MADRID 360

WHITE PAPER ON

URBAN AIR MOBILITY

MADRID

Madrid City Council. 2025

This document has been coordinated by the Directorate-General for Traffic Management and Surveillance.

Letter from the Mayor

Madrid has always looked to the future without renouncing its identity. Over the centuries, we have successfully combined tradition and innovation to build a diverse and progressive capital city. Today, that spirit is being put to the test once again with an exciting challenge: to prepare our city for a new dimension of mobility - air mobility, which will rise above our streets and connect the sky with urban life.

This very Madrid Urban Air Mobility White Paper represents a decisive step towards that path.

This book is the result of rigorous work coordinated by the City Council alongside the collaboration of other public bodies, universities, technology centres, companies and experts from the aerospace sector. All parties have contributed their knowledge to define a roadmap that will place Madrid among the pioneering European cities in innovative air mobility.

Our goal is clear: to ensure the transformation occurs in an orderly, safe, and sustainable manner while serving the people. Technology must be at the service of citizens and not the other way around. Therefore, every step we take will be guided by respect for the urban environment and a responsibility to improve the quality of life for those who live and work in this city.

Madrid has the conditions to lead this process: a solid industrial and technological base, a government committed to innovation, and, above all, a citizenry that has always known how to adapt and participate in the significant changes of its time.

This White Paper is not an endpoint, but rather a starting point. It sets the course for the future of a cleaner, more efficient and modern mobility scheme, which will continue to make Madrid a benchmark for progress and coexistence.

I invite all Madrid residents, public entities, institutions, companies and professionals to join us on this new journey from Madrid to the sky.

José Luis Martínez-Almeida

Mayor of Madrid

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Executive Summary

Urban Air Mobility (UAM) is emerging as a key solution for re-thinking transport in 21st century cities, thanks to the advances in new aeronautical technologies and the digitalisation of airspace as well as a growing need to decongest urban environments sustainably. This White Paper is based on the recognition that air mobility is already a process underway with specific milestones and increasingly defined regulatory frameworks, both at the European and national levels.

In Europe, UAM falls under the concept of Innovative Air Mobility (IAM) - an approach that prioritises orderly integration into urban space, environmental sustainability, interoperability between systems and regulatory safety from the initial stages of deployment. IAM encompasses both Innovative Air Services (IAS), which includes uses such as drone delivery, emergency medical transport and aerial surveillance. It also includes the development of urban passenger and cargo air transport services using advanced platforms such as electric vertical take-off and landing (eVTOL) aircrafts.

From a technological perspective, Urban Air Mobility revolves around several essential components. Firstly, Unmanned Aerial Vehicles (UAVs) constitute the operational core of the new ecosystem: these particularly include eVTOL aircrafts as well as fixed-wing, single-rotor, multi-rotor, and hybrid machines. Secondly, physical infrastructure such as vertiports must be designed according to the principle of modularity, i.e. with differentiated services according to their use and demand, together with complementary components such as dronepads and drone-in-a-box stations for specific operations and/or smaller drones. This will enable a network adapted to different types of missions and urban environments.

In the surroundings, critical infrastructure will be deployed to support air operations. This includes systems to facilitate communications, navigation and surveillance alongside meteorological systems, cybersecurity and data management, all of which are key to ensuring reliable and safe operations.

Within this framework, another essential element for Urban Air Mobility is the airspace where UAV operations will be integrated. It is also important to note the importance that U-space will have in this regard. Europe is moving towards the progressive integration of unmanned aircraft and manned aviation, in a model based on automation and cooperation between systems. Although there are significant challenges related to interoperability between providers, contingency management and institutional coordination, various European projects are already actively working on their implementation.

Along with the essential components mentioned above, it is essential to consider the role of the global players that make up the IAM ecosystem: aircraft manufacturers (such as Zipline, Wing, Joby, Vertical or Archer), operators, U-space system developers (such as ENAIRE, ANRA, Unifly or ITG), infrastructure integrators (such as Skyports or Bluenest) and national and international authorities, all of which make up a dynamic and highly specialised scenario.

At the regulatory level, the analysis conducted in this White Paper reveals the development of a robust framework to ensure the safe operation of aircraft in urban areas. At the international level, ICAO regulations provide general guidelines, while the European Union, through regulations such as 2019/947 and 2021/664, has established an advanced legal framework for UAS operations and the deployment of U-space services.

In the case of national regulations, the recent approval of Royal Decree 517/2024 represents a step forward in regulatory terms as it improves the definition of the technical and operational conditions for enabling urban air corridors – for example beyond visual line of sight flights in urban areas, U-space areas and specific use spaces, providing the necessary tools to plan safe scenarios for delivery, logistics and passenger transport with eVTOLs in urban environments..

In turn, there are regulatory policies at the local and regional level, such as the Land

Law or municipal mobility and noise ordinances, which allow the deployment of UAM to be adjusted to the urban and social characteristics of each city.

In this context, the city of Madrid is positioned as a strategic hub – this is thanks to its institutional ecosystem, the existence of logistics and airport infrastructure, and its powerful aerospace sector. This positioning allows for real operations to be tackled with gradual implementation in order of complexity between now and 2035, from medical or logistics delivery drones to eVTOL flights for cargo as well as passengers from urban vertiports.

In addition, European regulations have established specific certification frameworks for eVTOL aircraft through Regulation (EU) 2018/1139, and Part-21 and CS-23 frameworks adapted to aircraft with VTOL capability. EASA has defined the technical, operational and airworthiness requirements that facilitate the progress in validating the aircraft that are safe and suitable for dense urban environments - a fundamental element for Madrid to be able to host real operations under high safety standards.

The analysis of leading cities in Urban Air Mobility at an international level provides valuable lessons for Madrid. Shenzhen was the first to authorise commercial unmanned flights with eVTOLs. Meanwhile, Dubai and New York have begun construction of vertiports and multimodal integration, and Rotterdam and Helsinki are making progress in implementing logistics corridors with drones and U-space platforms. On the other hand, Dallas and São Paulo are experimenting with simultaneous and diverse operations in complex urban environments. Milan, Geneva and Brisbane are developing Strategies to integrate vertiports, major events and public services are being developed by Milan, Geneva and Brisbane.

Conversely, cities such as Dublin, Miami and Munich are exploring hybrid models of public-private partnership with ambitious deployment targets. Zurich operates Switzerland's first U-space in real phase, within the national SUSI system managed by the Swiss ANSP (Skyguide), with basic U1/U2 services for drones in GEO areas and digital coordination with USSP providers, while Hamburg leads U-space demonstrations applied to logistics and medical services. Madrid, with the first steps of technical planning and institutional coordination already underway, is in an advantageous position to join this group of pioneering cities.

The implementation of urban air mobility requires coordination between multiple stakeholders. The Spanish Government, alongside its autonomous communities and local authorities, are responsible for establishing regulatory frameworks, while European civil aviation authorities (such as EASA) define certification and airspace control standards. Urban planners, public transportation agencies, and technology providers must collaborate to ensure the functional and safe integration of new systems into the existing transport system.

Operators and infrastructure developers face the challenge of deploying sustainable, efficient services that are adaptable to a constantly evolving sector. Above all, however, the success of the system will depend on its acceptance. In this context, public-private partnerships are proving to be a key instrument. These partnerships are already taking shape in the form of R&D projects co-financed by European institutions, such as U-ELCOME, CORUS five, EUREKA, BURDI, EALU-AER and DALI-LAB. These projects range from operational concepts and U-space platforms to structures for vertiports, the integration of manned and unmanned aircraft, and Living Labs for testing commercial use cases.

The distribution of powers shows a clear need for multi-level collaboration. While the State retains exclusive powers over airspace and general aircraft regulation, the autonomous communities and local councils have fundamental roles in areas such as urban planning, local mobility, public safety and infrastructure management. The European legal framework, and its transposition into the National U-space Deployment Plan, requires coordination mechanisms between administrations at all levels for the management of U-space geographical areas and the implementation of related services, making local authorities essential players in the safe and efficient deployment of IAM.

Local authorities play a key role in regulating key aspects such as the definition and management of U-space geographical areas, the use of public space and the integration of vertiports into the urban fabric. They are also responsible for the proper development of aeronautical activities and the environmental requirements of operations. On the other hand, autonomous communities have powers in the authorisation and supervision of aeronautical infrastructure, as well as its regional and inter-municipal regulation. The coordination of powers between different administrative levels is crucial to the success of urban air mobility.

Taking this into consideration, Madrid City Council established the Municipal Commission for Urban Air Mobility on 31 January 2024. Promoted by His Excellency José Luis Martínez Almeida, Mayor of Madrid, this commission brings together technical and strategic representatives from various municipal areas with the aim of establishing the basis for an ordinance that will allow for an efficient deploymentof UAM.

To approach the work in a specialised manner, the commission has been structured into six working groups focused on key areas: Regulations, Operations, Infrastructure, Safety, Environment and Citizenship, and Economic Operators. These groups not only provide technical knowledge but also serve as spaces for analysis, dialogue, and inter-institutional coordination. This promotes a cross-cutting vision that incorporates critical aspects such as sustainability, citizen coexistence and the economic viability of the system from the outset.

Based on the work carried out by these groups and an international comparative analysis, a roadmap structured in three phases has been defined. In the initial period (2026-2028), priority will be given to institutional and regulatory consolidation through the consolidation of the Municipal Urban Air Mobility Commission. A specific ordinance on the use of UAS at the municipal level, and the definition of administrative and technical procedures for their safe operation, will be drafted. Controlled test environments and pilot projects, feasibility studies for the implementation of infrastructure will be promoted, as well as public information and awareness campaigns paired with the strengthening of the police unit specialising in air control and safety.

The focus of the second phase (2029–2031) will be on operational and technological consolidation of the urban ecosystem. Progress will be made in the deployment of U-space management systems, the planning of an initial network of vertiports, and the implementation of supporting technological infrastructure, including meteorology and communications. Simultaneously, common environmental assessment criteria will be developed, and collaboration with the business and academic communities will be strengthened to promote innovation and professional training.

Lastly, from 2032 onwards, the city will consolidate a mature ecosystem with manned aircraft, stable air corridors, interurban infrastructure and full integration with ground mobility. Collaboration with innovation projects and constant regulatory updates will be encouraged, and performance metrics will be deployed to ensure transparency, sustainability and public confidence.

Overall, this White Paper presents a strategic, realistic and ambitious vision to consolidate Madrid as a European benchmark in Urban Air Mobility. The proposed roadmap is not just a technical exercise, but an institutional commitment to a more connected, clean, efficient and inclusive city, ready to take off into the third dimension of mobility.

1. Introducción

Municipal area of Madrid covers 604.5 square kilometres and is divided administratively into 21 districts. It is the second largest city in the European Union in terms of population, with 3.5 million inhabitants (behind only Berlin) and the second largest urban metropolitan area with more than 6.7 million inhabitants in the wider Greater Madrid area.

Its territory boasts significant communication infrastructure, making it the main logistics hub in Spain and southern Europe. It has an extensive network of motorways and dual carriageways, both radial and ring roads, and is the centre of the national rail system. This enables efficient communication with other parts of the region as well as the rest of Spain and Europe. It is also home to Spain's most important airport, both in terms of passengers and freight, and one of the largest in Europe. In addition, it has one of the most efficient, extensive, and functional public transport networks in Europe, including bicycles, metro, trains, urban, and interurban buses.

In 2024, public transport in the Madrid metropolitan area reached a record high with nearly 1.722 billion journeys, including the Metro, urban and interurban buses, and Cercanías commuter trains. The Madrid Metro carried approximately 715 million passengers, while city buses operated by the EMT recorded 476 million, and intercity buses reached 307 million validations. Cercanías Madrid carried nearly 200 million (Community of Madrid, 2025).

