CLEAN AVIATION
JOINT UNDERTAKING

WORK PROGRAMME and BUDGET 2024-2025

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.

Table of Contents

1 INTRODUCTION

1.1 Mission statement of the Clean Aviation Joint Undertaking

The Clean Aviation Joint Undertaking (CAJU) will develop disruptive new aircraft technologies to support the European Green Deal and achieve climate neutrality by 2050. These technologies will deliver net greenhouse gas (GHG) reductions of no less than 30%, compared to the 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 an 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 this 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. 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 including compatibility with new fuel or energy sources 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 towards 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 effect 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.

The Clean Aviation Joint Undertaking (CAJU) will update the SRIA throughout the first half of 2024 (targeting the adoption by the Governing Board in June 2024) to:

- refine the strategy of the second phase of the programme based on the performed activities and available critical results from projects funded by the partnership since its launch, i.e. in the first phase of the programme;
- include aircraft concepts expected from Clean Aviation including the critical demonstrators and key technologies;
- integrate, at the core of the SRIA, the cooperation based on synergies with other parts and partnerships of Horizon Europe and other EU, National and Regional programmes to maximise impact on the partnership's objectives as set out in the Council Regulation (EU) 2021/2085[1] and the SRIA.

1.3. Strategy for the implementation of the programme

The programme's high-level objectives (HLO) as set in the Council Regulation (EU) 2021/2085 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 HLO.

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:

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

- The first phase of the programme (Phase 1: 2022–2025 – technology maturation) 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 the most promising technology options and integrated solutions.
- The second phase of the programme (Phase 2: 2026-2031 – integration and demonstration), 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.

The 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.

The appropriate number of calls will be defined in the light of the content of the SRIA (up to three calls on a yearly basis over the period 2025-2027) based on critical results from Phase 1 and, proposed approach throughout Phase 2, to accelerate the maturation, integration and demonstration of the most promising breakthrough innovations coherently with private members' market strategies and in particular with the ambition to target entry into service of such innovations by no later than 2035.

Following the successful outcome of the Call for Expression of Interest for additional Associated Members launched in 2023, and in particular taking into consideration the substantial enlargement of the private members, the CAJU members have all the required capabilities to address the ambition of the second phase of the programme.

The CAJU 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, noting that the Clean Sky 2 programme is set to conclude in 2024.

2 WORK PROGRAMME 2024-2025

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 2024 and 2025. It also includes relevant administrative and legal details and aspects regarding the establishment and functioning of the Clean Aviation Joint Undertaking (CAJU).

The joint efforts of the private and public members, together with the JU programme office, will be required in the next two years to ensure the successful implementation of this ambitious and challenging programme. In 2024 and 2025 the CAJU will focus its efforts on the execution of Phase 1 through the implementation, monitoring and assessment of Innovation Actions (IAs) and Coordination and Support Actions (CSAs) selected from the two calls for proposals launched under the Work Programme 2022 and 2023 covering the activities needed in the three thrusts and covering activities in support of the Clean Aviation programme.

The scientific priorities of the programme, its challenges and the expected impact are succinctly described in the next sections organised per thrust and per project. Each of the 28 Clean Aviation daring projects is highlighted in terms of main objectives and major milestones expected during 2024-2025.

In terms of new activities to be kicked off during this period, the CAJU will be planning a third large call, currently foreseen to be launched at the beginning of Phase 2, in the first half of 2025. The topics for this call will be included in an amended version of this Work Programme. The selection of the topics will take place after thorough examination of the first and second call expected results and in alignment with the last Strategic Research and Innovation Agenda (SRIA) update, which sets out the way to achieve the programme's specific objectives and overall vision, in terms of timescales and magnitude of impact. The launch of the next calls will be followed by the subsequent evaluation and selection of proposals for funding, aiming at a start of the projects before the end of the year 2025. The proposals will be subject to independent evaluation and will follow the Horizon Europe rules on calls for proposals.

Building already on the experiences and success stories from the Clean Sky 2 programme, synergies will continue to be an important piece of the 2024-2025 framework. The CAJU will further develop the structured cooperation with the relevant European partnerships, EU agencies, such as EASA and other EU funding programmes, including those managed by national or regional Managing Authorities. Cooperation with Regions and Member States will be reinforced by the ramping up of the implementation of the action plan launched in cooperation with DG R&I "Clean Planet" Directorate to establish strategic cooperations on synergies with the European Aeronautics Regions/Member States and to accelerate the maturation and demonstration of low-emission technologies for an entry into service [EIS] by 2035. The CAJU aims for this cooperation to go beyond what has been achieved under the Clean Sky 2 programme, in which Memoranda of Understanding (MoU) were signed with Member States/Regions largely through aligning regional smart specialisation strategies and operational programmes, as well as leveraging synergies with National/Regional funding (e.g. ESIF).

Communication and outreach activities will ensure that stakeholders and target audiences are duly informed about the CAJU and will position the CAJU as the European Hub for research & innovation in the aeronautics sector, while re-enforcing its positive reputation as a European Public-Private Partnership that develops disruptive new aircraft technologies to support the European Green Deal ambition to achieve climate neutrality by 2050.

The CAJU will continue to implement sound financial management of all its activities in accordance with the principles of the Internal Control Framework and Financial Rules. Business processes and

procedures will be adapted to the provisions set forth in the Single Basic Act, and new ICT systems will be deployed over the period 2024-2025, to support both operational and administrative activities. Lastly, the CAJU will closely monitor the implementation of its budget and staff establishment plan and will continue its close cooperation with the other Joint Undertakings in matters of shared interest, in particular via the implementation of the Back Office Arrangements (BOA).

2.2 Message from the Executive Director

Dear Readers,

I am delighted to introduce the Clean Aviation Work Programme for the years 2024 and 2025. Since its launch in 2021, the Clean Aviation Joint Undertaking has been at the forefront of pioneering technologies that are driving the sustainable aviation revolution, working towards the industry's target of achieving climate neutrality by 2050.

Our 28 daring projects focus on the development and demonstration of the most promising technologies and solutions by 2028/2029, to support an entry-into-service of new, highly efficient aircraft by 2035. Those technologies will help to reduce fuel burn and net emissions of greenhouse gases for commercial air travel by no less than 30% compared to the state-of-the-art aircraft models available today.

The programme's first phase runs until 2025/2026 and will concentrate on the development and maturation of technologies and solutions, while the programme's second phase from 2025 to 2029 will focus on the integration and demonstration of the best candidate technologies for the most promising aircraft concepts. Our revised Strategic Research and Innovation Agenda (SRIA) planned for mid-2024 and the initial results of the first programme phase will guide us in setting the priorities for phase two.

I warmly welcome you to discover our projects' key innovation priorities, challenges and expected impact as listed in this Work Programme.

With the recent expansion of our Membership to 59 Members, the Clean Aviation Joint Undertaking now possesses all the necessary capabilities required to address the programme's ambitions. However, achieving climate neutral aviation by 2050 is a massive challenge and can only be achieved by joining forces at EU, national and regional levels.

Therefore, maximising synergies with programmes and initiatives across Europe contributing to sustainable aviation will remain a core priority of Clean Aviation throughout 2024-2025. We will continue to closely cooperate with the European Union Aviation Safety Agency (EASA), and with European Partnerships such as Clean Hydrogen JU, SESAR3 JU and BATT4EU. In parallel we will seize new cooperation opportunities within Horizon Europe, and will also investigate opportunities with other EU programmes such as the European Innovation Fund.

We are also enhancing our collaboration with European aeronautics regions and Member States. Our recent Memoranda of Cooperation with Campania (IT) and Occitanie (FR) mark the initial successes of this endeavour. To continue it, I extend an invitation to interested national and regional authorities wishing to join us to express their intention to collaborate.

While our focus remains on the years ahead, it is equally important to take a moment to reflect on and celebrate the achievements of the past. As the Clean Sky 2 programme nears its conclusion in 2024, it will have notched up an impressive tally of close to 1000 entities from across Europe, delivering more than 100 demonstrators and over 1,000 innovative technologies designed to propel the sustainable aviation systems of the future. Notable accomplishments encompass ground-breaking innovations such as the Ultra Fan engine, the Multi-Functional Fuselage Demonstrator, and the RACER helicopter.

In conclusion, together we can achieve extraordinary milestones and transform the aviation industry for generations to come. With this Work Programme, we are setting the crucial steps in turning this shared vision into reality. I hope that you enjoy reading about our planned flight path.

Axel Krein
Executive Director

2.3 Operational activities of the 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 technologies to pave the way towards the EU's ambition of climate neutrality by 2050. The CAJU will develop and demonstrate technologies that deliver net greenhouse gas (GHG) reductions of no less than 30%, compared to the 2020 state-of-the-art technology. The technological and industrial readiness will allow the entry into (commercial) service of new aircraft capable of these reductions by no later than 2035, with the aim of replacing 75% of the world's civil aviation fleet 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 up to 90%. The CAJU 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 contributing to the replacement of 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 high-level 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.

[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).

Three key "***thrusts***" have been identified, each with targeted R&I and demonstration efforts driving the energy efficiency and the emissions reductions of future aircraft by realising 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 and likely to be more expensive:

- 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.
- 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.
- 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 (to be established) Grant Agreements during the period 2024-2025 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 (HPA).

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 routes under 1000km, aircraft for classical short- and medium-range distances will 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 (2022-2025) is focused on selecting, maturing and qualifying 'best athlete' technologies to exploit their full potential integrated into an ultra-low emission single aisle, short/medium range aircraft. In line with the roadmap, the selected projects aim to improve the energy efficiency of a new generation of short/medium-range aircraft by 30%. This is being targeted by no later than 2035 thanks to a combination of disruptive technologies related to the airframe with ultra-efficient propulsion systems and their integration. The selected projects also focus on 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.

The SMR 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 at the end of this section..The roadmap to develop, mature and demonstrate this vehicle is composed of two programme phases.

The first phase of the programme (2022-2025) is based on the distinct specification of top-level aircraft requirements that are framing the boundaries of a 'technology workspace' for candidate technologies and concepts. This phase involves finalising the conceptual design and the preliminary design

characteristics of the targeted demonstration aircraft by selecting the best configuration. This is 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 is being 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.

Clean Aviation projects selected in the first phase of the programme and contributing to the development of an ultra-efficient SMR include HEAVEN, developing an Ultrafan with hydrogen and hybrid gas turbine engine; SWITCH, developing a sustainable Water-Enhanced-Turbofan (WET) comprising hybrid-electrics; OFELIA, developing an Open fan engine demonstrator; UPWING, developing an ultra-performance wing; FASTER H2, developing the fuselage and empennage integration of a H2-powered aircraft; and the SMR ACAP project, developing a new SMR aircraft architecture and technology integration. This list of projects is completed with projects selected in the Second Call for Proposals launched in 2023 (AWATAR and COMPANION).

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 of the programme 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 tables below outlines the activities and critical milestones in 2023-2026 for the projects launched in the First Call for Proposals in the SMR thrust.

SMR Thrust

Legend
Project duration
★ Mid-term "gate reviews"
▲ Impact Monitoring outputs

Project	Main technology	2023	2024	2025	2026
ACAP Jan 2023 - June 2026	SAF and LH2 concepts for SMR applications	-Initial Concepts -First Release Digital Backbone	-TRL3 SAF concept -TRL2 H2 concept -Preliminary Life Cycle Assessment report	System maturation such as: TRL3 Inductive Anti-Ice Systems; TRL5 Electric Environmental Control System	-TRL4 SAF concept -TRL3 H2 concept
OFELIA Nov 2022 – Dec 2025	TRL5 OpenFan engine architecture for SMR		- TRL4 on key technologies	-TRL5 OpenFan architecture	
SWITCH Jan 2023 - Dec 2025	Hybrid Water-Enhanced Turbofan	-TRL3: Electric Aircraft Propulsion (EAP)	-TRL4 EAP -TRL 3 Hybrid Water Enhanced Turbo Fan	-TRL5 EAP -TRL 4 Hybrid Water Enhanced Turbo Fan	
HEAVEN Jan 2023 – Dec 2026	SMR UltraFan®		TRL4 Advanced Low Speed Fan and Intake	TRL4 SMR PGB, Combustor, High Load IPT and Fuel System	-TRL5 Advanced SMR Subsystem Technology

Project	Main technology	2023	2024	2025	2026
FASTER-H2 Jan 2023 – March 2026	Ultra-efficient and hydrogen enabled integrated airframe (rear fuselage and empennage)		-TRL3 Down-selection - H2 Storage & Systems Integration/Safety/ Green Aerostructures	-TRL4 Storage/ Integration/Structures	-TRL5 Storage /Integra tion
UP Wing Jan 2023 - June 2026	Ultra Performance Wing – Integrated HAR SAF Wing		-TRL3 Novel control/ Unconventional lam inates/ MF Trailing edge/ Compact LE devices	- TRL4 High Aspect Ratio multifunctional Wing design/Novel control/ Compact LE devices	-TRL4 Unconventional laminates/ MF Trailing edge -TRL5 Novel control
AWATAR* Jan 2024-Dec 2026	Ultra Performance Wing Technologies and Integration for Short and Short-medium Range Aircraft (dry wing)	*GA in preparation			
COMPANION* Jan 2024-Dec 2026	High-TRL Flight Demonstration Means for Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft				

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 on routes under 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 aircraft certification rules.

Vision 2030 and following

By mid-2030, mobility of people and goods is expected to undergo progressive changes, especially on routes under 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 routes 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 are 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 are 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 can shorten time-to-market and affordability are pursued. The development of regulations and new infrastructure to support such disruptive aircraft configurations is a key complementary issue to address 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 involve several interdependent areas of research.

In a **first phase** (up to 2025) the building blocks and different integration options are studied back-to-back for their potential and integration perspective to identify the most promising architectures.
Clean Aviation projects selected in the first phase of the programme and contributing to the development of a Hybrid Electric Regional Aircraft include HE-ART and AMBER, developing Multi-Mega Watt hybrid electric power trains and related techno-bricks; TheMa4HERA, developing thermal management solutions; HECATE, developing electric distribution solutions; HERWINGT, developing green technologies for wing integration; and HERA developing a new HER aircraft architecture and

technology integration. The list of projects is completed with projects selected in the Second Call for Proposals launched in 2023 (HERFUSE and ODE4HERA).

In a **second phase,** most promising technologies having potential for entry into service by 2023 will be further matured and validated via major ground and flight demonstrators.

The table below outlines the activities and critical milestones in 2023-2026 for the projects launched in the First Call for Proposals in the HER thrust.

HER Thrust

Project	Main technology	2023	2024	2025	2026
HERA Jan 23 - Dec 2026	Hybrid-Electric Regional aircraft concepts Use-Case A : twin engine Use-Case B : distributed propulsion	A/C concepts. Requirements.	Prelim. Design. Linked projects techno assess.	Prelim. Design iteration & Trade-offs	A/C integration Archi. selection. TRL4 (A/C level)
AMBER Jan 23 - March 2026	MW Hybrid Electric power train. Thermal engine, Fuel Cell system, electric-motor, gear box & propeller, systems.	Conceptual system design	Preliminary design. Demo preparation	Critical Design TRL4 Demo/testing	
HE-ART Jan 23 - Dec 2025	MW Hybrid Electric power train. Thermal engine, electric-motor, gearbox & propeller, power management	Requirements & architecture Test bench PDR	Detailed design CDRs Demo preparation	TRL 4 to 5 Demo/testing	
TheMa4HERA Jan 23 - Dec 2026	Thermal management systems Cabin air supply / conditioning / distribution Hybrid Electric systems cooling	Architecture & techno trades.	Design/Modelling. Demo preparation	TRL4 Demo/testing	TRL5 Demo/testing. Scaling studies.
HECATE Jan 23 - Dec 2025	Integrated High Voltage electrical distribution Primary and Secondary power distribution. Power conversion, control, cables/connectors.	Requirements & architecture	Detailed design CDRs Demo preparation	TRL5 Demo/Testing	
HERWINGT Jan 23 - Dec 2025	Innovative Wing architecture (cantilever, strut-brace, distributed propulsion, high aspect ratio) Advanced composite materials structures H/E propulsion and systems integration	Innovative wing architecture and requirements	Detailed design. CDRs Demo preparation	TRL5 Demo/Testing	
HERFUSE* Jan 2024 – Dec 2026	Innovative fuselage and empennage Advanced composite materials structures H/E energy storage and systems integration	*GA in preparation			
ODE4HERA* Jan 2024 – Dec 2026	Open Digital Platform for HER aircraft dev. (MBSE, MDO, SDM, PLM)				

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 biofuels, resulting in low or net-zero CO_2 emissions, and non-drop-in fuels such as hydrogen, resulting 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.

The advantages of hydrogen over drop-in fuels are clear: hydrogen as an on-board fuel or energy source 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 challenges, 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, in a first phase (up to 2025), Clean Aviation matures and demonstrates 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 are considered from the beginning.

Clean Aviation projects selected in the first phase of the programme and contributing to the development of disruptive technologies to enable hydrogen-powered aircraft include CAVENDISH and HYDEA, developing hydrogen-burn turbine demonstrators; NEWBORN, developing next generation of hydrogen fuel cells-based powertrain; H2ELIOS, developing an innovative hydrogen light-weight tank; FLHYing Tank, developing hydrogen light-weight tank demonstrator; and HYPOTrade, developing hydrogen fuel cell electric powertrain demonstrator. This list of projects is completed with projects selected in the Second Call for Proposals launched in 2023 (TROPHY, FAME, HEROPS).

Systems are developed 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). Building on this, radical short and medium range aircraft are expected to 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 is laying the foundations for the future clean hydrogen aircraft propulsion architecture.

The table below outlines the activities and critical milestones in 2023-2026 for the projects launched in the First Call for Proposals in the HPA thrust.

HPA Thrust

Project	Main technology	2023	2024	2025	2026
HYDEA Jan 2023 – Dec 26	H2 combustion system, engine fuel system, engine integration and controls, H2 burn low NOx, aircraft integration.	TRL2 Prelim. Engine system architecture / Combustor modelling and initial test	TRL3 Combustor modelling and test / Fuel System Preliminary Design	TRL4 Emissions Characterization (full combustor test)/ Fuel System Critical Design	TRL5 integrated LH2 engine ground test
CAVENDISH Jan 2023 – Dec 26	H2 combustion system, LH2 engine fuel system, engine integration and controls, dual-fuel system, Cryo-compressed H2 tank system	TRL3 1st full annular test	Dual fuel injectors developed. 1st engine test (reference engine operation)	TRL4 Dual fuel Injectors tested Engine test preparation	TRL5 Full engine test (LH2 integration) Tank demonstrator tested
NEWBORN Jan 2023 – June 26	Fuel cell power source, high voltage battery system, electrical propulsion system, LH2 storage.	System architecture freeze	Prelim design FC stack assembly completed	TRL3 Sub-system proof of concept testing	TRL4 Integrated full system test
H2ELIOS Jan 2023 - Dec 2025	Composite foam insulated tank, LH2 refuelling system, tank pressure control system, SHM/H2 sensor	TRL3 System feasibility design review	TRL4 Critical design review Digital twin architecture completed	TRL5 Integrated LH2 tank ground test Structural test	
HyPoTraDe Jan 2023 - Dec 2025	FC powertrain control system, DC-DC converter, high voltage battery pack, cryo enabled thermal management system, distributed propulsion system	TRL3 Prelim system architecture	TRL4 Scaled H2 conditioning tested 500kw distributed propulsion tested	TRL5 Powertrain test campaign completed	
FLHYing Tank Jan 2023 - Dec 2025	Composite vacuum insulated tank, LH2 re-fuelling and supply system, tank pressure control system.	TRL2 Tank architecture definition (Preliminary design review)	TRL3 Critical design review Sub-system and instrumentation assembly completed	TRL5 Tank flight test campaign drone A/C Thermo-fluid-structural digital twin validation	

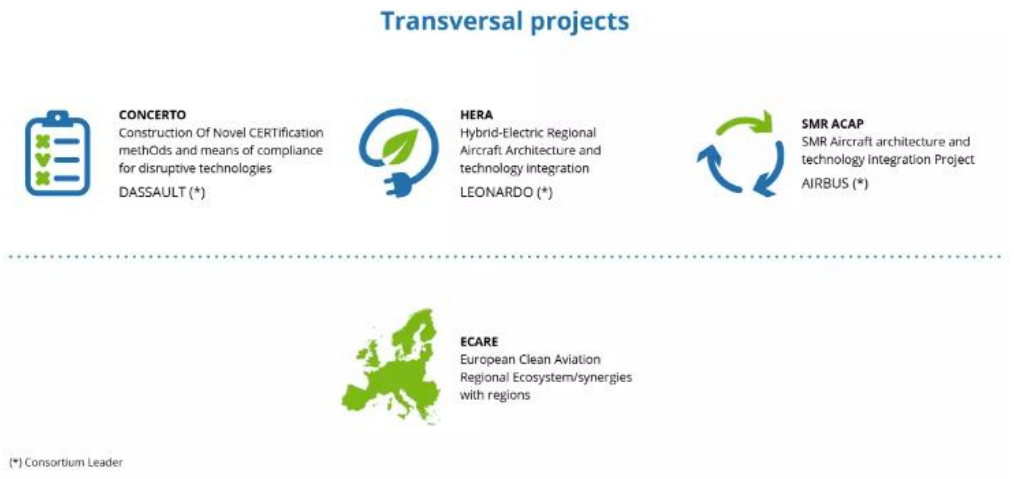
Project	Main technology	2023	2024	2025	2026
TROPHY* Jan 2024 – Dec 26	H2 fuel system development, waste heat recovery system, aircraft-engine control integration, Flight test preparation	*GA in preparation			
FAME* Jan 2024 – Dec 2026	Fuel cell power source, electrical propulsion system, LH2 storage.				
HEROPS* Jan 2024 – Dec 2026	Fuel cell power source, electrical propulsion system, LH2 storage.				

Legend
Project start
Mid-term "gate reviews"
Impact Monitoring outputs

Transversal Areas - Project summaries

The thrusts are supported by transverse projects, which will define aircraft requirements and explore certification needs to align the technology development in the different Clean Aviation projects.

Clean Aviation has three transversal projects in the First Call for Proposals. The first one is **CONCERTO**, which addresses the growing certification challenges associated with the three thrusts. The other two projects deal with aircraft integration supporting SMR and HER concepts, namely **SMR ACAP** and **HERA** projects. All other impact action projects under Clean Aviation contribute directly or indirectly to at least one of these two (or to both) aircraft thrusts, including hydrogen powered aircraft projects. Finally, a supporting action, **ECARE**, draws links between European/national/regional roadmaps and aeronautical stakeholders and co-creates synergies through a pilot. In the Second Call for Proposals, a supporting action, **CLAIM,** will analyse the worldwide community of climatology and atmospheric sciences, and of aviation climate impact and its greenhouse gas emissions contributions.



- **CONCERTO** (Construction Of Novel CERTification methOds and means of compliance for disruptive technologies) - Project Reference: 101101999

1. Objectives

Clean Aviation's ambition to go over decisive impactful steps in demonstrated disruptive aircraft performance compatible with 2035 EIS will only be possible if the future regulatory framework is not an impediment to innovation. Having a de-risked certification path is an important step, to which CONCERTO will contribute.

The project will deliver a comprehensive set of regulatory materials and a preliminary description of means of compliance for critical challenges for certification to the three ""thrusts"" of Clean Aviation, tackled through Proof of Concepts in CONCERTO. Additionally, a first status of a digital framework to support collaborative model/simulation-based processes for certification will be delivered.

Critical challenges for certification for the regional and short and medium range aircrafts, including hydrogen, will be easily transposable and scalable to different product lines and aircraft segments such as general aviation, rotorcraft, business jets or commercial medium-long range affecting the complete fleet.

The composition of the project consortium reflects a mix of aircraft manufacturers (for large and small airplanes (CS-25 and CS-23)), engine manufacturers (CS-E), equipment manufacturers, research centres, universities and SME. The involvement of EASA experts acting together with industrial and research technical teams for the conception, the endorsement of new solutions, and the enhancement of the international community acceptance, is also essential.

2. Description of major milestones for the year 2024-25

1. Definition of the CRL (Certification Readiness Level) scale and metrics for Proof of Concept studies	Due date: Q1 2024
The CRL (Certification Readiness Level) scale is a new scale for evaluating the maturity of disruptive technologies in terms of certification. The CRL scale has six levels, each of which represents a different stage in the certification process and it will be applied with expected results and metrics for each PoC.	
2. Iron Bird Hardware in the Loop (HiL) Flight Control Computer (FCC)	Due date: Q2 2024
The Iron Bird HiL with FCC constitutes a first step for the Iron Bird / HiL demonstration including external hardware and avionics buses. Most of the aeroservoelastic model will still be simulated, but the control laws and active wing functions will run on a separate flight control computer (FCC). This step will validate the avionics bus communication as well as the flight control computer software development workflow. As such, it constitutes a significant milestone in the development of the Iron Bird / HiL demonstration.	

3. High Voltage Distribution (HVD) Regulations Gap analysis	Due date: Q3 2024
Based on a HVD generic concept, the critical areas and gaps in the current certification regulations (i.e. CS-25, CS-23 and CS-E) and in the impacted standardisation bodies (such as EUROCAE) are identified.-	
4. Experimental Validation Aircraft (EVA) flight tests commenced	Due date: Q2 2025
The inaugural flight of the EVA in mid-2025 will signify the culmination of the design, manufacturing, and ground testing phase. It will also indicate that all necessary flight authorisations have been granted by the relevant authorities. This significant milestone denotes the moment when the EVA can serve as a flying testbed for experimenting with flexible aircraft control systems.	
5. Availability of draft regulatory material s (including Means of Compliance) for the H2 PoC study	Due date: Q4 2025
Draft regulatory materials for the new H2 technologies, as well as the draft means of compliances are available.	
6. Digital Certification environment feasibility study	Due date: Q4 2025
The results of the feasibility study of a digital certification environment, based on the analytical work on the digital transformation to be conducted associated with the results on experiments on key features, are available. A commonly agreed estimation of the level of maturity of the different changes to be conducted is also available. This will serve as a recommendation for actors in the sector, paving the way for future implementation.	

- **SMR ACAP** (SMR AirCraft Architecture and technology integration Project) - Project Reference: 101101955

1. Objectives

SMR ACAP shall be the central place to assess and integrate all technologies at aircraft level, from across the projects in the SMR thrust. The setup of the ACAP project is tailored to steer and manage the definition of the targeted SMR aircraft configurations to deliver solutions aligned with the Clean Aviation high level goals: to reduce the greenhouse gases by -30% compared to 2020 state-of-the-art technology; to support the launch of new products by 2035 and with the aim of replacing 75% of the fleet by 2050.

