

# Common Technical Roadmap between Andalusia and Clean Aviation

related to the Memorandum of Cooperation signed on 22<sup>th</sup> July 2025 by the Regional Government of Andalusia and the Clean Aviation Joint Undertaking

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## 1. Context

The Clean Aviation Joint Undertaking ('CAJU')<sup>1</sup> is the European Union's ('EU') leading research and innovation ('R&I') programme for transforming aviation towards a sustainable and climate-neutral future, in line with the European Green Deal. CAJU is an European public-private partnership between the European Commission through Horizon Europe ('HE'), the EU research and innovation programme, and the European aeronautics industry. It has a budget of €4.1 billion divided into €1.7 billion in EU funding and no less than €2.4 billion in private funding. Building on the results of Clean Sky programmes (2008-2024), the Clean Aviation programme will support the demonstration of disruptive aircraft technologies reducing net greenhouse gas emission by 30% of Short-Medium Range ('SMR') aircraft and regional range aircraft. The technological and industrial readiness of the Clean Aviation technologies will support the deployment of new aircrafts by 2035, with the aim of replacing 75 % of the global civil aviation fleet by 2050. Fundings are assigned to applicants according to the HE regulation through open and competitive calls for proposals.

As part of the programme's Phase 1 (2022-2025), the CAJU has launched large-size, industry-led projects that are developing novel concepts for the next-generation of low-emissions commercial aircraft; investigating various disruptive aircraft technological innovations options powered either by Sustainable Aviation Fuels ('SAF') or hydrogen, combined with electric hybridization; and performing trade studies to assess various aircraft configurations incorporating the most promising technology options. These projects are supported by more than €800 million in EU funding through HE. This public-side support is complemented and leveraged by a declared private-side in-kind contributions amounting to a total research effort of €2 billion, confirming a strong members' commitment by the European aviation ecosystem (industry, supply chain research organization, academia and SMEs) to CAJU to achieving the programme objectives and contributing to transforming European aviation towards a sustainable and more competitive system. Further calls for proposals will be launched during the course of the programme's Phase 2 (2025-2030), with focus on demonstrating the most promising aircraft technologies reducing net greenhouse gas emission by 30% and supporting an entry-into-service ('EIS') by 2035.

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<sup>1</sup> Council Regulation establishing the CAJU, (EU) 2021/2085 of 19 November 2021. Official Journal: OJ L 427, 30.11.2021, available here: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R2085>

The autonomous region of Andalusia is a strategic European region pioneering research, development, production and promotion of technologies for the aerospace sector; also with a powerful aeronautical industrial ecosystem, with a long tradition and experience and with great flexibility to adapt to changes.

With an ambitious Operational Programme 2021-2027, Andalusia will contribute to accelerate the transition towards an air-transport system with zero emissions by 2050. To meet the challenges of climate change and inclusive economic growth, based on sustainable competitiveness, Andalusia supports the European Union's initiative about sustainable aviation, contributing with key competencies, capabilities and activities, promoted both from the public and private sector

Clean and sustainable aviation plays a key role in the innovation and industrial strategic frameworks of the Regional Government of Andalusia. The Andalusian Aerospace Strategy has a specific program (Program 1.1 for financing companies in Future Aviation technologies) that includes among its strategic objectives *the promotion and innovation in green-sustainable/zero-emission aircraft technologies, among others*. Additionally, the Smart Specialization Strategy for the Sustainability of Andalusia 2021-2027 (S4Andalucía), promoted by the Ministry of University, Research and Innovation identifies *aeronautics* as key sector within the specialization area of *Driving Industries*; or the Andalusian Energy Strategy 2030, led by the Ministry of Industry, Energy and Mines, that will promote a SAF (Sustainable Aviation Fuel) Promotion Program 2025-2026 in Andalusia.

