participating states of that joint undertaking.

[7] Those general categories of actions in blue are mentioned here to facilitate monitoring and evaluation activities in the future, and only those relevant for the AA mentioned in the AAP should be kept. Please find attached guidance on examples of AA that could be included per category.

IKAA 2023 BREAKDOWN PER COUNTRY	
Country	**Estimated value (M€)**
Czech Republic	3.704
France	175.806
Germany	160.337
Greece	0.893
Ireland	1.727
Israel	0.358
Italy	22.747
Netherlands	8.906
Poland	1.120
Romania	1.001
Slovenia	2.283
Spain	19.392
Sweden	5.627
Turkey	1.698
Total	**405.599**

4.3.2 Clean Sky 2 IKAA plan 2023

MEMBER NAME	*Planning Period*	*Value of Additional activities (excluding Union funding)*	*Activity title and relevance*
DAV - DASSAULT AVIATION	2023	3,963,000.00 €	• Multidisciplinary Aircraft design and aircraft certification process using numerical tools: Impacts to CS2 are drag reduction concepts (definition and evaluation of laminarity profiles (wing, Horizontal Tail Plan, and nacelle), architecture optimisation, passenger comfort, certification process • Design criteria for innovative architecture using composite materials, aeroelasticity design and optimization tools: Impacts to CS2 are weight-to-drag ratio improvements (new materials, architecture optimisation) • Green manufacturing processes , efficient composite manufacturing process (environmental impact, cost, cycle, waste) Green maintenance: weight to drag ratio improvement, efficiency and productivity increase in terms of environmental impacts. Alternate ideas to CS2 development for eco design Nature of Contributions: Personnel costs (engineer), other costs (consumables, materials,..)
AOA - Diehl Aviation Gilching GmbH	2022	300,000.00 €	LuFo V-3 Project: HUTAB Efficient Manufacturing processes and Technologies for Single Tank Waste-Water Systems. Nature of Contributions: R&T project expenditure
AH-SAS - AIRBUS HELICOPTERS SAS	2023	8,000,000.00 €	Additional R&T: THE RACER demonstrator will benefit from several additional activities projects mainly regarding -new lateral rotor -new main rotor designed for high speed flight -powerplant (ECO MODE)
CASA - AIRBUS DEFENCE & SPACE SAU	2023	4,495,000.00 €	• HV-Net 1455 – GTF: High Voltage electrical network • ATENEA 1455 – SEV: Manufacturing Technologies towards Industry 4.0 • CERTERIN 1455 – GTF: Investigation on advance materials and manufacturing processes that allows more efficient processes and integrated structures for weight savings • FLEXA 1455 – SEV: Innovative solutions to ensure modular and flexible assembly for a more efficient low rate production • MALTA2020 1455 – GTF: MALTA 2020 will provide a cost reduction through new materials and processes associated to adequate curing times and temperatures, increased lay-up productivity and low cost materials for composite manufacturing. • MALTA2020 1455 – SEV: MALTA 2020 will provide a cost reduction through new materials and processes associated to adequate curing times and temperatures, increased lay-up productivity and low-cost materials for composite manufacturing. • MALTA2020 1455 - SEV 2: MALTA 2020 will provide a cost reduction through new materials and processes associated to adequate curing times and temperatures, increased lay-up productivity and low-cost materials for composite manufacturing. • NG-GTS 1455 – SEV: Development of new generation of ground test systems to achieve greater competitiveness and efficiency