In order to accelerate the maturation of the technologies, ACAP will also provide a digital collaborative framework with tools, means and skills enabling the continuous linking of all R&T activities within the SMR pillar.

Coordinated by Airbus, the project consortium compromises a well-balanced mix of innovative actors from the aeronautical industry covering almost all technical disciplines of aircraft R&T complemented by a strong foundation of Academia and Research and Technology Organisations.

The ACAP project aims to identify "best athlete" SMR aircraft concepts before the end of Phase 1 and, based on a sound analysis of the expected impact with respect to the Clean Aviation high-level objectives, to propose which technologies shall be further developed and demonstrated in Phase 2.

2. Description of major milestones for the year 2024-25

1. TRL3 Aircraft Concepts using SAF as energy source	Due date: Q4 2024
This review will cover all short and medium range (SMR) aircraft architecture concepts using Sustainable Aviation Fuel (SAF) as energy source that are being developed within the Clean Aviation SMR-ACAP project. The different SMR aircraft concepts will also integrate the relevant technologies developed in other Clean Aviation projects. This review will address the evidence of each of the agreed TRL3 Technology Readiness Criteria. Industrial panel members will assess the evidence and provide their final view on the maturity of the aircraft concepts presented, resulting in a ranking of the aircraft concepts meeting the Clean Aviation high level goals.	
2. TRL2 Aircraft Concepts using LH2 as energy source	Due date: Q4 2024

This review will cover all short and medium range (SMR) aircraft architecture concepts using Liquid Hydrogen (LH2) as energy source that are being developed within the Clean Aviation SMR-ACAP project. The different SMR aircraft concepts will also integrate the relevant technologies developed in other Clean Aviation projects. This review will address the evidence of each of the agreed TRL2 Technology Readiness Criteria. The panel members will assess the evidence and provide their final view on the maturity of the aircraft concepts presented, resulting in a ranking of the aircraft concepts meeting the Clean Aviation high level goals.	
3. Architecture Trades for Propulsive Energy / Non-Propulsive Energy system	Due date: Q2 2025
One of the project objectives is to investigate new overall aircraft systems architectures. The aim is to mature the engine hybridisation architectures in order to optimise the behaviour of the engines by supporting them with an electrical system. The principles are very similar to those considered in the automotive industry where hybridisation starts to become a standard. In order to do so, it is key to mature the propulsion and non-propulsion energy architecture of the aircraft, and develop the associated technology bricks, and optimise their behaviour to reduce fuel consumption. This is to contribute to the high-level goals of Clean Aviation in terms of reduction of net greenhouse gases.	
4. TRL End-Year Review	Due date: Q4 2025
This review will cover the short and medium range (SMR) aircraft architecture concepts using Sustainable Aviation Fuel and Liquid Hydrogen as energy source that are being developed within the Clean Aviation SMR-ACAP project. The different SMR aircraft concepts will also integrate the relevant technologies developed in other Clean Aviation projects. This review will address the status of the evidence of each of the agreed TRL3/TRL4 Technology Readiness Criteria. This review will identify gaps that need to be delivered for the Technology Readiness Review planned in 2026 and ensure that the project is well on track to deliver to meet the Clean Aviation high level goals.	

- **HERA** (Hybrid-Electric Regional Architecture) - Project Reference: 101102007

1. Objectives

The Hybrid-Electric Regional Aircraft (HERA) project being part of the regional thrust will assess and analyse different concepts of hybrid electric regional aircraft and their key system architectures. This will enable significant block fuel and emission reduction (>50%). The HERA concepts, seating approximately 50-100 passengers, will operate in the regional and short-range air mobility by mid-2030 on typical missions of up to 500 km. The HERA concepts will include hybrid-electric propulsion based on batteries or fuel cells as energy sources supported by SAF or hydrogen burning for the thermal source, to reach up to 90% lower emissions while being fully compliant with ICAO noise rules. In this respect, HERA will quantitatively evaluate innovative aircraft architectures integrating disruptive enabling technologies including high voltage MW scale electrical distribution, thermal management, new wing and fuselage as well as the new hybrid-electric propulsion and related new energy storage at low GHG. To support this unprecedented integration challenge, HERA will develop suitable processes, tools and simulation models to support the new interactions, workshare in the value chain and interfaces among systems and components. HERA will also elaborate on the future demonstration strategy of a hybrid–electric regional aircraft in Phase 2 of Clean Aviation to support the high TRL demonstration required for an early impact for HERA solutions.

The HERA concepts targeting entry into service by mid-2030 will pursue new certification rules and be able to interact with new ground infrastructure, supporting new energy sources. This will make the HERA concepts ready for actual revenue service, offering to operators and passengers sustainable, safe and fast connectivity means at low GHG emissions.

2. Description of major milestones for the year 2024-25

1. Assessment of the technologies from the linked projects (first loop)	Due date: Q1 2024
Hybrid Electric Regional Thrust will advance in the development of major systems that are key for the development of Hybrid Electric A/C concepts (thermal management, high voltage electrical distribution, fuel cells and H2 tanks). In the light of the cooperation agreement and cooperation plan, system features and technical information will be shared with HERA. Thus, a detailed assessment of the different systems' performances and of the related key characteristics is carried-out in order to assess compliance with initial requirements and systems' interfaces and then to secure a robust integration into the two HERA aircraft concepts – first design loop.	
2. Release of Design tool (software and methods) for preliminary aircraft design of the new configuration	Due date: Q3 2024
The development of a new architecture of Hybrid electric regional A/C requires the development of new high-fidelity tools and numerical modules representative of the different sub-systems (thermal, electric, propulsion, structures, aerodynamic, flight physics, etc). The first integrated design tool chain is released to enable the complete design of two HERA aircraft concepts.	
3. Mid-term review of the two Hera Aircraft Concepts (Use cases A and B)	Due date: Q4 2024
The second release of the 2035 aircraft concepts embedding hybrid-electric propulsion, innovative wing design, thermal and electrical systems enabling significant reduction in emissions and fuel consumption are released. This includes integration of consolidated systems architectures coming from other linked Clean-aviation projects. Aircraft performances on typical missions will be assessed with respect to the programme objectives.	
4. Engine Interfaces Review Revision (second loop)	Due date: Q4 2025
Final architectures of the Hybrid Electric power train are released to HERA for the integration into the final A/C loop of design. This includes integration of consolidated power train design concepts such as thermal and electrical power units, propeller, gearbox, electrical and thermal management systems.	
5. Third year review of the two Hera Aircraft Concepts (Use cases A and B)	Due date: Q4 2025
The third release of the 2035 aircraft Concepts, embedding consolidated architectures and solutions for hybrid-electric propulsion, innovative wing, thermal and electrical systems (inputs coming from other linked CA projects), is delivered.	
6. HERA impact monitoring constraints and high-level targets	Due date: Q4 2025
Third loop of design of the HERA 2035 Aircraft concepts is finalised. Final requirements and constraints for the Impact Monitoring evaluation are released. The aircraft (Technical and environmental) performances are assessed on typical missions and compared to a 2020 reference aircraft	

- **ECARE** (European Clean Aviation Regional Ecosystem) - Project Reference: 101101970

1. Objectives

To reach European climate neutrality by 2050 as envisioned by the European Green Deal, it is necessary to drastically reduce emissions from aviation. The CAJU has set out an exceptionally ambitious innovation programme to achieve this goal but it is also necessary to create synergies with the different aeronautical regional/national funding programmes in order to create leverage effects and maximise funding impact.

ECARE project's objective is to draw links between European/national/regional roadmaps and aeronautical stakeholders and co-create synergies through a pilot covering four major aeronautical European regions (Occitania and Nouvelle-Aquitaine in France, the State of Hamburg in Germany and Campania in Italy) with the aim of creating a methodology that is expandable to other aeronautical European regions. The resulting ECARE digital platform will provide firstly a mapping of funding opportunities, relevant projects, scientific and industrial resources, (and secondly a forum for exchange of information. The ECARE Stakeholders Group (funding bodies, clusters and other aeronautical

stakeholders) will foster and spread the ECARE methodology. After more than a hundred interviews with aviation players, national and transnational workshops will co-elaborate and provide recommendations for the Phase 2 implementation by 2025.

The consortium is composed of three major European aeronautical clusters (Aerospace Valley, Hamburg Aviation and Campania Aerospace District) and one Belgian SME specialised in aeronautics technology services (EASN-TIS). All are experts in their domain and other European aeronautical clusters are involved as well, inter alia, via the EACP (European Aeronautical Clusters Partnership) partnership coordinated by the Hamburg Aviation cluster. Eventually the project is expected to bring together more than 300 entities via the ECARE digital platform and 30 ECARE Stakeholders Group members that will collaborate on the synergy to help the European aviation achieve its ambitious goals.

2. Description of major milestones for the year 2024

1. Transnational workshop	Due date: Q4 2023
The workshop will bring together all project stakeholders to develop initial recommendations for a synergy methodology. Project stakeholders include regional and national funding bodies, representatives of ministries, clusters and business networks. The workshop will promote a common understanding of the funding, synergies and opportunities in the European aviation industry. It will result in a number of concrete recommendations, new funding and methodologies for future synergies, which will be proposed by the ECARE project.	
2. First set of recommendations for synergy	Due date: Q1 2024
Building on the work performed, the ECARE consortium will propose a first set of recommendations for funding and synergies. These recommendations will be developed through a collaborative process involving stakeholders from Europe. These recommendations will be based on the work performed at national and transnational workshops, the mapping of the current landscape of funding, projects, and the stakeholders' competences in the European aviation industry. The ECARE methodology will ensure that the recommendations are aligned with the needs of the industry and are realistic in terms of implementation.	
3. National Workshops session 2	Due date: Q2 2024
The second set of National Workshop (NWS) with regional and national funding bodies will be held in April 2024, building on all the previous work of the ECARE project. The goal of the first NWS was to consult with funding bodies and get their feedback on the industry/RTO interview outputs, their experience, best practices, synergies, gaps, and needs. The second NWS will refine the new potential synergies, funding opportunities, and recommendations identified in the first NWS, by taking into account the new knowledge and information that has been further gathered and developed.	
4. Validated Recommendations for synergies	Due date: Q2 2024
The ECARE project will validate a set of recommendations for synergies between regional, national, and European funding bodies. These recommendations will help to improve collaboration and coordination between these actors, and to support the development of new funding and synergies for clean aviation technologies. These recommendations will be included in a handbook that will be developed as part of the project's deliverable D4.1. This handbook will be a valuable resource for all funding bodies in Europe.	
5. Digital platform available for ESG members	Due date: Q2 2024
ECARE digital platform will be online and available to ECARE Stakeholder Group (ESG) members. This is an initial phase of the platform where ESG members will have full access to the digital platform and the development team will gather feedback to incorporate any upgrades and improvements. The platform will provide a single point of reference for information on funding opportunities, past and present projects, and stakeholder competences from across the European aviation industry. The platform will facilitate collaboration and networking, playing a significant role in driving innovation and growth in the sector.	
6. Digital platform publicly available	Due date: Q4 2024
The final updated version of the ECARE digital platform will be made available to the public. A business plan will be developed to ensure the platform's long-term viability.	

- CLAIM (Clean Aviation Support for Impact Monitoring) - Project Reference: 101140632

The CLAIM project main objectives are firstly to obtain an answer on how to best translate the Clean Aviation high-level objective to reduce net greenhouse gas emissions by at least 30% into tangible metrics, and secondly to compile an inventory of relevant aeronautical advanced research activities and technology areas. The project will collect and analyse the current level of scientific understanding within the worldwide community of climatology and atmospheric sciences, and of aviation climate impact and its greenhouse gas emissions contributions. It will also identify knowledge gaps, barriers, and needs for research. The inventory of relevant aeronautical advanced research will include elements not only from the aviation community but potentially also from other sectors. Among others, the project will

- analyse aeronautical literature on "disruptive aircraft concepts" as well as on climate-neutral aviation in general, including their (preliminary) environmental performance/results;
- propose an approach that highlights the assumptions and metrics used to reconcile the numbers and the prospects of performance improvements for the main technologies;
- categorise these concepts in terms of aerodynamics, structural, systems and propulsion technologies and their associated benefits at aircraft level;
- perform a preliminary performance assessment using proposed assumptions and criteria for an SMR and an HER aircraft.

Consequently, through achieving its objectives, the CLAIM project will assist the CAJU, the EC and EASA by providing more clarity on metrics and expected outcomes.

First Call for Proposals project summaries

The diagram below provides an overview of the projects in the First Call for Proposals centred around the 3 thrusts. It is followed by a short description of each project and its major milestones for 2024-2025.

Ultra Efficient Short & Medium Range Aircraft (SMR)

- OFELIA (Open Fan for Environmental Low Impact of Aviation) - Project Ref.: 101102011

1. Objectives

Reducing SMR aircraft environmental impact is a priority of the Clean Aviation SRIA, which objective is to have technologies ready for the future generation of SMR aircraft. The engine is key in this effort and the Open Fan engine architecture is the most promising solution in terms of fuel efficiency to both achieve environmental goals (20% emissions reduction versus 2020) and target a rapid entry into service, as early as 2035. In synergy with national programmes, OFELIA gathers a large European consortium to contribute to the RISE technology demonstration announced in June 2021. OFELIA aims to demonstrate at TRL5 the RISE Open Fan architecture, for the SMR to achieve or surpass the Air Transport Action Group's goals on the way towards Carbon neutrality by 2050. To this end, OFELIA will focus on a high TRL full scale demonstration of the engine architecture and on the development of key enablers for the Open Fan. OFELIA will allow installation of an increased fan diameter on a conventional aircraft configuration, thanks to innovative turbomachinery technical solutions.

Following the architecture definition, OFELIA will perform a large-scale Open Fan engine ground test campaign, deliver a flightworthy propulsive system definition and prepare an in-flight demonstration for the phase 2 of Clean Aviation.

The project will also optimise the engine installation with the airframer and address certification, in close collaboration with airworthiness authorities, taking advantage of the permit-to-fly activity.

OFELIA will then deliver a TRL5 Open Fan engine architecture for SMR, demonstrate a credible path to 20% CO2 reduction versus 2020 and prepare the path to flight tests to consolidate the roadmap for entry-into-service in 2035. As part of the technology maturation plan, the compatibility of Open Fan with hydrogen will be investigated in coordination with the HPA thrust.

2. Description of major milestones for the year 2024-25

1. TRL4 on key technologies for the Open Fan Low Pressure System	Due date: Q4 2024
OFELIA aims at demonstrating the integration of key technologies dedicated to the Low Pressure System of the Open Fan SMR engine demonstrator. Their maturity will be assessed in parallel to the design of the engine demonstrator. Based on multiple maturation studies and dedicated rig tests, technologies such as Fan, Booster, Reduction Gearbox and Low Pressure Turbine will reach their TRL4 prior to engine ground tests.	
2. Core engine enabling technologies	**Due date: Q4 2024**
The open fan architecture developed within OFELIA seeks to not only improve propulsive efficiency, but also a step change in thermal efficiency. This occurs through the engine core, where the compressor and combustion systems play a key role in meeting the program objectives. Like the Open Fan Demonstrator technologies, the OFELIA partners are maturing the technologies through component and module level rig tests in targeted areas of the engine in advance of a full-scale demonstrator. Completion of the milestones achieved in 2023 provide confidence to move forward with the activities planned in 2024, while the assessment of the maturity of these technologies will continue as the test results are received.	
3. Advanced systems technologies	**Due date: Q4 2024**
The third element to realizing the full potential of the performance objectives stated in OFELIA includes the application of advanced systems onboard the engine. These systems, namely hybrid electric and advanced thermal management systems, unlock efficiency capability not realized in previous generations of engines. Through continued component and module design and testing, the maturity of these advanced systems will progress, with critical project milestones planned in 2024.	
4. TRL5 on key technologies for the Open Fan Low Pressure System	**Due date: Q4 2025**
OFELIA aims at demonstrating the integration of key technologies dedicated to the Low Pressure System of the Open Fan SMR engine demonstrator. Within OFELIA, an assessment of the maturity level will this be performed, based on test results supported within and in parallel to the project (additional activities), through a dedicated Technology Maturation plan. Technologies such as Fan, Booster and Low Pressure Turbine will reach their TRL5 following the integration into the Open Fan Engine demonstrator.	
5. Reduction Gear Box (RGB) TRL5	**Due date: Q4 2025**
Thanks to dedicated rig test campaigns on the Reduction Gear Box (RGB) with and without shaft loads, the Reduction Gear Box (RGB) will demonstrate TRL5. The application of fan loads on the rig will allow a more comprehensive representativity of the external loading of the RGB. This is an important step before testing the engine in flight where these fan loads can occur with more likelihood and intensity than on an engine ground test.	
6. TRL5 for Open Fan Engine architecture	**Due date: Q4 2025**
The OFELIA project aims at reaching TRL5 on the open fan architecture through a multi-phased approach. The continued Technology Readiness Level maturation of the enabling technologies through 2025 will culminate in a full-scale engine demonstrator of the Low-Pressure system. This first engine ground test campaign will contribute to the further validation of the TRL level for the Open Fan architecture as defined in OFELIA. In terms of environmental impact, the open fan architecture envisioned within OFELIA targets a savings of 20% of fuel consumption and CO2 emissions compared to today's latest narrow body engines. In meeting these objectives OFELIA supports the Clean Aviation long-term goal to improve the energy efficiency of a new generation of SMR aircraft by 30%, including through preparations for a first flight test with the innovative Open Fan engine architecture.	

- **SWITCH** (Sustainable Water-Injecting Turbofan Comprising Hybrid-electrics) - Project Reference: 101102006

1. Objectives

SWITCH aims to answer the challenge of climate-neutral short-medium range air transport by developing a revolutionary sustainable gas turbine propulsion system – the hybrid Water-Enhanced Turbofan (hybrid WET). It boosts WET technology with hybridisation (Electrical Aircraft Propulsion – EAP) to improve energy efficiency by 25% and reduce climate impact by 75% (using net zero-CO2 sustainable aviation fuel, and 50% with conventional Jet-A kerosene) compared to a state-of-the-art engine. It is the only concept to significantly reduce all three major warming effects on our climate: CO2 through unmatched efficiency, NOx through water injection in the combustor, and contrails through particle removal and water recovery.

Local air quality and noise levels around airports are improved through electric taxiing. The hybrid WET is fully compatible with drop-in SAF and could also be adapted to burn hydrogen. It addresses all climate-notable market segments: Short-, medium- and long-range.

The SWITCH project will meet this challenge with a global consortium, through an unprecedented programmatic effort between airframer, engine and system OEMs, key tier 1 suppliers and leading researchers in combustion and propulsion, leveraging relevant and effective synergies between European and national programmes.

SWITCH will mature the hybrid WET's two key innovation concepts by 2025: The WET engine to technology readiness level (TRL) 4 through validation of its key enabling technologies and the EAP system to TRL 5 through a flight-ready engine ground demonstration of the full propulsion system. Results from SWITCH will reinforce confidence in the climate reduction potential of the hybrid WET propulsion system and form the technological foundation to achieve TRL 6 by 2030. This will enable the innovation to enter into the market by 2035 on a new short-medium range aircraft to significantly reduce aviation's climate impact towards the European Green Deal's goal of climate neutrality by 2050.

2. Description of major milestones for the year 2024-25

1. Vaporiser Test Readiness Review	Due date: Q2 2024
As part of the technology development of the evaporator for the WET engine concept, two demonstrators are planned. One of these demonstrators is a cold test where the focus is on performance related to the hot exhaust gases. At concept review, the test setup for the cold test at Chalmers University was defined. With test readiness review completion and the availability of the rig hardware (both in M18), the test campaign at Chalmers University can begin.	
2. WET Combustor Test DLR Rig, second iteration	Due date: Q4 2024
Conceptual design of a combustor capable of operating with a high steam-air ratio, required for the WET concept, is being developed. Rig testing will be performed at DLR Stuttgart for fundamental measurements of combustor and swirler behaviour, including flow and flame characteristics, made using advanced optical techniques. These fundamental experiments at DLR Stuttgart will be used to refine the swirler and combustor designs that will be tested at the single nozzle rig (SNR) at Raytheon Technology Research Center (RTRC). The target is demonstration of a WET combustor in the SNR at RTRC that meets the technology metrics for TRL 4.	
3. Prototype Hardware delivered to integration Test at Collins GRID Lab	Due date: Q4 2024
A hybrid-electric GTF powertrain will be demonstrated in a ground test demonstrator (EAP Demonstrator). The aim of the GRID testing is to emulate the Hybrid electric system such as the integration of the hybrid electric powertrain along with the DC distribution panel and the hybrid electric propulsion (HEP) controller. The tasks that will be performed post unit delivery from all partners are: Integration of components on the rig, emulation of engine on the rig i.e. ensuring engine can be emulated using dynamometers. Once the integration activities are completed the performance and function testing of the electrical system without the engine and the battery	

system will be performed. The target is to have a successful demonstration of the electrical powertrain system across the flight envelope as relevant to SWITCH programme.
4. Water Recovery Test Rig - first test campaign finalized — **Due date: Q4 2024**
The Water Recovery unit recovers the liquid water from the core exhaust and is an integral part of the WET engine concept. The aim is to design a water recovery unit that works in engine representative operating conditions. In a rig test, the water recovery factor and pressure drop are tested for varying geometries and configurations of swirl generators and separation lips in a modular test bed. The test data will be used to validate the simulation tools for the water recovery unit and for proposing an optimized water recovery unit concept that can fulfil the requirements.
5. WET Combustor at PW Rig, second iteration — **Due date: Q1 2025**
Conceptual design of a combustor capable of operating with a high steam-air ratio, required for the WET concept, is being developed. Rig testing will be performed at DLR Stuttgart for fundamental measurements of combustor and swirler behaviour, including flow and flame characteristics, made using advanced optical techniques. After the second round of testing at DLR Stuttgart, the swirler and combustor designs will be refined, and will be tested in the second and concluding round of testing at the SNR at RTRC. The SNR at RTRC measures the performance of the fuel nozzle, swirler, and combustor at WET cycle conditions. Evaluation will be made of combustion operability and efficiency with respect to steam loading. Measurements will be made of NOx and nvPM emissions. This data will be used to make the decision of the design(s) that will be used in the Phase II portion of the WET development.
6. Delivery of demonstrator engine and STE to MTU and Delivery of EPP hardware to MTU — **Due date: Q2 2025**
A hybrid-electric GTF powertrain will be demonstrated in a ground test demonstrator (EAP Demonstrator). The hybrid-electric GTF powertrain will enable even greater efficiency across all phases of flight by leveraging highly efficient megawatt class electric motor generators, power electronics, and batteries to optimize the performance of the fuel-burning gas turbine. The EAP Demonstrator engine and the electric propulsion hardware are delivered to the ground test facility. This Milestone will mark the start of assembly of the hybrid engine and powertrain, in preparation for engine ground testing. The engine mounted hardware will be installed, and the electrical powertrain will be integrated into the facility. The completion of this work will ultimately lead to the start of the engine ground test campaign.
7. Rig Test Report Water Recovery — **Due date: Q3 2025**
The Water Recovery unit recovers the liquid water from the core exhaust and is an integral part of the WET engine concept. After the optional second test campaign of the water recovery rig, a test report will be written summarizing the test results for pressure drop and water recovery factor of the water recovery tests for varying geometries and different modular configurations. Based on the results a water recovery configuration can be proposed that reaches the required water recovery factor with minimized pressure drop.
8. Vaporiser hot flow test report — **Due date: Q4 2025**
As part of the technology development of the evaporator for the WET engine concept, two demonstrators are planned. Regarding the second demonstrator, which will be tested at GKN in Trollhättan in a hot test (the same temperatures expected in the SWITCH/WET cycle), the focus will be on both the boiling of water and debugging any fault modes, as well as verifying from a thermal perspective that thermal stresses will not be a future obstacle. With the completion of the second demonstrator, information and knowledge from these test campaigns will be fed back to the overall WET concept design work package. In connection with this, a test report will also be written and published within the project.
9. Engine Ground Test Report — **Due date: Q4 2025**
A hybrid-electric GTF powertrain will be demonstrated in a ground test demonstrator (EAP Demonstrator). Subsequent to the completion of the engine ground test campaign, post-test analysis will be completed and results will be documented. Through the validation during engine ground test on the EAP Demonstrator, all major hybrid functions will be validated in a relevant environment, and TRL5 will be achieved.

- **HEAVEN** (Hydrogen Engine Architecture Virtually Engineered Novelly) - Project Reference: 101102004

1. Objectives

Climate-neutral aviation will require the use of alternative fuels such as green hydrogen and Sustainable Aviation Fuel (SAF) combined with the power density of an ultra-efficient gas turbine engine for the Small and Medium Range (SMR) market which corresponds to approximately 50% of the current share of air transport emissions. Rolls-Royce (represented within the HEAVEN project by RR-UK, RR-D and ITP) supported by key UK and European academia, industry and research centres, is currently developing a new generation of very high bypass ratio geared engine architecture called UltraFan® initiated in 2014. From the outset, this ducted engine architecture has been designed to be scalable and meet the needs of both widebody and SMR markets.

To achieve the necessary 20% fuel burn reduction Rolls-Royce proposes to significantly evolve the UltraFan design into UltraFan H2. The advanced engine architecture design will further improve the efficiency of the gas turbine, leveraging the properties of net zero carbon fuels such as hydrogen to increase efficiency, combining this with Hybrid electric technology to reduce wasted energy. Numerous innovative enabling technologies already at TRL3 will be incorporated into this new architecture to improve the gas turbine efficiency.

Together with work proposed on hydrogen in CAVENDISH (HPA-01) and Hybrid Electric in HE-ART (HER-01) Clean Aviation proposals, alongside activities in national and regional programmes, these efforts will be cohesively combined to validate up to TRL6 the highly innovative UltraFan H2 design to support a 2035 EIS. HEAVEN brings together a highly specialised European industrial and academic consortium already deeply involved and acquainted with the UltraFan programme. Additionally, the partner easyJet, a European airline operator who has the largest fleet of European manufactured SMR aircraft operating in Europe, will bring an in-depth knowledge of operational requirements and their impact in this market.

In 2023 Rolls-Royce and partners have successfully tested to maximum power the novel UltraFan engine architecture on which the HEAVEN SMR UltraFan is based. This development and testing supported by Clean Sky 2 has proven the UltraFan architecture to TRL5 maturity. HEAVEN will build from this mature platform utilising test data and learning from Clean Sky 2 in combination with additional advanced technology to deliver a propulsion system that meets the SRIA objectives.