In addition, through its industrial policy 'GROW Industry Action Plan', Andalusia aims to continue advancing in the development of the necessary capacities for the promotion of high-tech industrial projects and taking advantage of the opportunities related to the Green Deal Net-Zero and RePowerUE industrial plan. In this way, the instruments that articulate the industrial policy of Andalusia focus on promoting the growth of value chains that are developed or that can be developed in Andalusia, as well as opportunities for circularity, digitization and integration in global chains, seeking the greatest impact on economic, social and territorial cohesion. In addition, Andalusia seeks for opportunities in emerging sectors and in aligning with the European Commission's STEP policies. With the 'GROW Industry Action Plan', Andalusia aims to improve the productivity of its industrial sector based on technological development and innovation in products and processes, adopting dynamics of collaboration and corporate social responsibility, to face the great challenges of sustainability and digitisation that arise at European level and better positioned internationally. The promotion of industrial activities with high added value and innovation is one of the main measures to reinforce the global positioning of the Andalusian industrial value chains; since the aerospace sector stands out as Andalusian high-tech industry, the region seeks to further strengthen it.

Considering that Andalusian industrial and innovation strategies are well aligned with the Clean Aviation objectives, the Regional Government of Andalusia and the Clean Aviation Joint Undertaking signed in July 2025 a Memorandum of Cooperation with the main objective of establishing a framework of strategic collaboration, incentivising the design, development and deployment of innovative technological solutions for clean, net-zero-emission aviation. Andalusia and CAJU will be referred hereinafter as the "Parties".

## 2. Challenge

The goal of transforming air transport towards climate neutrality is a long-term ambition. To meet this challenge, it is essential to pull together the best expertise and resources from beyond the aviation ecosystem

and include world-class research and innovation from other strategic sectors, such as hydrogen, batteries and digital, as well as industrialization, advanced materials and manufacturing. However, achieving a climate-neutral aviation system is well beyond the private sector's ability and capacity to invest on its one. The aviation sector currently estimates that at least €12 bn in research and innovation would be needed over the timeframe of Horizon Europe<sup>2</sup>. No single country in Europe has the financial, technological and industrial capacity to fully support the required transition. This challenge highlights the need for a collaborative strategy including boosting competitive Short Medium Range aircraft. As a result, the collaboration between the parties prioritizes key areas of cooperation to drive competitiveness, including achieving high production rates of 100 aircraft per month based on advanced manufacturing technologies, digitalization and robotic technologies.

Efforts should be made at Union, Member State and Regional level by sharing roadmaps and managing synergies utilising a wide array of funding and financing sources from regional, national authorities and the European Union's Multiannual Financial Framework.<sup>3</sup>

### 3. Purpose and scope

The purpose of the present document is to lay out a 'Common Technical Roadmap' ('Common TR') between the Parties, as stated in the signed Memorandum of Cooperation. The goal of the Common TR is to identify relevant technical areas for R&I topics on which to prioritize regional investments, in order to establish and maximise synergies between the Parties.

In particular this document presents the high-level/strategic objective of the cooperation, areas of technical cooperation, expected impacts, and expected funding made available from both Parties.

### 4. High level objective of the cooperation

The objective of this cooperation is to accelerate the demonstration of low-emissions aircraft technologies and concepts, so that these innovations are part of new aircraft concepts with entry-into-service by 2035, in alignment with the Parties respective strategies and in strong collaboration with the regional ecosystem.

The CAJU's *Strategic Research and Innovation Agenda* ('SRIA')<sup>4</sup> sets out the path towards achieving the overall Clean Aviation vision, in terms of timeframe and scale of impact, focusing on three *thrusters*:

- i) hybrid-electric regional aircraft;
- ii) ultra-efficient small/medium range ('SMR') aircraft;
- iii) hydrogen-powered aircraft, H<sub>2</sub> direct burn and fuel cells.