On the other hand, private vehicle traffic remains a significant contributor to Madrid's mobility. For example, on the M-30, the city's busiest ring road, 375 million vehicles travelled in 2024 with a daily average of more than 1,000,000 cars. At the metropolitan level, there are an estimated 1.4 million daily trips by private vehicle (Community of Madrid, 2022).

In the medium term, forecasts point to a sustained increase in the use of public transport. Provisional data for May 2025 show an annual increase of 3.4% (INE, 2025) in total journeys. In urban logistics, the express courier market (CEP) in Spain shows projected growth until 2030, equivalent to a CAGR of 3.8% per annum (Mordor Intelligence, 2024), suggesting that last-mile deliveries will also continue to expand in Madrid.

This momentum is reinforced by the region's economic strength, which consolidates Madrid as one of the main drivers of growth in Spain. The capital has shown remarkable progress during 2024 and the first months of 2025, especially in the labour market. Employment continues to grow, reaching record highs each quarter, while unemployment continues to decline, and labour force participation among Madrileans is at a record level. Meanwhile, tourism has also experienced a significant boost, having fully recovered from the pandemic. The number of tourists and overnight stays has reached record-breaking figures, with the majority being international travellers. This is further reinforced by Madrid's outstanding position in the fields of science, technology and innovation. The city far exceeds the national average in terms of investment in research and development (R&D) as a percentage of GDP and is home to some of the country's most important universities and technology centres, both public and private.

Illustration1
Aerial image of Madrid City Council headquarters.
Source: Madrid Municipal Police

Thanks to these factors, Madrid has established itself as a vibrant economic hub with a strong capacity to attract talent and investment. Its vitality extends throughout the country, emphasising its significant role in the Spanish and European context. This favourable economic framework provides a solid foundation for the deployment of new initiatives linked to Urban Air Mobility (UAM), which require innovative environments with a robust business fabric and high international connectivity.

In this context of economic growth and expanding mobility, Madrid is also establishing its position as the epicentre of the Spanish aeronautical industry. This key sector stands out for its ability to generate high-quality employment, promote advanced technologies and have a knock-on effect on other industries. The aerospace industry in Spain ranks fourth in continental Europe in terms of sales and employment, with a turnover of €13.9 billion in 2023 (15% more than in 2022) and more than 215,000 direct and indirect jobs, 59% of which come from exports. The wider Madrid

area accounts for 43.1% of employment in the sector, 49.2% of turnover and 28.7% of production centres in the country, according to the 2023 activity report of the Spanish Association of Defence, Security, Aeronautics and Space Technology Companies (TEDAE).

This leadership is structured around two key areas of specialisation: Getafe, focused on earth observation technologies and aeronautical component manufacturing, and Tres Cantos, specialising in satellite communications. In addition, the region has a first-class academic and research ecosystem, including the Polytechnic University of Madrid (UPM), the Carlos III University of Madrid (UC3M), the Rey Juan Carlos University (URJC), the European Space Agency Business Incubation Centre (ESA-BIC) as well as the National Institute of Aerospace Technology (INTA), NASA's Madrid Deep Space Communications Complex and the Centre for Astrobiology, among others. These entities promote innovation in aeronautics, from propulsion systems to materials science. This position puts Madrid at the forefront of European aerospace advances and establishes it as a significant hub for the development of new Urban Air Mobility (UAM) solutions..

Urban Air Mobility, a market with strong growth prospects

The global market for drones and Innovative Air Mobility (IAM) is undergoing a phase of strong expansion driven by the development of new applications in logistics, urban transport, security and industrial inspection. According to Global Market Insights (2024), the global IAM market reached an approximate value of $11.5 billion in 2024, with a forecasted annual growth rate of around 20% until 2034, exceeding $77 billion by that time. This is supported by the technological advancements in unmanned aircraft, investments by major manufacturers in electric vertical take-off and landing (eVTOL) platforms, and the progressive development of regulatory frameworks that facilitate their safe integration into the airspace.

The Asia-Pacific region is rapidly emerging as a key source of momentum for the UAM sector. Several cities in the region are expected to be early adopters of UAM technology due to the prevalence of several regional companies in the sector. Several countries, such as China, Japan, and South Korea, have been investing heavily in the development of UAM ecosystems in the region in the coming years. Shenzhen is home to 1,700 drone companies (DJI, EHang, etc.), which supply 70–80% of the global commercial drone market, with 79% of patents registered by Chinese companies.

In Europe, the trend is equally positive with a clear commitment to developing a competitive air mobility ecosystem. According to Grand View Research (2024), the European IAM market was valued at $3.605 billion in 2024 and is projected to reach $40.86 billion by 2035, representing an average annual growth rate of over 25%. This progress is being driven by strategic R&D programs, such as those managed by the SESAR 3 Joint Undertaking or Horizon Europe, and by the roll-out of various initiatives across different cities in Europe, including Madrid.

It is important to note that among these initiatives are the deployment of large-scale demonstrators such as the U-ELCOME, EALU-AER and BURDI projects, which seek to deploy U-space ecosystems to accelerate the development of commercial drone operations in the medium term. They also look to adopt city-focused initiatives like the development of guidelines for the deployment of urban air mobility in cities, with examples such as Urban Air Mobility and Sustainable Urban Mobility Planning (UIC²/ Smart Cities Marketplace (EU), 2021) or Drones and Sustainable Urban Air Mobility (UAM) (European Commission / EACEA, 2022). These initiatives position the European continent as one of the main hubs of innovation in the integration of UAM solutions in cities.

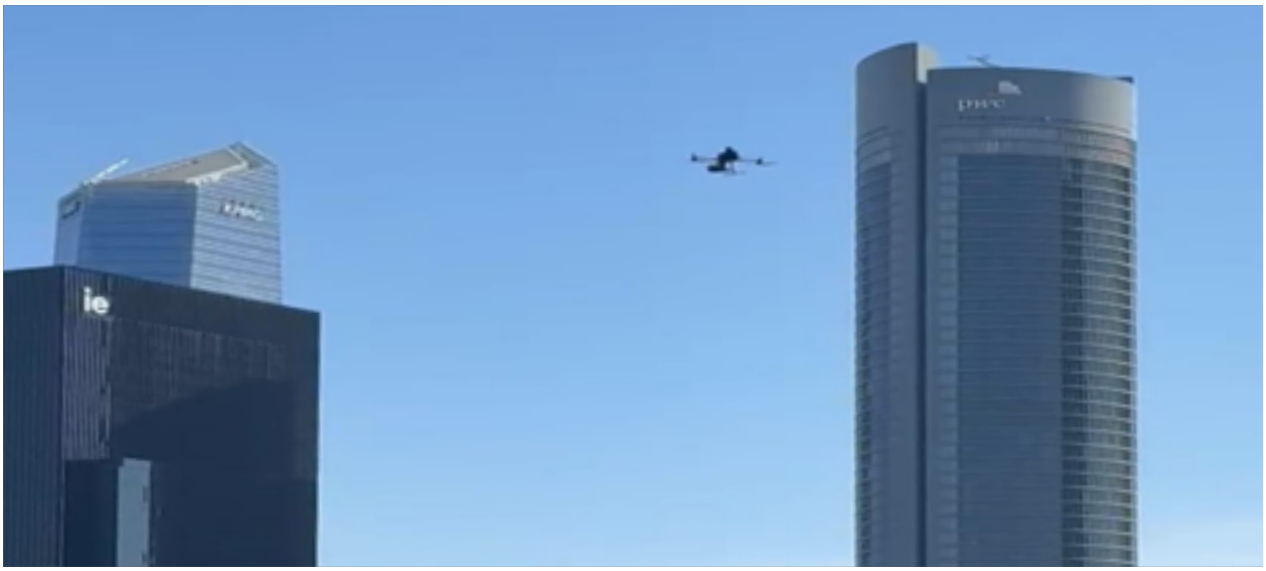

Illustration 2
Flight of the European U-ELCOME demonstrator to stimulate the transport of medicines between two hospitals in Madrid

In recent years, Madrid City Council, through the Municipal Police Air Support Section, has promoted significant advances in the use of drones, consolidating them as an essential resource in urban management. To illustrate this, during 2022, the unit carried out 1,670 flights in 334 air operations, representing a 145% increase compared to 2021. In 2024, the number of operations exceeded 2,500, representing a 32% increase compared to 2023, a period in which it already had 34 drones equipped with thermal cameras and night vision.

Furthermore, the increase in the use of drones in the city is also reflected in the number of UAS coordination processes by ENAIRE, which rose from 1,003 in 2023 to 1,344 in 2024, representing a year-on-year growth of 33.9%, with those related to the audiovisual sector accounting for the largest share. Currently, visual line-of-sight (VLOS) flights with pilots that could be classified as SAIL III are routinely carried out, especially in photography and recording applications. Throughout 2024, the following operations were authorised (ENAIRE data):

Activity	Number	%
PHOTOGRAPHY	50	3,72%
FILMING	931	69,27%
PHOTOGRAMMETRY	4	0,30%
TRAINING AND EDUCATION	1	0,07%
OBSERVATION / PATROL / SURVEILLANCE	206	15,33%
SCIENTIFIC RESEARCH	-	0,00%
INSPECTION / RESEARCH AND INSTRUMENTAL RECONNAISSANCE	2	0,15%
MISCELLANEOUS / OTHER	147	10,94%
ADVERTISING	1	0,07%
RESEARCH AND DEVELOPMENT	-	0,00%
SHOW / EVENT / EXHIBITION / FESTIVAL	1	0,07%
TEMPORARY SEGREGATED AREA	1	0,07%
TOTAL	1.344	100%

Table 1 - Number of UAS coordination requests processed by ENAIRE – 2024

The future of Urban Air Mobility in Madrid

Urban Air Mobility is an emerging activity. Even in the most developed countries, such as China, most operations are carried out under regulatory exemptions (sandboxes) with the aim of gaining experience and gradually developing appropriate regulations for this type of activity.

At the European level, initiatives such as U-space, promoted by the European Aviation Safety Agency (EASA), and various Urban Air Mobility (UAM) programmes supported by the European Commission are laying the foundations for the safe integration of drones and unmanned aircraft into urban airspace. In Europe, the development of regulations for urban operations aims to ensure safety and effective integration within cities in a sustainable manner. Each region has its own unique characteristics, resulting from different national histories and urban developments, which require specific operating conditions that need to be analysed in detail.

In this regard, cities such as Dublin, Rotterdam, Hamburg, and Helsinki are actively participating in pilot projects that seek to test urban air corridors, deploy U-space services, and trial delivery drone operations (among other initiatives) within the framework of R&D initiatives and through their own programmes. Likewise, networks such as the UAM Initiative Cities Community (UIC2), which brings together more than 40 European cities committed to the development of this new dimension of mobility, are working to place cities at the centre of the process and ensure that their needs and particularities are reflected in planning. To move forward, each city will need to establish an appropriate regulatory framework that enables the effective deployment of these services, which are still in their early stages of development. Incorporating a 'third dimension' to mobility not only invites new opportunities to relieve pressure on ground infrastructure but also allows us to rethink urban planning from a three-dimensional perspective. Concepts such as air taxis, delivery drones, urban air corridors and multimodal interchange hubs have the potential to significantly transform the way we understand connectivity and accessibility in cities. In addition, the deployment of drones will open the door to new services and business models, with a positive impact on the urban economy and the development of innovative technological ecosystems.