2. Description of major milestones for the year 2024-25

1. Coupled Low Speed Fan Intake Rig (Rig 150) Ready to Test	Due date: Q4 2024
HEAVEN aims to develop close-coupled low speed fan & intake capability required to achieve the true fuel burn reduction benefits of the high By-Pass Ratio (BPR) cycle. This is achieved through Computational Fluid Dynamics (CFD) tools and particularly through experimental Rig 150 testing performed in DNW's world-class Large-Low-Speed Facility (LLF), located in the Netherlands. Rig 150 will allow detailed high accuracy test data to be acquired in a controlled environment with multiple degrees of freedom. Data from these experiments will be used to understand and optimise fan-intake systems for the Small-Medium Range (SMR) market, allowing an improvement in Specific Fuel Consumption (SFC) whilst maintaining adequate operability.	
2. Low Emission Fuel Spray Nozzle Design & Make Complete	Due date: Q4 2024

Low emission combustion for a Short-Medium Range (SMR) engine core introduces additional challenges on the combustor, as some design features will not scale linearly with the Fuel Spray Nozzle (FSN) tip diameter. The intent is to deliver a FSN design optimised for SMR ready for test. Analysis in combination with testing will be used to drive the FSN design exploration. This work will be carried out across the UK and Germany, through close collaboration between the University of Cambridge, DLR, Loughborough University and Rolls-Royce. Successful completion of the design and manufacture of low emissions SMR-scale FSNs is an important milestone in HEAVEN, as the FSNs will be used for generating test evidence needed to enable reductions in emissions for SMR applications.	
3. Intermediate Pressure Turbine Rig Test Readiness Review	Due date: Q4 2024
The development and validation of an integrated highly-loaded Intermediate Pressure Turbine (IPT) concept for the Small-Medium Range (SMR) market is essential in order to increase engine efficiency, while simultaneously reducing noise and CO2 emissions, as well as engine weight. This IPT concept, developed by ITP, will be experimentally validated by means of rig testing in a high-speed tunnel at CTA facilities in Spain. The Test Readiness Review (TRR) of the ITP rig is a formal review to confirm that the rig conforms to the required specification & standard, as well as ensuring that all required elements are in place for an on-plan pass to test with no unknown outstanding issues. Following a successful TRR, the rig testing activities can be launched at CTA, underscoring the maturity of HEAVEN towards achieving the high-level objectives of the project.	
4. HEAVEN Engine Preliminary Design Review	Due date: Q3 2025
The Preliminary Design Review (PDR) will confirm that the HEAVEN engine concept is at a sufficient level of maturity to begin detailed design required for engine build, with all key architectural and technology decisions taken. It will confirm the integrated propulsion system is on track to deliver a 20% fuel burn reduction, in line with the High-Level Objectives (HLO) of the project when the engine is integrated onto the ACAP SMR aircraft. Technical feasibility will be established by an independent audit team, including remaining risks and mitigation actions.	
5. Fan Flutter Rig Passed to Test	Due date: Q3 2025
Fan flutter is an exponentially growing vibratory phenomenon that affects all gas turbine engine manufacturers. Flutter can very quickly reach an amplitude that begins to erode the life of a fan blade, which is a safety concern due to the risk of release of high energy debris. Revolutionary fan blade designs, needed to optimise whole engine attributes in the Small-Medium Range (SMR) market such as specific fuel consumption (SFC), cost, and weight, are restricted by the threat of flutter, undoing potential improvements achieved by the design itself. The fan flutter rig being developed by Rolls-Royce and TU Darmstadt in Germany will generate test evidence to be used to understand the common root cause mechanisms of flutter, to help optimise fan blade design. The Pass to Test (PTT) milestone indicates that the rig has been transferred to the test house to begin commissioning and pre-test activities.	
6. Short-Medium Range Power Gearbox Critical Design Review	Due date: Q3 2025
A power gearbox (PGB) between fan and turbine increases overall engine efficiency by allowing both modules to run at their optimum speed, independent of whether conventional fuel, synthetic fuel (SAF) or hydrogen is used to drive the core engine. Successful completion of the Critical Design Review (CDR) by Rolls-Royce Deutschland will confirm that the PGB design can be released for manufacture and that it delivers the impact targeted attributes for the Short-Medium Range market such as efficiency and weight.	

- **UP Wing** (Ultra Performance Wing) - Project Reference: 101101974

1. Objectives

The UP Wing project will validate, down select, mature and demonstrate key technologies and provide the architectural integration of "ultra-performance wing" concepts for targeted ultra-efficient Short/Medium Range aircraft (SMR), specifically 150-250 PAX and 1000-2000nm range.
The project is directly targeted to provide a major contribution of a key Clean Aviation objective to reduce the fuel burn of a minimum of 30% at aircraft level, compared to the state-of-the-art reference

Aircraft A321neo. UP Wing will consider two aircraft configurations: a high aspect ratio SAF wing with turbofan engine targeting 10-13% increase in energy efficiency and a dry high aspect ratio wing with open rotor, aiming for up to a 17% energy efficiency increase on wing level.
UP Wing will develop the integrated high aspect ratio SAF wing up to TRL4 until the end of this project and will provide concepts studies for several dry wing configurations. These results will be advanced in Clean Aviation phase 2 achieving TRL6 until the end of the Clean Aviation programme.
These Clean Aviation objectives are well aligned to the development plans of future aircrafts entering into service in 2035 (SAF SMR & H2 Regional), aiming for 75% market penetration by 2050. Academia involved will ensure proper scientific exploitation, while the industrial partners will mature specific technology bricks to TRL4 and higher.

2. Description of major milestones for the year 2024-25

1. Manufacturing Processes and Trials Report for the Advanced Leading-Edge Device	Due date: Q2 2024
The Advanced Leading-Edge Device will be integrated in the volume-constrained area of the outer wing, thus requiring a new design and manufacturing process of the leading edge device.	
2. Definition, Optimisation and Aeroelastic Performance of the Initial Dry Wing Design	Due date: Q3 2024
A first structural dry-wing design will be delivered based on the reference planform including: definition of load cases for structural topology optimisation of dry wing, topology optimisation of the internal structure of a HAR (strut) wing concept, definition and optimisation of a strut wing design (sizing, sweep, aerodynamic properties) with a detailed assessment of the junctions. A first aeroelastic evaluation will be achieved using low-fidelity aeroelastic analyses for flutter and coupled CFD/CSM static simulations.	
3. Gust Generator Design and Construction for the DNW-High Speed Wind Tunnel	Due date: Q3 2024
The gust generator will be designed, manufactured and integrated in the DNW-HST wind tunnel and subsequently calibrated. The activities require preceding aerodynamic flow simulations and the subsequent selection of the most promising gust generation method. The wind tunnel tests are dedicated to gathering experimental data of the aeroelastic behaviour of an elastic wind tunnel model, equipped with remotely controlled control surfaces, to validate novel control strategies aiming at load alleviation.	
4. Gust Load Alleviation Test in the DNW-High Speed Wind Tunnel	Due date: Q3 2025
The wind tunnel tests are dedicated to gather experimental data on the aeroelastic behaviour of an elastic wind tunnel model, equipped with remotely controlled control surfaces, to validate novel control strategies aiming at load alleviation. The control laws will explore multifunctional control surface concepts, use distributed sensor networks and include feed-forward information as provided by the gust generation system from the wind tunnel.	
5. Hardware Prototyping (Build & Assembly) of the Ultra Compact Leading Edge Device Actuation System	Due date: Q3 2025
To avoid the risk of stall on the outer leading edge wing a novel Ultra Compact Leading Edge Device Actuation (UCLEDA) system will be developed and tested. One of the main challenges is its integration into very small space constraints when also considering the higher structural deflections. The actuation subsystem will be designed and matured to reach a system TRL5 level by the end of Phase 1. Based on the specified system architecture and its failure detection principles for a sub-system actuating a compact UCLEDA system will be designed, built and tested.	
6. Flight Test for UV Lidar Receiver Validation	Due date: Q3 2025
The structural mass reduction of a high aspect ratio wing will be achieved with the aid of feed-forward load control fed by turbulent wind information provided by an UV Doppler Wind Lidar (DWL). The long-term objective of the activities is to demonstrate TRL6 for a complete (UV) lidar-based gust load alleviation function by 2030. The objective of the flight test is to focus on a significant TRL increase of the wind sensor and the processing electronics, by optimising and demonstrating the technology in relevant environments.	

The UV lidar systems engineering models used for optimising the design will be validated through flight testing at the NLR experimental aircraft.

- **Faster-H2** (Fuselage, Rear Fuselage and Empennage with Cabin and Cargo Architecture Solution validation and Technologies for H2 integration) - Project Reference: 101101978

1. Objectives

The FASTER-H2 project will validate, down select, mature and demonstrate key technologies and provide the architectural integration of an ultra-efficient and hydrogen enabled integrated airframe for targeted ultra-efficient Short/Medium Range aircraft (SMR), specifically 150-250 PAX and 1000-2000nm range.

To enable climate-neutral flight, SMR aircraft have to rely on ultra-efficient thermal energy-based propulsion technologies using sustainable drop-in and non-drop-in fuels. Besides propulsion, the integration aspects of the fuel tanks and distribution system as well as sustainable materials for the fuselage, empennage are essential to meet an overarching climate-neutrality of the aviation sector.

Not only do the specific properties of hydrogen necessitate a re-evaluation of typical aircraft configurations, requiring new design principles formulation and fundamental validation exercises, but they also raise many important questions relating to hydrogen distribution under realistic operational constraints and safety aspects.

The project will explore and exploit advanced production technologies for the integrated fuselage/empennage to reduce production waste and increase material and energy exploitation with Integrated Fuselage concept selected (maturity TRL3/4) until end of first phase in 2025. An anticipated route to TRL6 until end of the Clean Aviation programme in 2030 will ensure entry-into-service in 2035.

2. Description of major milestones for the year 2024-25

1. Airframe H2 Tanks & Systems Integration trade studies	Due date: Q1 2024
Definition of the aft fuselage baseline Trades for H2 Integration and evaluation of the key Technologies. The aircraft configuration considered integrates a turbofan engine with LH2 combustion under the HAR wing with the fuselage concepts of FASTER-H2. This LH2 baseline aircraft features a conventional layout carrying over elements from the SAF baseline.	
2. TRL3 Down-selection	**Due date: Q2 2024**
This down selection marks a set of concepts to be developed for TRL3. This is the technology readiness level (TRL) 3 preparation for all selected Technologies in FASTER H2. This requires: • a Concept & Technologies feasibility demonstration (incl. down-selection) with the assessment of critical performance, key characteristics of chosen solutions. • Identification of performances and characteristics behaviour at limits. • Risk mitigation plan for key specific technical risks defined on the technologies. The down-selected options and applications will be followed up to TRL4.	
3. Technical review meeting (TRM) for Tank Accessibility	**Due date: Q1 2025**
Tank replaceability is a major requirement. The development of load carrying structural concepts must allow quick release and removal of H2 tanks.	
4. Crash concepts preliminary definition	**Due date: Q1 2025**
The integrated tank mount with a linked Crash Concept is a technical enabler for a new H2 A/C. The solution will be installed in the aft fuselage and is linked to system installation and the access to the tank for maintenance and repair. This concept is safety-related and linked to several particular risk analyses (PRA). The major function is to enable crash worthiness and energy absorption in the event of a crash. This milestone is marking the completion of a list of concepts to be further analysed and down-selected at the end of the project.	
5. TRL4 Review - Sustainability Life-Cycle Assessment	**Due date: Q2 2025**

The Use Case is an EcoRudder with Green Sandwich Aerocover. Based on different thermoplastic materials (core & face sheet), a pre-selected concept based on the experience and the requirements available by all partners is requested. The Material characterisation and tests are part of the TRL Process. The TRL4 Review focuses on the Life-Cycle Assessment of the Sandwich Panel.

Second Call for Proposals project summaries

Ultra Efficient Short & Medium Range Aircraft (SMR)

- COMPANION (COMmon Platform and Advanced Instrumentation Readiness for ultra efficient propulsion demonstration) - Project Reference: 101140627

The purpose of the COMPANION project is to define, design and prepare a common flight test demonstrator platform (FTD) to enable the validation of ultra-efficient propulsion systems developed in Clean Aviation First Call for Proposals' projects at full scale and across a broad spectrum of realistic operational conditions. Given the clear requirement in the roadmap planning of the CA projects OFELIA and SWITCH for flight test demonstrations in Clean Aviation Phase 2 to achieve TRL 6 before the end of the programme in 2030, the project targets to prepare and deliver the hardware of the FTD ready for engine installation by the end of June 2026. The FTD is proposed on the basis of an Airbus A380 aircraft with one of the inboard engine pylons modified to accommodate an Open Rotor test engine alongside a hybrid electric Ultra High ByPass Turbofan. The flight clearance process will be opened in COMPANION, but will need to continue with the installation of the demonstrator engines in follow-up projects to be defined at the end of CA Phase 1. The flight test aircraft will be fully equipped to host a diversity of standard and special flight test instrumentation to provide all data required to quantify the performance of the demonstrator engines under operational conditions. Furthermore, the test aircraft allows the demonstrator engines to operate on conventional kerosene and SAF at up to 100% blending rates.

- AWATAR (Advanced Wing MATuration And integration) - Project Reference: 101140588

In order to accelerate the entry into service of ultra-efficient hydrogen Short/Medium Range (SMR) aircraft, AWATAR develops a Very High Aspect Ratio, Strut-Braced, Dry-Wing characterised by laminar portions in the outer areas, advanced integrated Leading Edge systems and an optimised integration of an open-rotor propulsion system. With the purpose of anticipating and accelerating future certification processes, the targeted maturation relies on high-fidelity simulations and ground tests, like the most advanced aerodynamic test facility in European Transonic Wind tunnel and Icing Wind Tunnel testing. The novel aerodynamic configuration with a large aspect ratio targets a drag reduction at aircraft level of 18% with respect to a 2020 state-of-the-art aircraft. Regarding the Advanced Leading Edge solution integrating the ice protection system, the investigated technology aims for a 50% reduction in the energy demands of a fully evaporative system. For laminarity, the expected aircraft drag reduction is about 5-10% depending on the configuration. In addition, the optimised integration of the Unducted Single Fan limits installation drag to less than 4% of the aircraft's total drag. Ultimately, AWATAR aims at an integrated SMR aircraft (250 passengers - 2000 nm) offering an 18% reduction in block energy. The project relies on a strong consortium comprising aircraft manufacturers, aerospace suppliers, research centres, wind tunnel operator and universities.

First Call for Proposals project summaries

Hybrid Electric Powered Aircraft (HER)

- **HE-ART** (Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft) - Project Reference: 101102013

1. Objectives

The EU-funded HE-ART project will demonstrate the viability of a hybrid electric turboprop within a dedicated integrated "full-scale" ground test demonstrator. By combining an electric drive train with an ultra-efficient thermal turboprop engine and ensuring 100 % sustainable aviation fuel compatibility, HE-ART will target efficiency improvement and reduction of GHG emissions up to 30%. Moreover, it will integrate new technologies including core thermal engine, electric drive train, electrical distribution, gearbox, propeller, nacelle and heat exchanger. The main ambition of the project is to ground test and validate the viability of a hybrid electric thermal turboprop (e-TP) engine. The power class of the e-TP will be 2,15-2,85 MW, depending on the combination of the power fractions of the gas turbine and of the electrical drive train. The ground test will be performed using a dedicated demonstrator which integrates state-of-the-art technologies into the demonstrator (core thermal engine, electric motor and power electronics, modular gearbox, innovative propeller, nacelle and heat exchanger).

2. Description of major milestones for the year 2024-25

1. Critical design review (CDR) - electric drive train	Due date: Q1 2024
One of the key technologies of HE-ART for hybrid electric propulsion system is the electric drive train. The drive train using electric power contributes together with the gas turbine to drive the propeller via a power gearbox. The design of the electric drive train including electric machine, converter and interfaces will be finally consolidated. Manufacturing and assembly drawings are issued enabling start of the procurement, production and manufacturing phases. All this will be reviewed in the CDR.	
2. Modular and Scalable Gear Box design review	**Due date: Q1 2024**
The modular gearbox is located in the centre of the driving elements electric drive train / gas turbine and the propeller. It has to handle different input power ratios coming from the electric machine and the gas turbine. The design of the modular gearbox sub-system for the HE-ART - Hybrid Electric power train is consolidated enabling start of the procurement, production and manufacturing phases. This will be reviewed in this gear box design review.	
3. Heat Exchanger module Critical Design Review	**Due date: Q2 2024**
In a hybrid electric propulsion system, heat could be generated by gas turbine, electric engine, gearbox and electric drive train. Hence, the heat exchanger of the thermal management is an enabler for the safe operation of the HE ART Hybrid electric power train. Considering GTD configuration, the heat exchanger integration was adapted for gearbox cooling. External test means will have the capacity to cover all the GTD heat dissipation. Main challenge is to achieve a compliant integration of the heat exchanger to oil gearbox circuit taking into account GTD specification.	
4. Electrical drive train hardware delivery to Ground Demonstrator test rig	**Due date: Q1 2025**
Complete electrical drive train components (Electric motor, power electronics and accessories) are delivered for assembly into the Ground Demonstrator test rig. This is a major milestone where the electric drive train hardware will be delivered for assembling with the other parts of the hybrid electric propulsion system for its ground test using the dedicated demonstrator vehicle.	
5. Hybrid electric Turbo Prop delivery	**Due date: Q2 2025**

The turbo prop will be a novel propeller explicitly designed for a hybrid electric propulsion application. Hybrid electric Turbo Prop representative of the HE-ART power train architecture is assembled and delivered to its dedicated testing facility for the ground test demonstration.
6. Ground Test Demonstrator finalisation — **Due date: Q4 2025**
Ground tests on the complete HE-ART Hybrid Electric power train are finalised; Functionality and performance of the integrated power train and of all the sub-systems will have been tested and validated via full -scale demonstration. This is the overall technical objective of this research project HE-ART; to demonstrate the viability of a hybrid-electric propulsion system for regional aviation application.

- **AMBER** (InnovAtive DeMonstrator for hyBrid-Electric Regional Application) - Project Reference: 101102020

1. Objectives

A hybrid-electric propulsion system for regional aircraft is seen as a promising step towards achieving a more sustainable aviation industry. To address the challenge of climate change, the AMBER (innovAtive deMonstrator for hyBrid-Electric Regional application) project, as part of the Hybrid electric regional aircraft thrust will seek to mature, integrate and validate key technologies necessary for a megawatt (approximately 2MW) class hybrid electric propulsion system powered by hydrogen fuel cells. This will significantly contribute to reduce greenhouse gas emissions and fuel burn compared to 2020 state-of-the-art regional aircraft. In this respect, the project is aimed at decarbonising aviation and reducing pollutant emissions.

The AMBER project addresses this aspect and pursues the maturation of hybrid-electric key components and the validation of a representative parallel hybrid-electric propulsion system architecture, fuel cell based and 100% SAF compatible for next-generation regional aircraft with EIS (entry to service) by 2035 to meet the ambitious environmental goals set out in SRIA (Strategic Research and Innovation Agenda) and the Clean Aviation topic call.

2. Description of major milestones for the year 2024-25

1. Hybrid Electric Power Train - Conceptual System Design	**Due date: Q1 2024**
The AMBER propulsion system architecture will be matured through different design phases. This first key project milestone represents the finalization of the concept design for the overall propulsion system configuration. This will enable the launch of the next design phases targeting preliminary design, detailed design, and major sub-systems validation.	
2. Preliminary integration report	**Due date: Q3 2024**
At this stage of the project the design phase of preliminary design review will be completed, this milestone provides a summary of the achievements in terms of KPIs against target, status on TRL maturity and major technical achievement for each power train module.	
3. Control system bench readiness	**Due date: Q4 2024**
This milestone represents the achievement of the readiness of the test bench that will be used as simulation environment to validate the AMBER supervisory control system, which is one of the critical technologies developed within the project.	
4. Detailed System Design Completed	**Due date: Q1 2025**
With the achievement of this milestone, the detailed system design of the overall propulsion system configuration will be finalised. This enables the launch of the next phase of the project consisting in hardware procurement, manufacturing and assembling towards the test bench readiness for the sub-system demonstrators.	
5. Thermal Management System test	**Due date: Q2 2025**

The thermal Management System is one of the key technologies that will be matured and validated within the AMBER demonstrator. This system is crucial for the safe and efficient operation of the whole AMBER propulsion system. At this stage of the project, the whole thermal Management System will be ready to be, integrated into the ground-test bench. for testing.
6. MW H2 Fuel Cell system test — Due date: Q3 2025
The Fuel Cell (FC) is one of the critical modules that will be integrated into the AMBER propulsion system. With this milestone, an assessment of all functional requirements for the selected FC technology will be achieved then, MW fuel cell system is integrated into the ground-test bench and tested to measure performances in relevant operating conditions for the power train

- TheMa4HERA (Thermal Management for Hybrid Electric Regional Aircraft) - Project Reference: 101102008

1. Objectives

The TheMa4HERA project takes on the immense challenge of on-board thermal management that comes with the introduction of hybrid electric power and propulsion systems in Regional and Short and Medium Range aircraft. This will be achieved through the development, design and testing of wide range of innovative technologies from Air Supply to Air Conditioning, Systems Thermal Management to Cabin Air Distribution. Whereas today's thermal management systems need to handle a heat dissipation of about 35-50kW, tomorrow's hybrid electric regional aircraft will have to handle heat dissipation in the order of 1.000kW. The main challenges are then related to an increase in heat loads, low-grade heat and sensitivity to overheat (low temperature differences between cooling source and sink), and either no or less heat exhaust depending on bleed architecture. The project is therefore a key enabler of hybrid electric aircraft concepts and will go beyond the state-of-the-art using a combination of novel technologies with optimisation at aircraft system level (i.e. novel architecture).
With a consortium comprising all key aerospace players in the market of thermal management, this project will address almost all currently known thermal management technologies. Through the development of a full digital twin, the project will be able to simulate and optimise component level requirements for any given aircraft architecture. The project will finally validate and demonstrate its results via relevant ground demonstrators.

2. Description of major milestones for the year 2024-25

1. Cabin Air Compressor (CAC) TRL4 Review — Due date: Q1 2024
In a bleedless architecture, the CAC is a key component to supply sufficient airflow to the cabin as well as the required cabin pressurisation; the CAC will reach TRL4, meaning that many design artifacts and simulation results will be available, enabling the manufacture of the first prototype.
2. TRL 4 Mechanically Pumped Loop (MPL) components — Due date: Q1 2024
HERA is expected to use a higher number of high-power electronics hardware, hence the need for new cooling technologies. MPL is such a technology and its TRL4 means that MPL components will have gone through a detailed design and system modelling. This technology is required for high heat flux power electronics conditioning and heat transport between heat & cold sources.
3. Aerodynamic simulation, thermal simulation & FEM analysis report — Due date: Q3 2024
Electrical fan for unpressurised areas simulations: current aircraft architecture relies on bleed air-driven fans, therefore they shall be replaced by electrical fans in HERA's architecture. Doing so, the objective is to lower volume and gain weight. Simulations will help validate the specific design before the first prototype assembly.
4. Initial Digital Twin — Due date: Q2 2025
The first complete version of the thermal model of HERA will be finalised and will include the major systems of the aircraft and a demonstration will be performed with the involved consortium partners. The demonstration

will provide guidance on the future set-up of flight tests, such as the identification of a set of critical test-cases upfront.
5. Ground demonstrator vs technologies cross-reference matrix — Due date: Q2 2025
The project will decide which demonstrations shall be physically performed on a test rig, and which shall be so by virtual means. This will allow for the definition of the test cases, performance targets, platforms, tools needed and their associated schedule.
6. Vapour Cycle System (VCS) Condenser & Evaporator TRL5 review — Due date: Q2 2025
With bleedless engines, the efficiency of the air cycle system may be lower, hence the need to look for high efficiency technologies. VCS is known to provide the highest efficiency for the Environmental Cooling System (ECS), with minimum bleed off-take. The condenser & evaporator are heat exchangers; the condenser cools down the refrigerant in order to control the temperature of the air towards the evaporator, and the latter controls the temperature of the air to the cabin. Their TRL5 means that their prototypes will have gone through non-destructive testing including proof pressure, leak and pressure drop tests.

- **HECATE** (Hybrid ElectriC regional Aircraft distribution Technologies) - Project Reference: 101101961

1. Objectives

Development of hybrid electric regional aircraft can only be accomplished with power distribution networks that can safely handle the high power and high voltage levels, ultimately up to several megawatts. To meet these ambitious targets for commercial aviation in both terms of fuel efficiency and supply demand, a paradigm change is needed. Therefore, HECATE will define, design and provide the required technology enablers related to the electrical distribution by means of technology bricks that will act as the building blocks of the architecture. Among others, the HECATE project will address the associated challenges of system weight and power density, high voltage challenges with lightning, arcing and electromagnetic interference as well as optimised thermal management, in addition to digitising the design process with digital twins. This will lead to transformative technology bricks, which are holistically optimised at system integration architecture level.
The HECATE project will demonstrate a >500 kW architecture in a copper bird in highly representative ground demonstrator. This will provide a clearer understanding of high voltage challenges and suitable technical solutions, which allows for delivering a roadmap towards flight demonstration and later exploitation in new Hybrid Electric Regional aircraft by 2035. Furthermore, environmental impact and LCA will be assessed.

2. Description of major milestones for the year 2024-25

1. Primary distribution critical design review completed	Due date: Q4 2024
The maturation of the Primary Distribution technology brick, to supply power to the electrical propulsion system, to a TRL4 level. Technology will be tested and validated in a laboratory environment assessing its critical operation.	
2. Secondary distribution technical specifications	Due date: Q2 2024
The maturation of the Secondary Distribution technology brick, to provide power to the rest of the aircraft's loads, to a TRL4 level. The technology will be tested and validated in a laboratory environment assessing its critical operation.	
3. Power Converters critical design review completed	Due date: Q4 2024
The maturation of the Power Conversion technology brick, to ensure power is delivered at the required voltage levels within electrical distribution and to the loads, to a TRL4 level. The technology will be tested and validated in a laboratory environment assessing its critical operation.	
4. TRL5 – Power Management and Control System	Due date: Q4 2025

The maturation of the Power management and control system, to ensure global supervision of the power distribution system and to facilitate hybrid-electric propulsion, to a TRL5 level. The technology prototype will be tested and validated in the relevant environment.	
5. Electrical Architecture Integrated in the test bench	**Due date: Q4 2025**
The maturation of technology bricks to a TRL5 level with final testing and integration on a representative test bench (COPPER bird), showcasing a fully integrated electrical distribution system capable of addressing the needs of a Hybrid Electric Regional aircraft.	
6. Electrical Architecture Digital Twin validated	**Due date: Q4 2025**
The Electrical architecture Digital Twin (a digital representation of a physical system that provides real-time evaluation of its physical counterpart by collecting, analysing data and providing feedback in a continuous manner) fully developed and validated against the results coming from the test report.	