MEMBER NAME	Planning Period	Value of Additional activities (excluding Union funding)	Activity title and relevance
			• VER.0001 - Chromates 1455 – SEV: ECO Design. Regulatory • VER.0003 - Halon 1455 – GTF: ECO Design. Regulatory • RD NGTA: Next Generation Transport aircraft studies: Conceptual studies of definition for the Next Generation Transport aircraft • RD ISR State of the Art: support to planar technologies of planar SATCOM: Support activities about alternative planar antennas SATCOM for transport aircrafts • SATCOM GILAT FLAT ANTENNA: Antenna satcom flat • LIFESEEKER: Airbone phone location system • AMC: New computer FITs Airborne Management Computer Nature of Contributions: R&T project expenditure
CIRA - Centro Italiano Ricerche Aerospaziali SCpA	2023	250,000.00 €	• ADDITIVE LAYER MANUFACTURING: Qualification, safety of flight and certification routes for additive layer manufactured parts. The activities are relevant with respect to the activities developed under CS2 and can have a leverage effect, since they increase the level of knowledge of the underpinning challenges of the technology and give opportunity to enrich the experimental database. • NUMERICAL METHODS FOR NON LINEAR PHENOMENA IN COMPOSITE-HYBRID: Methodologies for impact dynamics (crashworthiness, bird strike), post buckling, scalability of structural concepts. The activities are relevant with respect to the activities developed under CS2 and can have a leverage effect, since they increase the level of knowledge of the underpinning physics of the problems and give opportunity to enrich the numerical tools available. • SURROGATE MODELS: SURROGATE MODELS DESCRIPTION Surrogate models of control surfaces, based on Proper Orthogonal Decomposition. The activities are relevant with respect to the activities developed under CS2 and can have a leverage effect, since they increase the level of knowledge of the underpinning physics of the control surfaces and give opportunity to aid the PtF route. • SMART LANDING GEAR: Set up of methodologies and test activities aimed at defining a smart landing gear architecture based on fiber optics. The activities are relevant with respect to the activities developed under CS2 and can have a leverage effect, since they increase the level of knowledge of the underpinning challenges of the technology and give opportunity to enrich the experimental database.
LDO-Ltd - Leonardo MW Ltd (ex-AGUSTA WESTLAND Ltd)	2023	4,000,000.00 €	Tiltrotor Proprotor: Continue the development of tiltrotor proprotor technology for delivery as background IPR and application on the Clean Sky 2 demonstration air vehicle. Objective is to establish tilt rotor capabilities that can be transferable to future tilt rotor applications. Nature of Contributions: R&T project expenditure
LDO Spa - Leonardo Spa (Helicopter division - ex AW Spa)	2023	1,800,000.00 €	Tiltrotor Air Vehicle: Overall tiltrotor air vehicle design integration and analysis, including design tool validation, in support of Civil certification. Nature of Contributions: R&T project expenditure

MEMBER NAME	Planning Period	Value of Additional activities (excluding Union funding)	Activity title and relevance
LDO VEL - Leonardo Spa (Aeronautic Sector - ex Alenia)	2023	1,561,472.00 €	• Hybrid Propulsion and Innovative Systems for a Regional A/C: Main links are with REG IADP WP1 “High efficiency regional aircraft” and WP 2.3 “Energy optimised regional aircraft”. Impact on CS2 is found in the field of environmental benefits (noise, CO2, NOx reduction). • Ice Detection Sensors for Regional A/C: Links are with REG IADP WP 2.3.1 “Low Power wing ice protection system”. Impact on CS2 is found in the synergy with this WP to obtain both environmental and competitiveness benefits. • Validation of new generation 3D icing engineering tools: Links are with REG IADP WP 2.3.1 “Low Power wing ice protection system”. Impact on CS2 is found in the synergy with this WP to obtain both environmental and competitiveness benefits. • Advanced Technological Studies for optimization of regional aircraft production: Main links are with REG IADP WP 3.1” Adaptive Wing Integrated Demonstrator (FTB#1 and OWB)” and WP 3.2 “Fuselage / Pax Cabin Integrated Demonstrator”. Impact on CS2 is found in synergy with these WPs to obtain both environmental and competitiveness benefits. Nature of Contributions:- R&T project expenditure (European Research Project – LDO VEL in-kind contribution) - Research project expenditure (LDO VEL internal activity)
MPC - Meggitt Aerospace Limited	2023	86,250.00 €	UK Innovate project: Butterfly: Project Butterfly brings together a consortium of UK manufacturing organisations (Parker Meggitt, BAE Systems, GKN Aerospace, Nissan, Leonardo, Moy Park, ARMC, University of Lincoln, Accenture and Intellium AI), solution providers and research organisations, working across a number of UK sectors. They share best practice and demonstrate the power of industry 4.0 to deliver near-term impact on the road to net zero manufacturing. Small changes can have a big impact; this is known as the butterfly effect. It is this principle that Project Butterfly looks to use to accelerate progress to net zero. The project has a specific focus on improving efficiency in the use of materials and energy by using manufacturing data to 1) optimise processes 2) increase right-first-time yield 3) provide visibility of information to everyone in the factory This can be done by using data to automatically update the schedule to deliver the most efficient use of energy. Using data from the process to improve the process by making it more efficient or increase the right-first-time yield. Nature of Contributions: The overall vision for the project is to develop a demonstrational use case for Artificial Intelligence to support net-zero manufacturing. Data will be captured from the pilot to understand the baseline for emissions in the current state and compare the sustainability and productivity savings with the final state. The pilot will support the application of machine connectivity and AI and will be used to demonstrate how digital technologies can be used to support net-zero targets. Nature of Contributions: R&T project expenditure