Focus is placed on the regional and SMR segments targeting increased efficiency in commercial aviation by no less than 30% for SMR aircraft and no less than 50% for the regional range aircraft, as these segments account for more than 50% of global aviation greenhouse gas emissions. The first phase (2022-2026) of the Clean Aviation programme focuses on development of concepts, technologies and architecture options. The second

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<sup>2</sup> Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, and repealing Regulations (EU) No 1290/2013 and (EU) No 1291/2013 and (EU) n. ° 1291/2013

<sup>3</sup> Commission Notice on Synergies between Horizon Europe and ERDF programmes, [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022XC1104\(02\)&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022XC1104(02)&from=EN)

<sup>4</sup> CAJU Strategic Research and Innovation Agenda available here: [CAJU-GB-2021-12-16-SRIA](#)

phase (2026-2031) will address the maturation and integration of these technologies and concepts through (flight) demonstration.

The Andalusian aerospace sector considers relevant to boost aeronautic R&I on low-emission technologies while also prioritizing sustainable competitiveness for general and commercial aviation, including regional and SMR segments. Thematic areas to address could include ultra-efficient powertrain systems with zero/very low emissions, advanced materials, high integrated components with complex design in composite materials, end-to-end (E2E) automated industrial systems based on robotics technologies, artificial intelligence for data acquisition, process monitoring and predictive quality checks new electrical architectures, smart mobility, manufacturing security or certification path. In the same way, it is needed to develop the competences and capacities of a robust ecosystem for the Next Generation Single Aisle aircraft.

Also, mobility and advanced manufacturing are expected to play a key role in supporting the transformation of aviation towards a sustainable and climate-neutral future. Highlighted technologies and working areas could include fuel cells, green hydrogen production and storage, biofuels, SAF, green airports, advanced power conversion and distribution systems, eco-friendly materials, recyclable materials, additive manufacturing, predictive maintenance, artificial intelligence, digital twin and digital technologies, automation and robotics production, or efficient materials and its application.

In line with these high-level common objective and shared challenges, the Parties may cooperate and develop synergies on the following technical areas:

## 5. Areas of technical cooperation

Intersecting synergies, i.e., areas of intervention by both Parties:

- Hybrid-electric regional aircraft with 50% increased efficiency compared to 2020 state-of-the-art aircraft available for order/delivery:
  - Aircraft architecture
  - Airframe systems (e.g., wing, fuselage, empennage)
  - Thermal management
  - Energy generation and management
  - Power conversion and electrical distribution systems
  - Electromagnetic compatibility design and assessment
  - Electromechanical actuators
  - Batteries and fuel cells suitable for aviation application
  - Multi-MW hybrid-electric propulsion system based on fuel cells and/or battery, including system integration, sub-systems, modules and components
  - Electrical motors and inverters
  
- Ultra-efficient and competitive SMR aircraft with 30% increased efficiency compared to 2020 state-of-the-art aircraft available for order/delivery:
  - Aircraft architecture with high level integrated configuration
  - Advanced materials, manufacturing and assembly technologies to increase manufacturing efficiency and enable high production rates including new generation quality checks

- E2E automated industrial systems based on robotics technologies
  - Digitalization and artificial intelligence in the design, manufacturing and assembly processes as well as maintenance, and certification allowing predictive quality checks
  - Light weight airframe systems (e.g., wing, fuselage, empennage)
  - Ultra-efficient propulsion system able to use 100% SAF or H2 as fuel, including system integration, sub-systems, modules and components
- Hydrogen-based technologies enabling the development of regional/SMR hydrogen-powered aircraft:
    - Technology and demonstrators for multi-MW H2-fuel cell propulsion and aviation systems
    - Propulsion system based on H2 burn gas turbines, including system integration, sub-systems, modules and components (with ultra-low NOx hydrogen combustion)
    - Liquid-H2 storage and distribution onboard
    - On-board liquid-H2 refuelling system (with venting)
    - Electrical motors and inverters
    - Power conversion and electrical distribution systems
    - Electromechanical actuation systems
  - Transversal areas
    - Ground and flight demonstration and testing (including industrial set up and conversion)
    - Novel certification methods and means of compliance, including simulation systems
    - Advanced materials and advanced manufacturing (including development of advanced assembly lines) and new generation quality checks
    - Advanced manufacturing and assembly means
    - E2E automated industrial systems based on robotics technologies
    - Digital technologies for simulation, integration, modelling, digital twin
    - Digital trainers for operations
    - Digital assistant in the context of single pilot
    - Artificial intelligence for simulation and design and data acquisition and process monitoring
    - Digitalisation in the field of manufacturing, predictive quality checks and maintenance and certification
    - Digital logistics
    - Flight trajectories optimization and eco-flight assistance
    - Life-cycle aspects
    - Noise abating technologies compatibly with noise regulations foreseen at entry-into-service 2035
    - E2E sustainable industrialization
    - Aeronautics engineering skills and competences development