- **HERWINGT** (Hybrid Electric Regional Wing Integration Novel Green Technologies) - Project Reference: 101102010

1. Objectives

The Hybrid Electric Regional Wing Integration Novel Green Technologies (HERWINGT) project is focused on contributing to decarbonisation in aviation systems by designing and developing a novel wing architecture, ideal for the future Hybrid-Electric Aircraft of the Regional Segment. Additionally, it aims to develop advanced structures, and technologies allowing higher integration of major systems specific for hybrid electric aircraft concepts. Through integration of disruptive wing architectures and technologies, it will contribute to reach 50% fuel burn reduction, at the aircraft (A/C) level compared to a 2020 State-Of-Art (SoA) A/C, in three different ways:

- Pioneering wing configurations and improved aerodynamic leading to drag reduction and enabling a fuel burn reduction of 15% at the wing component level.
- Developing more integrated systems, and new material technologies, resulting in a weight reduction of 20% at the component level, compared to a 2020 SoA wing.
- Advancing development technologies and solutions enabling integration into the wing of different hybrid-electrical systems (H2/Batteries + fuel systems using Sustainable Aviation Fuels (SAF)).

HERWINGT will deliver digital twins and a life cycle assessment of the components, subsystems, and full wing system compatible with the reference aircraft digital framework and requirements.
Finally, different physical demonstrators will be developed to validate the overall wing design architecture. These include:

- Integrated Centre section wing box structure with the inner Propulsion stage: full span (pylon to pylon) torsion box concept representative of more ambitious tip-to-tip concept.
- Inner section Leading Edges, Integrated Inductive ice protection system integration, Inner section Flap and high lift solutions: Integrated flap solutions. Multifunctionality application to flap.

2. Description of major milestones for the year 2024-25

1. High aspect ratio wing configuration architectural aero-structural configuration definition	**Due date: Q1 2024**
Preliminary design of the composite high aspect ratio wing: • Preliminary 3D CAD (including controls and high lift movables). • Structural FEM (Finite Element Model) for wing box of the primary wing.	
2. TRL4 Assessment: Technologies for demonstrators	**Due date: Q3 2024**

Validation of the integration of the new techno bricks in the demonstrators, including Outer Wing, Center Wing Box, flap and Leading Edge demonstrators.	
3. Critical design review (CDR) of pylon to pylon, flap, leading edge, outer wing box	**Due date: Q4 2024**
Validation of the design and structural analysis for some physical demonstrators of multi-functional structures.	
4. Disruptive wing configuration - Wing model delivery	**Due date: Q2 2025**
Preliminary design of the composite distributed propulsion wing (3D CAD model).	
5. Test completion of wing demonstrators	**Due date: Q4 2025**
• Tests of Outer Wing Box, Centre Wing Box and strut demonstrators completed. • Structural tests aimed to demonstrate the wing design performances and maturity at TRL5 at full wing system level through relevant tests and ground demonstrations.	
6. Impact Monitoring Final	**Due date: Q4 2025**
• Impact of the manufacturing, processing, structural and integration technologies. • Impact and scalability analysis of the system technologies developed. • Impact and scalability analysis of the solutions selected for the demonstrators.	

Second Call for Proposals Projects – Summaries

Hybrid Electric Powered Aircraft (HER)

- **HERFUSE** (Hybrid-Electric Regional FUSelage & Empennages) - Project Reference: 101140567

The goal of HERFUSE project is to design innovative fuselage and empennages suitable for the future Hybrid-Electric Regional aircraft (HER) that will contribute to the overall target to reduce Green House Gases (GHG) emissions. HERFUSE will analyse the challenges on fuselage and empennages layout, material, components, manufacturing and assembly derived by integration of the relevant fuselage systems for HER. HERFUSE integrates features and components necessary to regional hybrid-electric propulsion and complementary systems as well as improves weight, durability, aerodynamic efficiency and operational aspects.
HERFUSE technologies, manufacturing and assembly of critical components will make it feasible to achieve the targeted performance gains of HER enablers such as low GHG energy sources (batteries and fuel cells), their storage (probable liquid in hydrogen case), their distribution and management, operational and safety features, thermal management provisions, electrical and thermal insulation. Technical solutions set by the HERFUSE will contribute then to the overall target and studies performed at aircraft level in HERA to reduce emissions.

- **ODE4HERA** (Open Digital Environment for Hybrid-Electric Regional Architectures) - Project Reference: 101140510

The objective of the Open Digital Environment for Hybrid-Electric Regional Architectures (ODE4HERA) project is to enable and accelerate the development of Hybrid-Electric Regional (HER) aircraft thanks to improved tools and techniques implemented in a transferable and Open Digital Platform (ODP). HER configurations imply far higher complexity than conventional configurations while involving new aircraft technologies and broader collaboration across the value/supply chain. State-of-the-art digitalisation techniques limitations put at risk the achievement of the 2035 HER entry into service (EIS) target.
To address these challenges, the ODP developed in ODE4HERA will combine MBSE, MDO, SDM and PLM technologies and extend them with novel open interfaces, formats, smart model and data transformation technologies that efficiently handling and processing HER configurations complexity,

including frontload verification at design stage and virtualise validation for improved virtual certification.

First Call for Proposals project summaries

Hydrogen Powered Aircraft (HPA)

- CAVENDISH (Consortium for the AdVent of aero-ENgine Demonstration and aircraft Integration Strategy with Hydrogen) - Project Reference: 101102000

1. Objectives

Breakthrough technologies related to direct 100% hydrogen combustion systems will be researched, prototyped and integrated onto a modern donor aeroengine for ground testing. This aeroengine test on liquid hydrogen will be a first of a kind in Europe and the cornerstone to further in-flight demonstration, eventually leading to product development aimed at meeting Europe's and the industry's ambition for the entry in service of commercial, mass-transport, hydrogen-fuelled aircraft in 2035.
Additionally, CAVENDISH will work on system and powerplant aircraft integration with several established airframers and a supplemental type certificate organisation to define certification pathways and formulate a route to obtain a permit to fly.
CAVENDISH will also explore alternative enabling technologies in the form of a dual fuel combustor system capable of operating on 100% hydrogen and 100% SAF (Sustainable Aviation Fuel) and in the form of a cryo-compressed tank system. Both these technologies will offer flexibility and could ease the introduction of hydrogen in aviation.
CAVENDISH brings together expertise-leading European organisations in aeronautics, power and propulsion, combustion, fuel and controls systems and aircraft. It builds on multiple national technology programmes and is connected to activities in other Clean Aviation projects, on SMR and Certification activities specifically, notably project proposals HEAVEN and CONCERTO.

2. Description of major milestones for the year 2024-25

1. Engine Zero Ground Test Complete	Due date: Q2 2024
The purpose of the Engine Zero test campaign is to validate the new hydrogen-related systems and to baseline the performance for comparison with the new hydrogen gas turbine engine cycle. The first phase of testing for assembly verification, characterisation of the core and demonstrating its functioning with 100% SAF in 2023. The insights collected from this test will significantly reduce risk for the second phase. The new Hydraulic, Starting and Heat Management systems will be assembled into Engine Zero for the Phase 2 test.	
2. Design of Dual-Fuel Combustion System	Due date: Q3 2024
CAVENDISH works on key technologies towards developing a combustion system which can operate on both hydrogen or hydrocarbon fuels (SAF or kerosene). The dual-fuel technology is based on the latest generation of kerosene technology, and the hydrogen technology developed within nationally funded programmes (Germany and UK). This milestone marks the end of the fuel injectors development, which will subsequently be manufactured and evaluated in a state-of-the-art test campaign, from single sector to full annular test. This demonstrator enables achieving TRL5 by 2026.	
3. Preliminary Design Review (PDR): Engine-Aircraft systems and Powerplant Control.	Due date: Q3 2024

CAVENDISH demonstrates, through a paper study, that a hydrogen engine can be integrated into an existing airframe. For this activity, a powerplant acting as the donor engine is considered. The design study will be completed to a level of detail for review at a PDR (Preliminary Design Review). The technical feasibility will be established, including remaining risks and mitigations.
4. System Safety Analysis (SSA) — **Due date: Q1 2025**
The Route-to-Flight work package culminates its integration work with the issue of the System Safety Analysis (SSA). The Preliminary SSA (PSSA) allocates safety requirements in a top-down manner, while the SSA verifies them in a bottom-up way. This analysis will be discussed and agreed upon with the aviation authorities.
5. Evaluation of Dual-Fuel Combustion System — **Due date: Q2 2025**
The fuel injectors designed in 2024 (see 'Design of Dual Fuel Combustion System' milestone from 2024) will progress in their development. This milestone marks the end of the fuel injectors manufacturing and test campaign, including a full annular test. The results will be also evaluated using data from an optical probe system developed within CAVENDISH. This demonstrator enables achieving TRL5 by 2026.
6. Hydrogen Tank System demonstrator ready to test — **Due date: Q2 2025**
This milestone marks the commissioning of the 'iron bird' demonstrator for the cryo-compressed hydrogen tank system. The system will be subject to testing to verify the requirements defined in 2023. This demonstrator enables achieving TRL5 by 2026.

- **HYDEA** (HYdrogen DEmonstrator for Aviation) - Project Reference: 101102019

1. Objectives

The project proposes a strong and time-effective technology maturation plan to develop a hydrogen propulsion system to secure an entry into service of a low-emission aircraft by 2035. HYDEA will demonstrate the feasibility of liquid hydrogen propulsion on an aircraft engine up to ground testing. The project aims to address fundamental questions related to the use of hydrogen as an aviation fuel, also including emission studies and technologies, which will serve as an outlook to future engines.
Moreover, HYDEA will pave the way towards the development and certification of new products integrating hydrogen technology. HYDEA results will support the ZEROe technology exploration project, launched by Airbus in 2020. As the demonstrator may not be fully reflective of a future product, a series of studies and activities will be performed to help understand what the impact of the simplifications introduced on the demonstrator could be, and how to close the identified gaps with a potential future product, for instance NOx optimisation studies, potential contrail emissions and further optimisation of the integration of all the subsystems, with the propulsion system and the aircraft. The revolutionary technologies in scope and the need to maintain a clear focus on impact requires an early certification authority involvement.

2. Description of major milestones for the year 2024-25

1. Technology maturation of the hydrogen burn combustor module — **Due date: Q4 2024**
The technology maturation of the hydrogen burn combustor module will undergo development throughout multiple test campaigns, with increased level of fidelity and up to representative working conditions with respect to the final configurations selected for the Demonstrator. The combustion sector test will facilitate the collection of relevant validation data to perform the assessment of the combustor preliminary design and substantiate the hydrogen demonstrator engine configuration.
2. Hydrogen Engine Fuel System Preliminary Design — **Due date: Q2 2024**
The Hydrogen Engine Fuel System will be matured to respond to the requirements defined for the engine and to guarantee its integration into the "End-to-End" fuel propulsion system. At the preliminary design phase, the configuration of the system and its components will be matured at the level that will allow the start of the procurement phase of long lead time components.

3. Preliminary End-to-End Hydrogen Fuel and Propulsion system design and installation baseline summary	Due date: Q3 2024
The "End-to-End" Fuel and Propulsion System and its physical and functional integration at aircraft and engine level will be matured to define and validate a technical baseline for a structure and systems installation concept, equipment's locations and space allocations, and preliminary loads envelope of the systems, including feedback from the engine and its fuel system.	
4. Hydrogen burn combustor module - NOx emission and temperature profile characterisation from FAR test at representative condition	Due date: 2025
Full Annular Test (FAR) is the higher TRL gate that the hydrogen combustor system will reach prior to First Engine Test delivery. The outcome of this test, carried out with the representative final engine hydrogen combustor module defined for the demonstrator, will inform about the key technical learning both for the combustion module behaviour under the usage of hydrogen fuel and for the engine compliance assessment in terms of durability requirements.	
5. Hydrogen Engine Fuel System Critical Design	Due date: 2025
The Hydrogen Engine Fuel System will be matured up to the detailed design level where each component and sub-component will have been designed to be compliant to the hydrogen demonstrator mission requirements. The Critical Design will allow the start of the procurement for all the components/sub-components that will lead to the hardware delivery for the system testing.	
6. Pre-Flight Test contrail modelling	Due date: 2025
The first Pre-test simulations of the Full-Scale Hydrogen Burn Demonstrator configuration will be delivered, as well as recommendations for the test plan and instrumentation.	

- **NEWBORN** (NExt generation high poWer fuel cells for airBORNe applications) - Project Reference: 101101967

1. Objectives

NEWBORN focuses on development and demonstration of the TRL 4 ground demonstrator of the overall propulsion system using fuel cells technology. The consortium plans to investigate the technology for CS-23 19-pax commuter aircraft with a total system take-off power of approximately 2 MW. Technology will be matured and optimised to support an EIS of CS-23 aircraft by 2030 and of regional aircraft by 2035.

The 18 multi-disciplinary partners, including three non-traditional aerospace partners and two SMEs, will work on a wide range of key enabling technologies to be integrated.

By the end of 2025, the project will demonstrate a widely scalable fuel cell power source technology. The overall aim is to achieve a propulsion system efficiency of 50% by 2026, calculated as a ratio of energy on the propeller shaft to the hydrogen lower heating value. An innovative cryogenic tank concept will be integrated, demonstrating a gravimetric index of 35% for the CS-23 aircraft and being scalable up to 50% for regional aircraft. The project will also address high power density high voltage energy conversion, propulsion systems, and the next generation microtube heat exchangers, along with an accurate digital twin of the overall system.

2. Description of major milestones for the year 2024-25

1. Ground demonstrator preliminary mechanical design complete	Due date: Q2 2024
The NEWBORN project ground demonstrator integrates all the subsystems of the fuel cell propulsion system, and its purpose is to validate achievement of system level KPIs. The demonstrator preliminary design complete is an important milestone defining how the tank with the hydrogen line, air subsystems, Fuel Cell power source, cooling system, air inlets and exhausts, powerline, battery, and all instrumentation subsystems will be modified, and interfaces manufactured, and how the test rig will be designed and built.	
2. Power electronics design complete	Due date: Q2 2024

The powerline subsystem of the NEWBORN project is responsible for all forms of electric power transmission from the Fuel Cell System to the propeller driveshaft. This includes the main traction power path from the fuel cell to the electric motor via a scalable non-isolating bus-tied DC/DC converter and the motor inverter, as well as power provided to the Fuel Cell compressors and the Balance of Plant (BoP) via an isolating BoP DC/DC converter. The project also defines the overall electric topology for the powerline, designs necessary junction boxes.	
3. Fuel cell stack delivery and assembly	Due date: Q4 2024
By achieving the Fuel cell stack delivery and assembly milestone, NEWBORN ensures that the key component of the system, the Fuel cell stack, is available, and delivered for system integration. The developed stack targets stack power density of >5kW/kg in 2025, stack-level scalability up to 1MW (further by paralleling), stack efficiency of approximately 60% (trade with weight), and stack peak (hot spot) operating temperature of 105 degC in the timeframe of the project. The unit cell development, especially the bipolar plate, leverages existing synergies with Clean Hydrogen JU project.	
4. Stack integrated with collocated components ready for testing	Due date: Q1 2025
This milestone marks one of the multiple sub-systems testing campaigns that will be conducted in parallel to validate the different sub-systems prior to full system testing. The testing of the Fuel cell stack sub-system is one of the most critical ones because the Fuel Cell system is the "heart" of the Fuel Cell propulsive powertrain, with all the systems revolving around supplying the different media for the stack to produce electricity. As such, NEWBORN will perform a test of the Fuel Cell stack with the air, coolant, and hydrogen loop to validate the performance predicted as part of the design phase.	
5. Real-time digital twin complete	Due date: Q2 2025
The development of a multi-fidelity Digital Twin is a critical outcome of NEWBORN project as it will support the design phase by enabling detailed sub-system integration and enable the development of the control laws of the system. This digital twin will be calibrated and validated as an outcome of the system testing performed by NEWBORN. Achieving this milestone means that that all subsystems are integrated into the digital twin environment, and it can support system integration and validation activities as well as a first step towards sharable Digital Twin model.	
6. Sub-system functionally integrated within the ground demonstrator	Due date: Q4 2025
This milestone defines marks that full system demonstrator development and integration is finished, and the system is ready for the NEWBORN fuel cell powertrain system integration and functionality testing. The aim of the tests is to ensure the functionality, and safety of the demonstrator and its readiness for final demonstrator performance validation.	

- **H2ELIOS** (HydrogEn Lightweight & Innovative tank for zerO-emisSion aircraft) - Project Reference: 101102003

1. Objectives

The H2ELIOS project will develop an innovative and effective lightweight Liquid Hydrogen (LH2) storage system for aircraft. To enable a technologically and economically feasible Hydrogen powered aviation, new integral LH2 tank solutions are essential. These solutions should be capable of serving as part of the airframe main structure and capable of withstanding its respective loads. It will implement a demonstrator, duly supported by component and subsystem ground tests at appropriate scale at project completion (TRL 5 at storage level).

H2ELIOS will provide a feasible and novel low-pressure double-layer composite tank-based system. This system will enable the tank shape to be either conformal or non-conformal to the aircraft's profile. Its general effectiveness will be assessed in terms of high gravimetric performance and ease of integration within the aircraft structure.

This concept will be supported by the latest evolutions of innovative methods and technologies in terms of multidisciplinary design development, manufacturing processes and means of compliance. It shall be demonstrated in operational conditions on ground up to TRL5. Potential market application is expected in the 2030-2035 period. The activities of H2ELIOS will be supported by explicitly agreed support of

EASA and an External Advisory Board comprising commercial aircraft OEMs, hydrogen management and cryogenics experts, MRO services, airlines, aircraft system integrators, materials developers and suppliers and airports operation.

2. Description of major milestones for the year 2024-25

1. Final Design of the LH2 Demonstrator	Due date: Q2 2024
H2ELIOS project will develop a key component to enable a hydrogen aircraft, the liquid hydrogen storage tank. H2ELIOS will design a novel lightweight liquid H2 storage tank, which will have the particularity of being capable of carrying the aircraft structural loads. The tank developed by the consortium will also include all systems components required to refuel the tank, manage the pressure, and ensure a safe operation of the solution. H2ELIOS will design a scaled demonstrator of 150Kg to prove a concept capable of achieving a gravimetric index of 35% and a dormancy of >12h.	
2. LH2 control and SHM/Leak subsystems arrangement	**Due date: Q4 2024**
A key system development of the Liquid H2 tank is the development of the Liquid H2 control Hardware (valve bay), which is a critical system for the safe operation of the tank (fuel, refuel, pressure control, etc). This system will be tested in a specific setup manufactured by the consortium, with a target to demonstrate a 0% leakage refuelling process compatible with an aircraft turnaround of 45min or less. The consortium will also install instrumentation in the valve bay which will include the SHM (Structural Health Monitoring) system and hydrogen leak detection hardware, critical for the safe operation of the tank.	
3. Digital Twin Architecture of the LH2 Demonstrator	**Due date: Q4 2024**
A digital twin of the demonstrator tank, capable of reproducing virtually the tank mechanical and thermo-fluidic behaviour, will be a critical outcome of the project. The digital twin will be calibrated and validated by testing a 150Kg LH2 physical tank demonstrator manufactured by the consortium. The digital twin will be used for the characterisation of the functional behaviour of the LH2 tank. This will enable the consortium to perform optimisation and scalability studies, essential for the development of future larger tanks (>1000Kg). The consortium is targeting to identify the feasibility of scaled tanks with a gravimetric index (ratio between mass of the tank and mass of the hydrogen stored) greater than 50% for these larger applications.	
4. Structural Tests Execution	**Due date: Q3 2025**
A structural test rig will be designed and manufactured by the consortium to validate the structural performance of full-scale Liquid H2 storage tank demonstrator. As the H2ELIOS concept tank is structural (meaning that the tank will transfer the fuselage loads), the tank will be tested under a simulated set of both the operational and pressurisation loads expected during Aircraft operation (flight). The structural validation of this novel tank functionality is a critical step as it will provide evidence of compliance with the aircraft safety requirements.	
5. LCA (Life Cycle Assessment)	**Due date: Q3 2025**
The consortium will provide an assessment of the environmental impacts and financial costs of the proposed tank solution. The target for the life cycle analysis assessment is to confirm the reduction of the environmental impact emissions by ≥20% compared to current equivalent technology. Additionally, a ≥80% recyclability target compared to current tanks and a life cycle costs reduction of ≥ 20%, compared to current materials, manufacturing, assembly and SHM /maintenance technologies will be validated.	
6. Functional Tests Execution	**Due date: Q4 2025**
The consortium will validate the critical functions of the tank by performing a comprehensive test of the 150kg LH2 tank manufactured. The consortium will first develop and manufacture a bench to safely operate a tank fully loaded with liquid H2. The objective of this test will be to perform the sequential testing operational scenarios (including filling/refilling), without impacting current turn-around operations and with 0% recurrent leaks. This test will also validate the boil-off and dormancy performance of the tank targeting 0 LH2 vented in at least 12 hours.	

- **fLHYing tank** (flight demonstration of a Liquid HYdrogen load-bearing tank in an unmanned cargo platform) - Project Reference: 101101946

1. Objectives

The fLHYing tank project targets flight-testing a relevant-scale composite LH2 tank on a UAV platform, with the goal of gathering experimental data for validation of a LH2 storage system digital twin developed in the project.

The project will encompass the design, manufacturing, and qualification of a 1,000-litre vacuum-insulated composite LH2 storage system, including peripherals (e.g., for filling, pressure control, hydrogen output, boil-off management, safety), and instrumentation for the thermal, fluid, and structural characterisation of the system. The system will be flight-tested in the Pipistrel Nuuva V300 hybrid-electric VTOL unmanned cargo aircraft. A thermo-fluid-structural digital twin of the system will be developed and validated. The designed LH2 fuel tank is intended for scale-up towards future commuter, regional, and short-to-medium range aircraft.

The main impact of the fLHYing tank project is the unprecedented reduction in the time-to-market of revolutionary technologies in the aeronautical industry. This is achieved through the ground-breaking fast-track flight testing of a relevant-scale composite LH2 storage system using a UAV, achieving comprehensive understanding of the behaviour of LH2 tanks in the flight environment within minimum timeframe, risk, and cost. This ambitious goal can be achieved within the first phase of the Clean Aviation Programme thanks to the fLHYing tank project.

2. Description of major milestones for the year 2024-25

1. Peripherals and instrumentation Critical Design Review	Due date: Q1 2024
The peripherals will ensure that the operation of the tank is controlled and safe. The instrumentation will be used to measure the operating conditions of the tank during flight test. This allows the retrieval of experimental information about the behaviour of liquid hydrogen tanks during flight, which will help identify the necessary improvements for future tank design. During the CDR, the design of the peripherals and instrumentation will be evaluated in relation to meeting project objectives. The outcome will be a frozen design of the instrumentation and peripherals. This will contribute to the body of knowledge that will guarantee the safety of liquid hydrogen fuel use in aviation.	
2. Liquid hydrogen tank Critical Design Review	Due date: Q2 2024
The liquid hydrogen tank shall store hydrogen in a controlled, safe way. To do this, it shall be designed based on best engineering practices. A team of expert engineers on cryogenic tank design will work for several months on developing a tank design that complies with the requirements needed to perform the flight test. The Critical Design Review (CDR) is a review of design documentation to ensure that the design meets the requirements in a safe and optimal way. During the CDR, an experienced engineering team will evaluate the tank design in relation to meeting project objectives. The outcome will be a frozen design of the tank. This will contribute to the body of knowledge that will guarantee the safety of liquid hydrogen fuel use in aviation.	
3. Assembly of peripherals and instrumentation	Due date: Q3 2024
After designing the peripherals and instrumentation, they will be manufactured or purchased. Manufacturing will be performed at the state-of-the-art facilities of the fLHYing tank partners. After manufacturing, individual components will be tested. After all components have successfully passed the tests, assembly will be performed.	

The outcome of this activity will be an assembled set of peripherals and instrumentation, ready to be tested. This sets an important milestone towards the manufacturing of the final tank.	
4. Finished development of thermo-fluid-structural digital twin	Due date: Q2 2025
A digital twin is a computer model that simulates the performance of the system with high accuracy. A digital twin of the liquid hydrogen tank with peripherals will be developed by experts in fluid dynamics and structures during the fLHYing tank project. This digital twin will emulate the performance of the tank on ground and in flight. The finished development implies that the development framework will be frozen, pending calibration and validation based on experimental data. This milestone will enable the start of the calibration and validation of the digital twin with flight test data. In the future, this digital twin can be used to improve the fidelity of performance simulation of aircraft with liquid hydrogen tanks, further improving the operational safety and reducing the time-to-market.	
5. End of qualification testing campaign for liquid hydrogen tank:	Due date: Q3 2025
To ensure the safety of the flight test campaign, ground qualification testing is required. This includes an extensive set of ground tests to de-risk the system. The ground tests will be run at controlled conditions to ensure the safety of the involved engineering teams. A progressive build-up testing approach will be followed to this end. The outcome of the qualification testing campaign is the confirmation that the tank system is safe for flight. This milestone ensures that the flight test team will operate a safe system.	
6. Successful flight test campaign of liquid hydrogen tank	Due date: Q4 2025
After integration of the tank in the flight test platform, flight test campaign will start. During the flight test campaign, representative aircraft manoeuvres will be simulated, and data of the performance of the tank will be gathered. Sloshing of the liquid hydrogen during flight test will be characterised. The flight test campaign will finish when all data required for calibration of the digital twin has been acquired. The outcome of this activity will be the availability of one of the most complete experimental datasets on behaviour of liquid hydrogen tanks in flight up to date. This will have a significant impact on the time to market of new products, accelerating substantially the development and optimisation of the liquid hydrogen tank.	

- **HyPoTraDe** (Hydrogen Fuel Cell Electric Power Train Demonstration) - Project Reference: 101101998

1. Objectives

HyPoTraDe focuses on developing and testing a modular 500 kW fuel cell battery hybrid powertrain, scalable up to the MW class. It also explores utilising the fuel cell's residual heat to enhance system efficiency and tests the powertrain under flight-relevant conditions (with altitudes up to 25,000 ft). Given the important of safety in aviation, the potential failures of the powertrain will be analysed, and the necessary mitigations will be validated in the test campaign.
The project will create a digital twin validated by test data, enabling accurate performance predictions for future scaled powertrains. Its distinctive feature, modularity, will enable the various components to be interchanged with other validated subsystems, thus paving the way to digital certification process.
The key impact of HyPoTraDe lies in fast-track characterisation of fuel cell powertrain architectures, providing the members of the CAJU with a comprehensive understanding of the operational characteristics of modular, fuel cell - battery hybrid-electric, distributed electric propulsion powertrain architectures. Thus, the results of the project will contribute to fulfilling the ambitious goals of the CA Programme. This includes regional and short-range hydrogen-powered aircraft with EIS in 2035 to meet EU's climate neutrality targets by 2050.