MEMBER NAME	*Planning Period*	*Value of Additional activities (excluding Union funding)*	*Activity title and relevance*
Imperial College London	2023	92,280.00 €	Computational methods: multi-scale analysis, non-linear mechanics, machine learning Methodology developments: baseline free damage detection in composite structure. Research for new materials and advanced manufacturing processes for multi-functional sensors printed sensors and diganostic film Nature of Contributions: Researcher time
THA - THALES AVS France SAS (ex-THALES AVIONICS SAS)	2023	1,000,000.00 €	HMI: Thales internal R&T project: work on new HMI concepts and innovative interface protocol with core avionics functions Nature of Contributions: R&T expenditures the planned additional activities are R&T activities carried out outside of the clean sky 2 programme, i.e. not co-financed by the joint undertaking. none of the planned additional activities are performed in the frame of ec, national or regional co-funded projects. they are R&T activities internal to Thales and funded with Thales own investment.
Fraunhofer-Gesellschaft	2023	1,800.000.00 €	Commending LCIA on Research for new materials and advanced manufacturing processes, Reuse and Recycling; backed by open scientific publications. Nature of Contributions: Researcher time
Total Planned 2023		27,348,002 €	

4.4 List of Members (CS2 and CA)

4.4.1 Clean Sky 2 Leaders

#	Organization Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
1	LEONARDO - SOCIETA PER AZIONI	Leader		X	X	X					
1A	Leonardo MW Limited	Participating Affiliate			X	X					
2	Airbus Defence and Space SA	Leader	X	X		X		X			
2A	Airbus Defence and Space GmbH	Participating Affiliate	X			X					
2B	Compañía Española de Sistemas Aeronáuticos (CESA)	Participating Affiliate						X			
3	Airbus SAS	Leader	X			X	X	X			
3A	Airbus Operations GmbH	Participating Affiliate	X			X		X			
3B	Premium Aerotec GmbH (PAG)	Participating Affiliate	X								
3C	AIRBUS OPERATIONS SAS	Participating Affiliate	X			X	X	X			
3D	STELIA AEROSPACE	Participating Affiliate	X								
3E	Airbus Operations Limited	Participating Affiliate	X			X		X			
3F	Airbus Operations SL	Participating Affiliate	X			X		X			
4	Airbus Helicopters SAS	Leader			X	X					
4A	Airbus Helicopters Deutschland GmbH	Participating Affiliate			X	X					
4B	Airbus Helicopters Polska Sp z o.o.	Participating Affiliate			X						
4C	Airbus Helicopters España	Participating Affiliate				X					
5	Dassault Aviation SA	Leader	X			X		X			
6	Deutsches Zentrum Fuer Luft - Und Raumfahrt Ev - DLR	Leader	X			X	X				X
7	Evektor, spol. s.r.o	Leader				X		X	X		
8	Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung E.V	Leader	X	X		X	X			X	
9	Liebherr Aerospace Lindenberg GmbH	Leader	X					X			
9A	Liebherr Aerospace Toulouse SAS	Participating Affiliate	X	X				X			

#	Organization Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
9B	Liebherr Elektronik GmbH	Participating Affiliate						X			
10	MTU Aero Engines Ag	Leader					X				
10A	MTU Aero Engines Polska Soo	Participating Affiliate					X				
11	Piaggio Aero Industries Spa*	Leader				X	X	X	X		
12	Rolls Royce Plc	Leader	X				X				
12A	Aero Gearbox International SAS	Participating Affiliate					X				
12B	Rolls-Royce Deutschland LTD & CO KG	Participating Affiliate	X				X				
12C	KONGSBERG MARITIME CM AS (ex ROLLS-ROYCE MARINE AS)	Participating Affiliate	X								
12D	ROLLS-ROYCE ELECTRICAL NORWAY AS	Participating Affiliate	X								
13	SAAB AKTIEBOLAG	Leader	X			X		X			
14	Safran SA	Leader	X				X	X			
14a	Safran Aircraft Engines Sas (ex SNECMA SAS)	Participating Affiliate	X				X				
14B	Safran Transmission Systems (ex-HISPANO-SUIZA SA)	Participating Affiliate					X				
14C	Safran Aero Boosters (ex TECHSPACE AERO)	Participating Affiliate					X				
14D	Safran Electrical & Power SAS (ex Labinal Power systems)	Participating Affiliate	X					X			
14E	Safran Helicopter Engines (ex TURBOMECA)	Participating Affiliate					X				
14F	Safran Landing Systems SAS (ex Messier-Bugatti-Dowty)	Participating Affiliate						X			
14G	Safran Nacelles SAS (ex AIRCELLE)	Participating Affiliate	X				X				
14H	Safran Nacelles Limited	Participating Affiliate					X				
14I	SAFRAN ELECTRICAL & POWER UK LTD	Participating Affiliate	X								
14J	Safran Electronics and Defense SAS (ex SAGEM)	Participating Affiliate									
15	Thales AVS France SAS (ex Thales Avionics SAS)	Leader	X					X			
15A	Thales UK Limited	Participating Affiliate						X			
15B	Thales Avionics Electrical Systems SAS	Participating Affiliate						X			
	*undergoing a special restructuring procedure under Italian national law and placed into receivership										

