Alliance for Zero-Emission Aviation

Work Plan 2025-2026

January 2025

Contents

Purpose of this document

The *Report Flying on electricity and hydrogen in Europe* published in June 2024 provides a shared Vision of how the Alliance sees the deployment of aircraft powered by electricity and hydrogen in Europe and has been a major step forward and an outcome of joint effort. While continuing to conduct the necessary analyses, the Alliance must now develop, as its main tool, a Roadmap providing a concrete plan and clear recommendations to support the entry into service of these aircraft. The Alliance should also start planning new activities to contribute to this objective where it can best add value.

The Alliance's work is mainly driven by mandates adopted in respect of its six Working Groups to adequately address the multitude of challenges associated with the entry-into-service of novel electric and hydrogen-powered aircrafts. The Working Groups' mandates were formally adopted in November 2022 as Alliance-internal, time-bound mandates. They provided guidance to the setup and organisation of the Alliance's workstreams.

The **AZEA Work Plan** lays down the work to be undertaken by the Alliance for Zero-Emission Aviation (AZEA) in the period 2025-2026. To enable Working Groups to continue conducting the necessary analyses for the delivery of a Roadmap, but not limited to, the present document establishes the renewed Working Group mandates considering new priorities and areas of interest.

Furthermore, with this document, the Alliance also provides its more than 195 members with guidance on the way forward, by means of confirming and adjusting priorities, while also identifying new areas of action and informing the wider public about the Alliance's work priorities.

The Alliance for Zero-Emission Aviation

What is an Industrial Alliance?
Industrial alliances are a tool to facilitate stronger cooperation and joint action between all interested partners and can play a role in achieving key EU policy objectives through joint action by all the interested partners. The European Commission has launched several industrial alliances to support the digital and green transition. As with other alliances, AZEA's members have to publicly commit to supporting its objectives. The mode of functioning, including the Alliance's governance structure is described in its Terms of Reference.

In June 2022, the European Commission launched AZEA with the purpose to support the transition of European aviation towards low/no in-flight climate harmful emissions ('zero-emission') and promote the competitiveness of the European aeronautics industry by supporting its efforts to switch to electric and hydrogen propulsion technologies.

The specific objective of AZEA as defined by its Declaration is to "*to prepare the aviation ecosystem for the earliest possible entry into service of hydrogen- and electric-powered aircraft*", in other words to address all barriers and requirements stemming from the use of electricity and hydrogen as novel fuels to power aircraft. It covers all technologies leveraging hydrogen and electricity as power source (battery-electric, hybrid-electric, fuel cell, hydrogen combustion, etc) and all the market segments in which these aircraft are expected to operate within the 2050 timeframe.

AZEA brings together more than 185 members representing all the different categories of stakeholders involved (see the list of members), including representatives from aircraft manufacturers, airlines and lessors, airports, energy companies and fuel providers, research and standardisation organisations, regulators, regions, passenger and environmental interest groups, etc.

AZEA members jointly work to identify all barriers to the entry into commercial service of these aircraft, establish recommendations and a Roadmap to address them, promote investment projects and create synergies and momentum amongst members. In particular, the members look at issues such as the required financial support and investment to put such aircraft on the market, the fuel and infrastructure requirements of hydrogen and electric aircraft at airports, industry standards and regulations/certifications, and the implications for operators (airlines) and air traffic management.

The Roadmap is the main tool to be developed by the Alliance to support the adaptation of the ecosystem to new aircraft powered by electricity and hydrogen. It should identify the actions required by all stakeholders and promote their coherent implementation. The Roadmap builds on the analyses performed by the six Working Groups, that have been established according to the Alliance's Terms of Reference to allow a broad participation and support of all AZEA members. The orientation of Working Groups may be adapted when it is considered that they have accomplished the task assigned to them, while new ones can be created in case required to address newly identified needs. The Roadmap should help monitoring the progress made by the sector towards the objective. The Alliance should consider updating the Roadmap at regular intervals (e.g. every 3 years). Beyond the Roadmap, the Alliance should also undertake specific activities in order to support the Alliance objectives where the Alliance can best contribute.

Work undertaken by the Alliance to date

In September 2022, the Commission designated representatives of the main stakeholder communities to the Alliance's Steering Committee composed of a balanced group of representatives of Member Organisations, which should not be subject to control by a third country. A Support Group to the Steering Committee has been established to provide operational support to the functioning of the Steering Committee. At the Alliance's first General Assembly on 14 November 2022, all but one of the Working Groups (WGs) had been constituted and began working under the mandate allocated to them.

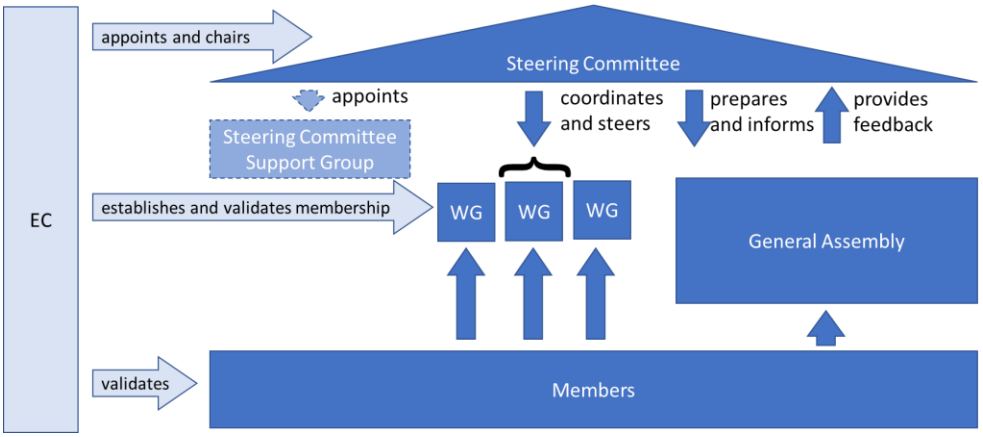

Figure 1: Governance structure of the Alliance

At the occasion of the 2nd General Assembly in June 2023, the Alliance issued its first progress report providing a state of play on the work initiated by the Working Groups and subsequent analyses in view of enabling a transition towards hydrogen and electric flight in Europe. First results for public dissemination were released in the form of reports on the Current standardisation landscape and Aviation regulatory landscape for hydrogen and electric aircraft. At the 3rd General Assembly in January 2024, the Alliance published a first iteration of a Concept of Operations to integrate novel aircraft configurations into the European network.

To further raise awareness for the ecosystem's readiness to transition towards hydrogen-powered and electric aircraft, in June 2024, AZEA published its report on 'Flying on electricity and hydrogen in Europe' a high-level Vision of the deployment of electric, hybrid and hydrogen aircraft in Europe, setting out the ambitious objective to have 36 to 68% of intra-EU flights operated by these new aircraft configurations by 2050 and identifying the main benefits and challenges.

Figure 2: AZEA report "Flying on electricity and hydrogen in Europe"

The Vision report built upon the analyses and quantifications undertaken by the relevant Working Groups, demonstrating the ecosystem's determination to roll out novel propulsion technologies and its level of ambition in the proposed scenario.

Under the leadership of Working Group Chairs representing the broad range of the aviation ecosystem, the Working Groups have succeeded in creating inclusive collaboration environments that are open to all Alliance members. Attracted by this participatory approach, Alliance members continue to meet on a regular basis across Working Groups and their sub-groups, both in-person across Europe and virtually, to jointly address the challenges of deploying hydrogen-powered and electric aircraft leveraging their individual expertise.

Following the launch of the Vision report, Alliance members have expressed their wish to accelerate the work on a Roadmap laying down the actions and recommendations to be taken to jointly move towards its objectives.

The present Work Plan will contribute to steering the Alliance's efforts to the development a Roadmap for the ecosystem. The AZEA Work Plan is the result of active participation by Alliance members, in particular through the input provided by the Working Groups and their Chairs. The development of the Work Plan was communicated to the membership at the 4th General Assembly which took place on 7 June 2024 at ILA Airshow in Berlin, Germany. Members were invited to have their say in the development of the Work Plan through EUSurvey from 18 June until 31 July 2024. In the preparation of the document, DG DEFIS engaged with the Chair Teams of the six Working Groups to take stock of the progress made, as well as to identify new areas of interest.

Work Plan 2025-2026

The following sections are structured as follows:

1. Analyses to be undertaken by the Working Groups of the Alliance

The six Working Groups of the Alliance have proven to be a powerful tool to bring together likeminded stakeholders from various sectors within the ecosystem to develop analyses and recommendations that are built on a common view. With this document, the current structure of the six Working Groups is re-confirmed on the basis of renewed mandates included in this section. The Working Groups' renewed mandates are based on the stocktaking of the previous mandates and taking into account new ideas and adjustments expressed during the process of developing the present Work Plan. The elected Working Group Chairs with the support of the Steering Committee are responsible for the delivery of the identified tasks.

2. Development of a Roadmap for the ecosystem

Following the launch of the Vision report demonstrating the objectives of the transition towards electric and hydrogen flight, the Alliance will now move towards the development of a Roadmap for the ecosystem. To be impactful, the Roadmap must be considered by the different stakeholders as a relevant tool to inform their own decision-making processes. Contributions to the Roadmap will come from the Working Groups on the basis of the renewal of its mandates as well as additional workstreams to be established by the Alliance.