2. Description of major milestones for the year 2024-25

1. Realisation of a high-capacity battery	Due date: Q3 2024
The current SoA TRL9, EASA-certified Pipistrel Velis Electro battery is 400 V, 47 kW and 10 kWh. HyPoTraDe's demonstrator will encompass a kilovolt-class battery and electric distribution system, achieving a system peak	

power of 500 kW on the total fuel cell powertrain system. The battery system is an integral part of a fuel cell powertrain system, as it mitigates the power peak required by the system and also serves as an energy reservoir for storing energy when excess power from fuel cell system is available.	
2. Testing of a 500kW DEP propulsion array	Due date: Q4 2024
Distributed electric propulsion (DEP) has been demonstrated to lead to an improvement in aircraft performance, thanks to the higher propulsion efficiency that enables SFC reduction, short take-off performance, higher ROC, reduction of the control surfaces, and low noise. The combination of the fuel cell-battery hybrid power generation system and DEP is a promising option for the development of zero-emission aircraft.	
3. Realisation of a scaled Hydrogen conditioning system tested with LH2	Due date: Q3 2024
Different technological solutions will be explored to identify promising concepts where the residual heat of the fuel cell stack is reused to lower cooling requirements of the FC and at the same time heating-up the cryogenic hydrogen stream to the FC, effectively saving system weight, drag and electric power. A scaled configuration of the optimal feasible hydrogen conditioning system identified in the first phase of the project will be built up, to ground test elements of these concepts.	
4. Testing of the full-scale Hydrogen conditioning system	Due date: Q1 2025
After the scaled ground test campaign, a full-scale hydrogen conditioning system will be manufactured, tested and installed in the fuel cell powertrain, implementing a solution capable of increasing system efficiency by reusing residual thermal power to heat up the hydrogen supplied to the FC from the cryogenic temperatures up to the operational temperature needed by the FC.	
5. Commissioning of the powertrain setup	Due date: Q3 2025
The HyPoTraDe project will evaluate different powertrain architectures considering the relevant operational environment, to identify the best system configuration for the demonstrator. The corresponding sub-systems will then be manufactured and provided by several project partners for final integration at NLR facilities. After verification of the correct system integration, functional testing of the demonstrator subsystems will be performed. Finally, the testing of the complete powertrain will be performed.	
6. Powertrain test campaign completed	Due date: Q4 2025
The selected architecture will be ground tested to validate the digital twin. The demonstrator will encompass a LH2 tank with its distribution system, a H2 fuel cell and a battery pack as power sources, a kilovolt-class electric distribution system, propulsive loads including the electric motors, inverters and propellers, emulated aircraft non-propulsive loads, and also a complex thermal management system which will be connected to all abovementioned subsystems. The test campaign will demonstrate the feasibility of a system architecture capable of increasing system efficiency by reusing residual thermal power of the fuel cell systems and will allow for the validation of a modular digital twin suitable for a future digital certification process, and for failure mode mitigation strategies in emulated test flights.	

Second Call for Proposals Projects - Summaries

Hydrogen Powered Aircraft (HPA)

- **TROPHY** (Technological Research On Propulsion by Hydrogen) - Project Reference: 101140638

The hydrogen-powered aircraft will play a significant role towards carbon neutrality targeted by 2050 for the aviation industry as per the European Green Deal. The TROPHY project, which stands for "Technological Research On Propulsion by HYdrogen", will support the Clean Aviation HYDEA funded project (HYdrogen DEmonstrator for Aviation), which aims at demonstrating the feasibility of hydrogen propulsion on an aircraft engine in a condensed timeframe (2023-2026) up to ground test. One of TROPHY's key objectives is to deliver the engine fuel system that will be used for the ground test activities within HYDEA. Another key contribution of TROPHY to the Clean Aviation roadmap is to help in the transition between Phase 1 and Phase 2 by supporting and anticipating the preparation of flight test activities, that will culminate during Phase 2. TROPHY's ambition will greatly benefit from a

consortium which is heterogeneous in nature and spans from large OEMs to SMEs to RTOs. Six different countries will be involved in the project: France, Italy, Belgium, Germany, Poland and Turkey.

- HEROPS (Hydrogen-Electric Zero Emission Propulsion System) - Project Reference: 101140499

HEROPS aims to introduce climate-neutral propulsion into regional aircraft by developing MTU's Flying Fuel CellTM (FFC) propulsion system concept. This disruptive hydrogen-electric propulsion system uses fuel cells (FC) as sole power source and a liquid hydrogen fuel system without the need for high-power batteries. Integration of both the FC system and the electric propulsion unit into a compact engine nacelle will ensure an efficient system at high power-to-weight ratio.
HEROPS targets to demonstrate a 1,2 MW propulsion system. The core module and all further sub-systems will confirm scalability to the 2–4 MW power level through simulation and testing. All aviation-native technologies will be matured against relevant certification requirements.
HEROPS paves the way for the overall programme to advance the FFC concept for integration and demonstration on a regional aircraft by 2028 and for commercial prototyping and entry into service by 2035. It delivers key propulsion technologies to reach the European Green Deal's objective of climate-neutral aviation by 2050 with 100% prevention of CO_2 and NOx.

- FAME (Fuel cell propulsion system for Aircraft Megawatt Engines) - Project Reference: 10114055

Green hydrogen offers the possibility to significantly reduce or even eliminate certain aircraft's greenhouse gas emissions. In combination with fuel cells for propulsive power generation no CO2, NOx or SOx are emitted. The most promising way to bring a fuel cell (FC) aircraft to the market is to develop the FC propulsion system as an integral part of a new LH2 aircraft concept. This means moving away from the current "plug-and-play" philosophy towards a disruptive integrated way of development, requiring a co-creation approach of propulsion system and aircraft. FAME follows this approach by collaborative R&D between partners involved in the development of all needed subsystems and Airbus as engine integrator and aircraft design organisation thereby ensuring an optimisation at all levels.
FAME focuses on developing a complete compact high-efficiency full electric propulsion system based on LH2 as energy source for short to medium range (SMR) aircraft. FAME will develop all needed subsystems and integrate them into a megawatt FC propulsion system ground demonstrator with a route to scale it up to aircraft level. FAME shows the feasibility of a multi-MW FC propulsion system for hydrogen-powered SMR aircraft providing the basis for a system flight test in phase 2.

2.3.2 Objectives, risk management and performance monitoring

The **general objectives of the Clean Aviation** Joint Undertaking as defined in Article 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 the 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 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 (Clean Aviation) 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;
- To implement an effective and efficient management and governance of the programmes (including for Clean Aviation design of the related business processes);
- To execute at least 90% of the budget as well as the relevant milestones and deliverables;
- To 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;
- To achieve a high level of process integrity at all levels of the programme implementation, including the calls and their resulting selection of CAJU Members and other participants.

The Clean Sky 2 programme is concluding at the end of 2024. The **specific objectives** for this programme are:

- ⇨ To execute the remaining technical content from 2023, mainly resulting from delays and ensure this is adequately implemented in accordance with the Clean Sky 2 Development Plan (CS2DP) and the grant agreements; with the support of additional funding identified by the CAJU and assigned to some of the CS2 demonstrators' activities[4];
- ⇨ To deliver the programme's major demonstrators and technology development themes, based on robust risk and progress reviews using the baseline set in the CS2DP; where necessary diverting resources to safeguard the achievement of the Clean Sky 2 programme's High-Level Objectives [HLOs];
- ⇨ 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;

[3] Council Regulation (EU) No 2085 2021 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe OJ L 42717.
[4] See GB decision on 13 October adopting amendment no 5 to the Clean Aviation Joint Undertaking Budget 2022-2023 - Ref. Ares(2023)6975489

⇨ To finalise the Technology Evaluation and to issue the second global assessment report of the Technology Evaluator (including the performance levels of the aircraft concepts at aircraft, airport and fleet level);

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	✈			✈			✈		✈		93.9
	Ultra-high Bypass and High Propulsive Efficiency Geared Turbofans	✈			✈	✈		✈		✈		354.0
	Hybrid Electric Propulsion	✈						✈	✈	✈	532.3	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		✈		✈			✈		✈		29.2
	Cabin & Fuselage	✈	✈		✈			✈	✈	✈	178.183	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			✈	✈				✈	✈		109.5
	RACER Compound Helicopter			✈	✈				✈	✈	222.563	110.1
	Regional Innovative Configuration		✈					✈	✈	✈		2.9
Aircraft Non-Propulsive Energy and Control Systems	Electrical Systems		✈		✈		✈	✈		✈		109.3
	Landing Systems		✈				✈	✈		✈		32.2
	Non-Propulsive Energy Optimization for Large Aircraft	✈						✈		✈	157.985	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 fully operational from the start of 2024. As compared to the two previous programmes in the aviation sector (Clean Sky and Clean Sky 2), the potential market uptake of research results will also be taken into account in the evaluation of the impact of the Clean Aviation programme.

The **specific objectives of the Clean Aviation Joint Undertaking (Article 57.2 of the SBA)** 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 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 the Clean Aviation Joint Undertaking** for the Clean Aviation programme for the period 2024-2025 are to:

- Maximise the added value of transversal coordination across the running projects launched under the Work Programme 2022-2023 and the Work Programme 2023-2024, and consolidate synergies within the CA programme;
- Keep maturing technologies (from TRL2 up to TRL4/5) contributing to the aircraft concepts pertaining to the Regional and Short-Medium Range aircraft domains;

- Revise the Strategic Research and Innovation Agenda (SRIA) throughout the first half of 2024 (targeting adoption by the Governing Board in June 2024) to
    - refine the strategy for the second phase of the programme in light of the activities and critical results from projects funded by the CAJU since its launch;
    - integrate where relevant contributions to the CA high-level objectives from other parts and partnerships of Horizon Europe, as well as other EU, National and Regional programmes, through cooperation based on synergies.
- Identify the technical and research priorities for the year 2025 to be included in the amended Work Programme 2024-2025.
- Prepare topics to launch the first call for proposals in 2025 for selecting projects and participants of Phase 2 of the programme and sign the related grant agreements.
- Maximise the added value and output of the impact monitoring and assessment strategy for the CA programme, in coherence with the Horizon Europe performance monitoring strategy and framework, and highlighting the CAJU high-performance within the Horizon Europe partnerships landscape;
- Establish and consolidate synergies with other parts and partnerships of Horizon Europe, and with research and innovation initiatives at National and Regional level contributing to the CA objectives and integrate relevant project results from these programmes into CA technologies/demonstrators; and seek opportunities for synergies with other EU programmes.

Risk management

The following table presents the summaries of the most significant risks to be noted for the execution of the Clean Aviation Programme, relevant for the Work Programme 2024-2025.

The risks have been defined through the risk assessment exercise performed by the CAJU's management and coordinated by the Internal Audit Officer. The assessment has considered the most relevant risks from Clean Aviation programme set-up and implementation including projects reporting.

None of the risks assessed by CAJU management and described 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 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 million. Consequently, the PA execution rate for the CA budget in 2023 may be very low.	High	Medium	Financial	The risk has been partially mitigated introducing a reporting period after 6 months for the grants of call 1	High
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 EU 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	No changes since the last assessment: 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. Securing substantial additional funding to CAJU following the expected Association Agreement of the UK to HE may partially contribute to mitigate such financial gap.	High

Risk description	Impact	Likelihood	Impact Category	Mitigation plan	Residual risk
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 2023: The EU-UK announced the agreement on the conclusion of the UK association agreement to HE which is expected to be signed by the end of 2023 and to enter into force from 01/01/2024. Discussions are ongoing with the Commission on the assignment of additional funding from the UK annual contribution to HE to the CAJU which is considered of highest importance for the budget planning and definition of phase II.	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 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)	High	High	Operational	The designed calls framework and approach to link projects against aircraft performance objectives was concluded in March 2023. All project coordinators have initiated the work to identify the nature of cooperation across projects and to deliver in June 2023 the nature of cooperation and the expected contribution from projects to aircraft concept definition implemented through SMR ACAP and HERA. The risk is still high that the cooperation between projects may not result in the expected outcomes, especially due to the lack of empowerments of aircraft owners *vis-à-vis* the other projects consortia and access to data and results. This will be reassessed by the end of the year, when the first impact results are available at project level. A dedicated approach to link Clean Aviation projects in Phase 2 might be considered in case the current framework is not producing the necessary outcomes.	High

Risk description	Impact	Likelihood	Impact Category	Mitigation plan	Residual risk
				The delay of the entry into force of the Single Basic Act (in November 2021) had an impact on an earlier launch of the open calls and technical activities. Looking at the next FP10, a more operational transitional regime should be considered by the Commission to allow an earlier preparation of the technical programme and open calls by the existing JU and with a proper mandate to prepare the next programme. This would allow a faster preparation and launch of the programme.	
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	Memorandums of cooperation have been signed with 2 regions, and with the Clean Hydrogen JU, to promote synergies. An action has also been carried at SRG level to collect information on relevant National Programmes and to request Member States and Associated Countries that may be interested to engage into a cooperation. The synergies process is defined. Once it is approved, the risk should be reduced, as the CAJU will have a mechanism for the synergies.	High
Migration to SUMMA[5] by end of 2022 - impact on financial management and programme execution	High	medium	Financial/Operational	The risk is high, since the development is taking too long. There is a delay in the implementation of the features to fix the existing issues.	High

[5] SUMMA - financial management system, based on the commercial software SAP S/4HANA will replace the Commission's current financial system, ABAC. Three agencies (CINEA, ERA and EUROJUST) were selected by DG BUDG to be the pilot organisations from 01/01/2022, while from 01/01/2023 CAJU was selected as SUMMA pilot project for the integration with eGrants, the major corporate system used for grant management.

Risk description	Impact	Likelihood	Impact Category	Mitigation plan	Residual risk
Misalignment of technology roadmaps with respect to Aircraft concept development	High	High	Operational	Initial technology roadmaps defined in the Grant Agreements in line with SRIA need to be continuously monitored with respect to Aircraft concepts development. Initial project operations show a general underspending with possible delayed execution that need to be carefully assessed with respect to projects critical paths to keep the required pace for Phase 2.	High
Disruptive Concepts facing Technological and/or Infrastructure barriers	High	High	Operational	Disruptive Concepts object of Phase 1 projects need to be assessed vs Technological and/or Infrastructure barriers. Lack of facilities preventing technology validation Regulatory framework gap analysis for certification of technology and infrastructure.	High
The preparation of the second phase will start at a time when results from Phase 1 will not be available. It may result in the wrong selection of priorities.	High	High	Operational	Strategic discussion to take place with members to assess in anticipation activities that will result in the expected impact out of the second phase of the program. A dedicated process should be established to engage the preparation of the phase 2 with the members with the aim to reduce this risk and to condition the definition of the second phase of the program (topic content and work program 2025) to the gate review scheduled end of 2024 for projects started early 2023.	High

Performance monitoring

Concerning the Clean Sky 2 programme, the CAJU 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 the 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 CAJU deployed a new programme management tool (PLANES) 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 enable efficiency gains 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), aims at monitoring the progress per project (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 as a basis for reporting both to the Technical Committee and the Governing Board.
The information in PLANES will also 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 CAJU with the involvement of independent experts.

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 (these sets of KPIs are used to monitor the partnership's specific impact pathways);
- CA Programme impact.

Clean Aviation JU financial and budget:

KPI name	Definition	Unit of Measurement	Baseline	2025 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 signing 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%
Percentage of completed AURIs	Completion of the total cumulative number of AURIs (both audit results and extensions, negative or positive/zero)	%	First year level	80%	80%
Timeliness negative audit adjustments implementation	-For closed projects with negative audit adjustments triggering a recovery order finalised within six months -For closed projects with negative adjustments not triggering a recovery order, and for ongoing and closed projects with positive or zero adjustment: AURI are finalised within six months - For on-going projects with negative adjustments: AURI are processed within six months	%	First year level	–50% –100% –100%	-50% -100% -100%

Audit:

KPI name	Definition	Unit of Measurement	Baseline	2025 Target	Target at Programme end
Residual error rate[6]	% residual error on H2020 programme	%	First year level	<2%[7]	<2%
Ex-post audit coverage[8]	Percentage of operational expenses covered by ex-post audits on H2020 programme.	%	First year level	15%*[9] *(accumulated from programme start till 2024)	15%* *(accumulated till from programme start until programme end)

Clean Aviation JU Resources:

KPI name	Definition	Unit of Measurement	Baseline	2025 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)	at least €2400 million (including up to EUR €39.2 million for administrative costs)
Synergies within Horizon Europe	1. **Ex ante:** N. of CAJU topics (in terms of associated total EU funding) promoting synergies with other HE PPPs.	€	First year level	1. €55 million* 2. TBD	1. TBD 2. TBD

[6] The Horizon Europe KPIs and metrics will be defined by the end of 2023 within the CAJU implementing approach to the HE control strategy.
[7] The final H2020 audit results are expected in the year 2024. Based upon these results, the residual error rate up to year 2024 will be calculated. The CAJU does not expect any 2025-specific H2020 audit results.
[8] The Horizon Europe KPIs and metrics will be defined by the end of 2023 within the CAJU implementing approach to the HE control strategy.
[9] The final H2020 audit results are expected in the year 2024. Based upon these results, the ex-post audit coverage up to year 2024 will be calculated. The CAJU does not expect any 2025-specific H2020 audit results.

	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 (in terms of 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 (in terms of associated EU funding, highlighting EU funding received by CAJU members.)			(*only based on 2022-2023 topics as 2025 topics are not yet available) 3. up to €40 million* 4. up to €160 million (*only based on 2024 topics as announced and not including 2025 topics as not yet available)	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). 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)	€	First year level	1. Up to €150 million (3 MoCs signed) 2. TBD	1. TBD 2. TBD

Clean Aviation Programme execution

KPI name	Definition	Unit of Measurement	Baseline	2025 Target	Target at Programme end
Share of projects and EU financial contribution allocated to Innovation Actions (IAs)	% of IA projects compared to total projects launched, and % of EU financial contribution allocated to IA compared to total funding available	%	First year level	>90%	>90%
Call topics success rate	Percentage of topics resulting in signing of GA	%	First year level	>90%	>90%
WP execution:	% of deliverables available versus planned	%	First year level	> 80%	> 90%

KPI name	Definition	Unit of Measurement	Baseline	2025 Target	Target at Programme end
deliverables delivered versus plan					
WP execution: milestones achieved versus plan	% of milestones achieved versus planned	%	First year level	> 80%	> 90%
Events organised by the JU	Number of events organised 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	2	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 / X (ex-Twitter) 1. -number of new followers 2. -number of posts / tweets 3. -number of impressions 4. -number of views	-	First year level	X (ex-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. These set of KPIs are the performance indicators to monitor the partnership's specific impact pathways.

KPI name	Definition	Unit of Measurement	Baseline	2025 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[10] | N/A TRL5: N/A | N/A TRL6: N/A | N/A	TRL4: TBD | TBD TRL5: TBD | TBD TRL6: TBD | TBD
Net[11] GHG emissions[12] 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)

[10] N/A = Not Available

[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.

[12] 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	2025 Target	Target at Programme end
CO_2 emissions reduction potential	CO_2 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% | >50% (>2035)
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 four to five years from the project launch)	340[13]
Peer reviewed scientific publications	- Number of peer-reviewed scientific publications - Share of peer reviewed scientific publications published in open access	- %	First year level	80* (*On average 25-30 per year in the programme duration)	350[14]

[13] This target may be subject to revision based on projects achievements by month 12 and/or month 24.
[14] This target may be subject to revision based on projects achievements by month 12 and/or month 24.

KPI name	Definition	Unit of Measurement	Baseline	2025 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	100* (*Low number of dissemination activities in the first 1-2 years of the programme is expected. On average 100 per year in the following years.) 100* (*Low number of communication activities expected in the first 1-2 years of the programme. On average 100 per year in the following years.)	600 TBD[15]

[15] this target may be subject to revision based on projects achievements by month 12 and/or month 24.

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	2025 Target	Target at Programme end
Net[16] GHG emissions[17] reduction at fleet level by 2050	Net[18] 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:	%	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.

[16] "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.
[17] 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.
[18] "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	2025 Target	Target at Programme end
	Two aircraft platforms are differentiated: SMR I HER				
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

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, the evolution of EASA environmental certification requirements and reporting framework (including the European Aviation Environmental Report), and to communicate the impact of EU aviation research and relevant policies. Two projects ("Impact Monitor", led by DLR and "PULSAR", led by ONERA) have been awarded as a result of the call HORIZON-CL5-2022-D5-01-14 - European Aviation Research Policy in support of EU policies and initiatives. They will perform an assessment of the Clean Aviation aircraft concepts emissions on the ground and their performance at fleet level. All necessary agreed information (data exchange) and interaction for this task will emanate from the impact monitoring tasks implemented in the Clean Aviation programme itself.

The Clean Aviation aircraft integrator projects (SMR ACAP and HERA), 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.

This task is intended to 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.

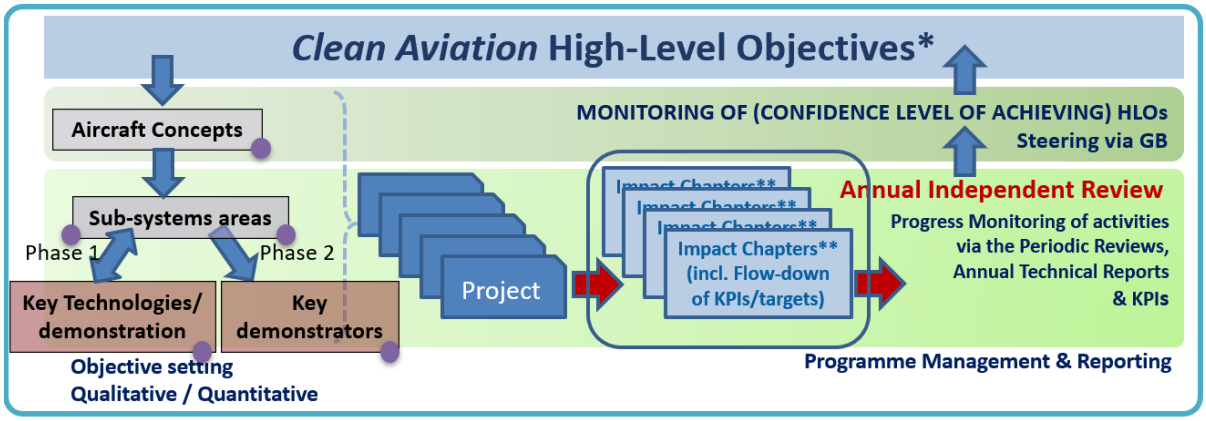


Figure 2. Schematic principles of the CAJU Impact Monitoring Framework.

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 the alignment/reconciliation of 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 (SMR ACAP and HERA as 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.

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 within 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 (consultations by the Scientific Advisory Board and States Representatives Group), and in accordance with monitoring and evaluation principles set out in the Council Regulation (EU) 2021/2085.

A well-defined process has been established to support the coordination and reporting activities related to the Clean Aviation Impact Monitoring duties (see Figure 3).

First, an ad-hoc Working Group of the Technical Committee has been set-up. It is in charge of defining additional relevant assessment criteria and climate metrics in relation to the GHG objectives of the regulation and defining the contribution process and its inputs and outputs. This working group has delivered a first report in October 2023, clarifying the GHGs to be considered and in line with the EU ETS Directive 2023/958 on non-CO2 emissions monitoring, reporting and verification (MRV). The Scientific Advisory Board has been consulted on this matter and has issued a position paper in September 2023, which served as an input to the work of the TC sub-group.

Second, an Impact Monitoring Committee (IMC) has been set-up at projects level in order to implement the reporting obligations of projects in a consistent manner (an impact monitoring deliverable template has been issued by the CAJU PO to harmonise the periodic project reporting activities at M6, M11, M23, etc.) and to implement any guidelines defined by the Technical Committee to assess the results. The IMC is responsible for the reporting on impact from and across the projects as defined in the grant agreements and for preparing the Annual Impact Assessment Report to be included in the Clean Aviation Annual Activity Report, in line with the duty of the Executive Director to report to the Governing Board.

This activity will be complemented by a Coordination and Support Action project (CLAIM) recently awarded on the topic HORIZON-JU-CLEAN-AVIATION-2023-02-CSA-01 — Aviation Climate and Technology Impact Monitoring Methodology as part of the Second Call for Proposals. This project, led by DLR, will start in January 2024 with the aim of collecting, analysing and establishing the current level of scientific understanding within the worldwide community of climatology and atmospheric sciences, and of aviation climate impact and its greenhouse gas emissions contributions. All project deliverables will be public in order to share the resulting knowledge and serve the entire European aviation community.

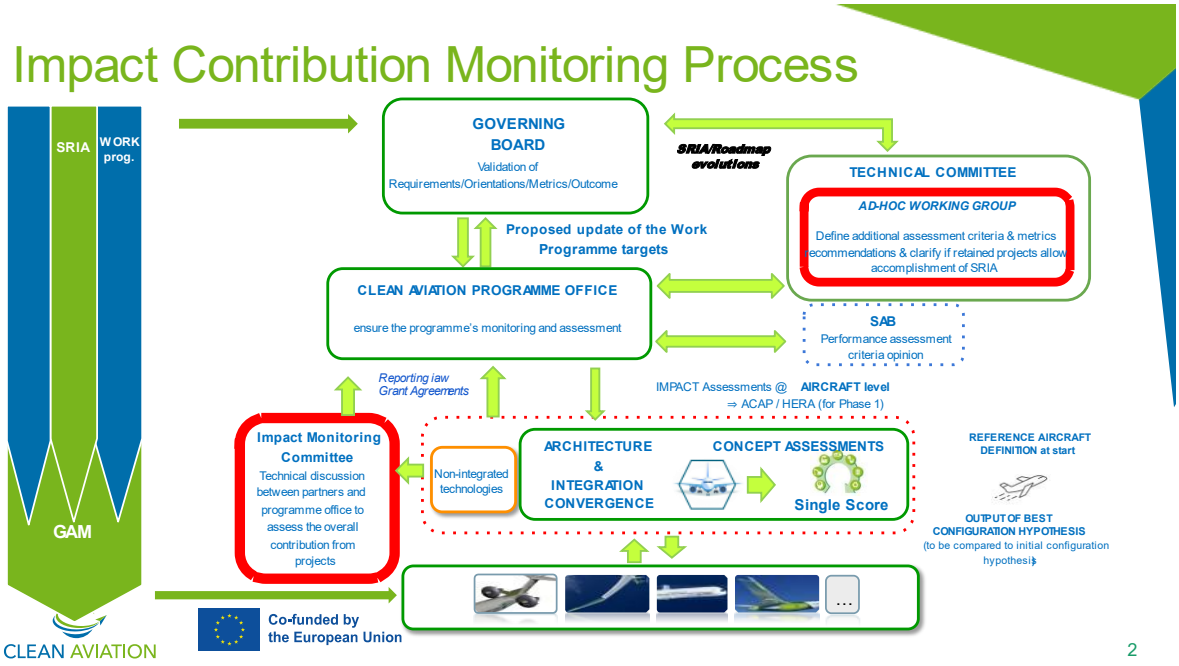


Figure 3 Impact Contribution Monitoring Process

The Annual Impact Assessment report(s) prepared by the IMC will be submitted by the CAJU Programme Office to the Technical Committee to propose, for deliberation and final decision by the Governing Board, revisions or optimisations of the technical scope of the programme in order to align the work programme and the objectives of the CAJU with Horizon Europe as a whole, and other European partnerships' related work programmes.