4.4.2 Clean Sky 2 Core Partners

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
1	ACITURRI ASSEMBLY S.A	Core Partner		X							
2	ACITURRI ENGINEERING SLU	Core Partner		X							
3	Acumen Design Associates Ltd	Core Partner				X					
4	ADVANCED LABORATORY ON EMBEDDED SYSTEMS, ALES S.R.L.	Core Partner						X			
5	Aernnova Aerospace SAU	Core Partner	X			X					
5A	Aernnova Aeroestructuras Alava SA	Participating Affiliate	X			X					
5B	Aernnova Composites Illescas SA	Participating Affiliate	X			X					
5C	Aernnova Engineering Division SAU	Participating Affiliate	X			X					
5D	Aerometallic Components SA	Participating Affiliate	X								
5E	GE AVIATION SYSTEMS LIMITED	Participating Affiliate	X								
5G	Internacional de composites SA	Participating Affiliate	X			X					
5H	Aernnova Composites SA	Participating Affiliate	X			X					
5I	Aeromac Mecanizados Aeronauticos SA	Participating Affiliate	X								
5J	HAMBLE AEROSTRUCTURES LIMITED	Participating Affiliate				X					
6	AERO-MAGNESIUM LIMITED (A.C.S)	Core Partner				X					
7	AEROSOFT SPA	Core Partner		X							

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
8	AEROTEX UK LLP	Core Partner				X					
9	AERTEC solutions SL (ex AERTEC INGENIERIA Y DESARROLLOS SLU)	Core Partner				X					
10	Airsense Analytics GmBH (AIRS)	Core Partner						X			
11	Airtel ATN Limited	Core Partner						X			
12	Akira Technologies SAS	Core Partner	X				X				
12A	Akira MecaTurbines	Participating Affiliate									
13	Akzo Noble Car Refinishes BV	Core Partner				X					
14	ALMA MATER STUDIORUM - UNIVERSITA DI BOLOGNA	Core Partner				X					
15	ALTRAN Deutschland SAS & Co KG	Core Partner				X					
16	ALTYS Technologies SAS	Core Partner						X			
17	ANSYS UK LTD	Core Partner					X				
18	ARKEMA FRANCE	Core Partner						X			
19	ARTUS SAS	Core Partner				X					
20	ASCO Industries N.V.	Core Partner				X					
21	BAE Systems Ltd.	Core Partner	X								
22	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	Core Partner				X					
23	BRIGHTLOOP SAS	Core Partner	X								
24	CAETANO AERONAUTIC SA	Core Partner		X		X					
24A	ALMADESIGN CONCEITO E DESENVOLVIMENTO DE DESIGN LDA	Participating Affiliate				X					
24B	CEIIA - CENTRO DE ENGENHARIA E DESENVOLVIMENTO (ASSOCIACAO) (CEIIA) (ex CENTRO PARA A EXCELENCIA EINOVACAO NA INDUSTRIA AUTOMOVEL)	Participating Affiliate									
24C	STRATOSPHERE SA (ex CRITICAL MATERIALS SA)	Participating Affiliate				X					
24D	EDISOFT-EMPRESA DE SERVICOS E DESENVOLVIMENTO DE SOFTWARE SA	Participating Affiliate				X					
24E	OPTIMAL STRUCTURAL SOLUTIONS Lda	Participating Affiliate				X					

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
24F	TEKEVER - TECNOLOGIAS DE INFORMACAO, S.A.	Participating Affiliate				X					
25	GMVIS SKYSOFT SA (GMV)	Core Partner	X			X					
26	SIA Centre Composite	Core Partner			X						
26A	SIA Aviatest Ltd	Participating Affiliate			X						
27	CENTRE DE RECHERCHE EN AERONAUTIQUE ASBL - CENAERO	Core Partner		X							
28	CENTRO ITALIANO RICERCHE AEROSPAZIALI SCPA	Core Partner	X	X	X	X		X			
29	CENTRE D'ETUDES ET DE RECHERCHES POUKR LES TECHNIQUES INDUSTRIELLES APPLIQUEES SA (Certia)	Core Partner		X							
30	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	Core Partner						X			
31	CORIOLIS COMPOSITES	Core Partner				X					
32	Coventry University	Core Partner	X								
33	DANOBAT S	Core Partner				X					
34	DEMA SPA - Design Manufacturing SPA	Core Partner				X					
35	DIEHL AEROSPACE GMBH	Core Partner						X			
36	Diehl Aviation Laupheim GmbH	Core Partner	X								
36A	Diehl Comfort Modules GmbH	Participating Affiliate	X								
37	Diehl Aviation Gilching GmbH (ex APPARATEBAU GAUTING GMBH)	Core Partner						X			
38	DSPACE DIGITAL SIGNAL PROCESSING AND CONTROL ENGINEERING GMBH	Core Partner						X			
39	Egile Corporation XXI SL	Core Partner					X				
39A	EGILE MECHANICS SL	Participating Affiliate					X				
40	ERNEO	Core Partner	X								
41	Eurotech Sp. z o.o.	Core Partner				X					