3. Horizontal tasks to be undertaken by the Alliance

The consultation process has shown that Alliance members have a strong interest in developing activities that go beyond the analysis phase supported by the Working Group and directly support AZEA's objectives. Examples of these activities are the need for communication activities to raise local awareness for the transition towards electric and hydrogen-powered flight and the organisation of workshops with decision-makers and investors to identify existing bottlenecks for the deployment of zero-emission aviation (e.g. dedicated workshops addressing funding opportunities and incentives). DG DEFIS in its role as Chair of the Alliance will coordinate the work on the identified activities.

Analyses to be undertaken by the Working Groups of the Alliance

The following task lists per Working Group were established in collaboration with the elected Working Group Chairs and Members. They take into account the still ongoing tasks and activities initiated as part of the previous mandates, some tasks are expected to be finalised over the course of Q1/2025. These are reflected in the updated and newly established Work Packages presented in the following sub-sections.

Where deemed useful, to organise and adjust the ongoing work within the Working Groups, the defined tasks and deliverables may be further broken down by the Working Group Chairs, e.g. in an internal Annex to this Work Plan. For example, Working Group 3 on Aerodromes will set up a dedicated sub-group addressing the need for full end-to-end hydrogen industry regulatory & standardisation frameworks as crucial enablers for uptake at aerodromes.

The following sub-sections provide a description of the six Working Groups, including their objectives and expected deliverables for the 2025-2026 period.

Rollout and network of electric and hydrogen-powered aircraft (WG1)

Objectives:

The Alliance must deliver a Roadmap providing actionable recommendations and develop actions contributing to effectively remove the obstacles to the rollout of electric, hybrid-electric and hydrogen-powered aircraft and

implement the transition to climate-neutral flights. It has, therefore, established a first step of quantified high-level objectives or "figures of reference" based on a rollout scenario leveraging forecasting data of aircraft deliveries. In the next step, the WG should focus on developing a flight network that describes where and how such aircraft could or should be deployed in the market, starting with Europe but not limited to this.

State of play:

To support this objective, under its previous mandate WG1 completed in June 2024 an internal report establishing a first analysis of the expected deliveries of aircraft powered by electricity and hydrogen and their penetration in the different market segments for two scenarios (baseline and ambitious). The work undertaken during the previous mandate was based on a comprehensive analysis of performance characteristics of such novel aircraft (speed, range, decarbonised electricity/hydrogen requirement, number of seats, Maximum Take-off Weight or MTOW, etc.). More importantly, in a subsequent step WG1 provided an estimation of the global energy requirement (high-level "figures of reference") to ensure the growth and the development of the electric and hydrogen-powered flights in Europe. These findings constitute the backbone of the Alliance's report on "Flying on electricity and hydrogen in Europe" published in June 2024.

In a next step, WG1 has established a close cooperation with WG2, WG3 and WG5 (establishing an ad hoc Task Force), to develop a geographical repartition of the operations of those aircraft in Europe and to further detail the energy requirements per regions and airport categories. The results to be produced as part of this workstream will support the Alliance's Roadmap for the ecosystem on the introduction of hydrogen and electric flights in Europe.

Description of focus areas for the 2025-2026 period:

The rollout scenario developed by this WG makes use of industry market forecasts, business cases, existing studies and the Clean Aviation Technology Evaluator platform. It is based on assumptions and requirements related to the entry into service of the different aircraft sizes and propulsion technologies, including:

- the performance characteristics of such aircraft (speed, range, decarbonised electricity/hydrogen requirement, number of seats, MTOW, etc.).
- operational aspects led by WG 5 (safety requirements, turnaround times, integration in the airspace, effects on aerodrome capacities, etc.).

While an initial inventory of performance characteristics of such aircraft has been provided, the analysis of the operational aspects mentioned above needs to be further analysed jointly with WG5 and be aligned with WG3 results in terms of infrastructure requirements.

To further supplement the first rollout scenario, it should also consider the broader ecosystem context of the operations of hydrogen and electric aircraft, including:

- decarbonised electricity and hydrogen, volume requirements, availability and transportation;
- the future travel patterns (not limited to existing routes, but also taking into account the potential provided by clean technologies to develop new regional mobility offers involving also secondary aerodromes), etc.;
- identification of passenger markets, operators and networks that can serve as "early adopters" for zero-emission aviation.

On this basis, in its next phase the WG will continue to develop network scenarios electric and hydrogen flights in Europe (flight network). It will establish requirements for decarbonised electricity and gaseous/liquid hydrogen availability and indicate a repartition of the needs between regions and airport categories across Europe. These key metrics and figures of reference of the future zero emission aviation will also serve as a unique reference to communicate and perform the advocacy efforts toward net zero aviation by 2050.

Deliverables:

Title of the Work Package	Description of the Work Package	Deliverable
WG1/25-26/WP1: Development of a European flight network and related energy requirements	The objective is to describe a potential network of future electric and hydrogen destinations in Europe and to deliver recommendations, in close collaboration with WG2, WG3 and WG5 (per NUTS regions and/or Member States and airport categories) for energy production and distribution and airport investments, considering their potential for deployment of electric, hybrid-electric and hydrogen-powered aircraft and the hydrogen/electricity infrastructure readiness levels of the aerodromes. WG1 will focus on identifying where required energy, related distribution and airport infrastructure will be needed in order to support an analysis of related investment costs to be estimated by WG2. In a next step, the related energy requirements as an enabler for the network should be established.	Initial description of a European flight network
WG1/25-26/WP2: Development of case studies on regional air mobility in Europe	In alignment with the results of WP1, the objective of this task is to take a closer look at parts of Europe where regional air mobility is vital to connectivity. At least two areas of interest within Europe will be featured in the case study, with the aim of projecting the roll-out of electric/hydrogen-powered aircraft in the chosen regions. The case studies should take into consideration existing PSO arrangements and overall conditions which may benefit the uptake of such novel aircraft.	Case study reports on regional air mobility in Europe
WG1/25-26/WP3: Monitoring of the figures of reference	In the first phase of the WG, a set of figures of reference were established. In due course, these figures should be revisited and adequately updated by the industry experts, taking into account recent developments in the area of i) aircraft development/launch plans, ii) energy requirements in view of potential efficiency gains or similar.	Update of the flight network and related figures of reference

Green electricity and hydrogen supply (WG2)

Objectives:

This WG should ensure that the decarbonised electricity and hydrogen requirements necessary for the roll-out of electric and hydrogen aircraft are adequately identified and integrated in the broader context of European and national energy policies and cross-sectorial initiatives, including the Hydrogen Alliance, the Renewable and Low-Carbon Fuels Value Chain (RLFC) Alliance, ReFuelEU Aviation and the Alternative Fuels Infrastructure Regulation. It should identify and promote appropriate synergies with those initiatives. It should address the competition for decarbonised electricity and hydrogen with other fuels (SAF) and sectors such as heavy industries, shipping or road transport.

State of play:

The Working Group developed so far two main streams of activities. The first one is devoted to the assessment of the infrastructure capacity required for the production and supply of the decarbonised electricity and gaseous/liquid hydrogen necessary to support the development of the network of electric and hydrogen flight destinations in Europe.

Significant work was delivered by the Working Group focusing on green electricity and hydrogen supply in order to support the calculation of energy requirements presented in the AZEA Vision report, in particular an analysis of the generation capacity for the different scenarios presented at the 3rd General Assembly in January 2024.

Based on the ongoing work on the flight network within WG1, WG2 is currently developing future distribution CAPEX estimates for hydrogen deployment at airports, as well as estimations on the future electricity and hydrogen demand at airport level.

In a second work stream the Working Group evaluated the expected impact of regulations (e.g. AFIR, ReFuelEU Aviation) and policies (e.g. national hydrogen strategies) supporting the production and distribution of decarbonised electricity and decarbonised hydrogen and identified relevant initiatives In January 2024, WG2 completed an internal regulatory report providing a set of recommendations on policies and regulations on hydrogen infrastructure for aviation. WG2 is currently finalising a regulatory report providing a comprehensive overview of the current legal landscape surrounding the provision of hydrogen and electricity to airports in the EU and discussing whether existing or proposed regulations on the provision and expansion of renewable electricity and hydrogen impede progress for electrical and hydrogen powered aircraft.

Description of focus areas for the 2025-2026 period:

Based on the decarbonised electricity and hydrogen requirements established by WG1 and on an analysis of polices and horizontal initiatives in the fields of decarbonised electricity and hydrogen (like the Hydrogen Alliance), the WG should identify existing gaps and possible synergies with other initiatives. It should establish recommendations to develop the necessary production and distribution infrastructures to enable the flight network (with electricity and hydrogen infrastructures needed at aerodromes to be addressed by WG3) and identify the gaps jeopardising the readiness of electricity and hydrogen supply chains in order to secure the availability of the required hydrogen and/or electricity for aviation in time, quantity and price at the appropriate aerodromes for the fleet of aircraft.

This should include, in particular, to:

- Determine the total infrastructure capacity (electrolysers, hydrogen compression, liquefaction, electrical grid, hydrogen transmission network, storage solutions etc.) up to the boundaries of an aerodrome to ensure the supply of the decarbonised electricity and gaseous/liquid hydrogen where and when the energy is required

for aircraft recharging and refuelling (according to the needs defined by WG1 on the basis of the flight network developed) and for other aerodrome needs (supply of electricity to stationary aircraft, aerodrome's equipment, etc. to be identified by WG3.) over time.