The role of Urban Air Mobility in Madrid must combine technological and regulatory possibilities with adequate integration into the city's transport systems and infrastructure, ensuring coexistence with other means of transport and respect for the environment and citizens. According to data from the Directorate-General for Mobility Planning and Infrastructure, in June 2025, Madrid saw 6,260,973 daily trips by private vehicle, 3,847,053 by public transport, 148,794 by bicycle or personal mobility vehicle (PMV), and 3,605,733 on foot. How many of these journeys will be made by air in the future? What percentage of urban goods distribution will be done by drones? These are questions which do not yet have an answer.

Madrid has already taken its first step with the Mayor's Decree of 20 September 2023, which created the Urban Air Mobility Commission and regulates its composition and operation. The Air Mobility Commission is an "advisory body under Article 76.2 of the Organic Regulations of the Government and Administration of the City Council of Madrid, of 31 May 2004, responsible for collaborating with AESA and other state and regional authorities, the aerospace sector, the transport and innovation sectors, to study the conditions under which urban air mobility of remotely piloted aircraft should be regulated within the framework of Community, state and, where applicable, regional regulations enacted on the operation of these systems and their integration into the mobility models developed."

Six working groups have been set up to carry out the work: regulations, safety, operations, infrastructure, environment and citizenship, and operators.

Economic - made up of representatives from the city council, public bodies, innovation centres, universities, transport operators, technology developers and independent experts to draw up a White Paper on Air Mobility in the City of Madrid.

Its objective is to lay the foundations for building a complex ecosystem that will prepare

the city for the paradigm shift that new mobility will certainly bring. This change is already underway and will require the most relevant stakeholders to come together and reach an agreement to ensure its success. Urban Air Mobility is not a single solution, but rather an addition that presents a real opportunity to enhance our way of life and travel in a flexible and sustainable manner. As a result of the joint work of these groups, this White Paper has been developed, aiming to serve as a reference tool for public officials, private agents, and citizens alike. The document is structured in five sections:

- The first analysis examines the current landscape in Urban Air Mobility and technology, addressing existing national and international frameworks, key technological advances, and the main development trends.
- The second section discusses international benchmarks: cities around the world that have already begun experimenting with pilot projects, vertiport infrastructure, or integrated air mobility strategies.
- The third section identifies the principal players in the UAM ecosystem, including start-ups, aircraft manufacturers, logistics operators, academic institutions, infrastructure managers, and regulatory authorities.
- The fourth section presents the conclusions reached by the control and working groups organised by the Commission, structured by themes such as regulation, urban planning, technology, sustainability and citizen participation.
- Lastly, the White Paper proposes a roadmap towards 2035 for deploying Urban Air Mobility in Madrid, identifying milestones, priority investments, potential phases, necessary regulatory frameworks, and government tools.

We invite readers to read this White Paper in anticipation of the bright future offered by this new form of mobility, which will likely generate new opportunities in the city of Madrid. Furthermore, we encourage those engaging in the report to then participate in the creation of this new ecosystem through the relevant channels of the Madrid City Council.

2. Current situation of urban mobility

In recent decades, air mobility has transformed the global transport ecosystem. According to the 2023 annual report of the Observatory of Transport and Logistics in Spain, the number of air passengers in 2022 reached 201.8 million, an increase of 116% over the previous year. International travel saw greater growth than domestic travel, with EU Schengen traffic carrying the highest number of passengers at 86.6 million, a 104.9% increase over the previous year.

The rest of international traffic carried 74million passengers, 194.3% more than in 2021. Finally, domestic traffic carried 41.2 million passengers in 2022,58.3% higher than the figures recorded in 2021. This growth is based on a wide range of services, low costs and strict safety standards, which have made air travel the preferred means of transport for long distances.

However, in urban areas, the use of aerial means has been significantly restricted. In Spain, their use is limited almost exclusively to security and emergency services due to their high cost and the difficulties of operating these services in urban environments at low altitudes. Beyond land use permits (restricting public roads) and other elements related to public safety, factors such as increased risk on the ground, due to the presence of uninvolved persons and infrastructure, and in the air, due to the airspace closer to large airports and heliports, as well as urban obstacles, which requires greater professionalisation, detailed risk analysis and complex coordination with multiple local and aeronautical actors.

In recent years, a new paradigm has emerged, driven by disruptive technological advances and a growing demand for sustainable solutions, promising to transform the way people and goods are transported. In this context, two concepts have become particularly relevant: Advanced Air Mobility (AAM) and Innovative Air Mobility (IAM). Although neither term has a strict definition, they reflect a converging evolution towards

a new model of air transport:

Advanced Air Mobility (AAM) and Innovative Air Mobility (IAM). Although both terms do not have a strict definition, they reflect a convergent evolution towards a new model of air transport that transcends the limitations of traditional aviationl:

- The term **Advanced Air Mobility (AAM)**), which originated in the United States and is the acronym used by the International Civil Aviation Organisation (ICAO), is used to describe the set of air transport services and systems that use innovative aircraft, many of them electric or hybrid and with a high degree of automation, to move people and goods more efficiently, safely and sustainably.

  This concept includes both urban (UAM) and regional operations and focuses on the integration of new platforms, such as vertical take-off and landing (VTOL) aircraft, electric or hybrid propulsion systems and lightweight airframes, intending to connect previously inaccessible or underserved locations. It also envisions the development of specific infrastructure, such as vertiports, and advanced operational frameworks, including U-space, to enable the safe management of low-altitude air traffic.

- The concept of **Innovative Air Mobility (IAM)**, which originated in Europe, has begun to establish itself as a broader and more inclusive alternative. This term, promoted by the European Union Aviation Safety Agency (EASA), incorporates not only technological deployment, but also a comprehensive approach that considers everything from aeronautical design to user experience, including modal integration, sustainability and social acceptance. IAM is not limited to an urban environment, as is the case with Urban Air Mobility (UAM), but encompasses applications in rural, interregional and coastal environments, as well as logistics, health and public safety missions.[1]

One of the key differentiating elements of the European approach is the centrality of citizens in the development of the air mobility ecosystem. Concerns about safety, privacy, noise and environmental impact have been addressed through consultation processes and translated into design criteria and adaptive regulation. In this way, innovative air mobility not only seeks to maximise technical and operational efficiency, but also to ensure public acceptance and compatibility within the social and cultural fabric of the urban environment in which it is deployed.

Technological development plays a critical role in this process. The viability of air mobility depends largely on the degree of development achieved in areas such as sustainable propulsion, flight automation, intelligent airspace management, secure communication networks and interoperable infrastructure. These advances not only enable new forms of transport, but also pose new regulatory, ethical and urban challenges that must be addressed in a multidisciplinary manner.

In the following pages, European terminology will be used to develop the contents of the White Paper.

2.1 Technological reference framework

Innovative air mobility, particularly its use in urban environments, depends on a combination of technologies ranging from aircraft to traffic management systems, infrastructure, communications, sustainability and social acceptance.

According to the White Paper on R&D for Unmanned Aviation in Spain, published by the State Aviation Safety Agency (AESA) in 2022, multiple priority technological areas have been identified that will shape the sector's development in the short and medium term.

1. Advances in **aerial platforms, such as drones and electric vertical take-off and landing (eVTOL) aircraft**, are essential. These systems require improvements in

1 NOTE: With regard to the use of Advanced Air Mobility (AAM) or Innovative Air Mobility (IAM), this White Paper has opted to use IAM in order to align UAM developments in Madrid within the European framework. Furthermore, U-space has been chosen over UTM in order to follow the same criteria.

their navigation capabilities in complex urban environments, as well as in their operational range, level of on-board intelligence, and collision detection and prediction systems.

The ability to conduct beyond visual line of sight (BVLOS) and fully autonomous operations in a safe and regulated manner will be one of the key factors in their integration into urban spaces.

A commitment to sustainability is also seen as an essential requirement. The electrification of aircraft, the exploration of alternative energy sources such as hydrogen, and the design of circular life cycles for vehicles and their components are priority areas for development. At the same time, UAS are positioned as useful tools for urban environmental management, offering solutions for environmental monitoring, emergency response, and improved resource efficiency.

2. **Physical infrastructure for operations**. Vertiports, of various sizes, types and purposes, designed as logistics and urban mobility hubs, must be integrated with the rest of the metropolitan transport system and with smart urban structures. Their design and location will be determined by criteria of operational efficiency, accessibility, digital connectivity and sustainability.

3. **Critical infrastructure to support operations**. Communication, navigation and surveillance (CNS) infrastructure, together with advanced meteorology, cybersecurity and data management, fall within the group of critical infrastructure to support operations and are essential for enabling safe BVLOS operations in urban environments.

   Technologies such as 5G, satellite links and redundant networks enable reliable, low-latency communications, while accurate meteorological information and cybersecurity systems reduce operational risks. The integration of real-time data analysis platforms will be key to optimising trajectories and ensuring continuous operations with the highest safety standards.

4. **Air traffic management systems**, known as UTM (Unmanned Traffic Management) and U-space in the European context, will be responsible for automatically and safely organising the coexistence of multiple unmanned aircraft in low-altitude airspace. These systems must be capable of interoperating with manned aviation and control agencies, incorporating remote identification tools, dynamic geo-awareness and digital coordination protocols between operators.

Together, these technologies form the pillars on which the urban air mobility ecosystem is built. Their degree of maturity, the coherence of their integration and their ability to adapt to the particularities of Madrid's urban environment will be decisive for the success of any implementation strategy. At the same time, the concept of technological sovereignty in strategic sectors is gaining increasing importance, understood as the ability of a country or region to control the development and use of its own technology without excessive dependence on external actors.

This approach has direct implications for national security, economic development, and regulatory control, and will be key to ensuring that urban air mobility develops in a sustainable manner and in line with local interests

2.1.1 Unmanned Aerial Vehicles (UAVs)

In the context of urban air mobility, the current market for unmanned aircraft offers a diverse range of platforms that cater to various operational needs, levels of endurance, and regulatory requirements. These platforms can be classified into four main categories: fixed wing, rotary wing (single rotor, multi-rotor) and hybrid wing, each with different degrees of technological maturity (TRL), potential applications and associated challenges. In addition, eVTOLs, which are fully electric and available in multiple configurations, are notable for their recent introduction into the ecosystem.

Each of these technologies will be analysed below, focusing on their usefulness within the IAM.