General Horizon Europe Key Impact Pathways indicators

The Horizon Europe Regulation provides for a definition of **impact areas** to monitor results against **Key Impact Pathways**[19] **(KIPs)** indicators. As confirmed by the European Commission – DG R&I, reporting on these indicators will be implemented automatically via the European Commission IT tools.

Action plan for the implementation of the recommendations of the Internal Audit Service (IAS) on the performance framework for research

The CAJU will implement the action plan (Ares(2023)4544801) submitted in June 2023 to address the IAS recommendations provided in the final audit report of the IAS on the performance framework for research (Ares(2023)635071).

In close cooperation with the European Commission – DG R&I, the CAJU will rely on the contribution of the Technical Committee and Scientific Advisory Body to implement the action plan, concerning the Clean Aviation programme only, in particular to propose clear definitions for the terminology used in the Clean Aviation's specific objectives (Article 57.2) of the JU regulation (i.e. IAS recommendation 1.1), and to formulate clear definitions, set targets and milestones and establish data collection

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

requirements and controls for the partnership's specific impact pathways (i.e. IAS recommendation 1.3), following the structure defined in the sub-section "Clean Aviation Programme Outcome". An action plan answering the recommendations of the IAS is to is to be submitted to the IAS at the end of March 2024.

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%*

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 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).

As part of the Clean Aviation Work Programme 2024-2025, while no call is planned in 2024, a Call for Proposals is foreseen in 2025 to launch Innovation Actions (IAs) and Coordination and Support Actions (CSAs).

No Call for Expression of Interest to become an Associated Member of the CAJU is foreseen during the period 2024-2025.

2.4.1 Calls for Proposals

The Clean Aviation Calls for Proposals are open to all. Members as well as non-members of the CAJU are equally invited to 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 2024-2025 covers

- the execution of Phase 1 through the implementation, monitoring and assessment of Innovation Actions and Coordination and Support Actions selected from the two Calls for Proposals launched under the Work Programme 2022 and 2023 covering activities needed in the SMR, HER and HPA thrusts, as well as CSAs covering activities in support of the Clean Aviation programme.

- the preparation and launch of a Call for Proposals in 2025, followed by the evaluation and selection of proposals for funding.

The proposed strategy is to launch a large call in the first half of 2025 (Call #3) as part of the total funding available for Phase 2 (approximately €854 million).

Innovation Actions

The Third Call for Proposals 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)[20]. These priorities will be determined throughout the second half of 2024 based on the revised Clean Aviation SRIA and Strategic Roadmaps defined by the stakeholders, taking into account the results and activities of Phase 1, as well as and as far as possible the results and activities (on-going and planned) under other parts/partnerships of Horizon Europe and other EU/National/Regional programmes.

Coordination and Support Actions

The JU may launch call topics for Coordination and Support Actions[21] (CSA). The need for support through CSAs will be assessed over the course of 2024.

Call publication and evaluation of IAs and CSAs

[20] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CONSIL:ST_12156_2021_INIT&qid=1646380000738&from=EN

[21] Subject to confirmation by the European Commission

The detailed description of the calls for proposals will be announced at the time of the publication of the call on the 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 CAJU. 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 unique 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 expected 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 accordance with the provisions of the CAJU model Grant Agreement, Consortium Agreement, Membership Agreement and Cooperation Agreement.

2.4.2 Calls for Expression of Interest

No Call for Expression of Interest to become an Associated Member of the CAJU is foreseen during the period 2024-2025.

2.4.3 Conditions and management of the calls

In accordance with the SBA, the CAJU may operate 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) of the SBA 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.
As stipulated in Article 7.2 and Article 19.4(k), the Executive Director of the Joint Undertaking shall assess the applications for membership submitted following an open call for expression of interest and submit proposals for associated members to the Governing Board.

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 has been set out and described in the CAJU rules for submission, evaluation, selection, award and review procedures of the Calls for Proposals[22] approved by the Governing Board and published on the CAJU website and on the Funding & Tenders opportunities portal together with calls documents:

CAJU-GB-2022-03-16-Rules-of-Submission_published.pdf (clean-aviation.eu)

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-

[22] Rules for submission, evaluation, selection, award and review procedures of Calls for Proposals, Governing Board Decision n. CAJU-GB-2022-03-16- Rules for submission calls; https://clean-aviation.eu/sites/default/files/2022-03/CAJU-GB-2022-03-16-Rules-of-Submission_published.pdf

2024/wp-13-general-annexes_horizon-2023-2024_en.pdf), complemented by the specific conditions of the call, if any.

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 the applicable 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 the 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 Article 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) when launched by the CAJU in line with Article 7 of the SBA.

The applicant 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 CAJU.

The applicant organisations shall sign a “Letter of Commitment” (LoC) as required in Article 6.3 of the SBA by which they agree in being jointly committed to the in-kind requirement set in Article 61 of the SBA (jointly with the Founding Members and Associated Members). The selected organisations will be proposed for selection to the Governing Board in accordance with Article 7.3 of the SBA.

It should be noted that the organisations established:

- in countries for which an Association Agreement to the Horizon Europe has not yet been concluded, or
- in countries to which an Associating Agreement has been concluded but it has not yet started producing legal effects either through provisional application or their entry into force (it should take such decision only when there are clear elements to confirm the association (i.e., protocol ratification), 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 CA 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 signing of a grant agreement.

In accordance with 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 billion, including up to €39.2 million for administrative costs) 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/2023-2024/wp-13-general-annexes_horizon-2023-2024_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.

Beneficiary non-member: entities which participate in the action as beneficiaries 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[23]
- low- and middle-income countries[24]

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.

Special rules also apply to entities covered by Commission Guidelines No 2013/C 205/05[25]

Eligible activities

The following activities are the only eligible for grants under Horizon Europe Clean Aviation Programme[26]:

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

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:

[23] Please see the Horizon Europe List of Participating Countries on the Portal for up-to-date information on the current list and on the position for Associated Countries.

[24] Please see the Horizon Europe List of Participating Countries on the Portal for an up-to-date list of these countries.

[25] Commission guidelines No 2013/C 205/05 on the eligibility of Israeli entities and their activities in the territories occupied by Israel since June 1967 for grants, prizes and financial instruments funded by the EU from 2014 onwards (OJEU C 205 of 19.07.2013, pp. 9-11).

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

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 (definition of SMART objectives) and the extent to which the proposed work is ambitious and goes beyond the state-of-the-art;	- 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 contributions from the project; - Suitability and quality of the measures to maximise expected outcomes and impacts, as set out in the dissemination and	- 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 and intermediate results and consistent with final targets/objectives sought in the topic;

	- 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.	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.	- 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;	- Credibility of the pathways to achieve the expected outcomes and impacts	- Quality and effectiveness of the proposed project work

	- Quality of the proposed coordination and/or support measures, including soundness of methodology.	specified in the SBA specific objectives, work programme, topic description and the SRIA, (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.	plan, assessment of risks, decision making process and appropriateness of the effort assigned to work 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 CAJU will make appropriate checks concerning the exploitation of results during project implementation and the reporting phase. Article 16.4 of the Horizon Europe MGA[27] 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 to 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 of the MGA, 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

[27] 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

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.

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 17.2(u) 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 SBA 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 optimisation 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 based on fair and reasonable conditions – to legal entities that need the results to address a 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 four 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 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 of the MGA, 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 accede to the Clean Aviation Cooperation Agreement - under the conditions set out in *Annex 5 of the MGA*.

Founding and Associated Members must also ensure 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 (Article

9.2 MGA[28]). The provisions regarding fees and charges set out in Regulation (EU) 2018/1139 of the European Parliament and of the Council[29] apply.

The participation of the EASA in the projects funded 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.

2.4.4 Calls for tenders and other actions

The call(s) for tenders is/are expected to assist the Clean Aviation programme with tackling socio-economic and environmental challenges and ensuring the smooth uptake and further development of the green technologies generated under the 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 services that directly support the Programme Office and the CAJU in creating and maintaining a capability to:

- store and manage data related to assessments;
- 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;
- provide to the CAJU a communication / visualisation tool in its role as Programme Office and Public-private partnership (PPP) body;
- develop close synergies with other Horizon Europe (HE) initiatives and other Union programmes and funding instruments, particularly with those supporting the deployment of innovative solutions, education and regional development.

Calls for tenders are not, as such, activities that support one private member's activities within a grant agreement but represent services supporting the CAJU in the performance of its statutory tasks and membership at large, including the tasks of the Executive Director and the Governing 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 Aviation and their level of success towards well-defined environmental and societal benefits and targets as well as to the reinforcement

[28] 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 the MGA 'Other goods, works and services' budget category. See also Article 6.2.C. of the MGA.

[29] 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

of synergies with other HE initiatives and Union programmes. The foreseen administrative calls for tenders are listed under section 2.5.2.

The following indicative list of procurement procedures is currently foreseen:

Subject (indicative title)	Indicative budget (EUR €)	Type of procedure to be used	Indicative schedule
Independent study of expected Clean Aviation programme's impact and uptake technologies' forecast towards climate neutrality objectives for Aviation and global competitiveness of EU Aviation[30]	800 000	Open tender	Q4 2024-Q1 2025
Technical assistance to generate synergies with regions	300 000	Open tender	Q1-Q2 2024

The first tender is going to be launched in in Q4 2024/ Q1 2025 to assess the market uptake potential of the Clean Aviation technologies and the potential barriers preventing an early adoption on future aircraft entering into service by 2035.

The tender is expected to consider the recently revised documents having an effect on the Clean Aviation results and impact (non-exhaustive list below) with the aim to identify remaining challenges towards an entry into service in 2035, including competitive aspects such as eco-sustainable industrialization over the full production chain and other economic measures. The tender will also investigate the potential up-scaling of technologies to address the other market segments not covered in Clean Aviation with recommendations to achieve aviation climate neutrality by 2050.

- Updated CAJU's SRIA including key outcomes from on- going projects funded as part of CA call 1 and call 2 and CA Impact monitoring framework and progress/projects reports.
- the contributing Public Private Partnerships such as SESAR's updated ''European Air Traffic Management Master Plan'', 'and the updated SRIA of the Batteries PPP.
- other European initiatives in the field such as: ''Destination 2050'', ''Refuel EU regulation'' as a key part of the EU's Fit for 55 package and the latest revision of the ''ETS Aviation Directive (2003/87/EC)'' issued on 6 December 2022.

The expected outcomes of the tender are:

- Assessment of the Clean Aviation expected impact in terms of:

  i. GHG reduction potential at aircraft level and fleet level against the CAJU regulation objectives31 and updated SRIA objectives.
  ii. Identification of existing gaps to support the timely exploitation of CA results from 2035 onwards and formulation of proposals to address such gaps to achieve aviation climate neutrality.

[30] Tender included as a placeholder pending agreement on the content at GB level.
[31] Article 57 of the Council Regulation (EU) No 20852021 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe

iii. forecast of progress against climate neutral aviation objectives in the period 2035 - 2050.
iv. EU competitiveness and socio-economic benefits.

The second tender is going to be launched in the first half of 2024 to complement the Clean Aviation's CSA ECARE and to assist the CAJU to establish synergies with regions, in particular to support the European Commission-JU action plan as described in section 2.4.6 "Cooperation, synergies and cross-cutting themes and activities". It is going to be used to scale-up the number of regions (up to 10) collaborating with the CAJU on synergies on the basis of Memorandas of Cooperation (MoCs)[32], joint roadmaps on "Net-Zero Aviation" contributing to CA objectives, and regional funding aligned to these. In particular, the tender is going to focus on:

i. identifying regions in Europe with strategies (e.g. Smart Specialization Strategies S3) aligned to the CA objectives/SRIA, and competences and capabilities in aeronautics contributing to the CA objectives/SRIA;
ii. establishing efficient contacts with regional authorities responsible for regional strategies, programmes and funding focused on sustainable aviation;
iii. generating interest from these regions to establish collaborations with the CAJU;
iv. supporting the preparation of MoCs until signing and the related dissemination activities.

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

The present 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 (GAM) covering the period 2022-23 and extended to the first quarter of 2024. The grants of the IADPs/ITDs/TA impacted by delays beyond 2023 are to be amended in Q4 2023 in order to mitigate the risk of partial completion: additional funding resulting mainly from EC unused administrative credits and recoveries from ex post audits[33], will serve to de-risk the completion of some CS2 demonstration activities. These activities are further detailed in the following sub-sections.
Finally, note that the private members of the following ITDs, IADPs and TAs are listed in Annex 4.2.

IADP Large Passenger Aircraft

Description of remaining activities expected in Q1 2024
In 2024, technical activities in LPA will continue to complete the following demonstrators, which were delayed due to technical challenges:

- LPA Platform 1 - D13 UHBR Short Range Integration
- LPA Platform 1 - D15 Non-propulsive Energy (TRL5)
- LPA Platform 1 - D16 Low Pressure Turbine (TRL5)
- LPA Platform 1 - D8 Distributive Electric Propulsion (TRL5)
- LPA Platform 2 - D1 Multi-Functional Fuselage Demonstrator (TRL5)

[32] The CAJU signed MoCs with Occitania and Campania regions at Paris Air Show 2023
[33] See GB decision on 13 October adopting amendment no 5 to the Clean Aviation Joint Undertaking Budget 2022-2023 - Ref. Ares(2023)6975489

- LPA-02-D2: Next Generation Cabin & Cargo Functions (Crown Module TRL6)

Major milestones planned for Q1 2024

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones (carried over from 2023)
LPA-01-D08 - Radical Configuration Flight Test Demonstrator	First flight
LPA-01-D13 - UHBR SMR Integration	Test Readiness Review of the SA²FIR Wind Tunnel test @ DNW-LLF
LPA-01-D15 - Non Propulsive Energy	End of Power Sharing Tests for Bizjet (MIC)
LPA-01-D16 - Common Technology Bricks for Future Engines	LPT Demonstrator TRL5 (AVIO)
LPA-02-D1: Next Generation Fuselage, Cabin and Systems Integration	• MCA completed • TRL5 review outcome
LPA-02-D2: Next Generation Cabin & Cargo Functions	• Equipped crown module integrated in MFFD

Major deliverables planned for Q1 2024

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables (carried over from 2023)
LPA-01-D08 - Radical Configuration Flight Test Demonstrator	Test and data analysis report
LPA-01-D13 - UHBR SMR Integration	Delivery of validated data from the L/S acoustic test at DNW-LLF with SA²FIR
LPA-01-D15 - Non Propulsive Energy	Ground Demonstrator Power Sharing test results for Large Aircraft (SNE)
LPA-01-D16 - Common Technology Bricks for Future Engines	LPT final configuration assessment (AVIO)
LPA-02-D1: Next Generation Fuselage, Cabin and Systems Integration	• Barrel Delivery to ZAL
LPA-02-D2: Next Generation Cabin & Cargo Functions	• Platform concept TRL6 • EOC Multi-stack TRL4

IADP Regional Aircraft

Description of remaining activities expected in Q1 2024

In 2024, technical activities in REG will continue to complete the following demonstrators, which were delayed due to technical challenges:

WP2 – Technologies

- WP2.3 – Energy Optimised Regional Aircraft - Hybrid ECS & Thermal Management test campaigns will be executed on the full-scale Pax Cabin Demonstrator and relevant test reports will be issued;

- WP2.4 – Innovative Flight Control System - Flight Control System and IWT\MWL EACU TRLs will be assessed on the basis of FTB 1 test results.

WP3 – Demonstrations

- WP3.1 – Adaptive Wing Integrated Demonstrator (FTB 1 & OWB) - Flying Test Bed#1 campaigns will be completed and the analysis of data released for the achievement of TRL6 of the applied Load Control and Alleviation System technologies. The full-scale Outer Wing Box Demonstrator will be subjected to structural tests. 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 full-scale Pax Cabin demonstrator will be subjected to comfort tests. Test results coming from vibro-acoustic and comfort tests will be assessed and reported;
- The full-scale Fuselage Structural Demonstrator will be subjected to structural tests and relevant results will be assessed.

WP4 – Technologies Development / Demonstrations Results

- WP4.1 – Technology Assessment - Final interactions for the second TE global assessment are expected.
- WP4.2 – Eco-design Interface - OWB flagship demonstrator final interactions with ECO TA are expected.

Major milestones planned for Q1 2024

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones (carried over from 2023)
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 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 (Comfort/Thermal demonstrations)	Pax Cabin Comfort/Thermal/Systems Tests Readiness Review achieved (WP3.2)

Major deliverables planned for Q1 2024

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables (carried over from 2023)
REG D1 - Adaptive Wing Integrated Demonstrator – Flying Test Bed#1 (FTB1)	FCS TRL6 Assessment Report (WP2.4 and WP3.1)
REG D3 - Full scale innovative Fuselage & Pax Cabin demonstrator (Structural demonstration)	Fuselage Structure 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)

REG D3 - Full scale innovative Fuselage & Pax Cabin demonstrator (Comfort/Thermal demonstrations)	Comfort/Thermal Testing – Synthesis Report and Recommendations (WP3.2)

IADP Fast Rotorcraft

Description of remaining activities expected in Q1 2024

Activities relevant to the Next Generation Civil TiltRotor demonstrator (WP1): In 2024, NGCTR team will follow up on activities related to the First Flight in order to finally achieve Technology Readiness Level (TRL) 6 with a functional prototype. The main tasks include:

- Gathering and analysing the initial experimental flight data during flight Phase 1A (unrestrained ground run, taxing, First Flight and Helicopter in Ground Effect conditions) according to test schedules.
- Assess the level of technologies developed and integrated.
- Flight data will feed ADMITTED results for efficient and innovative analysis.

Activities relevant to the RACER demonstrator (WP2): Following the first flight, in 2024, activities will be dedicated to gathering and analysing the initial experimental flight data and to the flight domain exploration and completion to assess RACER performances in different flight conditions.

Transversal Fast Rotorcraft Activities - WP5 Fast Rotorcraft Project Coordination: The coordinator will continue to act as the primary interface to the Clean Sky 2 Joint Undertaking (CS2JU) for all aspects of the consortium task management. Appropriate representation in Clean Sky 2 Committees will be maintained to ensure coherence across all aspects of the programme. In addition, as part of the completion of the FRC IADP, the final review meetings will be held and final reporting prepared.

Major milestones planned for Q1 2024

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones (carried over from 2023)
ET1.3 - NGCTR-TD Flying Demonstrator	NGCTR- TD first Flight – WP1
ET2.1 - RACER Flight Demonstrator Integration	RACER demonstrator TRL6 achieved – WP2

Major deliverables planned for Q1 2024

Demonstrators / Techno Streams (as shown in CS2DP)	Major Deliverables (carried over from 2023)
ET1.3 - NGCTR-TD Flying Demonstrator	First Flight – Summary report For Press Release and/or special Event - WP1
ET2.1 - RACER Flight Demonstrator Integration	RACER TRL6 report – WP2

ITD Airframe

Description of remaining activities expected in Q1 2024

TS A-4.1.1 One of the GAINS activities focuses on the Ultra-low power ice protection/detection systems based on the piezoelectric effect. The objective here is to demonstrate the capabilities of developing ultra-low power ice protection systems (IPS) for small business jets and large commercial aircraft. Initially the test has been programmed into two stages test of IWTT at CIRA, but for programme reasons, the second stage has been rescheduled to take place at CRANFIELD University in Q1 2024 (February to March). The Key demonstrator involved in these tests is the D3-16 “Ultra low power ice protection”, its achievement date has been rescheduled to the end of March 2024 with all related Deliverables/Key-

Outputs and Milestones. This will lead to the reporting of the test (M-A-4.1.1.6-3) and a workshop to assess if the IWT yielded the necessary evidence to support TRL5 attainment (KO-A-4.1.1.6-1). Electro-thermal Code verification test will continue and will result in the achievement of M-A-4.1.1.3-2.

TA B-1.4, B-2.2 AIR-D1-6 ADS (CASA) Advanced Composite External Wing Box. Demonstration: On Ground Full scale static test. The following tasks will be undertaken in some of the projects in WP B-1.4 and WP B-2.2 in which ADS is leader:

- Achieving the agreed TRL (TRL5 OoA Full Scale)
- Completing the planned tests
- Delivering the associated documentation

Major milestones planned for Q1 2024

Demonstrators / Techno Streams (as shown in CS2DP)	Major Milestones (carried over from 2023)
D3-13-14-15-16 / TS A-4	GAINS assessment completed (Ultra low power ice protection)
D1-6/TS B-2	FTB#2 OoA Composite Wing full scale test completed (Advanced Composite External Wingbox)

ITD Engines

Description of remaining activities expected in Q1 2024

In 2024, ENG technical activities will continue to focus on completing the following demonstrators, which were delayed due to technical challenges:

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

The activities will focus on consolidating the Open Fan architecture, refining the engine demonstrator design at module and component levels, assessing the performance and performing detailed integration studies. This preparation work will culminate in the Ground Test Demonstrator design review. The TRL maturation of the Low-Pressure modules' technology bricks for both ducted and unducted engine architectures will be assessed in comparison with the CS2DP targets. Finally, a wrap-up of activities performed over the programme will be provided as part of the final reporting.

WP4 – Advanced Geared Engine Configuration (compression/expansion system):

For the expansion system engine demonstrator, the final reporting will be finalised at the beginning of 2024. For the 2-Spool-Compressor Rig the commissioning will be finalised, the start and run of the testing is planned. Furthers task of 2024 are the post-test activities like the evaluation and documentation of test data. In parallel, the final reporting will be prepared.

Major milestones planned for Q1 2024

Demonstrators / Techno streams (as shown in CS2DP)	Major Milestones (carried over from 2023)
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

Major deliverables planned for Q1 2024

Demonstrators / Techno streams (as shown in CS2DP)	Major Deliverables (carried over from 2023)

ENG 2 - Ultra High Propulsive Efficiency (UHPE) demonstrator for SMR	Ground Test Demonstrator (GTD) and UHPE technologies final report
ENG 4 - Adv. Geared Engine technologies	2-Spool Compressor Rig test report

Eco Design Transverse Activity

Description of remaining activities expected in Q1 2024

Regarding the programme completion, the coordination of the ecoDESIGN activity will shift its focus towards the interpretation and exploitation of the results. The FSDs will be used for scaling up to aircraft and industry level. The combination of LCA driven analysis on one side and the socio-economic scoping on the other side contributes to a deeper design for environment testimony.
Based on the results of the FSD analyses the Design for environment matrix is being updated as part of the final report. The reference Framework Handbook for LCA execution will be further elaborated in a white paper for LCA in aviation.
The Aviation Eco-Statement Document based on three Global KPI results will be provided by end of Q1 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.

Thus, there will be three final outcomes for the Clean Sky ecoDESIGN Transversal Activity being:

- An Aviation Eco Statement Document on the basis of three Global KPIs;
- A Reference Framework Handbook describing the agreed procedure for performing eco-statements in the European Aviation Industry;
- A Design for Environment 2020+ chapter that will reference the core development phase 2010-2023 for Clean Sky.

Reinstating in-person participation during workshops (as well in Q1 2024) will facilitate the wrap-up of activities for important outputs e.g., on Recycling, REACH or other regulative challenges and additive manufacturing. Efforts in dissemination and communication will be carried out via the relevant and identified platforms. An ecoDESIGN video will also be produced.

Major deliverables planned for Q1 2024

Demonstrators / Techno streams (as shown in CS2DP)	Major Deliverables (carried over from 2023)
ecoDESIGN TA (WP 7 - Transversal Coordination)	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

Technology Evaluator

Description of remaining activities expected in 2024

A Technology and Impact Evaluation infrastructure is and will continue to be 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. Its key role is assessing the environmental impact of the technologies developed in Clean Sky 2 and their level of success towards defined environmental (Noise, CO2, NOx) benefits and targets, and, where appropriate, it also covers societal impacts like e.g. mobility.

The Technology Evaluator consists of three major tasks:

- Monitoring of Clean Sky 2 achievements compared to defined environmental and societal objectives;
- Evaluation at Mission level by integrating, when appropriate, selected ITD outputs into concept aircraft and into TE concept aircraft;
- Impact assessments at airport and air transport system level using IADPs and TEs concept aircraft / rotorcraft

For the period spanning 2022 to 2024, the main activity will involve preparing and performing the second complete TE assessment. In 2024, the following activities will be conducted:

- Finalising the integration of Mission level, Airport level and ATS level assessment results into the second TE Assessment report, which will also include all TE CfP and CfT project results;
- Preparing for dissemination

Major milestones planned for 2024

Second Global TE Assessment	Major Milestones
End of March of 2024	Second TE assessment report ready

Major deliverables planned for 2024

Second Global TE Assessment	Major Deliverables
Mid 2024	Second TE assessment report

2.4.6 Cooperation, synergies and cross-cutting themes and activities

Establishing cooperation based on synergies with the other parts and partnerships of Horizon Europe programme, as well as with other EU, national and regional programmes is at the core of the objectives of the SBA.

In this context, the CAJU (with contributions from the **Technical Committee** and the **States Representative Group,** as appropriate) is strategizing and strengthening cooperation with the following programmes and initiatives to maximise the CAJU's contribution to the EU target of a climate-neutral aviation by 2050.

The European Aviation Safety Agency (EASA)

In line with the SBA, the CAJU continues to collaborate closely with the EASA (Memorandum of Cooperation signed in October 2022), which is participating in the Governing Board, Technical Committee and Scientific Advisory Body. EASA is also contributing to Clean Aviation projects via service contracts, innovation partnership contracts or as member of projects' Advisory Body.