- Different generic energy supply strategies should be developed for the different typologies of aerodromes (size, location, estimated energy demand, etc.) provided by WG3 (without analysing individual aerodromes).
- This analysis should include the volume and flows of required clean hydrogen (gaseous / liquid), global electrolysis power to produce clean hydrogen and associated resources (land use, clear water, catalytic materials…), the length of the hydrogen transmission network and the existing connections to the European Hydrogen Backbone, the number of hydrogen transportation vessels for import/export and number of hydrogen trucks for last-mile transport (among others)in order to establish the required network of hydrogen hubs at aerodromes.
- The same estimate as for hydrogen should be used for calculating the aerodrome's electricity needs, from aircraft recharging to ground support equipment and other needs, taking also into account the typology of aerodromes.
- This WG should establish a cooperation with the Renewable and Low Carbon Fuels (RLFC) Alliance in order to consider both the direct use of hydrogen and the production of e-fuel. As part of this cooperation, expected H2 demand for other fuel productions (which can have an effect on the H2 availability for direct use on Hydrogen powered aircrafts) should be considered along with fuel production assumptions to understand if these will have an effect at aerodrome level. The collaboration could also investigate price/energy comparison between direct H2 and other fuel production to assess the economic competitiveness/need for subsidies.

❖ Continue evaluating the expected impact of legislation supporting the production and distribution of decarbonised electricity and decarbonised hydrogen (e.g. AFIR, ReFuelEU Aviation, RED III, Gas & Hydrogen Decarbonisation Package, TEN-T and CEF Transport Alternative Fuels Infrastructure Facility, TEN-E and Projects of Common/ Mutual Interest under the cross-border hydrogen infrastructure category). Identify other policies and initiatives at EU, national or regional levels that could be of relevance to support the deployment of aircraft powered by electricity or hydrogen (e.g. national policy frameworks under AFIR and ReFuelEU Aviation), in particular those contributing to the EU Hydrogen Strategy. These initiatives include the Hydrogen Alliance's European Electrolyser Summit Joint Declaration, projects pipeline and European Electrolyser Summit Joint Declaration, Hydrogen Funding Compass the Clean Hydrogen Joint Undertaking (JU) and the Hydrogen Valley projects that may be developed in connection or close to aerodromes, the Hy2Use IPCEI, etc. Furthermore, other relevant pieces of legislation for zero-emission aviation could also be analysed, such as the new Batteries Regulation, the EU Taxonomy for sustainable activities and the Green Claims Directive.

- WG2 should evaluate the expected progress and relevance of these pieces of legislation and initiatives, identifying gaps on implementation

- WG2 should follow-up on the evolution of national H2 policies, infrastructure standards and planning policies as well as relevant EU legislation (e.g. Alternative Fuels Infrastructure Regulation Hydrogen & Gas Decarbonisation Package)

- WG2 should support WG3 in identifying existing policy gaps and formulate recommendations to support investments in H2 projects at aerodromes and in aviation, including analyses on financial instruments tailored to aviation H2.

❖ Considering those horizontal initiatives, build an investment plan, taking into account the various time scales and develop recommendations to promote synergies between the aviation sector and the electricity and hydrogen ecosystems at European, national and regional levels in order to maximise the benefits for aviation and ensure the development of the necessary infrastructure.

The WG may also address the needs for fuel cell and battery production, maintenance and recycling capacities (including the whole life cycle e.g. availability and security in the supply of raw materials).

WG2 should also support WG3 in identifying and analysing key horizontal issues related to the use of hydrogen, including:

❖ General safety (protection of public, operators and equipment, emergency response procedures, surveillance of installations, etc.);

❖ Administrative (facility deployment authorisations, Seveso requirements, connection to national and regional hydrogen network infrastructure, connections to the European Hydrogen Backbone etc.);

❖ Environmental compliance (use of resources - notably freshwater and decarbonised energy, gas emissions, noise, etc.).

To this end, WG2 energy supplier regulations and standards expertise is required to support the sub-group set up within WG3 – Aerodromes addressing the need for full end-to-end hydrogen industry regulatory & standardisation frameworks as crucial enablers for uptake at aerodromes.

It is acknowledged that to adequately address the identified focus areas, WG2 should also build upon relevant public analyses as well as identify areas where external expert support not represented within WG2 may be required.

Deliverables:

Title of the Work Package	Description of the Work Package	Deliverable
WG2/25-26/WP1: Detailed analysis on the total infrastructure capacity needs	Building on the initial assessment of the generation capacity for the different scenarios presented in January 2024 and on the outcome of the flight network workstream, WG2 should carry out analyses determining the total required infrastructure capacity that will be needed to ensure that required volumes of decarbonised electricity and hydrogen are adequately supplied to airports. This analysis should be based on an acceptable scenario for energy distribution (electricity and hydrogen) to the airports. This Work Package should also build on the results of the dedicated analyses undertaken by WG3. These reports include the estimation of future energy needs at airports and the analysis of the typology of aerodromes. WG3's	Report on total infrastructure capacity

Title of the Work Package	Description of the Work Package	Deliverable
	factsheets covering the infrastructure requirements to enable the effective supply of electricity and hydrogen to airports should also be considered. This Work Package should be segmented per type of necessary infrastructure to effectively deliver the required volumes of electricity and hydrogen to aerodromes (if possible, the report should provide a breakdown of the required capacity per infrastructure element). Infrastructure elements to be considered: renewable electricity generation, electrolysers, electricity grid, hydrogen transmission network, hydrogen liquefaction facilities, hydrogen compressors, electricity storage, hydrogen storage, hydrogen swapping tanks, hydrogen trucks etc. Overall, the work related to the electricity supply (in particular issues related to the grid) should be reinforced with the support of appropriate stakeholders.	
WG2/25-26/WP2: Regulatory analysis to enable the introduction of hydrogen for aviation	This Work Package should build upon the already completed reports providing recommendations on policies and regulations on infrastructure for hydrogen production, transmission and distribution as well as on the regulatory report on electricity and hydrogen supply for sustainable aviation at EU airports. On the basis of these materials, it should focus on formulating actionable recommendations and areas of engagement for EU hydrogen legislation of relevance for AZEA. The EU hydrogen to be considered should include at least the Gas & Hydrogen Decarbonisation Package, the TEN-T, the TEN-E, CEF Energy and RED III. This Work Package should also identify key stakeholders in the hydrogen distribution value chain and propose actions for engagement and alignment. As an example, future hydrogen transmission network operators (HTNOs/ current TSOs) need to be more strongly involved and considered in the development of regulatory analysis for hydrogen production sites and hydrogen distribution network infrastructure. Synergies with the analysis performed by WG3 on the deployment of hydrogen refuelling and electricity recharging at airports should be sought in particular as regards the implementation of the Alternative Fuels Infrastructure Regulation, ReFuelEU Aviation,	Report on regulatory analysis, including a timeline with actionable recommendations and areas of engagement with key stakeholders in the hydrogen distribution value chain

Title of the Work Package	Description of the Work Package	Deliverable
	and CEF Transport Alternative Fuels Infrastructure Facility.	
WG2/25-26/WP3: Investment recommendations	WG2 should elaborate a ranking of investments that should be prioritized to enable the required supply of electricity and hydrogen to airports. In close alignment with WG3 work on aerodromes' investment requirements, these ranking of investments should consider the future energy needs and uses at airports, as well as the different typology of airports. This Work Package should also provide a structure for the drafting of investment plans, outlining the key elements that should be considered, including granularity as regards timeframes. Key stakeholders in the electricity and hydrogen production and distribution ecosystem (both at the regional and national levels) should also be identified as part of this exercise. In alignment with WG6 on incentives and with the activities of the RLFC Alliance and the Hydrogen Alliance, this Work package should propose a set of recommendations for investment engagement actions (e.g. detailed description of how a B2B Matchmaking event should be designed).	Recommendations on investment plans, including ranking of priority investments and mapping of key stakeholders
WG2/25-26/WP5: Development of targeted recommendations to EU Member States and their regions to enable electric/hydrogen-powered flights	Based on the breakdown of energy and supply infrastructure requirements per Member State, the objective of this task is to develop targeted recommendations to EU Member States. These recommendations should consider the reporting requirements and mechanisms established under AFIR and RefuelEU Aviation. The Alliance should support this task by liaising with the relevant national bodies to present and discuss the recommendations developed by the WG, while also engaging with relevant DGs of the European Commission.	On a rolling basis
WG2/25-26/WP6: Fuel cell and battery production, maintenance and recycling capacities	The objective of this task is to perform analyses to address the needs for fuel cell and battery production, maintenance and recycling capacities (incl. the whole life cycle e.g. availability and security in the supply of raw materials) that arise from the operation of relevant novel aircraft.	Ad-hoc thematic reports or factsheets on battery production, maintenance and recycling capacities
WG2/25-26/WP7: Use of hydrogen in the aviation sector	In view of the specific requirements related to the production, storage and use of hydrogen, this task should address horizontal issues	Ad-hoc thematic reports or factsheets on general safety, administrative and

Title of the Work Package	Description of the Work Package	Deliverable
	related to the use of hydrogen in close coordination with WG3, such as: - general safety (protection of public, operators and equipment, emergency response procedures, surveillance of installations, etc.); - administrative (facility deployment authorisations, Seveso requirements, connection to hydrogen backbone etc.); - environmental compliance (use of resources - notably freshwater and decarbonised energy, gas emissions, noise, etc.). As part of this WP, the WG should investigate the state of play regarding Hydrogen Valleys and their contribution, also in terms of horizontal issues, to hydrogen for the aviation sector. Alignment with WG 3 on safety requirements for the distribution of hydrogen and the refuelling of aircraft should be sought, as well as with WG 5 on operational aspects.	environmental compliance aspects

Aerodromes (WG3)

Objectives:

This Working Group is responsible to perform a systematic analysis of the barriers and challenges (investments and others), in particular as regards infrastructure deployment for electricity and hydrogen supply, as well as opportunities related to the introduction of electric/hydrogen aircraft at aerodromes with particular attention to regional air mobility/general aviation where such aircraft will enter into service first, and issue recommendations to address them. Such recommendations should be formulated in support of airport master planning processes.