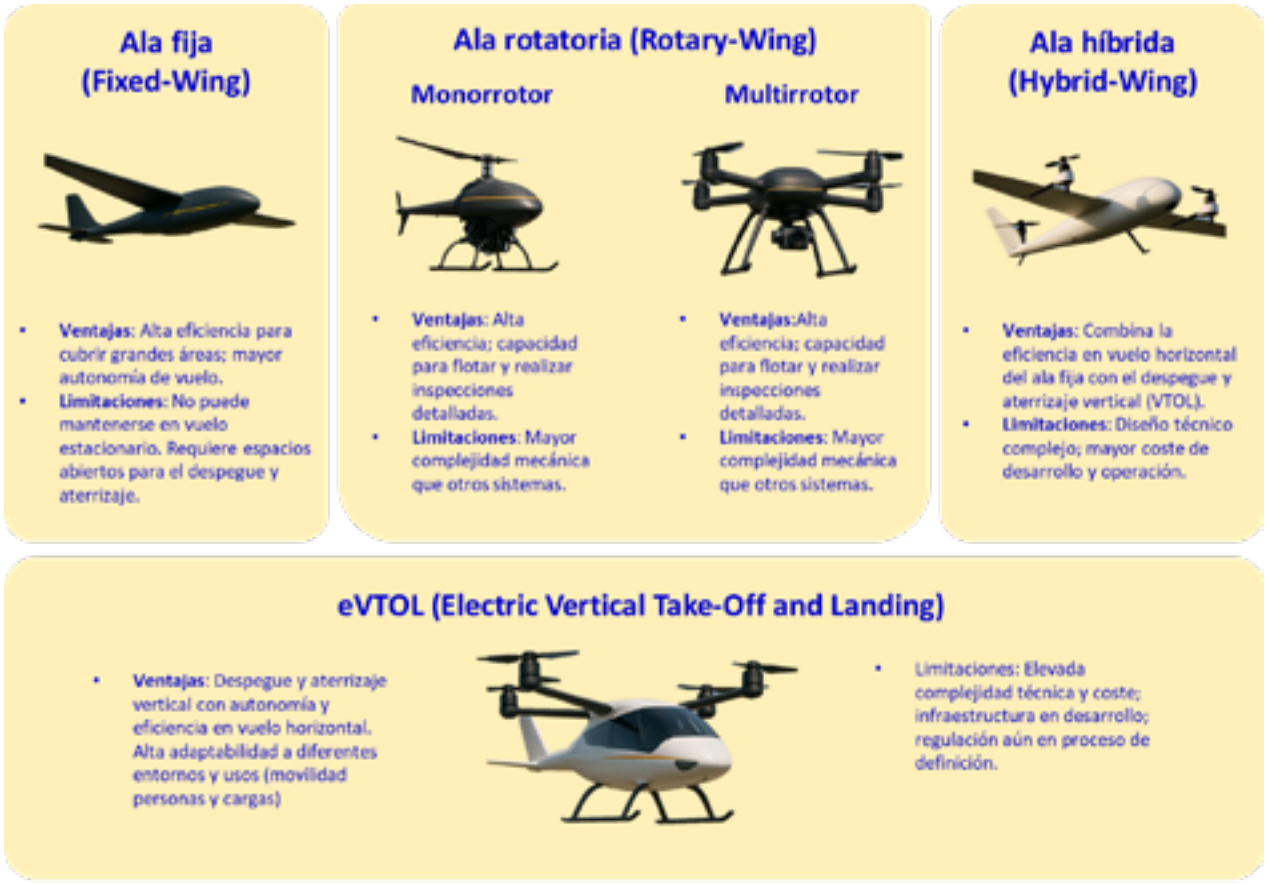

Illustration 3
Categories of unmanned aircraft.
Source: ITG

Fixed Wing

Fixed-wing drones are unmanned aircraft that generate lift mainly through a rigid wing surface, similar to a conventional aeroplane. Unlike multirotors, their lift depends on constant horizontal movement, allowing them to fly efficiently for long periods and cover greater distances.

Technical Characteristics

These drones feature an aerodynamic design that includes rigid wings and a lightweight fuselage constructed from composite materials, such as carbon fibre. They use engines that propel forward flight, creating aerodynamic lift. They generally require runways for take-off and landing, although there are VTOL (vertical take-off and landing) variants that combine rotors for vertical manoeuvres with wings for efficient cruise flight.

Key Applications

The main advantage of fixed-wing drones is their high energy efficiency, allowing them to fly longer and with greater endurance (from 1 to 5 hours), as well as a larger payload capacity (from 5 to 20 kg or more) compared to multirotor platforms. This makes them ideal for environmental monitoring missions, precision agriculture, large area surveillance, mapping, and long-distance logistics.

Therefore, some of the key applications are linked to this feature:

- Precision agriculture: monitoring large areas, detection of water stress, and crop condition analysis.
- Environmental and forest monitoring: ecosystem surveillance, fire

control, and monitoring of fauna and flora in remote areas.
- Cartography and topography: high-precision geospatial surveys in large areas.
- Logistics and remote transport: delivery of medical supplies, food or materials in rural or inaccessible areas.
- Security and defence: reconnaissance, aerial surveillance and support in emergency or rescue operations in rugged terrain.

Limitations and Technical Considerations

Their need for space to take off and land limits their use in dense urban environments. In addition, they are less manoeuvrable than multirotors, as they cannot hover or make tight turns easily. This restricts their usefulness in tasks that require high precision or work in confined spaces.

State of Development and Market

Fixed-wing drones are at an advanced stage of technological development, with a growing global market driven by improvements in batteries, sensors, and navigation systems. They are widely used in civil and military sectors and are expected to continue expanding with the advent of new technologies such as hybrid propulsion and integration into urban air mobility (UAM) systems.

Illustration 4
Fixed-wing drone.

The main advantage of fixed-wing drones is their high energy efficiency, allowing them to fly longer and with greater endurance (from 1 to 5 hours), as well as a larger payload capacity (from 5 to 20 kg or more) compared to multirotor platforms. This makes them ideal for environmental monitoring missions, precision agriculture, large area surveillance, mapping, and long-distance logistics.

Technological Evolution and Trends

Current innovations in fixed-wing drones focus on:

- Integration of high-density batteries (lithium-sulphur, hydrogen) and hybrid engines to extend range and energy efficiency.
- Use of lightweight materials and aerodynamic improvements to increase load capacity and range.
- Advanced automation with sensors such as LiDAR, multispectral cameras and GNSS RTK systems for precise navigation and complex missions.
- 5G connectivity and U-space networks enabling fleet coordination and real-time remote control for safe and autonomous operations,

even in urban environments.

In the future, fixed-wing drones could play a key role in commercial applications, urban air mobility, environmental monitoring and long-distance logistics, thanks to the expansion of BVLOS regulations and supporting infrastructure such as vertiports.

Monorotors (or unmanned helicopters)

Single-rotor drones, also known as monopters or unmanned helicopters, are aerial platforms that use a single main rotor to generate lift and a tail rotor or equivalent systems to control torque. This design is a direct descendant of the architecture of traditional manned helicopters, which gives them certain advantages in terms of endurance, load capacity, and hover stability.

Technical Characteristics

Single-rotor UAS have a large main rotor responsible for providing the necessary lift. To counteract the torque generated by this rotor, a tail rotor, counter-rotating coaxial rotors or torque control systems based on channelled air flows are incorporated. They are usually constructed from lightweight, resistant materials (carbon fibre, aluminium alloys) and can use electric or combustion engines, the latter being particularly suitable for operations requiring greater flight time.

One of their most notable technical features is their energy efficiency compared to multirotors, thanks to the larger diameter of the main rotor. This reduces energy consumption per unit of time and extends flight duration. In addition, their ability to maintain hovering flight makes them ideal for missions that require prolonged stability at a fixed point.

Illustration 5
Single-rotor drone

Key Applications

Single-rotor drones are mainly used in professional missions which require greater flight time or load capacity tan multirotor drones:

- Heavy industrial inspection: inspection of critical infrastructure (oil pipelines, power lines, offshore platforms) in prolonged operations.
- Medium-distance logistics: transport of payloads greater than those of multirotors, including medical supplies in rural or isolated environments.
- Agricultural applications: spraying and sowing crops over large areas, thanks to their high payload capacity

- Search and rescue: missions in hostile environments where flight time and the ability to carry additional equipment are critical factors.

Limitations and Technical Considerations

Although they have greater endurance than multirotors, monorotors are mechanically more complex, which increases maintenance and operating costs. Their single main rotor means greater inertia and, in some cases, less lateral manoeuvrability in confined spaces.

In addition, their larger size and large-diameter blades can pose a greater risk in urban operations. They also generate more noise than electric multirotors, limiting their use in densely populated urban environments.

State of Development and Market

Monorotor UAS are at an intermediate stage of technological maturity (TRL 7-8), especially in the agricultural and logistics applications segment. Their market is smaller than that of multirotors or fixed-wing drones due to their higher cost and complexity; however, they occupy an important niche in operations that require flight time, load capacity, and prolonged hovering. Manufacturers such as Yamaha, Quantum Systems, and Watts Innovations have developed benchmark platforms that integrate autonomous navigation systems and hybrid electric/combustion solutions.

Technological Evolution and Trends

Current innovations focus on:

- Hybrid propulsion systems (electric + combustion) to increase range and reduce emissions.
- Weight reduction through new composite materials and more efficient rotor systems.
- Automation and autonomous navigation with advanced sensors and artificial intelligence algorithms.
- Integration into U-space networks and improvements in Detect & Avoid systems for safe BVLOS operations.

In the future, monorotors could play a significant role in advanced logistics, large-scale precision agriculture, and inspection operations in critical industrial environments.

Multirotors

Multirotor drones, also known as multirotors, are the most widespread platform in today's unmanned systems market, both in recreational and professional applications. Their distributed rotor architecture enables efficient vertical take-off and landing (VTOL), as well as hovering stability and precise control, even in complex urban environments.

Technical Characteristics

A multirotor drone typically consists of four, six, or eight symmetrically arranged rotors. Each rotor generates vertical thrust, and attitude control is achieved by modulating the relative speed of the motors. This architecture eliminates the need for moving surfaces such as ailerons or rudders and allows for great stability in hovering, even in confined spaces or light winds.

By modulating the relative speed of the motors. This architecture eliminates the need for moving surfaces, such as ailerons or rudders, and allows for great stability in hovering flight, even in confined spaces or light winds (Fahlstrom & Gleason, 2022).

However, its main technical disadvantage is its energy inefficiency: by constantly relying on vertical thrust to stay airborne, its flight time is limited, typically ranging from 15 to 40 minutes, depending on weight, environmental conditions, and the type of battery used (Ayush, Michel, & Xinfan, 2025).

Key Applications

Multirotor drones have become versatile tools for a wide variety of sectors:

- Technical inspection: of infrastructure such as power lines, wind turbines, bridges, and solar plants.
- Safety and emergencies: perimeter surveillance, search and rescue (SAR), forest fire support.
- Precision agriculture: for crop analysis, selective irrigation, fumigation, or controlled sowing.
- Last-mile urban logistics: increasingly used by companies such as Amazon Prime Air and DroneUp to deliver small packages quickly in urban areas (Howe, 2022).
- Cartography and photogrammetry: especially in high-resolution 3D surveys in small or complex areas.

Illustration 6
Multirotor drone

Limitations and Technical Considerations

Although extremely practical, multirotors have limited flight endurance, low energy efficiency and lower payload capacity compared to fixed-wing or hybrid drones. These characteristics restrict their use in long-duration missions or medium- to high-volume logistics transport.

Due to their compact structure and light weight, multirotors are also sensitive to wind gusts and adverse weather conditions. In addition, in urban operations, they must comply with strict regulations on safety, noise and privacy.

State of Development and Market

Multirotor drones are at an advanced stage of maturity (TRL 8–9[2]) in most of their civil and commercial applications. Various globally recognised companies have developed advanced solutions based on multirotors, including embedded software and redundant control systems.

The White Paper on R&D for Unmanned Aviation in Spain (AESA, 2022) highlights multirotors as key platforms for developing services in urban and rural environments, particularly due to their adaptability to specific tasks, low operating costs, and potential for automation.

2 NOTE: The level of technological maturity, known as TRL (Technology Readiness Level), is a scale that measures the degree of development and readiness of a technology for real-world application. It ranges from TRL 1, which corresponds to the observation of basic principles, to TLR 9, which indicates a fully tested and operational technology in a real environment..

Technological Evolution and Trends

Currently, the development of multirotors is focused on improving:

- Autonomous navigation systems with artificial intelligence and computer vision.
- Conflict detection and prevention capabilities (Detect & Avoid).
- Energy optimisation through new batteries (Li-S, hydrogen) or hybrid systems.
- Integration with U-space networks for coordinated and safe operations in urban airspace.
- Research and development of innovative E-conspicuity[3] systems.

These improvements will enable expanded use in BVLOS operations and full integration into urban air mobility (UAM) systems, such as delivery nodes or support vehicles.

Hybrid (lift and cruise/vertical thrust)

Hybrid drones, also known as VTOL (Vertical Take-Off and Landing) platforms, combine the best features of multirotors and fixed-wing systems, offering greater versatility and endurance. Their design allows them to take off and land vertically in confined spaces, while achieving efficient horizontal cruise flight thanks to their wings. This type of platform is gaining relevance in the market due to its ability to operate in urban and rural environments, as well as its adaptability to medium and long-distance missions.