Complementary synergies, i.e., areas of intervention by Andalusia (as such areas are not covered in the CAJU SRIA):

- Development, production and use of green Hydrogen and SAF in Andalusia

## 6. Expected impact of the cooperation

The cooperation between the Parties is expected to maximize impact on the following areas:

- Increased number of demonstrated low-emissions aircraft technologies and concepts with EIS by 2035.
- Increased number of complementing stakeholders, competences, and capabilities (including newcomers to the field of aeronautics and in particular SME, startups and/or knowledge centres that can bring disruptive innovation) from the outset of CAJU and Andalusia funded projects contributing to the high-level common objective, as stated in section 4.
- Increased exposure of legal entities based in Andalusia to the CAJU programme and increased contribution of these entities to the CAJU objectives and EU Green Deal objectives.
- Increased exposition of legal entities based in Andalusia to the European level of aviation R&I and leading players worldwide, including CAJU Members and beneficiaries.
- Developed capabilities required for the future supply chain of the next generation of aircraft, and growth and increased competitiveness of the legal entities based in Andalusia.
- Increased number of jobs and availability of skills and competencies in Andalusia relevant to support transition towards climate neutral aviation by 2050.

## 7. Funding and timeline

CAJU is jointly funded by the European Union (€1.7 billion) and private members (€2.4 billion), bringing the total budget to €4.1 billion for the period 2021-2027 (end of funding in 2031). Fundings are assigned to applicants according to the HE regulation through open and competitive calls for proposals. Since the programme started, CAJU has launched 28 projects through its first call for proposal in 2022 and the second call for proposals in 2023. Further calls for proposals will be launched during the course of the programme. In phase 1 of the CA Programme (2022-2026), the focus is placed on developing and downselecting technologies with highest potential to reach TRL 6 by 2030. In phase 2 (2026-2031), the focus is placed on ensuring further maturation and demonstration of the selected technologies up to TRL 6, including aspects related to industrialisation to maximise potential entry into service by 2035.

Andalusia is expected to mobilize up to €35 million thanks to European funds in the coming years. In February 2025 the Regional Ministry of University, Research and Innovation approved ERDF €15 million to fund innovation projects applied to the sustainable aviation sector, and focused on technical priorities of this common roadmap. Industrial research or experimental development projects in Andalusia will be supported, so that they can contribute to offering innovative technological solutions to businesses and the general public through research and innovation, technology transfer, and cooperation between businesses and stakeholders in the Andalusian Knowledge System in the sustainable aviation sector.

Moreover, the Regional Ministry of Industry, Energy and Mines will also mobilize €20 million to support the Clean Aviation initiative, including €5 million from the Just Transition Fund (JTF). Currently, the "Jerez Net Zero Aeronautical Hub" project has made available €2 million to incentivize "Investment in the development of sustainable and technologically advanced products under the European Clean Aviation initiative." in the province of Cádiz. In 2026, it will launch two calls for aid that will incorporate actions linked to STEP technologies for the aerospace sector (as well as for other sectors), worth €20 million, and another specific one for the drone sector for €15 million.