State of play:

Aerodromes play an essential role in enabling the operation of novel aircraft propulsion technologies. In the first phase, WG3 completed a preliminary scenario for aerodromes, covering an overview of aerodromes' typology and an assessment of the energy needs for airports (including electricity recharging and refuelling for aircraft, but also electricity supplied to stationary aircraft and for ground handling equipment).

WG3 is currently working on the finalisation of a set of infrastructure factsheets covering requirements to enable the effective supply of electricity and hydrogen to airports. These factsheets cover electricity supply for 100% electric aircraft powered, electricity supply for hybrid-electric powered aircraft, supply of gaseous and liquid hydrogen by truck, supply of gaseous hydrogen by pipeline, supply of liquid hydrogen by tank swapping, gaseous hydrogen storage and compression, hydrogen storage and compression, hydrogen liquefaction and liquid hydrogen storage, gaseous and liquid hydrogen refuelling by truck, liquid hydrogen refuelling by pipeline and gaseous hydrogen refuelling by fixed or mobile stations.

The factsheets are accompanied by an overview of operational requirements for the deployment of electric, hybrid-electric and hydrogen-powered aircraft at aerodromes. In the case of electric and hybrid-electric aircraft, this overview covers stand configuration and design & allocation; battery charging and drop-in aviation fuels with passengers on board; thermal/climate conditions; weight and balance limitations and different turnaround milestones (A-CDM); firefighting, rescue and emergency; and storage areas security risk. Similarly, in the case of gaseous and liquid hydrogen-powered aircraft, the overview includes refuelling safety zone; stand configuration/design & allocation; dedicated areas/remote stands; refuelling with passengers on board; weight and balance limitations and different turnaround milestones (A-CDM); and firefighting and rescue and emergency.

Description of focus areas for the 2025-2026 period:

Considering the variety of aircraft, decarbonised electricity & hydrogen requirements, supply approaches and business models, it is suggested to conduct an analysis of the barriers based on well-defined aerodrome scenarios covering the variety of situations identified. The analysis should cover both the required infrastructure and the related investment requirements, as well as all other barrier that may exist, including barriers related to certification, regulation and standardisation from the aerodrome point of view (in coordination with WG4). The analysis should also help identify opportunities associated with the transition to zero-emission aircraft to facilitate aerodrome medium-term to long-term development strategies.

The current challenge of assessing a full end-to-end hydrogen industry regulatory & standardisation frameworks as crucial enablers for uptake at aerodromes requires expertise going beyond the scope of WG3 only, i.e. energy supplier regulation and standards experts from WG2 as well as seeking coordination with WG4 are required to contribute to the delivery of this assessment. To this end, WG3 will create a dedicated sub-group gathering relevant experts to emphasise the urgency of addressing this challenge.

Detailed description of aerodrome operations

To facilitate a systematic and complete screening of all barriers to the introduction of electric and hydrogen-powered aircraft at aerodromes and considering the results from WG1, the WG should further develop detailed scenarios of all aerodrome operations required to support the different types of aircraft configurations (electric, fuel cell, hydrogen capsules, direct hydrogen a/c refuelling, etc.). Those scenarios should cover in particular the electricity/hydrogen management aspects (distribution/storage) at aerodrome level (link with WG2) and aircraft charging/refuelling aspects including ground support equipment. They should identify all relevant interfaces.

On this basis, the WG should develop infrastructure guidelines defining for each of those aerodrome scenarios, the generic infrastructure requirements, including as relevant:

- electricity and hydrogen production, storage and distribution network within the boundaries of an aerodrome (considering a multi-usage of electricity and hydrogen at aerodromes) and their connection to/integration in local decarbonised electricity/hydrogen transmission networks/supply chain (e.g. electrical grid, local hydrogen transmission network, hydrogen liquefaction facilities, etc.);
- apron equipment (i.e. charging stations and hydrogen refuelling) and CONOPS for using this equipment in coordination with WG5;
- key actions to be taken by asset owners for short-term demonstration phases;
- regulation and standards as well as safety requirements for hydrogen and electric infrastructure at airports in coordination with WG4.

Such guidelines would help aerodromes identifying infrastructure deployment strategies and specific investments needs, in particular in the context of airport master planning.

Global infrastructure and investments requirements

Global infrastructure and investments requirements as a focus area is closely interconnected to WG2. WG 3 should identify the major elements of aerodrome-related infrastructures needed across Europe based on the following considerations: (i) the operational patterns of the expected electric/hydrogen aircraft (WG1) and on activities to green their own operations (supply of electricity to stationary aircraft, airport's equipment, etc.), (ii) the expected share of aviation needs not covered by existing or planned supply chains of decarbonised electricity and hydrogen (WG2) and (iii) the scenarios and guidelines defined above. These elements should be produced also in view of informing the Alliance's roadmap towards hydrogen and electric flight in Europe. Aerodromes' infrastructure models can vary, depending on aerodrome size, region, traffic, decarbonised electricity/hydrogen supply model, proximity to other decarbonised electricity and hydrogen hubs, and many more parameters. It is expected that aerodromes will be considered to fulfil the role of energy hubs, integration of ground infrastructure to handle new aircraft configurations will therefore have to be coordinated as part of a wider development strategy (e.g. at local/national level).

The analyses undertaken by the WG should anticipate the related investments required at aerodromes and establish guidance on aerodromes investment plans for medium- to long-term time horizons, identifying the needs for public and private financing and investing support schemes, highlighting priorities and promoting a coherent deployment of the necessary infrastructures at aerodromes. This workstream should also consider on-going initiatives supporting the deployment of decarbonised electricity and hydrogen at aerodrome such as ACI Aerodrome Carbon Accreditation, the Alternative Fuels Infrastructure Regulation (AFIR), the revised TEN-T Guidelines, the Alternative Fuels Infrastructure Facility (AFIF) under CEF and the EU Green Taxonomy.

Together with the output from WG2, providing guidance on investment planning will be the starting point of further work required to unlock the required investments. In alignment with WG6 on Incentives, the WG should further explore possible funding/financing mechanisms. This should include mapping available instruments and identifying the most appropriate ones as well as making recommendations – including those related to the existing and future EU regulatory and financial framework (such as for example revisions of TEN-T and AFIR regulations), having regard to the recommendations proposed by other Alliances where there is a common interest.

Other barriers and challenges

The WG should identify the impact of the introduction of electric and hydrogen-powered aircraft on aerodromes in aspects such as:

- stand management, turnaround, ground handling, passenger management, aerodrome design, impacts on surface delay and taxi time, etc.;
- regulation/standardisation/certification of infrastructures (including equipment for charging/refuelling and related ground support equipment) considering national dimensions, in alignment with WG4
- administrative, environmental and overall safety constraints, in particular fire safety, emergency procedures, Seveso requirements, environmental compliance (use of resources - notably freshwater and electricity, gas emissions, noise, etc.), in alignment with WG4;
- impact on the aviation safety and security regulatory framework (as input to WG4).

The WG should collect information about on-going electricity recharging and hydrogen refuelling infrastructure projects at aerodromes, identify gaps and make recommendations to address all affected dimensions (procedures, standardisation, etc.). To this end, specific case studies could be developed.

The WG should also assess the impact of new technologies on maintenance, repair and overhaul. It may also start investigating workforce requirements with regards to flight crew and ground personnel, with a special focus on safety-relevant issues. It shall assess the impact on employment and derive recommendations for skills development.

Opportunities associated with new operational and business models

While the introduction of zero emission aircraft poses several challenges for adaptation of aerodrome infrastructure it has also a potential for improving some of the processes as well as bringing new business development models for aerodromes and airlines. These will have in turn wider implications on the aviation employment and aerodromes' socio-economic environment. While this not being its main focus, the WG should be able to identify and assess the relevant emerging issues in this regard in order to help aerodromes to plan their long-term development strategies.