Technical Characteristics

Hybrid platforms typically integrate dedicated rotors for take-off and landing manoeuvres and a main motor or propeller for horizontal flight. This architecture allows automatic switching between multirotor and fixed-wing flight modes. The combination of aerodynamic wings and multiple propulsion systems offers greater energy efficiency than multirotors, achieving flight times of over 2–4 hours, depending on the payload and aircraft configuration (Molina, 2025).

Key Applications

Hybrid platforms excel in operations that require flexibility and range:

- Medium-distance logistics: delivery of goods and supplies in urban and rural environments without the need for runways.
- Inspection of linear infrastructure: such as gas pipelines, roads, power lines or railways, combining range and precision.
- Surveillance and security: thanks to its ability to cover large areas in less time.
- Emergencies and humanitarian aid: rapid deployment in areas that are difficult to access, maintaining sufficient flight time for prolonged missions.

Technical Limitations and Considerations

These aircraft are more complex mechanically and electronically due to the integration of two flight modes, which increases the cost and maintenance requirements. In addition, their hybrid design can penalise payload compared to purely fixed-wing systems.

State of Development and Market

The market for hybrid platforms is growing, with a medium to high TRL (7–8) in most of its applications. Europe and North America account for most commercial developments, while Asia leads in large-scale production. Their role within the IAM will be key as an intermediate solution for logistics and cargo transport on point-to-point routes, especially in integration with urban vertiports.

3 NOTE: The ability of an aerial vehicle, such as a drone or eVTOL, to be detected electronically by other air traffic systems and operators

Illustration 7
Hybrid drone

Technological Evolution and Trends

Current innovations in hybrid drones focus on::

- Optimising the transition between flight modes (fixed wing and multirotor) to maximise energy efficiency and stability in different operational phases.
- Improving advanced batteries, especially hydrogen and lithium-sulfur (Li-S) batteries, to increase endurance and reduce the overall weight of the system.
- Use of state-of-the-art composite materials to minimise structural weight without compromising strength and durability.
- Developing autonomous BVLOS navigation systems with integrated sensors and artificial intelligence algorithms to ensure safe and accurate flights in complex environments.
- Integration with U-space networks and 5G communication technologies to enable coordinated operations, efficient airspace management and regulatory compliance in dense urban areas.

In the future, hybrid drones could revolutionise sectors such as express delivery, industrial inspections in remote areas and environmental monitoring, thanks to their versatility and ability to operate in diverse environments with high autonomy and safety.

Electric Vertical Take-Off and Landing (eVTOL)

eVTOL (Electric Vertical Take-Off and Landing) aircraft represent an evolution in urban air transport, geared towards both passenger and light cargo transport in urban and peri-urban environments. These platforms, powered by electric motors, have emerged as the core of future air taxi and rapid freight transport services, thanks to their low noise levels, zero emissions during operation, and ability to take off and land vertically in "vertiports" or small areas. Unlike hybrid models, they may not have fixed wings.

Technical Characteristics

eVTOLs use exclusively electric propulsion, making them quieter and more sustainable than hybrid platforms. They typically incorporate multiple distributed rotors or tiltrotor configurations to combine manoeuvrability and aerodynamic efficiency in cruise. Currently, the most advanced developments achieve flight times of 20 to 50 minutes with payloads of up to 250 kg or 4–6 passengers (NASA, 2024).

Key Applications

eVTOL aircraft stand out for their suitability for use in urban or complex environments, especially in transport operations:

- Passenger transport (air taxis): drastically reducing travel times in metropolitan areas.
- Urgent logistics: rapid delivery of high-value or critical goods (medicines, organs for transplants).
- Operations in complex environments: access to rural or isolated areas without airport infrastructure.

Illustration 8
eVTOL eHANG 216.
Source: eHang

Limitations and Technical Considerations

The main barriers currently are limited battery range, regulatory certification, development costs and infrastructure deployment (vertiports and charging networks). Additionally, they require full integration into urban air traffic management systems (U-space) to ensure safe and efficient operations.

State of Development and Market

The eVTOL market is at a medium TRL (5–7), although major manufacturers and start-ups are accelerating their certifications, with initial commercial operations expected in 2026–2027 (EASA, 2025). The global eVTOL market is estimated to exceed €30 billion by 2035, driven by demand for urban air mobility.

Technological Evolution and Trends

Current innovations in eVTOL vehicles focus on:

- Improving the energy density of batteries to increase range and reduce the overall weight of the aircraft.
- Advancing hybrid-electric propulsion systems that combine energy efficiency with extended operating capacity and reduced emissions.
- Develop autonomous operation technologies, including advanced navigation, detection and avoidance systems for safe and accurate flights in complex urban environments.
- Design and deployment of critical infrastructure such as vertiports, which facilitate take-off, landing and ultra-fast battery recharging, enabling continuous and efficient operations.
- Creation of a flexible and adapted regulatory framework that allows for service scalability, ensuring safety, integration into urban airspace and public acceptance.

In the future, eVTOLs could transform urban mobility, offering fast and sustainable solutions for passenger and light cargo transport, as well as opening up new opportunities in areas such as medical emergencies, tourism and urban air logistics. The following table summarises the above, adding information on vehicles for specific cases such as cargo or passenger transport, which are particularly relevant to this document.

Platform Type	Flight Time	Approximate Payload	Advantages
Fixed Wing	1–5 hours	5–20 kg	Great endurance, aerodynamic efficiency aerodynamics
Single rotor	1–3 hours	5–15 kg	Good range, hovering capability, greater load capacity than multirotors
Multirotor	15–40 min	1–5 kg	High manoeuvrability, VTOL, low cost
Hybrid (lift and cruise/ vertical thrust)	45–90 min	2–10 kg	Combines VTOL and flight efficiency in flight
eVTOL (electric)	30–90 min	1–4 passengers / 200–400 kg	Zero emissions, silent, ideal for cities

Table 2 - Own elaboration. Main characteristics of the different aircraft of interest for this document

2.1.2 Physical urban air mobility infrastructure

Physical urban air mobility infrastructure can be defined as an aerodrome of variable size, located in urban environments and designed to serve both public and private air operations linked to the city. These modular infrastructures may include take-off and landing areas, navigation systems, operational support, security, maintenance, energy recharging and air traffic control, among other functions.

The professional use of drones in urban environments is constantly growing, especially in the US and China, covering applications in security, emergencies, inspections and logistics, among others. This development requires the creation of infrastructure adapted to each type of operation: from drone pads and temporary heliports, designed as temporary spaces for small drones, to advanced and certified vertiports, urban equivalents of airports, with variants such as vertistops, lightweight and modular facilities for rapid operations, or vertihubs, large logistics centres with multiple FATOs and complementary services.

In turn, Drone-in-a-box systems enable autonomous and continuous inspection, security or emergency response operations, and within this category, logistics lockers, automated urban lockers for parcel delivery and collection, stand out. To ensure maximum efficiency and flexibility, it would be necessary to develop integrated networks of the various physical UAM infrastructures, including vertiports, dronepads and Drone-in-a-box systems, optimising the use of urban space and adapting to the growing diversity of vehicles and operations within urban air mobility.

It is also essential to define the conditions for integrating drone infrastructure and operations into existing buildings and public spaces, particularly for small drones used in last-mile logistics applications. The future use of beyond visual line of sight (BVLOS) drones, whether remotely piloted or automated, will require the establishment of ground conditions for their safe operation. Given the building typology of the city of Madrid, where residential use in collective buildings predominates, it will be necessary to regulate the use of common spaces for these purposes.

Vertiports

Los "vertiports" representan el corazón operativo de la movilidad aérea innovadora, diseñados para facilitar la integración de aeronaves eVTOL en un entorno que maximice la eficiencia, la seguridad y la sostenibilidad.

Illustration 9
Solar-powered urban vertiport.
Source: Bluenest by Globalvia

Vertiports represent the operational heart of innovative air mobility, designed to facilitate the integration of eVTOL aircraft in an environment that maximises efficiency, safety and sustainability.

The development of vertiports involves not only the construction of landing and take-off facilities, but also the planning of systems that include cargo areas, passenger terminals, maintenance areas and energy supply systems.

Vertiports are modular infrastructures designed to adapt flexibly to the specific needs of each location and type of operation, offering services tailored to local demand. This modularity is key to optimising the architecture of each vertiport and ensuring that the drones operating there, whether for passengers, light cargo, heavy cargo or other uses, do so efficiently, safely and logically. Not all vertiports will offer the same services. For example:

- EIn vertiports geared towards passenger transport, the infrastructure must prioritise accessible and comfortable terminals, with efficient boarding and disembarking areas, as well as associated services such as waiting rooms, security checks and flow management systems to prevent crowding. It is essential to have advanced rapid battery charging or exchange systems, as well as preventive and corrective maintenance, and direct connectivity with other urban transport modes, to facilitate a seamless intermodal experience.

- In contrast, vertiports dedicated to light and heavy cargo operations require a configuration focused on logistics and goods handling. This involves separate take-off and landing areas, depending on the size of the drone and cargo requirements, as well as large storage areas, automated loading and unloading systems, infrastructure for managing pallets and packages, and solutions that integrate these operations with the urban supply chain. For heavy loads, robust platforms are required to support larger dimensions and weights, as well as specific safety systems for handling sensitive or bulky materials, ensuring efficient and safe operation at all times.

Vertiports will be integrated into vertiport systems that optimise connectivity and efficiency in advanced air mobility. They are not expected to operate independently; it is more reasonable to assume that they will form part of one or more networks connecting other vertiports.

These networks may be defined geographically or operationally, with urban vertiport networks serving a specific metropolitan area, or interurban networks connecting vertiports located in different cities within a region. Similarly, a network of vertiports may be defined functionally by the type of traffic or air operator, so that there may be networks specialising in cargo, consisting of vertiports dedicated to air freight transport, networks geared towards passenger transport, or even mixed-use infrastructures capable of carrying out cargo and passenger operations simultaneously.

Illustration 10 'Vertiport' stimulation. Source: Bluenest by Globalvia

Integration with existing infrastructure

The effective implementation of air mobility infrastructure in established urban environments requires a progressive and multidimensional integration strategy that complements the existing physical, functional, and regulatory fabric. This section addresses the technical and urban planning aspects essential for making vertiports compatible with current infrastructure, ensuring their technical, economic and operational viability.

- **Compatibility with Demand and Urban Structure:**
  Integration must be based on a geospatial analysis of demand that identifies areas with a high density of intermodal flows (people, goods, services) likely to benefit from air mobility services. For passenger-oriented vertiports, priority will be given to existing intermodal hubs (railway stations, interchanges, airports) that allow for seamless connections with other modes of transport.
  Vertiports focused on light or heavy cargo should be located near logistics areas, distribution centres or industrial zones, while drone pads or drone-in-a-box facilities for light drones can be installed on the roofs of public or private buildings, in strategic residential areas or in areas that are difficult to access, where operational flexibility is key. In addition, vertiports and take-off platforms should take advantage of underutilised infrastructure such as car park roofs, shopping centres or public buildings with suitable structural conditions, promoting the shared-use infrastructure model.