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
42	Fokker Aerostructures B.V.	Core Partner	X			X					
42A	Fokker Elmo BV	Participating Affiliate	X								
42B	Fokker Engineering Romania Slc	Participating Affiliate	X			X					
43	Fokker Landing Gear BV	Core Partner						X			
44	Fokker Technologies Holding B.V.	Core Partner	X			X		X			
45	Frequentis AG	Core Partner						X			
45A	Mission Embedded GmbH	Participating Affiliate						X			
46	FRIEDRICH-ALEXANDER-UNIVERSITAET ERLANGEN NUERNBERG	Core Partner						X			
47	Fundación Andaluza para el Desarrollo Aeroespacial (CATEC)	Core Partner				X					
48	Fundación Centro de Tecnologías Aeronáuticas (CTA)	Core Partner				X					
49	Fundacion para la Investigacion, Desarrollo y Aplicacion de Materiales Compuestos	Core Partner	X			X					
50	Fundación Tecnalia Research & Innovation (TECNALIA)	Core Partner				X					
51	GE AVIO Srl	Core Partner	X	X	X		X				
51A	AVIO Polska Sp.z.o.o	Participating Affiliate	X		X						
51B	General Electric Company Polska Sp. Zoo	Participating Affiliate	X				X				
51C	General Electric Deutschland Holding GmbH (GEDE)	Participating Affiliate	X	X	X		X				
51D	Nuovo Pignone SRL	Participating Affiliate					X				
52	GE Aviation Systems Limited	Core Partner		X			X				
53	GE Aviation Czech s.r.o	Core Partner					X				
54	GE Marmara Technology Centre	Core Partner					X				
55	Geven Spa	Core Partner				X					
56	GKN Aerospace Sweden AB	Core Partner	X				X				

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
56A	GKN Aerospace Norway AS	Participating Affiliate					X				
57	GKN Aerospace Services Ltd UK	Participating Affiliate					X				
58	GMVIS SKYSOFT SA	Core Partner	X			X					
60	GOODRICH CONTROL SYSTEMS PRIVATE UNLIMITED COMPANY	Core Partner						X			
61	GOODRICH ACTUATION SYSTEMS LIMITED	Core Partner						X			
61A	GOODRICH ACTUATION SAS FRANCE	Participating Affiliate						X			
62	Hellenic Aerospace Industry SA	Core Partner		X		X					
63	Honeywell International SRO	Core Partner	X					X			
63A	Honeywell Aerospace SAS	Participating Affiliate	X								
63B	HONEYWELL UK LIMITED	Participating Affiliate	X								
63C	COM DEV EUROPE LIMITED	Participating Affiliate						X			
64	IBK-Innovation GMBH & CO. KG	Core Partner			X						
65	IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE	Core Partner				X					
66	INASCO HELLAS ETAIREIA EFARMOSMENON AERODIASTIMIKON EPISTIMON EE	Core Partner				X					
67	ITP Industria de Turbo Propulsores S.A.	Core Partner					X				
67A	ITP NEXT GENERATION TURBINES SOCIEDAD LIMITADA	Participating Affiliate					X				
67B	ITP EXTERNALS SOCIEDAD LIMITADA	Participating Affiliate					X				
68	INEGI - INSTITUTO DE CIENCIA E INOVACAO EM ENGENHARIA MECANICA E ENGENHARIA INDUSTRIAL	Core Partner				X					

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
69	Institut National Des Sciences Appliquées De Toulouse	Core Partner				x					
70	INSTITUTO DE SOLDADURA E QUALIDADE	Core Partner				X					
70 A	INTERVENCAO EM SAUDE OCUPACIONAL, SA	Participating Affiliate				X					
70 B	DBWAVE.I ACOUSTIC ENGINEERING, SA	Participating Affiliate				X					
71	INSTITUTUL NATIONAL DE CERCETARI AEROSPATIALE ELIE CARAFOLI - I.N.C.A.S. SA	Core Partner			X						
72	SIEC BADAWCZA LUKASIEWICZ- SIEC BADAWCZA LUKASIEWICZ INSTYTUT LOTNICTWA (ex INSTYTUT LOTNICTWA)	Core Partner				X		X			
73	INVENT INNOVATIVE VERBUNDWERKSTOFFEREALISATION UND VERMARKTUNG NEUERTECHNOLOGIEN GMBH	Core Partner				X					
74	Israel Aerospace Industries Ltd.	Core Partner				X					
75	ITALSYSTEM SRL	Core Partner		X							
76	ESI ITI GmbH (ex-ITI GESELLSCHAFT FUR INGENIEURTECHNISCHE INFORMATIONSVERARBEITUNG MBH)	Core Partner						X			
77	LATELEC	Core Partner			X						
77 A	Latecoere	Participating Affiliate			X						
78	LORTEK S.COOP	Core Partner				X					
79	M&S Engineering Sk sro	Core Partner			X						
80	Magnaghi Aeronautica Spa	Core Partner		X	X						
81	MANUFACTURE FRANCAISE DES PNEUMATIQUES MICHELIN	Core Partner						X			
81 A	Michelin Espana Portugal SA (MEPSA)	Participating Affiliate						X			
81 B	Michelin Recherche et Technique SA	Participating Affiliate						X			
82	Meggitt A/S	Core Partner				X					
83	MEGGITT AEROSPACE LIMITED - MPC Ltd	Core Partner				X					
84	MT-Propeller Entwicklung GmbH	Core Partner					X				