Deliverables:

Title of the Work Package	Description of the Work Package	Deliverable
WG3/25-26/WP1: Guidance on airport configurations to enable the European flight network	In response to the work undertaken by WG1 and WG2 following the projection of a European flight network, the objective of this Work Package is to identify required airport configurations in terms of infrastructure requirements (refuelling/recharging and beyond) to enable the operation of envisaged demonstration and commercial aircraft. This Work Package is building upon the scenarios for airports already developed in its initial phase, while acknowledging that new aerodromes and regionals may be identified at a later stage to be incorporated. In a first phase, this WP should focus on the required installation of electricity recharging and hydrogen refuelling infrastructure. The plans of EU Member States for the deployment of such infrastructure under AFIR should be considered in the drafting of this guidance. As an output of this WP, the recommendations on the aerodrome configuration should consider the operational requirements related to the expected aircraft type(s) to be handled by airports. The recommendations should equally address the different propulsion technology configurations.	Guidance document on aerodrome configurations
WG3/25-26/WP2: Screening of aerodromes' standardisation, and regulation framework in view of enabling electric/hydrogen-powered flight	The objective of this task is twofold, focusing on: - creation of a dedicated sub-group to manage the expansion of WG2 WP2's work on H2 industry ways of working (Permitting processes, risk analysis methodologies, etc.) required for H2	Report analysing the aerodromes' certification, standardisation and regulation framework landscape and identifying existing gaps

Title of the Work Package	Description of the Work Package	Deliverable
	infrastructure establishment. This will enable experts on the aviation/airports side to benefit from an exhaustive understanding of the industry ways of working and requirements, then identify potential impacts (overlaps, gaps, etc.) from various standpoints (safety, operations, etc.). - screening the (national) regulations applicable to the installation and operation of production and supply infrastructures of electricity and hydrogen and the servicing of electric and hydrogen powered aircraft at aerodromes that are not under EASA oversight (those are addressed by WG4) in order to identify possible gaps and barriers; - identifying the need for standards related to the infrastructure supporting the operation of electric and hydrogen aircraft at aerodromes (complementary to those identified by WG4), identify the gaps and issue recommendations for the development of missing standards; the task should be undertaken with the involvement of appropriate stakeholders. This task should build on the work already being carried out by SAE, EURCAE, ISO, CEN and other relevant standardisation bodies. The full scope of WP2 will be further defined by a dedicated sub-group addressing this challenge.	
WG3/25-26/WP3: Guidance on aerodrome investments in the scope of airport master planning	Based on the identification of the major elements of aerodrome-related infrastructures needed across Europe and in alignment with WG2's work on investment plans, this WP3 should provide aerodrome operators with guidance and decision support tool on related investments in the scope of demonstration operational planning and airport master planning to ensure operational readiness and capabilities addressing the needs of aircraft leveraging novel propulsion technologies. The guidance material to be produced should also consider the specific business environment for airports to take appropriate investment planning decisions, identifying areas for private/public funding or subsidies. More specifically, the guidance material should identify the needs for public and private	Guidance report on investment priorities at aerodromes

Title of the Work Package	Description of the Work Package	Deliverable
	financing and investing support schemes, highlighting priorities and promoting a coherent deployment of the necessary infrastructures at aerodromes. As an example, the guidance material could provide estimates for the CAPEX needed at aerodrome level to enable operation of electric/hydrogen-powered aircraft for further reflection within WG6 on the definition of incentives.	
WG3/25-26/WP4: Skillset to enable electric/hydrogen-powered flight operations	As part of this WP, the Working Group should investigate the skillsets currently not available at aerodromes to enable the operation of electric and hydrogen-powered aircraft. It should propose new approaches for e.g. training requirements for the handling of hydrogen at airports, technical instructions for the charging of aircraft, MRO requirements, and similar. The task should build upon the screening results obtained under WP2.	Skillset and training requirements report, with guidance and recommendations on the steps to be followed by aerodromes to enable the effective and safe operation of electric and hydrogen recharging and refuelling stations

Aviation regulation, certification and standards (WG4)

Objectives:

This WG was set up to cover the following three objectives:

1. Identify the developments and/or adaptations of the aviation regulatory framework (in particular safety, environmental requirement and security) required to support an effective market uptake and enable operations of electric and hydrogen aircraft and the roll-out of zero emission aviation.

2. In close cooperation with the Clean Aviation Joint Undertaking and similar initiatives, prepare and facilitate the certification of upcoming zero-emission aircraft.

3. Support the aviation industry in the development of the required standards for rulemaking by e.g. mapping, identifying gaps and providing recommendations on the existing standardisation/certification landscape.

Recommendations should be coordinated and build on activities undertaken in the research phase, notably considering the progress on other activities and research projects, such as the ones under the Clean Aviation Joint Undertaking, Hydrogen Joint Undertaking, SESAR, collaborative research funded by Horizon Europe and research supported at the national, regional context and identify gaps in the current landscape.

Special attention should be given to the need to raise these questions at a global scale, addressing the key issues and requirements towards major rule makers and standardisation organisations.

State of play:

Before the adoption of the Work Plan 2025-2026, the Working Group on aviation regulation, certification and standards under its previous mandate published i) a report on the current standardisation landscape in the form of a

mapping exercise in May 2023 issued by Subgroup 3, as well as ii) a report on the current aviation regulatory landscape for aircraft powered by hydrogen or electric propulsion issued by Subgroup 1 in March 2023.

As a follow-up and update of the analysis of the current standardisation landscape published in 2023, WG4 has recently finalised a standardisation gap analysis report. This new analysis proposes a structure to guide the industry-wide standardization efforts that are required to support the certification of electric, hybrid-electric, and hydrogen-powered aircraft. It provides for each main technology a clear mapping of the ongoing standardisation activities or the ones to be planned to support regulations at two levels: the aircraft and the system (including sub-system and components).

In parallel, WG4 has been preparing certification strategies for aircraft hydrogen fuel cell propulsion technologies and a gap analysis for CS-23 hydrogen-powered aircraft configurations. WG4 has also completed a preliminary analysis on the state of play on aviation non-CO2 climate impact through a dedicated preliminary internal report.

Description of focus activities for the 2025-2025 period:

Aviation regulation

The following focus areas were identified:

- Screen the aviation regulatory framework (EU regulations as well as EASA certification specifications (CSs), acceptable means of compliance (AMC) and guidance material (GM)) in all relevant areas (airworthiness, environmental protection (e.g. NOx limits, noise), operations, aerodromes, etc.). This screening should be based on the rollout scenarios developed by WG1, by testing and demonstrators' activities ran by industry and regulatory sandboxes, in cooperation with Aviation Authorities and/or research centres. WG3 was tasked to complement the analysis from the aerodrome point of view, in particular but not limited to the certification of electricity and hydrogen infrastructure at aerodromes. For the purpose of refining the screening of relevant frameworks, WG4 will seek cooperation with WG3 where deemed useful.

- The significance of non-CO2 climate impacts from aviation activities, are at least as important in total as those of CO2 alone, however based on scientific assessments of historic global air traffic emissions, uncertainties from the overall non-CO2 effects are eight times larger than those from CO2, and the overall confidence levels of the largest non-CO2 effects (e.g. contrails) are considered 'low'. WG4 has provided a first qualitative assessment of the research regarding non-CO2 climate impacts of aviation with a view to facilitate robust impact assessments (e.g., costs, benefits, trade-offs, implementation challenges) to ensure 'no regret' options are addressed when introducing electric/hydrogen aircraft into the aviation system and as a foundation for future regulatory work on non-CO2 emissions. As research on this topic is evolving, the WG will further investigate the non-CO2 climate impacts of aviation through the involvement in the Aviation Non-CO_2 Experts Network (ANCEN) launched in June 2024.

- Identifying areas that require adaptation, further analysis or work at ICAO level; the definition of the regulatory requirements may need to be backed by appropriate studies (e.g. definition of hydrogen engine emission requirements would require a "non-CO2" requirements assessment which can feed into WG5's assessment at network level).

- Issuing recommendations for rulemaking work (including proposals for the European Plan for Aviation Safety (EASA Rulemaking Program)) and the promotion of cooperation with international actors (ICAO, FAA, UK CAA, etc.), including standard development organisations (SDOs).

Preparing for the certification of electric/hydrogen aircraft

This task should benefit from the certification-related work done under the Clean Aviation programme (EASA involvement in all technical projects and transversal project dedicated to the development of means of compliance related to new technologies/aircraft). An effective coordination and a close cooperation should therefore be continued with the Clean Aviation JU to avoid duplication of efforts.

The WG has started to take stock of all relevant developments in electric and hydrogen-powered aircraft, identifying main technical concepts and assess their impact on certification requirements.

On the basis of the mapping of existing activities, the WG should identify gaps and issue recommendations to further enhance the path to certification of new technologies. This may include to define milestones towards the development of Special Conditions and the following amendment of the relevant Certification Specifications (CS-23, CS-25, CS-E, etc) to support initial certification activities including the issue of first Type Certificates. In collaboration with WG3, the WG should support the identification of EHPS and hydrogen certification requirements (safety and quality).

Identification of standardisation gap

The WG has started to identify standards that are required to support the rulemaking and certification needs with regards to aviation safety, environmental measures, fuel production and dissemination. In its initial phase, it has performed a first gap analysis, which in its final version should cover worldwide aviation related existing standards/standardisation activities (e.g. EUROCAE/SAE WG-80/AE-7F, SAE AE-5CH, ISO/TC 197, EUROCAE WG-113, SAE E-40, EUROCAE WG-116, ASTM F44, etc.) to identify missing standards in all relevant areas.

For example, for hydrogen technologies, aircraft coupling to power source, refuelling/defueling, hydrogen purity requirements, safety distancing, operating procedures, leakage prevention, fire inerting, etc have been identified. For hybrid-electric technologies the main gaps in standardization include performance metrics under various operational conditions, integration with existing aircraft systems, and establishing protocols for maintenance and safety.