- **Coordination with the Air Environment and Traffic Management Systems**
  The implementation of aerial infrastructure must respect the operational restrictions of urban airspace, an environment that is already congested. Vertiports for passenger and heavy-lift eVTOL aircraft require well-defined air corridors that are coordinated with existing air routes. In contrast, drone pads and nests for light drones can operate at lower altitudes, provided they are integrated with U-space systems to avoid conflicts. The design of flight paths (approach and departure procedures) must take into account urban

terrain, local weather, no-fly zones (hospitals, schools, critical infrastructure) and aeronautical easements, as well as comply with the regulatory frameworks of EASA and national civil aviation authorities:

- **Urban airspace management**: Locations should be evaluated based on their compatibility with existing air routes and controlled areas, with priority given to areas with lower conventional air traffic density:
- **Interoperability with U-space**: The infrastructure must be compatible with digitised air traffic management platforms, in accordance with Implementing Regulation (EU) 2021/664. This involves integration with information, surveillance and strategic-tactical coordination services to avoid conflicts between aircraft.
- **Clear aerial topography**: Approach and departure paths must be free of significant vertical obstacles (buildings, power lines, cranes), in accordance with the criteria defined by EASA for UAM Operations. This poses a challenge in cities where there are frequent temporary and permanent changes to the heights used for urban air mobility.
- **Mitigation of environmental impacts**, including:
    - Noise reduction is necessary as noise can cause discomfort to the population and affect the quality of life in urban areas.
    - Management of the downwash generated by aircraft, which can affect pedestrians, vehicles and nearby infrastructure, must therefore be properly controlled.
    - Visual impact. The presence of vertiports and aircraft alters the urban landscape and can be perceived as an aesthetic intrusion.
- **Hyperlocal weather forecasting** to ensure that conditions are suitable for the specific vehicle being used..

- **Structural adaptation of existing sites**

  From a construction point of view, vertiports can be installed in:
  - Surface area: industrial land, vacant plots or intermodal infrastructure.
  - Roofs: Roofs of public buildings, hotels, hospitals or high-capacity car parks. A detailed structural assessment must be carried out (static and dynamic loads, vibrations, acoustic insulation), in accordance with the Technical Building Code (CTE) and Eurocode regulations.
  - Floating infrastructure: In port or river areas, adapting pontoons or floating platforms, particularly relevant in cities with land restrictions or the risk of urban saturation.

- **Intermodality and accessibility**

  The effectiveness of the IAM is multiplied by its seamless integration into the urban mobility ecosystem, but there are different cases depending on the type of use of the vertiport:
  - **Passenger vertiports**: These must be connected to transport hubs, public transport stops, road infrastructure, car parks, or micro-mobility stations to ensure convenient and rapid transit.
  - **Vertiports for light/heavy cargo**: These require direct connections to logistics corridors, industrial areas, and last-mile stations.
  - **Drone pads and drone-in-a-box**/nests for light drones: These need strategic locations in residential or commercial areas to facilitate recurring operations such as last-mile logistics or inspections.

  The integration of services into MaaS (Mobility as a Service) platforms will facilitate the use of services as an additional alternative to urban mobility..

Technical Infrastructure: Energy, Security and Connectivity

Adapting sites to existing service requirements requires strengthening the following key components:

- **Energy Supply**: The installation of fast-charging stations (AC/DC) with power ratings above 1 MW is exceeding. In urban environments, this may require expanding electrical capacity through dedicated transformer stations. Integrating these systems with smart grids is recommended to ensure efficiency,

scalability, and dynamic demand management.

- **Fire Protection**: Automatic detection and extinguishing systems must be implemented, including perimeter hydrants (with special attention to the possible presence of electrical fires) and the use of fire-retardant certified materials. All of this must comply with current self-protection regulations, such as Royal Decree 393/2007 and applicable UNE standards, ensuring the safety of the operating environment.
- **Digital Connectivity**: It is essential to equip facilities with redundant communication networks that ensure the continuous operation of critical services, such as navigation, aerial surveillance (ADS-B/UAT), environmental sensors, and remote-control systems. Redundancy ensures resilience against failures and enables the real-time operation of autonomous or semi-autonomous technologies.

The application of concepts such as modular vertiports would facilitate adaptation according to the services required in each area.

- **Regulatory Governance and Urban Planning**
  The integration of large aircraft vertiports requires explicit recognition in urban planning instruments (PGOU, PMUS), including:
  - Specific zoning for urban air mobility.
  - Definition of compatible uses (public, concessionary, private).
  - Coordinated processing with aeronautical and urban planning bodies.

  At the regional and supra-municipal level, their inclusion in Territorial Action Plans will enable a planned network of vertiports that maximises logistical synergies, minimises environmental impact, and optimises the use of airspace.

Infrastructure for Take-off and Landing of Small Unmanned Aircraft

Infrastructure for small unmanned aircraft systems (UAS) is evolving to facilitate safe, efficient and automated operations in urban and peri-urban environments. This infrastructure is essential for the expansion of professional and commercial drone use, covering areas such as:

- **Last-mile logistics**: Integration into urban distribution networks to facilitate fast, unattended deliveries.
- **Inspection and maintenance**: Enabling permanent base stations for drones that perform regular inspections of critical infrastructure or industrial areas.
- **Emergencies and security**: Rapid bases for deployment in surveillance, search and rescue operations.
- **Events and shows**: Support for drones used in audiovisual recordings or light shows.

Additionally, they offer the advantage of being compact and easy to install, with portable models available for specific applications.

There are several types, but the following two are the most relevant:

- **Drone-In-A-Box** or nests: automated, compact and secure stations that integrate different elements to enable remotely piloted or fully autonomous:
  - Housing and protection: A closed "nest" that shelters the drone when it is not in operation, protecting it from inclement weather and vandalism.
  - Automated take-off and landing: The drone takes off and lands autonomously inside the container, without human intervention.
  - Charging and maintenance: Integrated battery charging systems (electric or hybrid) and, in some models, basic maintenance or automatic inspection.
  - Communication and control: Interfaces for remote control, real-time tracking and connection to air management platforms.

  These stations allow drone fleets to be operated from strategically distributed points, facilitating frequent and repetitive missions with minimal on-site personnel requirements.

- **Dronepads**: specific surface infrastructure for small UAS:
  - **Fixed dronepads**: Area designed for safe landings and takeoffs, installed on rooftops, in open urban areas, logistics centres, or specialised vehicles. They can be equipped with visual signage and basic assisted navigation systems.
  - **Mobile dronepads**: Portable installations that allow drones to be operated from vehicles or mobile containers, ideal for temporary operations or in changing environments, such as emergencies or special events.

Illustration 11
DroneSafeBox®,
ITG's robotic hangar.
Source: ITG

Common technical characteristics

These infrastructures must meet technical criteria that ensure operability and safety:

- Non-slip and resistant surface: Adapted to the specific characteristics of drones (weight, type of landing).
- Positioning and guidance system: Visual markers, GNSS beacons or RFID systems that facilitate precise autonomous landing.
- Integrated energy charging: Fast charging stations with secure connections adapted to drone batteries.
- Protection and security: Physical or virtual barriers to prevent interference or unauthorised access, as well as fire protection elements.
- Connectivity: Real-time communication with air traffic control systems, U-space platforms and operators.

Trends and Future

The development of this infrastructure is geared towards complete automation, integrating advanced artificial intelligence to implement predictive maintenance and autonomous recharging systems. It also seeks to interconnect them in urban networks by creating true drone "ecosystems", supported by multiple Drone-in-a-Box systems and drone pads strategically distributed to optimise operations. Another key focus is sustainability, with a commitment to using renewable energies for aircraft charging and eco-efficient materials in their construction. Finally, work is being done on the development of regulatory and certification standards to enable the approval of these infrastructures and facilitate their safe and orderly integration into the U-space network.

2.1.3 Critical infrastructure to support air operations

To ensure safe, efficient, and sustainable deployment, it is necessary not only to develop physical infrastructure, such as vertiports or logistics bases, but also to establish a robust ecosystem of critical infrastructure to

support air operations. The latter is essential for comprehensive airspace management and ensuring continuity of operations in an increasingly complex and densely populated environment.

This term refers to infrastructure and systems that, although not always visible to the end user, enable communication, navigation, and surveillance (CNS), as well as the provision of meteorological data, cybersecurity, and operational information management. Proper planning, deployment and maintenance are essential for air mobility services to operate with the highest standards of safety and reliability.

CNS infrastructure: communication, navigation and surveillance

CNS (Communication, Navigation and Surveillance) infrastructure is at the heart of modern air operations. Its function is to enable aircraft to:

- Communicate securely with control centres and with each other (air-ground and air-air links).
- Navigate accurately using satellite systems (GNSS) or complementary ground stations.
- Be monitored in real time, enabling early detection of conflict or unauthorised trajectories.

In the field of IAM, where manned and unmanned aircraft will coexist in urban environments, CNS infrastructures must evolve to:

- Support high traffic densities in confined airspace.
- Integrate with UTM/U-space systems that manage automated operations.
- Incorporate 5G/6G and satellite technologies that enable low latency and high availability.
- Be resilient to failures or cyberattacks that could compromise operational safety.
- Efficiently manage the use of the radio spectrum, reserving specific bands, including private and dedicated bands for UAS control and communications, ensuring secure, robust and interference-free links in complex urban environments.

Meteorological infrastructure

Weather conditions are one of the factors that most impact the safety and continuity of air operations. Innovative Air Mobility, which will operate at low altitudes in urban environments, requires a network of advanced meteorological services and infrastructure capable of providing:

- Hyperlocal (micro-weather) forecasts of wind, rain, turbulence, and icing, among other factors.
- Sensors distributed in vertiports, communications antennas and strategic buildings for real-time data collection, enabling adjustments and reactions to significant changes in forecasts.
- Integration with artificial intelligence systems that enable the anticipation of weather changes and adjust flight routes in real time.

These infrastructures will be key to reducing the number of cancellations or diversions and ensuring that IAM can offer a reliable service even in adverse conditions, as well as improving the efficiency of operators by allowing them to optimise routes based on weather conditions or narrow their operating margins.

Cybersecurity and data management

The increase in connected systems, real-time data, and automation raises the exposure of Innovative Air Mobility to cyber threats. Therefore, cybersecurity must be considered a critical cross-cutting infrastructure that protects:

- CNS communications against signal spoofing or interference.
- UTM/U-space systems against unauthorised access or data manipulation.
- Integrity of meteorological and navigation data is essential for aircraft safety.

The creation of specialised IAM cybersecurity protocols and tools, with continuous monitoring and rapid response capabilities, will be an indispensable element in ensuring the resilience of the entire system. Likewise, given the enormous (and growing) volume of data that IAM services will generate and consume, such as:

- Aircraft positioning and telemetry data.
- Real-time meteorological information.
- Dynamic flight plans and operating authorisations.
- Predictive maintenance data and physical infrastructure status.

It is essential to highlight the need to evolve data management and storage infrastructures throughout the value chain to achieve:

- Secure, massive and scalable storage
- Real-time processing using technologies such as Edge Computing to reduce latency.
- Interoperability with authorities and other means of transport
- Compliance with data protection and privacy regulations.

Furthermore, direct interaction between drones and citizens introduces new challenges related to privacy protection and social trust. The risk of improper collection of personal data and possible manipulation of communications can affect both physical security and public acceptance of these systems. Therefore, cybersecurity must also be extended to the citizen level, ensuring that drone operation does not compromise fundamental rights or create perceptions of digital insecurity.

2.1.4 Urban Air Traffic Management Systems (UTM/U-space)

Traditional air traffic management (ATM) systems are not equipped to manage the new urban airspace, characterised by a large volume of autonomous aircraft and highly dynamic operations. These systems were designed for an environment with a small number of manned aircraft flying predefined routes at different altitudes, a scenario very different from that posed by urban air mobility.

Traditional management relies heavily on human intervention and rigid airspace structures, segmented into fixed levels and corridors. This model is unworkable in environments where thousands of drones and eVTOL aircraft are expected to coexist at low altitudes, with more unpredictable trajectories and the need for continuous airspace reconfiguration. Furthermore, current surveillance and communication technologies (such as secondary radar or ADS-B) are not designed to track small aircraft in complex urban environments.