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
84A	Avia Propeller s.r.o.	Participating Affiliate					X				
85	Noesis Solutions NV	Core Partner				X					
86	Nord Micro AG & CO OGH	Core Partner						X			
87	Novotech- Aerospace Advanced Technology S.r.l	Core Partner		X							
88	OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES - ONERA	Core Partner	X	X		X	X				
89	OFFICINE MECCANICHE IRPINE SRL	Core Partner			X						
90	Dariusz Dabkowski	Core Partner				X					
91	Pall Europe Limited	Core Partner						X			
92	PGA Electronic SA	Core Partner				X					
93	POLITECHNIKA RZESZOWSKA IM IGNACEGO LUKASIEWICZA PRZ	Core Partner						X			
94	Politecnico di Milano	Core Partner		X							
95	Politecnico di Torino	Core Partner		X		X					
96	Polskie Zaklady Lotnicze Sp zoo	Core Partner				X					
97	Protom Group S.p.A.	Core Partner			X						
98	Ramal srl	Core Partner				X					
99	Romaero SA	Core Partner			X						
100	Salver S.p.A	Core Partner			X						
101	SICAMB SPA	Core Partner									
102	SIEMENS Industry Software NV	Core Partner		X		X					
102A	Siemens Industry Software SAS	Participating Affiliate		X							
102B	Siemens Industry Software SRL	Participating Affiliate		X							
103	SOCIETE NATIONALE DE CONSTRUCTION AEROSPATIALE SONACA SA	Core Partner	X								
104	STEP SUD MARE Srl	Core Partner			X						

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
105	Stichting Nationaal Lucht- en Ruimtevaartlaboratorium (NLR)	Core Partner	X	X		X	X	X			
106	SZELIGA GREGORZ (ex SZEL-TECH)	Core Partner				X					
107	TECHNI-MODUL ENGINEERING SA	Core Partner				X					
108	TECHNISCHE UNIVERSITEIT DELFT	Core Partner	X	X		X					
108 A	SAMXL (SAM-XL)	Participating Affiliate	X								
109	Techno System Development SRL	Core Partner			X						
110	Costruzioni Aeronautiche Tecnam SPA (TECNAM)	Core Partner		X							
111	Element Materials Technology Seville S.L.U (ex Testing and Engineering of Aeronautical Materials and Structures SL - TEAMS)	Core Partner				X					
112	THE MANUFACTURING TECHNOLOGY CENTRE Limited	Core Partner		X							
113	THE UNIVERSITY OF SHEFFIELD	Core Partner				X					
114	TTTECH COMPUTERTECHNIK AG	Core Partner						X			
115	ULTRATECH Sp zoo	Core Partner				X					
116	Umbra Group Spa (ex Umbra Cuscinetti Spa)	Core Partner		X	X						
117	UNITED TECHNOLOGIES RESEARCH CENTRE IRELAND, LTD.	Core Partner						X			
117 A	UTC AEROSPACE SYSTEMS WROCLAW Sp. z o.o	Participating Affiliate						X			
118	Universidad Politécnica de Madrid	Core Partner				X					
119	Università degli Studi di Napoli Federico II	Core Partner		X	X	X					
120	Università degli Studi di Pisa	Core Partner		X							
121	Universitaet Stuttgart	Core Partner				X					
122	University of Bradford	Core Partner						X			
123	University of Nottingham	Core Partner				X	X	X			
124	PANEPISTIMIO PATRON (University of Patras)	Core Partner				X					
125	Viola Consulting Srl	Core Partner		X							
126	Vrije Universiteit Brussel	Core Partner				X					
127	ZAKLADY LOTNICZE MARGANSKI & MYSLOWSKI SA	Core Partner				X					

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
128	SAFRAN ELECTRONICS & DEFENSE COCKPIT (ex ZODIAC AERO ELECTRIC SAS)*	Core Partner	X								
129	SAFRAN AEROTECHNICS SAS* (ex ZODIAC AEROTECHNICS SAS)	Core Partner	X								
129 A	Zodiac Cabin Control GmbH	Participating Affiliate	X								
129 B	Zodiac Galleys Europe s.r.o.(ex Driessen Aerospace CZ SRO)	Participating Affiliate	X								
130	SAFRAN CABIN GERMANY GMBH (ex Sell GmbH)*	Core Partner						X			
131	Safran Cabin Catering B.V. (ex Zodiac Aircatering Equipment Europe BV)*	Core Partner	X					X			
132	Safran Passenger Innovations Germany Gmbh (ex-TriaGnoSys GmbH)*	Core Partner	X					X			
133	Safran Seats France (ex Zodiac seats France)*	Core Partner						X			