The WG should develop a standardisation roadmap and issue actionable recommendations to support their development (including the need for deeper analysis and coordination mechanisms). These results will complement the work undertaken by WG3 as part of its Work Package on the screening of aerodromes' certification, standardisation, and regulation aspects beyond EASA oversight in view of enabling electric/hydrogen-powered flight. WG4 should explore further collaboration and alignment with WG3 on these aspects.

Working structure of WG4

AZEA WG4 has currently divided the work in 3 sub-groups with a view to achieve the objectives identified:

- Subgroup 1 (SG-1) was tasked to identify the developments and/or adaptations of the aviation regulatory framework required to support an effective market uptake of electric and hydrogen aircraft and the roll-out of zero emission aviation.
- Subgroup 2 (SG-2) was tasked to prepare and facilitate the certification of upcoming zero-emission aircraft.
- Subgroup 3 (SG-3) was tasked to support the definition and introduction of the required standards for rulemaking, safe operations including testing, and certification activities.

Depending on the approaches identified to best address the production of relevant deliverables, WG4 may decide to restructure its subgroups accordingly.

Deliverable:

Title of the Work Package	Description of the Work Package	Deliverable
WG4/25-26/WP1: Standardisation Gap Analysis	This gap analysis is intended to be a support document for Standardisation Development Organizations (SDO), authorities, industrial and governmental stakeholders. It gives for each main technology a clear mapping of the ongoing standardization activities or the one to be planned to support regulations at two levels: the aircraft and the system (including sub-system and components). Based on the first results, within this Work Package WG4 will address focus areas where additional analyses are deemed useful for publication.	Reports providing a Standardisation Gap Analysis and Recommendations
WG4/25-26/WP2: Certification Gap Analysis	This certification gap analysis will identify existing gaps for the certification of zero-emission aircraft, while also including recommendations to bridge the existing gaps.	Report providing a Certification Gap Analysis and Recommendations
WG4/25-26/WP3: Non-CO2 climate impacts of aviation	As research on this topic is evolving, in due course the WG should revisit its internal report to further investigate the non-CO2 climate impacts of aviation and in view of future public dissemination.	Updated report on non-CO2 climate impacts of aviation

Integration into European airspace (WG5)

Objectives:

This WG was set up to cover the following two objectives:

1. Assess the efficient and sustainable introduction of electric and hydrogen-powered aircraft at both European network and ATM level, while also maximising the operational and environmental performance of the aviation system;

2. Assess the effectiveness and impact on operational stakeholders and the network of incentive mechanisms.

State of play:

In January 2024, Working Group 5 focusing on the "Integration into European airspace" of novel aircraft configurations published its first iteration of a Concept of Operations (CONOPS). The report addresses both the objective to decarbonise air transport together with the challenges and opportunities that will arise from the integration of new aircraft leveraging novel propulsion technologies into the European aviation system. It covers all components of the European ATM network, herein referred to as "the network", including airports' operations as part of the network

As a follow-up to the CONOPS, WG5 is focusing on simulation activities leveraging Eurocontrol's Base of Aircraft Data (BADA) and Network simulation (R-NEST) tools. The tools will enable impact assessments of operational network simulations considering novel aircraft configurations, as well as providing operational and environmental performance assessments for introduction of electric and hydrogen-powered flights in the European network.

Description of the focus activities for the period 2025-2026:

Activities needed to achieve those goals include:

- Based on inputs from WG1, understanding of aircraft behaviour/performance over the entire operation flight envelope and in all phases of flight (optimum cruising level, final approach speed, cruising speed, taxi speed and rates of climb and descent) and associated trajectory profiles.

- Contribution to the development of an operational concept description and subsequent iterations providing an overall picture of the operations according to defined use cases as well as addressing non-standard procedures, adequate risk assessments and mitigations. Based on the work on aircraft behaviour/performance described above, this will include an assessment of the emissions behaviour in comparison with conventional propulsion techniques.

- Assess required adaptation of the operational and environment performance indicators to the different capabilities of electric and hydrogen-powered aircraft.

- For the different rollout scenarios established by WG1 and subsequent flight network, and considering the state of play assessment by WG4, carrying out first qualitative assessments of both the environmental performance of AZEA aircraft operations, as well as impact of AZEA aircraft operations upon the performance of conventional aviation traffic, with the aim to optimise all trajectories/traffic flows at network level. This may later on lead to an initial modelling of non-CO2 impacts and effects (such as NOx, Sox, NVPM, local air quality effects, water etc.) and assessment of the impacts on aircraft trajectories, pending further improvements in scientific understanding.

- Propose recommendations for the optimisation of the network and the integration of electric and hydrogen-powered aircraft into the air traffic management system, including roles and responsibilities at, e.g. ANSP level. This may also include proposals to augment aircraft design performance to optimize the network, hence constituting a feedback loop to WG1.

- Support the identification of financial and operational incentives under WG6 by performing a comprehensive assessment across different indicators, simulating them at network level, and this in compliance with ICAO principles (revenue neutrality, transitional measures, etc.). As part of the next phase, modelling might include airspace users cost structures.

WG5 takes into consideration the different aircraft categories approved for instrument flight rules (IFR) operations, from commuters to medium haul in commercial aviation. Business aviation as an innovation incubator also falls under the working group responsibilities as well as vertical take-off and landing (VTOL) aircraft (also called electric urban air-taxis), although the availability of performance data may be limited.

As a prerequisite for carrying out the activities above, coordination with the five other AZEA working groups was established. To give an example, this considers:

- ✓ From WG1:
  - Aircraft performance characteristics
  - Market forecast (traffic, aircraft entry-into-service, penetration rate, etc.) including potential changes to the network topology (e.g., new regional operations). This incorporates information on airspace users' cost structure and implications on operations (link to WG6).

- Energy requirements for electric and hydrogen propulsion as applicable to the different aircraft categories

✓ From WG2

- Electrical energy for battery recharging and green hydrogen production (incl. leveraging of data that is publicly available)

✓ From WG3

- Operational considerations related to stand management, turnaround, taxiing operations, ground handling, passenger management, etc.
- Ground logistics at aerodromes and impact of the infrastructure availability on the network
- Supply expectations, in particular related to hydrogen production and distribution (incl. technology), as it will influence the topology of the network (in coordination with WG2)

✓ From WG4

- Timeline for hydrogen engine emission requirements and for standardisation / certification
- State of play assessment of non-CO2 climate impacts

✓ From WG6

- Operational incentives as well as those related to the running costs of electric and hydrogen aircraft.

Deliverable:

Title of the Work Package	Description of the Work Package	Deliverable
WG5/25-26/WP1: Coordination and integration	This WP tackles the transversal activities, including data acquisition and management as well as the development of an operational concept. It ensures transversal coordination with other Working Groups (improving transparency, alignment, iteration and cooperation) and is also transversal for all the information flows across subsequent WPs.	On a rolling basis
WG5/25-26/WP2: Modelling and simulation activities on aircraft behaviour/performance over the entire operation flight envelope and in all phases of flight	This WP has the objective to leverage the information provided by OEMs to better understand aircraft behaviour/performance in view of integrating such aircraft into European airspace. It should cover all modelling activities (incl. definition of new indicators, initial modelling of non-CO2 effects, network, etc.) as prerequisites for the operational, environmental and financial assessment activities of subsequent WPs. This WP should build upon the initially obtained information from OEMs, further refining them for modelling and simulation purposes in view of integration into BADA.	Presentation on simulation activities for zero-emission aircraft
WG5/25-26/WP3: Environmental performance assessment of novel	This WP aims to provide a comprehensive assessment of environmental performance of	Report providing an assessment of the

Title of the Work Package	Description of the Work Package	Deliverable
aircraft configurations in comparison to conventional aircraft during all stages of flight	novel aircraft configurations to identify areas for incentivisation/improvement in anticipation of a rollout of such aircrafts.	environmental performance of electric and hydrogen-powered aviation as compared to conventional aircraft
WG5/25-26/WP4: Recommendations on the integration into European airspace	This WP builds upon the results obtained through previous (e.g. first CONOPS) and ongoing analyses (e.g. modelling/simulation) to develop actionable recommendations for the management of such novel aircraft in European airspace. These should be formulated considering the role of the ATM Master Plan (and SESAR activities) in modernising European airspace.	Report including recommendations on the integration into the European airspace
WG5/25-26/WP5: Iterations of the Concept of Operations (CONOPS)	Based on the additional information obtained since the publication of the first CONOPS in January 2024, this WP is dedicated to the subsequent iterations thereof. Based on the data obtained from OEMs, the initial CONOPS should be further refined to account for the specific performance characteristics of novel aircraft.	Iterations of the CONOPS

Incentives (WG6)

Objectives:

This WG was tasked to identify the incentives necessary to promote and accelerate the swift adoption of electric and/or hydrogen aircraft in operators' fleets, prioritise the use of such aircraft by passengers. Such measures aim at creating a strong business case for novel technologies, which would stimulate the necessary investments by the different stakeholders, in particular financial partners, operators and aerodromes. Specifically for operators, it should identify and prioritise their needs as well as establish all possible incentive tools and assess their feasibility/impact.

State of play:

Under the previous mandate, Working Group 6 initiated analyses covering the entire aviation value chain and provided draft documents addressing recommendations on particular incentives for novel propulsion technologies. This WG is currently finalising two issue notes on the environmental modulation for zero-emission aircraft at airports and on internal market rules for airlines. The issue note on environmental modulation at airports aims to analyse current airport charges model and the revenue-neutral modulations explored by airports to incentivise sustainability. The issue note on internal market rules for airlines analyses the Public Service Obligations for zero-emissions aircraft. The WG has also already started to explore and draft recommendations on State Aids guidelines for such aircraft and modulation of enroute charges.