The forecast of exponential growth in the use of unmanned aerial vehicles (UAVs, also known as drones) in urban environments has driven the development of new air traffic management frameworks to ensure the safe, efficient, and sustainable integration of these vehicles into the airspace. Urban Air Traffic Management Systems, known as UTM (Unmanned Traffic Management) and its European equivalent U-space, are emerging as key solutions to address this challenge, enabling the automation, coordination and real-time monitoring of all low-altitude air operations..

UTM: Global Approach

The concept of UTM was initially proposed by the United States Federal Aviation Administration (FAA) in collaboration with NASA, in response to the increase in demand for autonomous flights in low-altitude airspace (below 400 feet or 120 metres). The main objective of UTM is to develop an automated digital system capable of managing unmanned flights without direct intervention from conventional air traffic controllers.

The main components of the UTM system include:

- Remote registration and identification of drones.
- Geofencing to limit flight zones.
- Automated flight authorisation management.
- Real-time data exchange, including position, speed, and planned trajectories.

- Automated conflict and contingency resolution.

Internationally, countries such as Japan, South Korea, Singapore and Australia have launched similar initiatives, adapted to their own regulatory frameworks. The ICAO (International Civil Aviation Organisation) has also launched efforts to harmonise UTM frameworks globally.

U-space: European Approach

In Europe, the unmanned air traffic management system and the ecosystem needed to deploy it is called U-space, promoted by the European Union Aviation Safety Agency (EASA) in conjunction with the SESAR (Single European Sky ATM Research) programme. **U-space aims to establish a set of digital services that enable the safe operation of drones in European airspace, especially in urban and peri-urban environments.**

The U-space framework is structured around four sets of services that will be deployed in stages:

- **U1: Network and geospatial information services** – access to digital maps, prohibited areas, and meteorological information.
- **U2: Flight authorisation** – automated management of operation requests.
- **U3: Traffic management and collision avoidance** – support for strategic and tactical separation of trajectories.
- **U4: Advanced integration with manned aviation** – dynamic coordination with conventional ATM.

Implementing Regulation (EU) 2021/664, which came into force in January 2023, establishes the legal basis for implementing U-space throughout Europe. The regulation introduces the concept of the U-space Service Provider (USSP) and Common Information Services (CIS) to facilitate interoperability between operators and ensure a collaborative environment.

Some notable pilot projects in Europe include:

Project	Type	Key area	Real-world demonstrations	Countries/
CORUS-XUAM	Conceptual / Demonstrator	U-space + UAM	Concept validation with real flights	France, United Kingdom, Sweden, Spain.
U-ELCOME	Deployment in ecosystems	Implementation of real operational U-space	Tests in real areas with multiple actors	France, Italy, Spain (Madrid, Valencia, Galicia, Catalonia, etc.).
EUREKA	Vertiports + UAM	Traffic management and urban vertiports	Flights in real airport environments	35 organisations from more than 8 European countries, including Spain.
BURDI	Deployment in ecosystems	Implementation of real operational U-space	Tests in real areas in port and urban environments	City of Antwerp, Port of Antwerp, Brussels and Liège.
EALU-AER	Deployment in ecosystems	Implementation of real operational U-space	Tests in airport environments	Five demonstration phases with increasing complexity at Shannon Airport.
DALi-LAB	Deployment in ecosystems	Implementation of urban living lab environment	Deployment of real operations in an urban environment	A Coruña + replica cities.

Table 3 - Relevant pilot projects in Europe

An essential part of deploying U-space in Europe is the delimitation of specific volumes of airspace, known as "U-space volumes". These are well-defined three-dimensional

areas where U-space services are enabled, and drone operations are required to follow certain rules of access and coordination.

The process of defining and publishing U-space volumes is regulated by Implementing Regulation (EU) 2021/664 and consists of several key stages:

1. **Identification of operational need**

   Member States, in coordination with local authorities, identify areas with high potential for drone operations, such as urban centres, ports, aerodromes, or logistics corridors. These zones may be permanent or temporary, depending on the nature of the operations.

2. **Volume design and risk assessment**

   The geographical and altitude limits of the volume are defined, taking into account factors such as proximity to airports, critical infrastructure, urban density and manned aviation routes. Operational risks are also assessed, and technical and mitigation requirements are established for operations within the volume.

3. **Public consultation and coordination with the air navigation service provider (ANSP)**

   The design of the U-space volume is subject to public consultation to ensure transparency and receive input from interested parties (citizens, operators, local governments). Subsequently, technical coordination with the ANSP is carried out to ensure compatibility with controlled airspace and other users.

4. **Publication in the aeronautical information system (AIS)**

   Once approved, the volume is officially published through the national AIS (or equivalent digital system), allowing U-space service providers (USSPs) and drone operators to plan their missions in accordance with the regulations..

5. **Activation and monitoring**

   U-space volumes can be activated permanently, by time slots or conditionally. During operation, USSPs must ensure compliance with mandatory minimum services (such as flight tracking, conflict management and communication with authorities). Authorities maintain real-time monitoring and auditing capabilities.

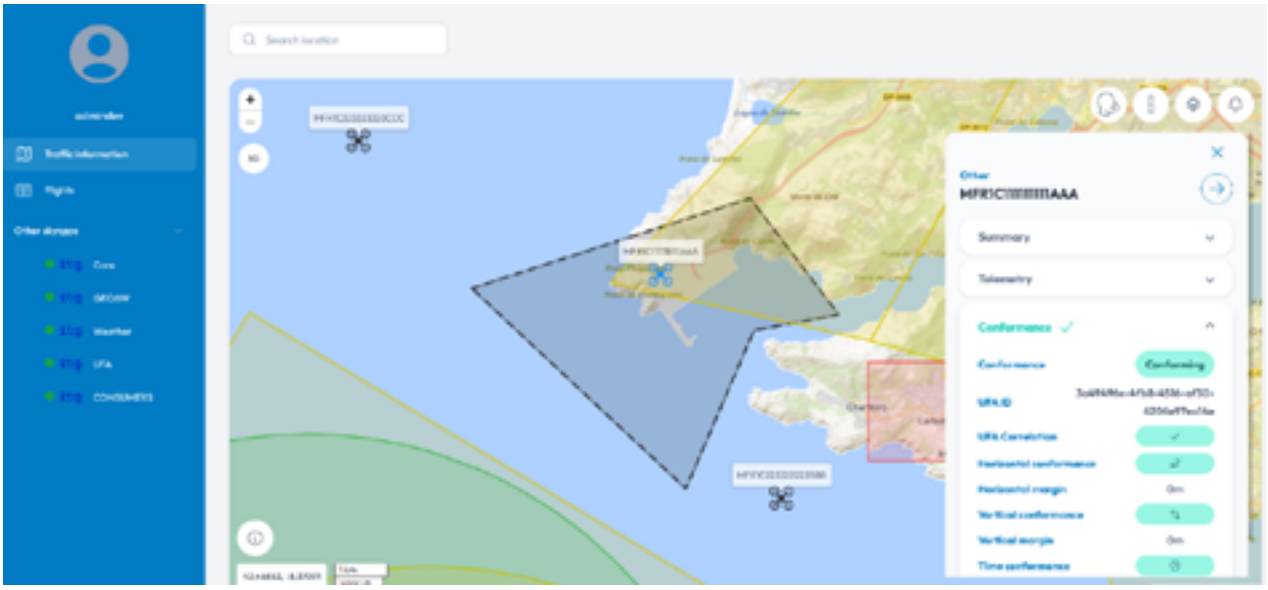

Illustration 12 Daliah®, ITG's USSP services platform. Source: ITG.

This approach is designed to enable Europe to strike a balance between technological innovation, aviation safety and public acceptance. It also facilitates the orderly coexistence of drones and other aircraft in shared airspace.

Current technological challenges and lines of evolution

Despite regulatory and technological advances, multiple challenges must be resolved before UTM/U-space systems can scale globally in complex urban environments:

1. **Interoperability between heterogeneous platforms and systems**

   The UTM ecosystem comprises multiple stakeholders, including drone operators, service providers, regulatory authorities, airspace users, and navigation systems. The lack of technical standardisation hinders smooth communication between these stakeholders, especially when different platforms or data exchange protocols are used.

2. **Real-time traffic management and dynamic conflict resolution**

   In a dense urban environment, where numerous drones fly simultaneously at different altitudes and speeds, advanced separation and trajectory planning algorithms are required that can dynamically adapt to changes in the environment or emergencies. The development of reliable AI for this type of system is still in its early stages.

3. **Cybersecurity and data protection**

   Given that UTM/U-space systems are based on digital interconnection and the continuous transmission of sensitive data (such as location, identity and flight plans), it is crucial to ensure their resilience to cyberattacks, such as identity theft, denial of service or malicious trajectory manipulation. This requires robust authentication, encryption and traceability protocols.

4. **Limitations in the communications infrastructure and GNSS**

   Many urban environments lack the necessary infrastructure for U-space/ UTM deployment, due to the requirement for specialised communication infrastructure that ensures high service availability and resilience. In addition, factors such as 'urban canyons' where GNSS signals (GPS, Galileo, etc.) are degraded or dependence on 4G/5G networks for real-time data exchange pose challenges in terms of coverage, latency and congestion. It is essential to have redundant networks and alternative navigation capabilities.

5. **Social acceptance**

   Beyond technical considerations, UTM systems must address issues of privacy, noise, and ethical use of urban airspace. Acceptance by the public and local governments will be decisive for their deployment. Operational transparency and adequate communication with citizens are key elements in building trust and legitimacy in the implementation of air corridors.

6. **Scalability and operational endurance**

   Currently, many UTM operations require human intervention in route validation or flight authorisation. The transition to a highly automated and autonomous system (capable of managing thousands of simultaneous flights without constant supervision) remains a long-term goal, requiring substantial advances in reliable and verified artificial intelligence.

2.1.5 Key global technology players

The Urban Air Mobility (UAM) ecosystem and drone systems continue to grow thanks to the participation of aircraft manufacturers, infrastructure companies and UTM/U-space technology developers rapidly. Below are some of the main global players classified by their specialisation:

Drone manufacturers (UAS/eVTOL)

These players specialise in the development of drones and electric vertical take-off and landing (eVTOL) aircraft:

- DJI (China): World leader in consumer and industrial drones.
- Parrot (France): European manufacturer of professional drones and aerial mapping solutions.
- EHang (China): Manufacturer of autonomous passenger and light cargo aircraft.
- Skydio (USA): Known for its autonomous drones with advanced AI capabilities.
- Zipline (USA): A leader in medical and logistics deliveries using fixed-wing drones.
- Wing (Alphabet - USA): Google subsidiary focused on urban deliveries using drones.
- Joby Aviation (USA): Manufacturer of eVTOL aircraft for passenger transport.
- Vertical Aerospace (United Kingdom): Developer of eVTOL aircraft for air taxi services.
- Volocopter (Germany): Pioneer in multi-rotor eVTOL aircraft for urban air mobility and passenger transport.
- Lilium (Germany): Developer of eVTOL aircraft with electric fan propulsion technology for regional travel.
- Archer (United States): Manufacturer of hybrid eVTOL aircraft for urban air taxi services.
- Wisk Aero (USA/New Zealand): Joint venture between Boeing and Kitty Hawk,
- specialising in autonomous eVTOLs.
- Beta Technologies (USA): Company specialising in long-range eVTOL aircraft and electric charging infrastructure solutions.
- Eve Air Mobility (Brazil): Subsidiary of Embraer dedicated to the development of eVTOL aircraft and urban air mobility ecosystems.
- Etrair (Spain): Manufacturer and developer of unmanned aircraft adapted to customer requirements.
- FuVeX (Spain): Operator and manufacturer of aircraft for inspecting critical infrastructure and power lines.
- Alpha Unmanned Systems (Spain): Aircraft manufacturer (combustion helicopters) for surveillance and civil/military use.
- Wake Engineering (Spain): Manufacturer of aircraft (fixed wing) for surveillance and civil/military use..