*Zodiac Aerospace and its affiliated companies were acquired by Safran with effect from 13 February 2018, thus the new legal situation will be taken into consideration by the CS2JU, while assessing admissibility and eligibility of proposals submitted in calls for partners. However, the former Zodiac companies selected by the CS2JU as Core Partners continue to perform their activities under the LPA IADP and SYS ITD under their status of Core Partners until the end of the Clean Sky 2 Programme.

4.4.3 Clean Aviation Founding Members

1. Aciturri Aeronáutica S.L.U.
2. Aernnova Aerospace SAU
3. Airbus SE
4. Centro Italiano Ricerche Aerospaziali SCPA (CIRA)
5. Dassault Aviation SA
6. Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)
7. Fokker Technologies Holding BV
8. Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung e.V.
9. GE Avio S.r.l.
10. GKN Aerospace

11. Honeywell International s.r.o.
12. Industria de Turbo Propulsores S.A.U.
13. Leonardo SpA
14. Liebherr-Aerospace & Transportation SAS
15. Lufthansa Technik AG
16. Łukasiewicz Research Network – Institute of Aviation
17. MTU Aero Engines AG
18. National Institute for Aerospace Research (INCAS)
19. Office National d'Etudes et de Recherches Aérospatiales (ONERA)
20. Piaggio Aero Industries
21. Pipistrel Vertical Solutions d.o.o.
22. Raytheon
23. Rolls-Royce Deutschland Ltd & Co KG
24. Safran
25. Stichting Koninklijk Netherlands Lucht- en Ruimtevaartcentrum (NLR)
26. Thales AVS France SAS
27. University of Patras

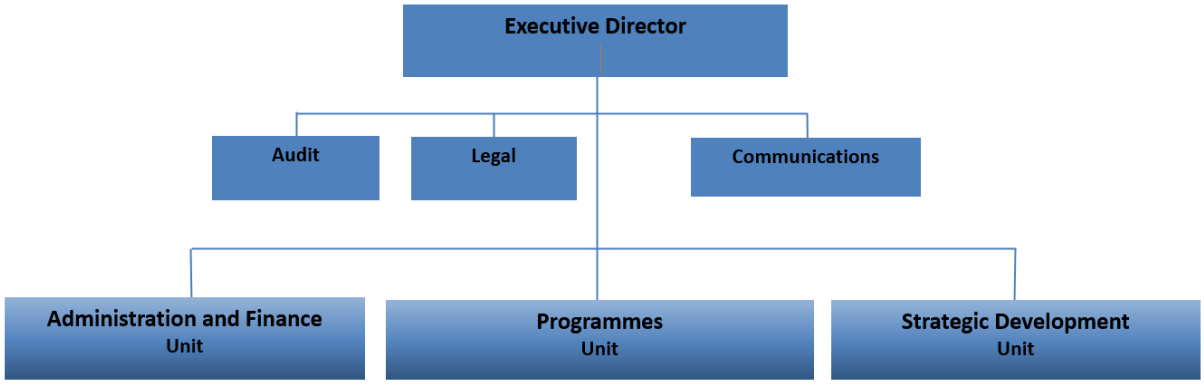
4.4.4 Clean Aviation Associated Members

	Company	MS	Domain	Sector	SMR	HER	H2
1.	Hellenic Aerospace Industry	EL	Aircraft	AERO	✓		✓
2.	Israel Aerospace Industries	IL	Aircraft	AERO	✓	✓	✓
3.	NTNU	NO	University	ENERGY	✓	✓	✓
4.	Politecnico di Torino	IT	University	AERO	✓	✓	✓
5.	Siemens	DE	Equipment/System	DIGITAL	✓	✓	✓
6.	SINTEF	NO	RTO	ENERGY	✓	✓	✓
7.	Solvay	BE	Aircraft	MATERIALS	✓	✓	✓
8.	TECNALIA	ES	RTO	AERO	✓	✓	✓
9.	Tecnam	IT	Aircraft	AERO		✓	✓

	Company	MS	Domain	Sector	SMR	HER	H2
10.	TU Braunschweig	DE	University	AERO	✓	✓	✓
11.	TU Delft	NL	University	AERO	✓	✓	✓
12.	University of Stuttgart	DE	University	AERO	✓	✓	✓

4.5 Organisational Chart

The revised organisational structure of the JU as approved by the Governing Board is shown below. The structure shows the three main units structure.