Description:

The WG was tasked to perform a systematic analysis of all EU (and national) regulations in order to identify possibilities to create incentives for operating electric and hydrogen-powered aircraft and contribute to make the necessary business cases to support their operational deployment.

On that basis, the WG should continue investigating all possible ways to incentivise the entry into service of electric and hydrogen aircraft, including for instance:

- Approaches (including policy recommendations) to incentivise zero-emission technology uptake compared with other forms of aircraft propulsion, in particular to ensure that the running costs of zero-emissions aircraft are a competitive alternative or complement to other technologies (in particular SAFs),
- The timescales over which such incentives need to be in place to overcome first-mover costs, and how the incentives can be scaled back once unit costs for zero-emission technologies have decreased,
- The timing of the introduction of these incentives in order to match the various EIS of aircraft and stimulate the market.

The WG should investigate all possible areas, including but not limited to:

- Approaches to reduce running costs of zero-emission aircraft (e.g. PAX taxes, aerodrome charges, ETS, navigation charges, etc.), including identification of opportunities in delivering a preferential operational service (e.g., air traffic flow and capacity management (AFTCM), flight profiles, modulation of charges) in close cooperation with WG5;
- Approaches to reduced purchase and ownership costs for zero-emission aircraft (e.g. buy-and-leaseback with partial public funding, state aid support adapted to the needs of zero-emission aircraft, and/or tax exemptions on aircraft ownership);
- Incentives for investors (linked to EU taxonomy and bankability of projects) and operators (e.g. slots prioritisation, guaranteed routes to cover);
- Financial support for aircraft renewal, conversion and retrofitting or for developing required infrastructure at/outside aerodromes and similar.

The WG should also consider all other sections of the aviation value chain to which incentives should be applied including decarbonised electricity/hydrogen suppliers, aerodromes, OEMs, ANSPs, the financial sector, etc. to promote a transition to novel propulsion technologies.

Finally, the WG should also develop recommendations to take adequately into account the perception of those new technologies by passengers and the wider public. It should consider inputs from the other WGs and ensure an appropriate coordination with those. Furthermore, it should also identify existing incentive mechanisms in different innovative sector and learn from those experiences.

Deliverable:

Title of the Work Package	Description of the Work Package	Deliverable
WG6/25-26/WP1: State of play of the incentives' landscape under the current regulatory/policy framework and recommendations	Having analysed the current regulatory/policy framework, this WP should focus on further refining the mapping of incentives across the ecosystem to transition towards electric/hydrogen-powered flights per stakeholder, with a specific focus on incentivising aircraft operators.	Report analysis the existing incentives' landscape under the current regulatory framework, including dedicated recommendations and areas for engagement

Title of the Work Package	Description of the Work Package	Deliverable
WG6/25-26/WP2: Production of issue notes and outreach materials	To address the complexity of incentivisation needed, as part of this WP the Working Group should select several key areas which should be highlighted in issue notes/outreach materials for communication purposes.	Issue notes and outreach materials on thematic topics
WG6/25-26/WP3: Business models and life-cycle assessment of zero-emission aircraft	To further support the uptake of zero-emission aircraft and inform decision-making by operators, this WP should provide analyses on their business models and life-cycle assessment in comparison to conventional aircraft. More specifically, this WP should investigate the economics of conventional aircraft powered with different carbon-based fuels: Kerosene, SAF (bio-based), SAF (synthetic, PtL), in order to understand the differences in cost for fuel supply scenarios. These analyses should take into assumption the existence of the set of incentives and recommendations established in view of accelerating the entry-into-service of zero-emission aircraft.	Report on business models life-cycle assessment of zero-emission aircraft

Development of a Roadmap for the ecosystem

The Alliance intends to deliver its first Roadmap for the ecosystem providing a path towards the rollout and integration of new aircraft leveraging novel propulsion technologies.

The adaptation of the aviation ecosystem relies on the contribution of many different private and institutional actors. The individual decisions required from each of these actors are, however, interconnected. They need therefore to find their place in a coherent set of actions (e.g. to justify airport investments in recharging facilities evidence should exist that electric aircraft will be available on the market, that its operators are interested and that it will have to possibility to have the necessary green electricity supplied). The AZEA roadmap aims to provide the entire ecosystem with a common ambition and a framework able to promote the coherent implementation of all actions required by the different stakeholders.

The AZEA Roadmap should therefore define a clear path on how electric and hydrogen flights can be progressively deployed in Europe, specifying the milestones (up to 2050) and the actions required by the different stakeholders. It should serve as a tool to inform decision-making both at European and national level to support the uptake of novel aircraft configurations. For example, the roadmap may support the implementation of the ReFuelEU Aviation Regulation and contribute to stress the need for inclusion of non-drop-in fuels, such as hydrogen and electric-powered planes, into the scope of the Regulation.

It should be a communication tool providing a high-level plan defining the overarching objective and the major steps to achieve it. It should at the same time be sufficiently detailed (at least for the initial stages) to provide actionable recommendations and promote the concrete actions and investments required and enable the monitoring of their implementation. For each detailed goals identified, it should highlight how it contributes to the overall objective, detail the task and effort required to achieve it and specify the related milestones and dependencies with other activities.

To be impactful, the Roadmap must be considered by the different stakeholders as a relevant tool to inform their own decision-making processes. Work is planned to support the production of information and analyses required to populate the Roadmap with the sufficient level of details. The present update of the mandates governing the six Working Groups will support the production of relevant information and analyses which will be organised to support the delivery of the Roadmap.

In addition, efforts to derive more e.g. specific recommendations and link them to milestones will be required. These efforts will be initiated by the Alliance accordingly.

The Roadmap will build on the description of the network of electric and hydrogen destinations developed by WG1 and the analyses performed by the other Working Groups. These analyses will have to be further elaborated to lead to the definition of actionable recommendations. To complement these analyses conducted per issues areas (aircraft, energy, aerodromes, aviation regulation, operations, incentives), focus groups will be established to channel contributions from members willing to support specific market segments (Helicopters, Urban Air Mobility (UAM), General Aviation (incl. schools), Regional Air Mobility/Regional Air Transport (RAM/RAT), Business aviation, Regional aircraft, Medium Range aircraft) and energy (electricity or hydrogen). The Roadmap will be elaborated with external support under the close monitoring of European Commission (DG DEFIS) supported by the Steering Committee. The Roadmap will be published by the end of 2025.

Horizontal tasks to be undertaken by the Alliance

In a first step, the Alliance focused on the analyses to be undertaken by the six established Working Groups. As an immediate priority following the launch of the Vision report, the Alliance will first and foremost focus on the preparation of a Roadmap for the ecosystem. Nevertheless, with the arrival of a first Work Plan for the Alliance, Members have expressed the wish to explore additional areas from a horizontal point of view as well as the need to increase awareness-raising efforts.

The following activities should serve as an indication of priorities expressed by the membership. Given the horizontal nature of the tasks, where necessary, the Alliance will decide on the timing and implementation of the below activities.

Investment strategies

- **Technology Showcase events to present AZEA members' efforts and progress in key areas**

  The Alliance should invite its members to submit proposals to showcase their efforts in making electric and hydrogen-powered flights a reality, also in view of demonstrating that already today significant (investment) efforts and technology advancements that are being undertaken to drive the transition. Following a call for interest open to AZEA members, examples of developments and progress covering the entire ecosystem should be collected.

  Potential actions to address this activity include: (1) Collection of examples reflecting developments and progress on AZEA members' activities and projects. These initiatives could be showcased in the AZEA website, as well as through other communication channels (e.g. Newsletter, AZEA Talks); (2) Organization of a dedicated Technology Showcase event, in which AZEA members would have the opportunity to present their innovations and attract funding. These events should be open to the public and to the whole ecosystem.

- Business case analyses and commercial strategies

Building upon, among others, the results obtained by WG6 on incentivising the uptake of hydrogen-powered and electric aircraft, the Alliance should engage with relevant stakeholders on the business cases underlying zero-emission aircraft. In a first step, this should be done through the organisation of dedicated workshops with relevant representation per market segment. The aim of these Workshops will be to address business cases and commercial strategies supporting the deployment of zero-emission aviation.

Potential actions to address this activity include: Organisation of a dedicated Workshops focusing on operators to discuss the existing challenges in current business cases for the entering into operation of zero-emission flights and to identify potential commercial strategies to overcome them.

- Identification of Pilot Projects and potential preparation of an AZEA Pipeline of Projects

Based on the investments needs estimated by WG2/WG3 and the roll-out scenario as the backbone of the flight network, the Alliance should use a stepwise approach in the identification of projects to be included in a potential future AZEA Project Pipeline. As a first step, a comprehensive set of Pilot Projects should be identified across the zero-emission aviation ecosystem, including the development of archetypes and evaluation approaches. As a second step, sufficiently mature industrial large-scale projects should be identified for the potential launching of an AZEA Pipeline of Projects. To this end, the Alliance should identify how to implement and promote these projects, also by learning from other Alliances (e.g. Hydrogen/RLCF Alliances).