The cooperation covers aspects such as:

- de-risking and demonstration of the feasibility of the new concepts and technologies implemented under the Clean Aviation programme;
- the evolution of industry standards;
- developing new certification methods and means of compliance for aircraft and systems designs;

- the evolution of the regulatory material in coordination with other regulators and ICAO (International Civil Aviation Organization).

Another key element of this cooperation will be monitoring the impact of the Clean Aviation Programme to ensure its projects meet the environmental targets set to create the pathway towards a climate-neutral aviation system in line with the European Green Deal and the EU Climate Law.

Additionally, organising knowledge sharing and dissemination events, in particular in the field of aviation safety, security, environmental protection, and promoting the newly set-up regulatory framework are also important areas of the cooperation.

Horizon Europe Partnerships and parts of Horizon Europe Work Programme

The CAJU continues strategizing and implementing collaboration with other Joint Undertakings and other European partnerships based on a **"synergies by design" approach**. This involves identifying the areas in which complementary or joint activities address the challenges more effectively and efficiently. Such a strategy avoids 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. With a similar approach, the CAJU continues to provide ongoing support to the European Commission in ensuring alignment of topic areas with the Cluster 5 Work Programme and in maximising project results exploitation.

For the period 2024-2025, the CAJU is prioritising the consolidation of synergies with the **Clean Hydrogen JU** (on the basis of the Memorandum of Understanding signed in 2023), the **SESAR3 JU** and the co-programmed partnership on Batteries (**BATT4EU**), to ensure that these programmes can respectively deliver hydrogen, ATM and batteries technologies meeting the requirements of the targeted Hybrid-Electric Regional and ultra-efficient Short Medium Range aircraft demonstrators. The CAJU is also planning to explore a more efficient alignment with relevant topics focused on aeronautics in the **Cluster 5 Work Programme** 2025-2027, and the potential development of synergies with other EU partnerships, in particular with the Made in Europe and the Chips Joint Undertaking.

Regions and Member States

The SBA aims to achieve a more effective use of institutionalised European partnerships, focusing specifically 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 SBA facilitates the close collaboration and synergies with other relevant initiatives at national and regional level, crucial to achieving greater scientific, socio-economic and environmental impact and ensuring uptake of results. In this framework, the CAJU is developing and establishing 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 period 2024-2025, the CAJU is planning to ramp up the implementation of the action plan launched in cooperation with DG R&I "Clean Planet" Directorate to establish **strategic cooperations on synergies with the European *Aeronautics Regions/Member States,*** to accelerate the maturation and demonstration of low-emission disruptive regional and SMR aircraft technologies for an entry into

service by 2035. The action plan also includes reaching out to additional competences/capabilities to be connected to the CAJU to support the CA roadmap. In line with the CAJU's key mission, its ambitious strategic and technical objectives, and the policy aim of strengthening synergies between the EU and Member States to maximise and accelerate the impact of the EU R&I funding, the goal of the CAJU action plan is to establish cooperation that goes beyond what has been achieved under the Clean Sky 2 programme, in which Memoranda of Understanding (MoU) were signed with Member States/Regions largely through aligning regional smart specialisation strategies and operational programmes as well as leveraging synergies with National/Regional funding (e.g. ESIF).

The CAJU action plan builds on three key principles: *i.e.* focusing on delivering impact on Clean Aviation objectives and its SRIA; leveraging substantial national/regional investments (including for example from Cohesion Policy Funds/ERDF, National Recovery and Resilience Plans) aligned to these objectives; *and* cooperating on synergies between the Regional/National Authority and the CAJU.

Collaborations with Aeronautics Regions/Member States will be developed on the basis of a strong alignment of regional/national strategies (e.g. Smart Specialisation Strategies) to CA and joint technical roadmaps on "Net-Zero Aviation". Memoranda of Cooperation will define the terms of the collaborations including co-designing of funding instruments at regional/national level and implementation aspects.

The CAJU is establishing networking events with European aeronautical states and regions, in order to further develop the synergies between the Clean Aviation programme and other related national and regional initiatives. The CAJU 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), to express their intention to engage in the programme, through a suitable Memorandum of Cooperation-based approach.

Other EU programmes and initiatives

For the years 2024-2025, in close cooperation with DG R&I "Clean Planet" Directorate, the CAJU will investigate opportunities for establishing synergies with other EU programmes (e.g. European Innovation Fund).

As a member of the Steering Committee, the CAJU will lead the activities of the Alliance for Zero Emission Aviation (AZEA), a voluntary initiative of private and public partners who share the objective to prepare the entry into commercial service of hydrogen-powered and electric aircraft. In particular, this Alliance is looking at issues as the fuel and infrastructure requirements of hydrogen and electric aircraft at airports, standardisation and certification, and the implications for operators (airlines) and air traffic management.

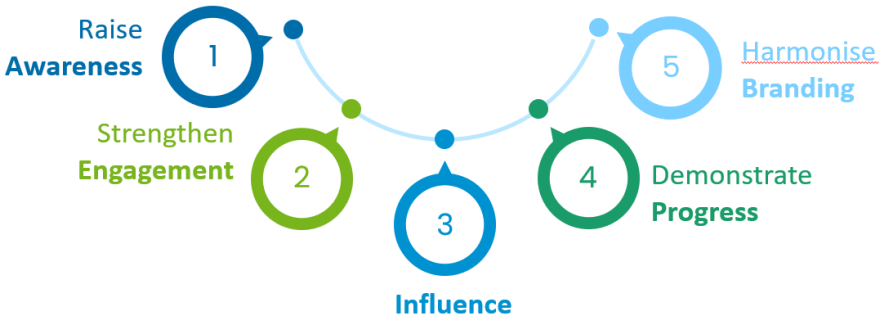
With the support of the SRG and the ECARE project – a Coordination and Support Action (CSA) launched under the Clean Aviation First Call for Proposals, the CAJU aims to establish close cooperation with AREANA, the Coordination and Support Action (CSA) launched under the Horizon Europe Cluster 5 WP 2023-2024, supporting the European Commission in establishing aviation research synergies between the framework programme, AZEA and national/regional R&I aviation programmes.

2.5 Support to Operations

2.5.1 Communication, dissemination and exploitation

2.5.1.1 Communication and events

The main communication mission is to position Clean Aviation as the European Hub for research & innovation in the aeronautics sector, while re-enforcing its positive reputation as a European Public-Private Partnership that develops disruptive new aircraft technologies to support the European Green Deal ambition to achieve climate neutrality by 2050. Communications will revolve around five core pillars linked to our political, technical, and civil society target audiences:



Actions:

PILLAR 1	We aim to raise Awareness and foster a deeper understanding of our goals as well as the significance of sustainable aviation
ACTIONS AWARENESS	• Set up comprehensive awareness-building Campaigns Example: High 5: Launch – Ceremony - Ambassador Programme (H2-2023). • Develop content diversification (member interviews - series 5 facts about sustainable aviation - benefits for Europe – policy and regulation evolution) and address topical issues, while pursuing the day-to-day promotion of the 28 daring projects. • Foster Press Relations, while facilitating interviews and activate paid-media opportunities. • Raise members' awareness with common key messages, lexicon and alignment to counter allegations of greenwashing. • Take EU 2024 Elections as an opportunity to reposition and garner support.

PILLAR 2	We aim to strengthen Engagement to enable meaningful connections and ignite a sense of purpose and urgency
ACTIONS ENGAGEMENT	• Develop a clearer understanding of CA's main stakeholders and conversely who they should reach > implement target audiences' needs/themes/channels plan to enable amongst others, extended reach towards EU institutions and aviation eco-system (airports and airlines) • Activate network of amplifiers: Media, High 5, Clean Aviation staff, Members, etc. • Improve Executive's Director online presence: audit, define priority areas, calendar of milestones. • Improve website user-friendliness and produce inspiring monthly newsletter E-news. • Perform Digital Communications audit twice a year to measure CA's footprint.

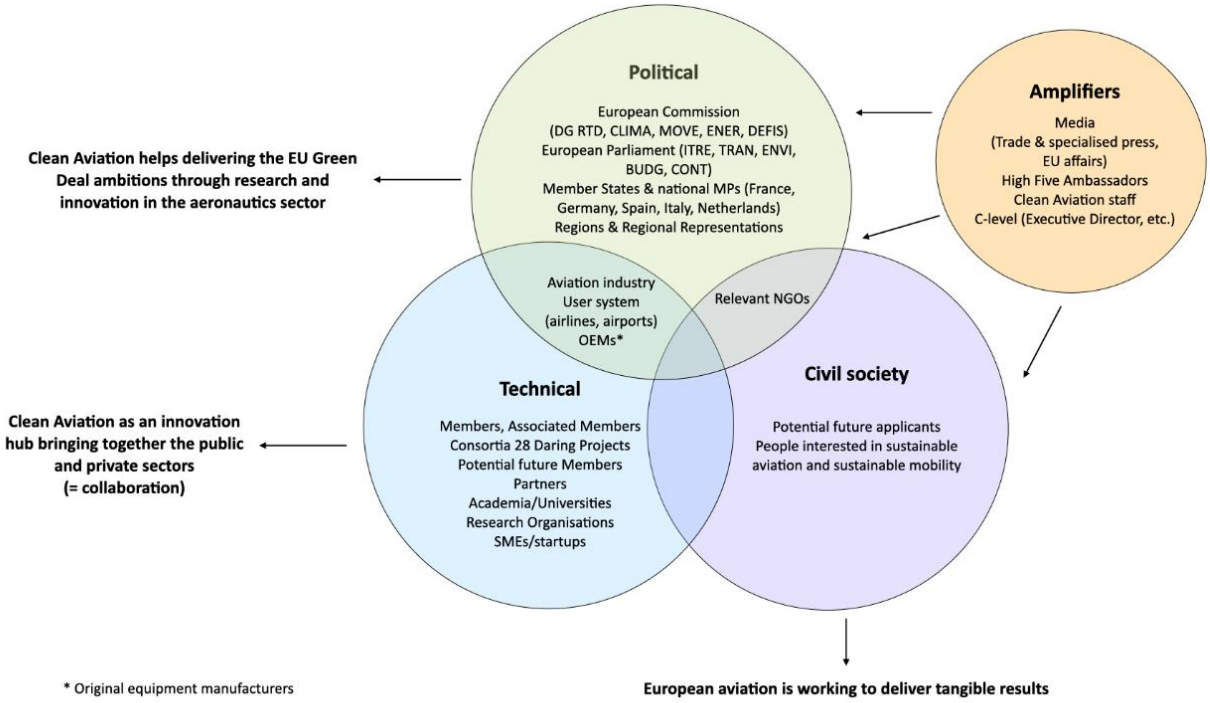
PILLAR 3	We aim to become a key Influencer, and convener in shaping the future of sustainable aviation.
ACTIONS INFLUENCER	• Launch a campaign to promote synergies with Regions & Member States as well as other Joint Undertakings in order to position CA as the European Aero Tech Hub and provide visibility to the technical roadmaps with a view to Zero Emission aviation. • Organise the Clean Aviation Annual Forum and be present at Trade Fairs and exhibitions (Transport and research Arena 2024 in DUBLIN - ILA BERLIN 2024) to showcase our commitment to disruptive technologies, with interactive exhibits to allow stakeholders and visitors to experience sustainable aviation solutions first-hand. • Participate actively at aviation and sustainability conferences throughout the year. • Host press briefings to present major announcements and progress updates to a global audience.

PILLAR 4	We commit to regularly demonstrate Progress and impact achieved in pursuit of sustainable aviation
ACTIONS PROGRESS	• Develop strategic content plan focused on impact stories and technical progress. • Set clear content communication & dissemination guidelines for consortia to promote the 28 daring projects made possible through Clean Aviation. • Make use of the Clean Sky 2 completion to communicate on tangible results. • Develop a plan to translate technical progress for non-technical audiences (political and civil society).

PILLAR 5	We will streamline branding efforts in order to maximise Clean Aviation visibility.
ACTIONS	• Expand current Clean Aviation Branding guidelines to incorporate 28 daring projects visual charter. • Build a communication kit for 28 daring projects consortia coordinators • Manage dual branding the phase out of CS2 and reinforcing CA branding. • Reinforce the EU brand, values, and key messages.

Target groups:

Clean Aviation's communication relies on key target groups (Political, Technical and Civil society) as well as amplifiers which include: Press and media, High Five Ambassadors and Clean Aviation staff members



2.5.1.2 Dissemination and exploitation

The CAJU will align with Horizon Europe Programme regarding the Dissemination & Exploitation of project results (D&E). Besides dissemination and exploitation activities performed by the beneficiaries of the grants, internal services of the CAJU will also 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

To perform the mission entrusted to the CAJU and to support its daily operations and infrastructure, the Clean Aviation Programme Office procures the necessary services and supplies based on its bi-annual planning reflecting the administrative needs.

To make procurement and contract management activities as effective and as efficient as possible, the CAJU resorts extensively to EU inter-institutional calls for tenders and multi-annual framework

contracts either awarded and signed by the EC services and/or Agencies or by the Joint Undertakings under the Back Office Arrangements (BOA).

In addition, a number of specialised administrative services are provided to the CAJU by Directorate-Generals and Departments of the European Commission in line with the concluded Service Level Agreements (SLAs).

In 2024-2025 the CAJU is planning to use part of its administrative budget to acquire, under the ongoing framework contracts and, in minor cases, via negotiated procedures, the following types of supporting services:

- Communication services
- ITC and software development services and licences
- Specialised audit services
- Infrastructure and logistics services
- HR consultancy and support services
- Specialised legal consultancy services including support in litigation.

The CAJU also aims to further simplify the management of the procurement procedures via their automation in the Public Procurement Management Tool (PPMT- first module of e-Procurement suite). In addition, the CAJU aims to improve the efficiency of contract management and to maximise the internal control on the execution of the framework contracts and plans to use a new IT tool Flowforma.

As the coordinator of the BOA procurement, the CAJU is also planning to take the lead in a number of upcoming inter-institutional tender procedures foreseen in Appendix 2 (Joint Public Procurement Planning) to the Service Level Agreement formalising the establishment and working arrangements of BOA Procurement parties. Beside the new tender procedures, several other joint contractual activities (joint specific contracts implementing framework contracts) have been foreseen for the benefit of interested Joint Undertakings.

	PROCUREMENT PLANNING 2024-2025			
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 130 000	2024-2025

2	Communication services	Specific contracts implementing FWC – Lot 2 - Digital communication	Max 80 000	2024-2025
3	Communication services	Specific contracts implementing FWC – Lot 3 - Events	Max 330 000	2024-2025
4	Communication services	Specific Contracts implementing FWC Lot 4 – Web services	Max 25 000	2024-2025
5	Media Partnerships-individual contracts	Negotiated procedures	Max 25 000	2024
6	Stand booking for Le Bourget 2025	Negotiated procedure	Max 65 000	2024
7	Stand booking for ILA Berlin 2026	Negotiated procedure	Max 60 000	2025
Financial, Audit and Legal Support Services				
8	Audit of the annual accounts	Specific Contract under FWC	Max 50 000	Q2 2024
9	Consultancy services in the operational support (audit & finance, specialised legal consultancy services)	Specific contracts implementing FWCs	Max 350 000	2024
10	Legal support in litigations	Negotiated Procedure	Max 60 000	2024
ICT Services				
11	PLANES Licences & maintenance services	Specific Contracts under FWC/ negotiated procedure	Max 304 000	2024-2025

12	AV Upgrade for meeting room	Joint Specific Contract under FWC		Max 400 000 (CAJU share Max 80 000)	Q2 2024
13	Cybersecurity assessment & upgrades	Joint Specific Contract under FWC		Max 50 000 (CAJU share Max 10 000)	Q2 2024
14	Move of the server room	Joint Specific Contract under FWC		Max 200 000 (CAJU share Max 40 000)	Q2 2024
15	Sharepoint, Flowforma, Intranet	Specific Contracts under FWC/negotiated procedure		Max 100 000	Q3 2024
16	Annual managed IT services	Joint Specific Contract under FWC		Max 400 000 (CAJU share Max 100 000)	Q1 2024
17	Refurbishment of offices - IT equipment	Specific Contracts under FWC/negotiated procedure		Max 150 000	2024
Logistics & Other corporate services					
18	Refurbishment of offices	Negotiated procedure(s)		Max 100 000	2024
HR support services					
19	Interims	Specific Contracts under FWCs		Max 470 000	2024
20	HR consultancy services	Specific Contracts under FWC/negotiated procedure		Max 50 000	2024-2025
BOA Procurement[34]					
21	Data protection specialised legal services	Inter-institutional open tender procedure	SESAR 3 JU in cooperation with CAJU, EU-RAIL	>140 000	2024

[34] The detailed Joint Public Procurement Planning can be consulted in Appendix 2 to the BOA Procurement Service Level Agreement kept updated on regular basis by the BOA Procurement Coordinator (CAJU).

22	Data Protection Register	Inter-institutional negotiated tender procedure	EU-RAIL	< 140 000	2024
23	Representation in Litigation	Inter-institutional call for expression of interests	CAJU	>140 000	2024

2.5.3 Other support operations

2.5.3.1 IT and Logistics

Following the confirmation in 2023 that the CAJU (and the other JUs) will remain in the current building a study will be launched in 2024 to identify ways to improve the ICT facilities, particularly in the common areas. This is needed as more meetings become remote or hybrid and the number of JUs in the building increases from six to eight or more. More JUs put more pressure on the facilities but equally, the cost of improvement can be split between more organisations. Further cooperation and savings will come from the Back Office Arrangement (BOA) on ICT in the expanding cluster of JUs.

Other items on the ICT planning for 2024 include the continued move to cloud based solutions and virtualisation of physical infrastructure, where possible. One example of the latter will be the replacement of the large encryption hardware needed for secure communications with the commission by a new solution hosted by DG DIGIT. Other examples will be moving the printer and WiFi servers to on-line management of those facilities using cloud solutions provided by the hardware vendors.

The user experience of the staff will also continue to evolve with more cloud-based storage solutions and application software for workflows, document management and communications. A new Intranet for CAJU and new workflow tools will be launched in 2024 for example.

Within the CAJU office space the refurbishment of the working areas mentioned in subsection 2.5.3.3 will need to be supported by new or upgraded IT facilities. Harmonised workstations for flexible working will be needed as will the wiring and equipping of the new floor space in cooperation with the building owner and the architect.

Another ICT item for 2024 will be a focus on cyber security. This is an on-going task in any case but the incorporation of any additional obligations when the new cyber security regulation of the commission is adopted is another aspect to be considered.

2.5.3.2 Data protection

Based on the results of a due diligence exercise carried out in 2023, the CAJU will continue to ensure compliance with the Regulation (EU) 2018/1725[35] through the implementation of a Data Protection Action Plan 2024 in close synergies with the other JUs and support of the external service provider. The Data protection Action Plan 2024 will focus on the following priorities:

[35] 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, OJ L 295, 21.11.2018, p. 39–98, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32018R1725

- the review of the Procedure for Data Subject Requests;
- the review of the Data Protection Privacy Statements;
- the review of the Personal Data Breach Rules;
- the update of the data register and review of the records of processing activities;
- the review of the JU's Information Security Policy.

2.5.3.3 Housing

The rental contract of the current location at the White Atrium expires in December 2024. All the JUs located in the White Atrium have collectively run the procedure for the selection of offices location. The selection has resulted in a renewal of the contract for the next 10 years in the White Atrium building.

The CAJU considers it important to provide its staff with a pleasant working environment adapted to the new ways of working experienced since the pandemic. In particular, the management wishes to launch a refurbishment in order to create office spaces conducive to the new flexible work scheme and provide flexible space usage (quiet areas & small meeting areas & bigger meeting spaces). The idea is to encourage teamwork and social interaction. The CAJU is working in cooperation with other Joint Undertakings to have similar working spaces, shared meeting rooms, and shared IT facilities such as for videoconferencing, to encourage exchanges between JUs.

2.5.4 Human Resources

2.5.4.1 HR Management

As foreseen in the establishment plan, the total number of staff has been reduced by 3 posts (two Seconded National Expert and one Contract Agent positions) at the end of 2023 leading to a total of 41 FTE. The creation of the Back Office Arrangements (BOAs) should provide the JUs with synergies where screening of resources has proved to be efficient and cost effective, while respecting the autonomy and the responsibility of each Authorising Officer. The BOAs "shall be provided by one or more selected joint undertakings to all others. Interrelated arrangements shall be kept within the same joint undertaking to the extent appropriate for efficient and effective implementation of the tasks concerned in order to ensure a coherent organisational structure".
The BOA concept in the domains of accounting, HR, ICT and administrative procurements has been implemented among JUs throughout 2023.

2.5.4.2 Strategy for achieving efficiency gains and synergies

The CAJU 2024 Staff Establishment Plan remains stable compared to 2023 with a total number of staff of 41 while the workload and tasks assigned to the CAJU remain high and complex. The CAJU will still be involved in the full completion of the CS2 programme during the first half of 2024.

In 2024-2025, 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.

In addition, the 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.

To ensure a fair career progression for its staff, CAJU has requested an updated Staff Establishment Plan.

2.5.4.3 Staff Establishment Plan

Function group and grade	2023				2024		2025			
	Authorised Budget		Actually filled as of 31/12/2023		Authorised Budget		Request of the Agency		Draft Budget Request	
	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts
AD 16										
AD 15										
AD 14		1		1		1		1		
AD 13										
AD 12		2		1		3		3		
AD 11		2		2		1		1		
AD 10		5		5		6		6		
AD 9		8		7		7		7		
AD 8		4		3		4		4		
AD 7		6		6		6		6		
AD 6		4		4		4		4		
AD 5										
AD TOTAL	**0**	**32**	**0**	**29**	**0**	**32**	**0**	**32**	**0**	**0**
AST 11										
AST 10										
AST 9						1		1		
AST 8		1		1						
AST 7						2		2		
AST 6		1 (1)		1 (1)						
AST 5		1		1		1		1		
AST 4										
AST 3										
AST 2										
AST 1										
AST TOTAL	**0**	**3**	**0**	**3**	**0**	**4**	**0**	**4**	**0**	**0**
AST/SC 6										
AST/SC 5										
AST/SC 4										
AST/SC 3										
AST/SC 2										
AST/SC 1										
AST/SC TOTAL										
TOTAL AD+AST	0	35	0	32	0	36	0	36	0	0
GRAND TOTAL										

Contract Agents	FTE corresponding to the authorised budget 2023	Executed FTE as of 31/12/2023	Headcount as of 31/12/2023	FTE corresponding to the authorised budget 2024	FTE corresponding to the authorised budget 2025 (if relevant)
Function Group IV	3	3	3	3	3
Function Group III	3 (1)	3 (1)	3 (1)	2	2
Function Group III					
Function Group I					
total	**6**	**6**	**6**	**5**	**5**

Seconded National Experts	FTE corresponding to the authorised budget 2023	Executed FTE as of 31/12/2023	Headcount as of 31/12/2023	FTE corresponding to the authorised budget 2024	FTE corresponding to the authorised budget 2025 (if relevant)
TOTAL	0	0	0	0	0

(1): 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.

Recruitment forecasts Year 2024 following retirement/mobility or new requested posts					
Job title in the JU	Type of contract (Official, CA, TA)		TA/Official		CA
			Function group/grade of recruitment internal		Recruitment
			(Brackets) and external (single grade)		Function Group (I,
			foreseen for publication [2]		II, III and IV)
	Due to foreseen retirement/ mobility	New post requested due to additional tasks[3]	Internal (brackets)	External (brackets)	
Legal Officer	Mobility		AD6	AD6	NA
Head of Internal control and audit	Mobility		AD7	AD7	NA
Programme Officer	retirement in 2023		AD6	AD6	NA

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 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 during 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's 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. They are 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 four heads of unit (HoU): the Programme Development and Communications HoU, Project Management HoU, the Governance 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 the 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)** plays 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 programme office of the Clean Aviation Joint Undertaking.

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 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 CAJU, 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 Clean Aviation 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' forums, 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 CAJU, 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 CAJU's website.

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

The States Representative Group (SRG) for the Clean Aviation Joint Undertaking represents 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 Clean Aviation 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 CAJU management will continue in 2024 and 2025, focussing in particular on the new Clean Aviation processes and related risks.

Continuous improvement business process - a 2023 project initiative under the quality management area linked to the CAJU reorganisation project and the Quality Manual revision, was launched in May 2023 with the aim to identify workflow interfaces between the CAJU units and propose improvement solutions for any issues recognised. On the basis of the conclusions of the project, the CAJU will further the initiative in 2024 under a continuous improvement approach and explore the improvement solutions resulting from this business activity.

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 & Horizon Europe rules and guidance.

2.7.2 Programme management

In 2024-2025, the CAJU plans to continue developing an IT tool (PLANES) that, on top of the common EC tools, supports 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 are generated (e.g. Annual Activity Report, Programme Development Plan, etc.). PLANES also enhances 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 the period 2024-2025, the admin & finance unit and the operational unit 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 CA 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 updated CAJU Manual of Financial Procedures, the Programme and Project Management Guidance Manual and the Quality Manual that are under regular revisions.

Ex-post controls:

The Ex-post audit (EPA) process represents a significant element of the Internal Control System of the CAJU. The main objectives of the audits are:

- To ensure the legality and regularity of the validation of cost claims performed by the CAJU's management;
- To provide an adequate indication on the effectiveness of the related ex-ante controls;
- To provide the basis for corrective and recovery activities, if necessary

For Clean Sky 2 projects, the audits take place in accordance with the H2020 ex-post audit strategy. For Clean Aviation projects, a HE risk audit strategy will be developed for an earliest application at the end of 2023, when the first cost claims of grants are submitted.

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 CAJU's activities.

The risk management strategy of the CAJU aims at improving the oversight for the CAJU's Governing Board and management regarding the potential threats for implementing the CAJU's strategy, including the dedicated process for an independent impact monitoring of the Clean Aviation programme and aviation research and innovation in general.

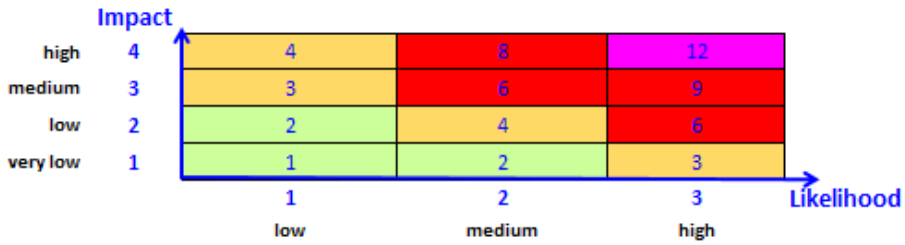
In addition, risks are considered for driving the CAJU's performance, leading to a contribution of the risk management process towards understanding the impact of risks on performance and improving the setting of performance targets.