4.6 LIST OF ACRONYMS, DEFINITIONS AND ABBREVIATIONS

A/C	Aircraft
ACARE	Advisory Council for Aeronautics Research in Europe
ACS	Aircraft Simulator
aECS	Adaptive Environmental Control System
AH	Airbus Helicopters
APU	Auxiliary Power Unit
ARE	Advanced Rear End
AStA	Approach Stabilisation Assistant
ATA	Air Transport Association
ATM	Air Traffic Management
ATN	Aeronautical Telecommunications Network
ATS	Air Transport System
BLI	Boundary Layer Ingestion
CA	Commitment Appropriations
CDR	Critical Design Review
CEI	Call for Expression of Interest
CfP	Call for Proposals
CFRP	Carbon-fiber-reinforced polymers
CfT	Call for Tender
CAJU	Clean Aviation Joint Undertaking
CS2DP	Clean Sky 2 Development Plan
CS2JU	Clean Sky 2 Joint Undertaking
CS-AED	Clean Sky AEronautical Database
CUMS	Cockpit Utility Management System
DAS	Data Acquisition System
DEP	Distributive Electric Propulsion
DGAC	Direction générale de l'aviation civile
DISCO	DISruptive COckpit
DOC	Direct Operating Costs
EASA	European Aviation Safety Agency
EASA´s CS-23	European Aviation Safety Agency Certification Specifications 23
EC	European Commission
ECO	Eco-Design
EDA	Eco-Design for Airframe
EEA	European Environment Agency
eECS	Electrical Environmental Control System
EIS2032	Entry Into Service 2032
EOC	Energy Optimised Cabin

EPGDS	Electrical Power Generation and Distribution System
ECS	Environmental Control System
EMA	Electro Mechanical Actuators
ES	Eco Statement
E-STOL	Hybrid-Electric Short Take-Off and Landing
FDT	Fatigue Digital Twin
FETT	First Engine To Test
FMS	Flight Management System
FRC	Fast Rotorcraft
FSD	Flagship Demonstrator
FSW	Friction Stir Welding
GAM	Grant Agreement for Members
GAP	Grant Agreement for Partners
GHG	Greenhouse gas
GPAHRS	Ground Positioning Attitude and Heading Reference System
GPP	Global Pollution Potential
GRA	Green Regional Aircraft
HER	Hybrid Electric Regional Aircraft
HLFC	Hybrid Laminar Flow Control
HTP	Horizontal Tail Plane
IADP	Innovative Aircraft Demonstrator Platforms
IAO	Internal Audit Officer
IATA	International Air Transport Association
IMBALS	Image Based Landing Solutions
IPS	Internet Protocol Suite
IPT	Intermediate pressure turbine
ITD	Integrated Technology Demonstrator
JTP	Joint Technical Programme
L/S	Low Speed
LCA	Life Cycle Assessment
LCI	Life Cycle Inventories
LiDAR	Light Detection and Ranging
LLF	Low Level Flight
LMD	Laser Metal Deposition
LPA	Large Passenger aircraft
LPT	Low Pressure Turbine
LRI	Liquid Resin Infusion
M	Milestone
MCA	Major Component Assembly
MEA	More Electrical Aircraft
MEMS	Micro-Electromechanical Systems
MFFD	Multi-Functional Fuselage Demonstrator
MPSU	Movable Passenger Service Unit
NGCTR-TD	Next Generation Civil TiltRotor Technology Demonstrator
NPE	Non-propulsive energy
OEM	Original Equipment Manufacturer
OoA	Out of Autoclave
ORAS	Open Rotor and Stator

PA	Payment Appropriations
PDR	Preliminary Design Review
PSM	Pilot State Monitoring
PSU	Passenger Service Unit
QPR	Quarterly Progress Report
R&D	Research & Development
RDPC	Remote Data Power Controller
SAF	Sustainable Aviation Fuel
SAB	Scientific Advisory body
SAGE	Sustainable and Green Engines
SAT	Small Air Transport
SBA	Single Basic Act
SESAR	Single European Sky Air Traffic Management Research
SFD	Scaled Flight Demonstrator
SHM	Structural Health Monitoring
SLD	Super Large Droplets
SMR	Short and Medium Range aircraft
SPD	System & Platform Demonstrator
SPO	Single Pilot Operation
SRIA	Strategic Research and Innovation Agenda
TA	Transverse Activity
TDT	Tie Down TiltRotor
TE	Technology Evaluator
ThM	Thermal Management
ToP	Type of Action
TP	Technology Products
TRL	Technology Readiness Level
UCI	Universal Cabin Interface
UHBR	Ultra-High Bypass Ratio
VAC	Volt AC
WBS	Work Breakdown Structure
WP	Work Package
WT	Wind Tunnel
WTT	Wind Tunnel Test
XDC	Cross Demonstrator Capacity
ZAL	Zentrum für Angewandte Luftfahrtforschung