Potential actions to address this activity include: (1) Setup of a pilot project pipeline; (2) Monitor the progress of the identified pilot projects and take stock of their learnings, in terms of challenges and enablers to overcome them.

- B2B matchmaking with support of AZEA members

To bring together potential business partners such as manufacturers, operators and investors interested in the roll-out of electric and hydrogen-powered aircraft, the Alliance should facilitate B2B matchmaking opportunities. Inspiration should be drawn from relevant initiatives, e.g. the “B2B Forum” by DG GROW, Hydrogen Europe and Clean Hydrogen JU, IPCEI Hydrogen Matchmaking procedure, RLCF Alliance matchmaking initiatives and similar.

Potential actions to address this activity include: Organisation of an annual B2B Matchmaking event, which should be open to manufacturers, operators, investors and financial institutions outside of the AZEA membership.

Promotion of funding instruments and projects

- Funding compass for the ecosystem

The Alliance should develop a funding compass tool devoted to EU funding instruments of particular interest for the zero-emission aviation ecosystem (e.g. CEF Transport Alternative Fuels Infrastructure Facility, Innovation Fund, Hydrogen Bank, Sovereignty Fund, Horizon Europe, EIC Accelerator Open and EIC Fund, Clean Aviation and Clean Hydrogen JUs and similar). Similarly to other Alliances, the tool should present the main EU funding programmes and opportunities tailored to stakeholders of the ecosystem. In a second step, the Alliance should investigate national funding opportunities in regions which will be at the forefront to receive zero-emission flights based on the Flight Network analysis conducted by WG1.

Potential actions to address this activity include: (1) Publication of a Funding Compass for the Zero-emission aviation ecosystem in the AZEA website; (2) Publication of a selection of relevant open and upcoming calls under the ''EU Funding and Financing'' section of the AZEA Newsletter.

- Promotion of EIB instruments

The Alliance should build upon its initial exchanges with the European Investment Bank (EIB) to investigate how EIB funding instruments can be used to achieve AZEA's objectives. Awareness-raising will be necessary to present stakeholders of the ecosystem with EIB's objectives translated into its funding programmes that are of relevance for civil aeronautics.

Potential actions to address this activity include: (1) Continue exchanges with the EIB to identify possible support actions; (2) Organization of a dedicated Workshop to present to the AZEA membership EIB's possible support instruments of relevance for the zero-emission aviation ecosystem.

- Guidance material on the de-risking of funding and financing

As the transition towards electric and hydrogen propulsion technologies will require joint action by the ecosystem, the Alliance should aim to provide guidance material to relevant stakeholders on the de-risking of funding and financing opportunities.

Potential actions to address this activity include: (1) Preparation of a de-risking guidance manual for the zero-aviation ecosystem. For the preparation of this guidance manual, alignment with the RLFC Alliance could be sought; (2) Preparation of guidance material on derisking opportunities to support manufacturers.

- Analysis of Hydrogen Valleys initiatives

From the Alliance's point of view, analysis should be undertaken to better understand the existing Hydrogen Valleys initiative and identify potential for supporting airports projects. In some Hydrogen Valley initiatives, the role of airport infrastructure and the provision of energy to novel propulsion technologies is already recognised.

Potential actions to address this activity include: (1) Promotion of collaboration opportunities with the Clean Hydrogen JU regarding the dedicated funding topics for Hydrogen Valleys under the JU's Annual Calls; (2) Identification of Hydrogen Valley initiatives of relevance for the zero-aviation ecosystem (e.g. Hydrogen Valleys explicitly envisaging the production of hydrogen to be use in aviation and enabling the transport of hydrogen to airports)

Synergies

- Develop synergies with other Industrial Alliances

In addition to the tasks already identified for which coordination with other Industrial Alliances would be useful, AZEA should identify and develop synergies specifically with the RLCF Alliance, Hydrogen Alliance and Battery Alliance.

Potential actions to address this activity include: (1) Involve Alliance members with the RLFC, Hydrogen and Battery Alliances to identify specific areas in which further collaboration could be explored; (2) Identification of potential synergies and specific actions with these Alliances within each of AZEA WGs.

- **Promote collaboration with international and national/regional initiatives**

Already today, ecosystems across Europe are preparing for the arrival of electric and hydrogen-powered aircraft. The Alliance should identify and analyse relevant initiatives covering e.g. recharging facilities, on-site production and storage of hydrogen and similar, to promote collaboration between these initiatives and Alliance members. Such collaboration would also be initiated to avoid overlap/duplication, promote complementarity and identify best practices for replication in other regions. An area of interest for best practices are also how local regulatory issues were addressed to enable the projects (e.g. storage of hydrogen at airports). This work can should consider the initiatives and actions on deployment of alternative fuels infrastructure in airports under the AFIR National policy frameworks to be submitted to the European Commission for assessment.

The Alliance should investigate existing policies and initiatives beyond the scope of the EU (starting from feedback received from non-EU AZEA members), continue the exchanges with the World Economic Forum, inform and support the promotion of zero-emission aircraft through the EU at ICAO, and investigate relevant initiatives on how to promote the introduction of electric and hydrogen-powered aircraft globally.

Potential actions to address this activity include: (1) Planning of engagement activities with relevant international organisations and initiatives outside of the EU, including ICAO, WEF and IATA; (2) Planning of engagement activities with EU and non-EU national governments active in the zero-aviation ecosystem and with similar initiatives.

- **Promote exchanges with ongoing research and deployment projects**

The Alliance should investigate ongoing deployment projects that are relevant to the rollout of electric and hydrogen-powered aircraft.

Potential actions to address this activity include: (1) Identification of related Horizon Europe, Clean Aviation and Clean Hydrogen JU projects where lessons can be learnt for similar projects to be launched by AZEA members and stakeholders of the entire ecosystem; (2) Showcase of relevant zero-emission research and deployment projects in the bi-monthly Newsletter.

- **Develop a strategy to engage with other relevant actors not focused on aviation**

The analyses undertaken so far have highlighted that joint effort beyond the typical aviation stakeholders will be necessary to transition towards zero-emission aviation. In particular, the Alliance should engage more with energy producers, transmission system operators and distributors, investors as well as regional authorities and tourism organisations to raise awareness and ensure readiness. A strategy should be developed to plan such exchanges.

Potential actions to address this activity include: (1) Engagement with relevant stakeholders outside of the aviation sector through AZEA events.

Communication and outreach

- **Production of communication materials for the membership and for the general public**

Alliance members are familiar of the opportunities and challenges associated with the market uptake of electric and hydrogen-powered aircraft. This is not necessarily the case with the general public, flying on electricity and hydrogen is highly disruptive from a technological point of view and will require significant changes to how the

aviation ecosystem works as we know it today. An action should be defined to identify further benefits (and drawbacks – e.g. in comparison with SAF solutions) and develop arguments and material to support public awareness and acceptance of electric and hydrogen aircraft. Such a workstream should include developing a survey on current public awareness/acceptance and the subsequent development of material and information campaign to raise public awareness.

Potential actions to address this activity include:

(1) Newsletter: Publication of a bi-monthly Newsletter in the AZEA website, which will be also distributed to the membership by email. AZEA Talks: Organisation of bi-monthly online sessions to provide a selection of members to introduce themselves and to showcase their relevant projects and achievements.
(2) Participation in relevant events for the zero-emission aviation ecosystem (in-person and online) to showcase developments on the zero-emission aviation ecosystem (including promotion and presentation of the Vision and Roadmap's objectives), as well as the role performed by the different Working Groups.
Preparation of additional dissemination materials, including promotional videos and relevant factsheets.

- Awareness raising towards specific sectors

The Alliance should identify needs and opportunities for dedicated awareness campaigns leveraging AZEA deliverables (e.g. roll-out scenario, roadmap, aerodrome factsheets) towards specific stakeholders (with a focus on operators, aerodromes, energy producers and distributors etc.) and organise relevant campaigns.

Potential actions to address this activity include: preparation of two or more dedicated workshops attended by relevant AZEA members as well as being open to stakeholders beyond the Alliance (e.g. operators, aerodromes not represented in the Alliance's membership).

- Label to support uptake of zero-emission aircraft

In collaboration with relevant stakeholders the Alliance should initiate work on a label to recognise stakeholders' efforts towards enabling and accommodating novel aircraft propulsion technologies.

Potential actions to address this activity include: Collaboration with stakeholders such as ACI Europe on the Carbon Accreditation Scheme, to explore opportunities for a label for the zero-emission aviation ecosystem.

- Outreach to EU national initiatives

Various initiatives have been set up at the local level to prepare for electric and hydrogen-powered aircraft, such as the Dutch Sustainable Aviation Roundtable To ensure complementarity and exchange on lessons learnt, the Alliance should establish regular exchanges with relevant stakeholders which may be used to establish similar initiatives elsewhere in Europe.

Potential actions to address this activity include: Planning of engagements with EU national authorities, including a pre-identification of specific areas for engagement and a clear prioritization of topics to be addressed.

Review of the Work Plan

Following the adoption of the AZEA Work Plan, the Alliance will proceed with the implementation of the tasks and actions identified in this document. Working Group Chairs may further break down internally the present mandates in a document in Annex to this Work Plan to ensure a timely delivery of the identified tasks.

A stocktaking exercise and review is foreseen during the period 2025-2026 in view of adopting a subsequent Work Plan for the period 2027 onwards, also considering the Alliance's role in implementing its Roadmap for the ecosystem.