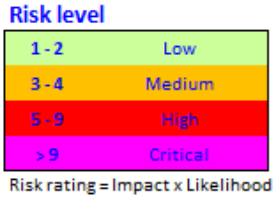
Finally, the CAJU risk management also aims at reducing the extent of irregularities and fraud.

The complexity of the CAJU 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 organisational 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 CAJU Risk Register, which provides for an evaluation of the risk level and description of the mitigating activities. With respect to the methodology used, the CAJU 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 highly important activities
2 Medium	1% < Impact < 2%	Some reputation or political impact with key stakeholder	Failure would create some disruption to important activities
1- Low	0% < Impact 1%	Impact primarily internal	Failure would disrupt minor activities

The outcome of the assessment of risks carried out for the CAJU in the year 2023 is described in subchapter 2.2.2.

In addition, the Risk Management manual of the CAJU has been updated. Regarding the risk assessment and the risk register, two rounds of workshops were organised in June and October 2023, and the risk register for 2023 has been finalised.

In 2024, two rounds of workshops will be conducted for the risk management exercise, in June and in October. A peer review exercise of the risk management process of the Agencies and JU's is also to be performed in the period September – October 2024.

2.7.5 Antifraud Strategy

The 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 CAJU 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 CAJU staff.

In line with guidance provided by the European Commission (DG R&I and OLAF), the CS2 JU had established its specific Antifraud Strategy, which is reassessed annually following a dedicated fraud risk

assessment. The CAJU will update the assessment of fraud risks in the context of the CA programme, but also in 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 include specific measures for preventing and detecting fraud and irregularities, applicable also for the CAJU. The related IT tools, for instance, for detecting plagiarism and double funding in H2020 and HE projects continue to be used by the CAJU.

For the prevention and detection of potential conflicts of interest, the CAJU continues to apply the multiple already existing processes concerning e.g. the Members of the CAJU'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, when and 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 CAJU will continue to work with the Internal Audit Service of the Commission on areas identified in its Strategic Audit Plan for the CAJU.

The Internal Audit Capability function will be phased out from the internal organisation of the CAJU, and a Head of Internal controls and Audit will be appointed during 2024. For assurance purposes, the CAJU will rely on the Internal Audit Service of the Commission and will no longer conduct internal audits.

3 BUDGET 2024-2025

The Budget presented below is the initial budget for the period 2024-2025.

It is to be noted that the EU contribution for 2024 includes a transfer of €37.5 million in Commitment appropriations to Clean Hydrogen JU which will be entirely reinstated to Clean Aviation JU in 2025[36]. The following table shows the updated LFS:

EFTA rate (in blue = estimate)		*2,66%*	*2,47%*	*2,89%*	*3,54%*	*3,54%*	*3,54%*	*3,54%*		
Description	**Period**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2021-2027**	**2021-2027 max. EU contribution per JU**
Cluster Climate, Energy and Mobility — Clean Aviation joint undertaking	(21-27)	382.000	1.440.000	2.027.000	3.265.000	4.074.000	4.671.000	23.364.000	39.223.000	**1.700.000.000**
Cluster Climate, Energy and Mobility — Clean Aviation joint undertaking	(21-27)	229.543.000	149.143.000	229.543.000	149.923.000	421.483.000	129.143.000	351.999.000	1.660.777.000	

Description		**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2021-2027**	**Correction to be applied**
Clean Aviation - support	*EFTA*		*35.568*	*58.580*	*112.335*	*139.289*	*159.700*	*798.808*	*1.304.279*	
	EFTA incl.	382.000	1.475.568	2.085.580	3.285.626	4.074.000	4.671.000	23.364.000	39.337.775	-114.775
Clean Aviation - operational	*EFTA*		*3.683.832*	*6.633.793*	*5.158.202*	*14.410.371*	*4.415.359*	*12.034.735*	*46.336.292*	
	EFTA incl.	229.543.000	152.826.832	236.176.793	150.870.128	421.483.000	129.143.000	351.999.000	1.672.041.752	-11.264.752
	Total	**229.925.000**	**154.302.400**	**238.262.373**	**154.155.754**	**425.557.000**	**133.814.000**	**375.363.000**	**1.711.379.527**	**-11.379.527**
CHP transfer					-37.500.000	37.500.000			0	
	Total	**229.925.000**	**154.302.400**	**238.262.373**	**154.155.754**	**425.557.000**	**133.814.000**	**375.363.000**	**1.711.379.527**	

The budget 2024-2025 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.
- Statement of expenditure: The expenditure includes the CAJU 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 CAJU for future use in accordance with Article 6.5 of the Financial Rules[37].

STATEMENT OF REVENUE				
Heading	**Financial year 2024**	**Financial year 2024**	**Financial year 2025**	**Financial year 2025**
	Commitment Appropriations	Payment Appropriations	Commitment Appropriations	Payment Appropriations
SUBSIDY FROM THE COMMISSION	154,155,754	57,963,564	428,557,000	437,785,300
CONTRIBUTION FROM MEMBERS (NON-EC)	3,509,527	3,509,527	4,074,000	4,074,000
CARRY OVER FROM PREVIOUS YEAR (executed and estimated)	4,381,099	185,344,952	2,534,578	19,761,361

[36] The trilateral agreement (Clean Hydrogen, Clean Aviation and Directorate C of R&I) is detailed in a letter signed by the three Directors (Ares(2023)1019491).

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

FINANCIAL REVENUES (BANK INTEREST)	0	0	0	0
TOTAL REVENUE	**162,046,380**	**246,818,045**	**432,165,578**	**461,620,661**
STATEMENT OF EXPENDITURE				
Heading	**Financial year 2024**	**Financial year 2024**	**Financial year 2025**	**Financial year 2025**
STAFF EXPENDITURE	Commitment Appropriations	Payment Appropriations	Commitment Appropriations	Payment Appropriations
STAFF IN ACTIVE EMPLOYMENT	5,170,000	5,170,000	5,270,000	5,270,000
MISCELLANEOUS EXPENDITURE ON STAFF	142,800	142,800	150,000	150,000
MISSIONS AND DUTY TRAVEL	277,000	277,000	214,000	214,000
SOCIOMEDICAL INFRASTRUCTURE	51,000	51,000	50,000	50,000
EXTERNAL STAFF SERVICES	558,000	558,000	380,000	380,000
RECEPTIONS AND EVENTS	20,600	20,600	21,000	21,000
TITLE 1 - TOTAL	**6,219,400**	**6,219,400**	**6,085,000**	**6,085,000**
INFRASTRUCTURE EXPENDITURE	Commitment Appropriations	Payment Appropriations	Commitment Appropriations	Payment Appropriations
RENTAL OF BUILDINGS AND ASSOCIATED COSTS	652,800	652,800	680,000	680,000
INFORMATION TECHNOLOGY PURCHASES	383,000	383,000	400,000	400,000
MOVABLE PROPERTY AND ASSOCIATED COSTS	16,780	16,780	17,000	17,000
CURRENT EXPENDITURE FOR RUNNING COSTS	25,600	25,600	25,000	25,000
POSTAGE AND TELECOMMUNICATIONS	20,400	20,400	20,000	20,000
EXPENDITURE ON FORMAL AND OTHER MEETINGS	134,000	134,000	138,000	138,000
COMMUNICATION ACTIVITIES	629,000	629,000	600,000	600,000
EXTERNAL SERVICES AND SUPPORT	1,338,500	1,338,500	748,000	748,000
COSTS ASSOCIATED WITH CALLS	0	0	0	0
TITLE 2 - TOTAL	**3,200,080**	**3,200,080**	**2,628,000**	**2,628,000**
TOTAL ADMINISTRATIVE EXPENDITURE (Title 1 & Title 2)	**9,446,480**	**9,446,480**	**8,713,000**	**8,713,000**
OPERATIONAL TITLE 3 & TITLE 4	Commitment Appropriations	Payment Appropriations	Commitment Appropriations	Payment Appropriations
TITLE 3 - CLEAN AVIATION PROGRAMME	149,923,000	130,567,200	421,483,000	441,336,884
TITLE 4 – CS2 PROGRAMME	0	87,103,003	0	0
TOTAL OPERATIONAL EXPENDITURE (Title 3 & Title 4)	**149,923,000**	**217,670,203**	**421,483,000**	**433,711,300**
UNUSED APPROPRIATIONS NOT REQUIRED IN CURRENT YEAR	**2,676,900**	**19,701,364**	**1,969,578**	**19,196,361**

TOTAL BUDGET	**162,046,380**	**246,818,047**	**432,165,578**	**461,620,661**

Multi annual instalments:

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

Description		2021	2022	2023	2024	2025	2026	2027	2021-2027
Clean Aviation - support	*EFTA*		*35.568*	*58.580*	*112.335*	*139.289*	*159.700*	*798.808*	*1.304.279*
	EFTA incl.	382.000	1.475.568	2.085.580	3.285.626	4.074.000	4.671.000	23.364.000	39.337.775
Clean Aviation - operational	*EFTA*		*3.683.832*	*6.633.793*	*5.158.202*	*14.410.371*	*4.415.359*	*12.034.735*	*46.336.292*
	EFTA incl.	229.543.000	152.826.832	236.176.793	150.870.128	421.483.000	129.143.000	351.999.000	1.672.041.752
	Total	**229.925.000**	**154.302.400**	**238.262.373**	**154.155.754**	**425.557.000**	**133.814.000**	**375.363.000**	**1.711.379.527**
CHP transfer					-37.500.000	37.500.000			0
Total		**229.925.000**	**154.302.400**	**238.262.373**	**154.155.754**	**425.557.000**	**133.814.000**	**375.363.000**	**1.711.379.527**
CA available - ops		**229.543.000**	**152.826.832**	**236.176.793**	**150.870.128**	**421.483.000**	**129.143.000**	**351.999.000**	**1.672.041.752**
Multi annual instalment	**Call 1**		382.369.832	83.665.259	150.870.128	37.010.781			653.916.000
	Call 2		0	152.511.534	0	0			152.511.534
	Call 3		0	0	0	384.472.219	129.143.000	351.999.000	865.614.219
	Total		**382.369.832**	**236.176.793**	**150.870.128**	**421.483.000**	**129.143.000**	**351.999.000**	**1.672.041.753**

The cumulative amount of budgetary commitments in instalments for the period 2022-2024 will amount to €616 905 219. This will represent 36% of the total budget for the programme period, thus below the threshold of 50% set in Article 27 of SBA.

NOTE: entities established in the UK in award procedures implementing budget 2021 to 2023 are non-eligible for EU funding, nor carried over appropriations should be used to fund UK beneficiaries. This can be achieved by allocating the carried over appropriations to specific calls/activities where the call conditions provide that UK applicants are not eligible. The Joint Undertaking will ensure that separate eligibility rules are complied with and maintain implementation separately from 2024 to 2026 budgets, which is subject to different eligibility criteria based on changes in associated countries with access to the award procedures.

4 ANNEXES

4.1 IKAA plans

4.1.1 Clean Aviation IKAA plans 2024-2025[38]

OVERVIEW ESTIMATED IKAA FOR 2024						
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] **Topic**	**Project Acronym**	Estimated value AA for 2024 (in M€) [6]	of which programme related IKAA
[Support to additional R&I][7]						
	will contribute to achieve the objectives in the following domains:	**will contribute to achieve the following 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; (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-HER-01	HE-ART	65.465	0.000
	Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-01	AMBER	12.086	0.000
	Thermal Management Solutions for Hybrid Electric Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-02	TheMa4HERA	8.589	0.000
	Electrical Distribution Solutions for Hybrid-electric Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-03	HECATE	12.506	0.000
	Innovative Wing Design for Hybrid-Electric Regional Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HER-04	HERWINGT	8.384	0.000
	Direct Combustion of Hydrogen in Aero-engines		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-01	HYDEA	33.010	0.000
	Direct Combustion of Hydrogen in Aero-engines		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-01	CAVENDISH	10.173	0.000
	Multi- Megawatt (MW) Fuel Cell Propulsion System for Hydrogen-Powered Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-02	NEWBORN	9.241	0.000
	Large Scale Lightweight Liquid Hydrogen Integral Storage Solutions		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-03	H2ELIOS	3.344	0.000
	Near Term Disruptive Technologies for Hydrogen-Powered Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-04	HyPoTraDe	2.073	0.000
	Near Term Disruptive Technologies for Hydrogen-Powered Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-04	fLHYing tank	0.412	0.000
	Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	SWITCH	22.445	0.000
	Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	OFELIA	126.539	0.000
	Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	HEAVEN	18.982	0.000
	Ultra Performance Wing for Short and Short-medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-02	UP Wing	14.532	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	8.872	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	22.746	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	13.086	0.000
	Novel Certification Methods and Means of Compliance for Disruptive Technologies		HORIZON-JU-CLEAN-AVIATION-2022-01-TRA-02	CONCERTO	4.301	0.000
	Developing a European Clean Aviation Regional Ecosystem (ECARE)		HORIZON-JU-CLEAN-AVIATION-2022-01-CSA-01	ECARE	n/a	n/a
				TOTAL	**396.785**	**9.175**
[Scale up of technologies]						
[Demonstrators]						
[Creating new business opportunities]						
[Training & skills development]						

[38] The 2024-2025 IKAA Plan was established based on the estimated IKAA of the CAJU members in their projects from call 1. At this stage it does not include the IKAA linked to the call 2 projects. An amendment of the 2024-2025 IKAA plan is expected during 2024.

[Contribution to the development of new standards, regulations and policies]					
[Supporting ecosystem development]					
[Communication, dissemination, awareness raising, citizen engagement]					
[Others]					
TOTAL ESTIMATED IKAA 2024					**396.785**

[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.

OVERVIEW ESTIMATED IKAA FOR 2025						
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 2025 (in M€) [6]	of which programme related IKAA
			Topic	**Project Acronym**		
[Support to additional R&I][7]						
will contribute to achieve the objectives in the following domains:		**will contribute to achieve the following 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;	HORIZON-JU-CLEAN-AVIATION-2022-01-	HE-ART	51.673	0.000
Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft			HORIZON-JU-CLEAN-AVIATION-2022-01-	AMBER	7.569	0.000
Thermal Management Solutions for Hybrid Electric Regional Aircraft			HORIZON-JU-CLEAN-AVIATION-2022-01-	TheMa4HERA	6.661	0.000
Electrical Distribution Solutions for Hybrid-electric Regional Aircraft			HORIZON-JU-CLEAN-AVIATION-2022-01-	HECATE	8.492	0.000
Innovative Wing Design for Hybrid-Electric Regional Aircraft			HORIZON-JU-CLEAN-AVIATION-2022-01-	HERWINGT	6.199	0.000
Direct Combustion of Hydrogen in Aero-engines			HORIZON-JU-CLEAN-AVIATION-2022-01-	HYDEA	44.491	0.000
Direct Combustion of Hydrogen in Aero-engines			HORIZON-JU-CLEAN-AVIATION-2022-01-	CAVENDISH	10.165	0.000
Multi- Megawatt (MW) Fuel Cell Propulsion System for Hydrogen-Powered Aircraft		(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	HORIZON-JU-CLEAN-AVIATION-2022-01-HPA-02	NEWBORN	7.944	0.000
Large Scale Lightweight Liquid Hydrogen Integral Storage Solutions			HORIZON-JU-CLEAN-AVIATION-2022-01-	H2ELIOS	1.827	0.000
Near Term Disruptive Technologies for Hydrogen-Powered Aircraft			HORIZON-JU-CLEAN-AVIATION-2022-01-	HyPoTraDe	1.477	0.000
Near Term Disruptive Technologies for Hydrogen-Powered Aircraft			HORIZON-JU-CLEAN-AVIATION-2022-01-	fLHYing tank	0.422	0.000
Ultra Efficient Propulsion Systems for Short and Short-Medium Range			HORIZON-JU-CLEAN-AVIATION-2022-01-	SWITCH	8.373	0.000
Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft			HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01	OFELIA	72.003	0.000

	Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft	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-SMR-01	HEAVEN	15.842	0.000
	Ultra Performance Wing for Short and Short-medium Range Aircraft		HORIZON-JU-CLEAN-AVIATION-2022-01-	UP Wing	14.577	5.750
	Advanced Low Weight Integrated Fuselage and Empennage for Short Range and		HORIZON-JU-CLEAN-AVIATION-2022-01-	FASTER-H2	5.265	3.425
	Aircraft architectures & technology integration for aircraft concepts ranging from		HORIZON-JU-CLEAN-AVIATION-2022-01-	SMR ACAP	22.996	0.000
	Aircraft architectures & technology integration for aircraft concepts ranging from		HORIZON-JU-CLEAN-AVIATION-2022-01-	HERA	11.084	0.000
	Novel Certification Methods and Means of Compliance for Disruptive		HORIZON-JU-CLEAN-AVIATION-2022-01-	CONCERTO	3.457	0.000
	Developing a European Clean Aviation Regional Ecosystem (ECARE		HORIZON-JU-CLEAN-AVIATION-2022-01-CSA-01	ECARE	n/a	n/a
				TOTAL	**300.517**	**9.175**
[Scale up of technologies]						
[Demonstrators]						
[Creating new business opportunities]						
[Training & skills development]						
[Contribution to the development of new standards, regulations and policies]						
[Supporting ecosystem development]						
[Communication, dissemination, awareness raising, citizen engagement]						
[Others]						
TOTAL ESTIMATED IKAA 2025					**300.517**	

ESTIMATED IKAA 2024 BREAKDOWN PER COUNTRY	
Country	Estimated value (M€)
Czech Republic	3.663
France	171.505
Germany	145.827
Greece	1.324
Ireland	1.917
Israel	0.408
Italy	35.710
Netherlands	8.725
Norway	0.100
Poland	1.220
Romania	1.804
Slovenia	3.033
Spain	17.966
Sweden	3.256
Turkey	1.663
Total	398.119

ESTIMATED IKAA 2025 BREAKDOWN PER COUNTRY	
Country	Estimated value (M€)
Czech Republic	3.553
France	104.931
Germany	108.112
Greece	1.421
Ireland	1.967
Israel	0.393
Italy	50.657
Netherlands	8.508
Norway	0.055
Poland	1.370
Romania	1.566
Slovenia	1.778
Spain	12.141
Sweden	3.742
Turkey	1.660
Total	301.852
Country	Estimated value (M€)

4.2 List of Members (CS2 and CA)

4.2.1 Clean Sky 2 Leaders

#	Organisation 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			
9B	Liebherr Elektronik GmbH	Participating Affiliate						X			
10	MTU Aero Engines Ag	Leader					X				

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
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										

4.2.2 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							
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			

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
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 CENTRE - 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					
24F	TEKEVER - TECNOLOGIAS DE INFORMACAO, S.A.	Participating Affiliate				X					
25	GMVIS SKYSOFT SA (GMV)	Core Partner	X			X					

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
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					
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			

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
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				
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			

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
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					
69	Institut National Des Sciences Appliquées De Toulouse	Core Partner				x					
70	INSTITUTO DE SOLDADURA E QUALIDADE	Core Partner				X					
70A	INTERVENCAO EM SAUDE OCUPACIONAL, SA	Participating Affiliate				X					
70B	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			

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
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						
77A	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			
81A	Michelin Espana Portugal SA (MEPSA)	Participating Affiliate						X			
81B	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				
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			

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
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						
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					
108A	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					

#	Organisation Name	Participation Status	LPA	REG	FRC	AIR	ENG	SYS	SAT	ECO2	TE2
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					
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			

4.2.3 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

4.2.4 Clean Aviation Associated Members

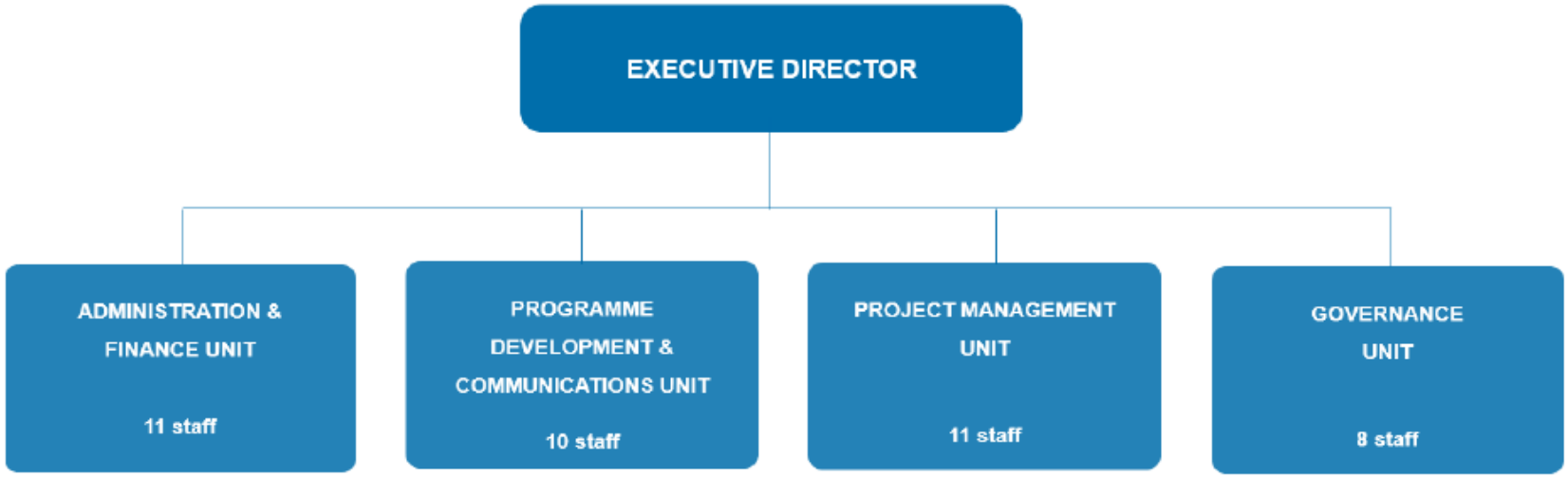
#	Organisation name	MS	Type of entity
1	Aeromechs srl	IT	SME
2	ASCENDANCE FLIGHT TECHNOLOGIES	FR	SME
3	Asco Industries N.V.	BE	Industry
4	Asociación de Investigación Metalúrgica del Noroeste – AIMEN Technology Centre	SP	RTO
5	ATR G.I.E.	FR	Industry
6	CAPGEMINI Represented by Capgemini Service SAS	FR	Industry
7	Fokker Next Gen N.V.	NL	SME
8	H2FLY GmbH	DE	Industry
9	Hellenic Aerospace Industry	EL	Industry
10	INEGI	PT	RTO
11	IRT Saint Exupéry	FR	RTO
12	Israel Aerospace Industries	IL	Industry
13	NTNU	NO	University
14	Politecnico di Torino	IT	University
15	PowerCell Sweden AB	SE	SME
16	Siemens	DE	Industry

#	Organisation name	MS	Type of entity
17	SINTEF	NO	RTO
18	Skylife Engineering S.L.	SP	SME
19	SOLiTHOR BV	BE	SME
20	Solvay	BE	Industry
21	TECNALIA	ES	RTO
22	Tecnam	IT	Industry
23	TEST-FUCHS GmbH	AU	Industry
24	The University of Nottingham[39]	UK	University
25	TU Braunschweig	DE	University
26	TU Delft	NL	University
27	TUSAŞ – Türk Havacılık ve Uzay Sanayii A.Ş. (Turkish Aerospace)	TR	Industry
28	Universidad Politécnica de Madrid	SP	University
29	University of Stuttgart	DE	University
30	Von Karman Institute for Fluid Dynamics	BE	RTO
31	VZLU - Czech Aerospace Research Centre	CZ	RTO
32	ZeroAvia UK[40]	UK	SME

[39] From 1 January 2024 and subject to the signature of the Letter of Commitment (LoC).
[40] From 1 January 2024 and subject to the signature of the Letter of Commitment (LoC).

4.3 Organisational Chart

The revised organisational structure of the CAJU as approved by the Governing Board[41] is shown below. The structure shows the four main units' structure.



[41] *CAJU-GB-Writ proc 2023-05 Decision Org structure*

4.4 LIST OF ACRONYMS, DEFINITIONS AND ABBREVIATIONS

4.4.1 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-fibre-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
DOC	Direct Operating Costs
EAP	Electrical Aircraft Propulsion
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
FTD	Flight Test Demonstrator
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
MoCs	Memorandas of Cooperation
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
S3	Smart Specialization Strategies
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
WET	Water-Enhanced Turbofan
WP	Work Package
WT	Wind Tunnel
WTT	Wind Tunnel Test
XDC	Cross Demonstrator Capacity
ZAL	Zentrum für Angewandte Luftfahrtforschung

4.4.2 LIST OF CA PROJECTS

AMBER	InnovAtive DeMonstrator for hyBrid-Electric Regional Application
AWATAR	Advanced Wing MATuration And integration
CAVENDISH	Consortium for the AdVent of aero-ENgine Demonstration and aircraft Integration Strategy with Hydrogen
COMPANION	COMmon Platform and Advanced Instrumentation Readiness for ultra efficient propulsion demonstration
CONCERTO	Construction Of Novel CERTification methOds and means of compliance for disruptive technologies
ECARE	European Clean Aviation Regional Ecosystem
FAME	Fuel cell propulsion system for Aircraft Megawatt Engines
Faster-H2	Fuselage, Rear Fuselage and Empennage with Cabin and Cargo Architecture Solution validation and Technologies for H2 integration
fLHYing tank	flight demonstration of a Liquid HYdrogen load-bearing tank in an unmanned cargo platform
H2ELIOS	HydrogEn Lightweight & Innovative tank for zerO-emisSion aircraft
HE-ART	Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft
HEAVEN	Hydrogen Engine Architecture Virtually Engineered Novelly

HEAVEN	Hydrogen Engine Architecture Virtually Engineered Novelly
HECATE	Hybrid ElectriC regional Aircraft distribution Technologies
HERA	Hybrid-Electric Regional Architecture
HERFUSE	Hybrid-Electric Regional FUSelage & Empennages
HEROPS	Hydrogen-Electric Zero Emission Propulsion System
HERWINGT	Hybrid Electric Regional Wing Integration Novel Green Technologies
HYDEA	HYdrogen DEmonstrator for Aviation
HyPoTraDe	Hydrogen Fuel Cell Electric Power Train Demonstration
NEWBORN	NExt generation high poWer fuel cells for airBORNe applications
ODE4HERA	Open Digital Environment for Hybrid-Electric Regional Architectures
OFELIA	Open Fan for Environmental Low Impact of Aviation
SMR ACAP	SMR AirCraft Architecture and technology integration Project
SWITCH	Sustainable Water-Injecting Turbofan Comprising Hybrid-electrics
TheMa4HERA	Thermal Management for Hybrid Electric Regional Aircraft
TROPHY	Technological Research On Propulsion by Hydrogen
UP Wing	Ultra Performance Wing