Infrastructure developers

- Ferrovial Vertiports (Spain): Global operator of vertiports and intermodal solutions.
- Skyports (United Kingdom): Specialist in the construction and operation of urban and rural vertiports.
- Urban-Air Port (United Kingdom): Developer of autonomous modular vertiports.
- Bluenest by Globalvia (Spain): Platform specialising in the design and operation of vertiports.
- Collins Aerospace (USA): Supplier of physical and technological infrastructure for unmanned aircraft, including CNS systems.
- Siemens Mobility (Germany): Development of electrification and charging systems for UAM.
- Honeywell Aerospace (USA): Manufacturer of navigation, communications and safety systems.
- Thales Group (France): Leader in control and protection solutions for critical infrastructure.
- Vaisala (Finland): development of meteorological sensors and observation stations.
- Campbell Scientific (USA): Develops advanced weather stations and atmospheric monitoring systems.

U-space / UTM platform developers

- Altitude Angel (United Kingdom): Developer of UTM tools such as the “Arrow” system of digital air corridors.

- Unifly (Belgium): Developer of U-space solutions for controlled airspace.
- OneSky (USA): Advanced low-altitude air traffic management platform.
- Droniq (Germany): Joint venture between Deutsche Telekom and DFS for U-space in Germany.
- SkyGrid (USA): Joint venture between Boeing and IBM focused on digital air traffic management.
- ENAIRE (Spain): National air navigation service provider in Spain, with active initiatives in the development of U-space. A common information service provider in Spain.
- D-Flight (Italy): Italian drone and U-space management platform, promoted by ENAV, Leonardo and Telespazio.
- Innov'ATM (France): Company specialising in air traffic management solutions
- and U-space solutions for urban and airport environments.
- ITG (Spain): Technology centre specialising in airspace management and provision of UTM/U-space services with its DroneSuite and Daliah tools.
- ANRA Technologies (USA): Provider of complete UTM platforms for drone integration.

2.2 Regulatory reference framework

The development of Innovative Air Mobility (IAM), along with Unmanned Aircraft Systems (UAS) operations and vertical take-off and landing (VTOL) aircraft, necessitates a robust, harmonised, and constantly evolving regulatory framework. Safety, efficient integration into airspace and social acceptance depend on a regulatory environment that provides certainty and facilitates responsible innovation.

This section presents a comprehensive analysis of the current state of regulations applicable to IAM, covering different regulatory levels: international, European, national, regional and local. The aim is to provide a structured and critical overview that serves as a reference for operators, authorities and other stakeholders involved in the air mobility ecosystem. In addition to reviewing current regulations, recent developments, regulatory challenges and future trends that will influence the implementation of these new services are identified.

The international analysis includes the provisions and recommendations of organisations such as the International Civil Aviation Organisation (ICAO), EUROCONTROL, and JARUS (Joint Authorities for Rulemaking on Unmanned Systems), which are working to achieve global harmonisation of the regulatory framework. At this level, emerging initiatives driven by projects such as SESAR and relevant regulatory frameworks in the United States, led by the Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA), are also considered.

At the European level, this White Paper focuses on the regulatory framework developed by the European Aviation Safety Agency (EASA), particularly in relation to the regulation of the U-space concept, which lays the groundwork for managing unmanned traffic. EASA promotes Innovative Air Mobility (IAM) as a comprehensive framework for introducing advanced services, such as air taxis, drones for medical deliveries, and urban cargo flights, ensuring that these services are safe, reliable, and economically viable. At the national level, Spanish state legislation and current technical regulations are analysed, which are fundamental aspects for the practical application of the European framework in Spain. Likewise, the regional and local levels are considered,

where there are regulatory peculiarities that affect territorial planning, environmental protection, urban mobility and infrastructure management. These regulations can influence the use of public space, restrictions or authorisation of flights for both manned and unmanned aircraft, reflecting the need for inter-administrative and multi-sectoral coordination for the orderly development of IAM.

Finally, the concept of Innovative Air Services (IAS) is incorporated, which encompasses operations and services made possible by new aviation technologies. This concept, promoted by EASA and supported by Member States and industry, classifies IAM into

urban, regional and international modes, intending to promote its development within a framework of safety and economic viability.

This analysis of the state of the art in regulation provides a more detailed understanding of the current legal framework, identifies areas that require regulatory development, and highlights issues that require regulatory solutions, with a view to laying the foundations for the safe, efficient and sustainable development of Innovative Air Mobility.

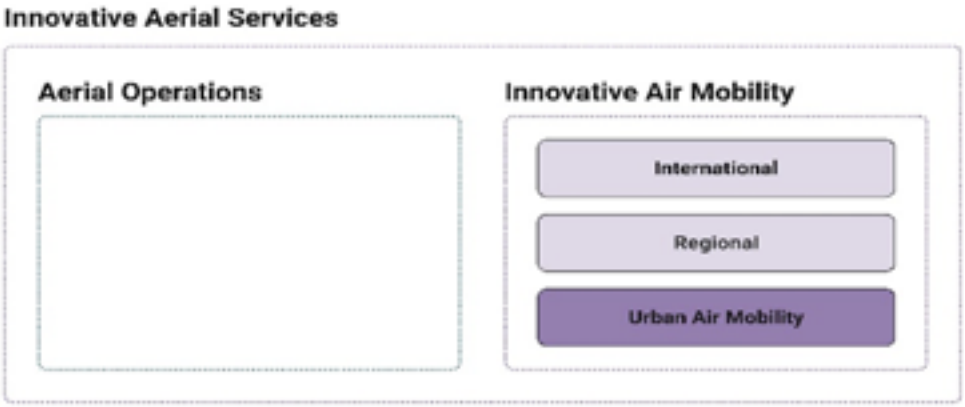

Illustration 13
Concept of Innovative Air Services.
Source: own elaboration based on AESA/EASA

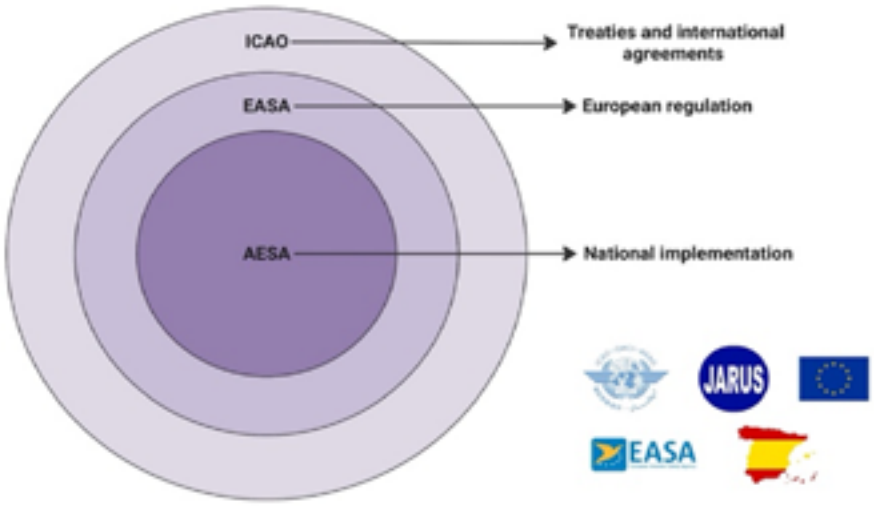

Illustration 14
From ICAO to national regulation and standardisation bodies 1/2.
Source: own elaboration based on AESA/EASA

Illustration 15
From ICAO to national regulation and standardisation bodies 2/2.
Source: own elaboration based on AESA/EASA

2.2.1 Strategic Context and Evolution of the Regulatory Framework

The transformation of global airspace is being driven by the emergence of new classes of unmanned aircraft, ranging from low-altitude drones to high-altitude persistent platforms such as HAPS, as well as tactical or medium-altitude, long-endurance (MALE) systems.

Although each of these systems has specific technical, operational and regulatory characteristics, they all share a common denominator: they form part of the broader category of UAS and require a common, consistent and risk-based regulatory framework for their safe integration into airspace, without prejudice to the specific regulation required for these unmanned aircraft to be integrated into urban mobility harmoniously and rationally with the terrestrial dimension of urban and peri-urban mobility, including interurban and regional mobility, taking into account, in all cases, both their specific characteristics and the type of transport or activity they carry out and the impact they have on cities, metropolitan areas and regions.

The development of a robust, interoperable and scalable UAS ecosystem has become a priority in air traffic modernisation strategies at national, European and international levels. In this context, the regulatory framework has evolved from a logic of segregation, focused on protecting manned traffic, towards an integrative vision that aims to facilitate the safe coexistence of manned and unmanned aircraft in a digitised and flexible airspace management environment.

This chapter provides an overview of the strategic context that has driven this regulatory evolution, identifying the principles, objectives and lines of action that have guided the design of the current framework.

It also analyses the regulatory transition from an environment dominated by static and limited structures towards adaptive, cooperative and service-oriented models, such as the emerging U-space. At all times, the starting point is the premise that, regardless of their altitude, endurance or purpose, all these systems are, in essence, UAS, and must be treated with a systemic, comprehensive and coordinated approach within the aeronautical legal framework.

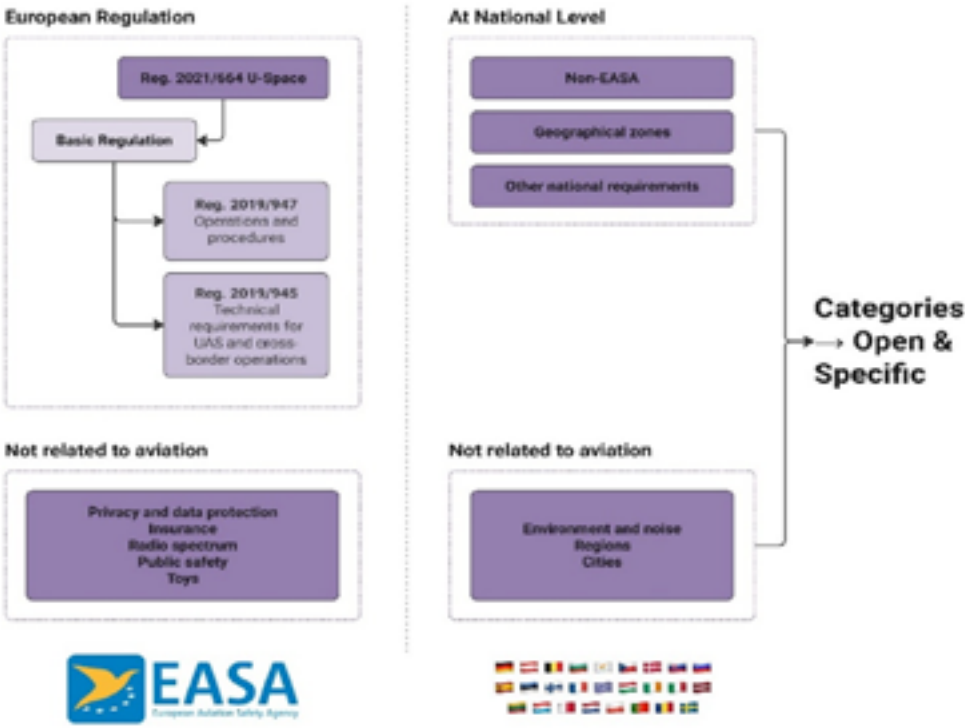

Illustration 16
Regulatory framework for UAS in the European Union.
Source: own elaboration based on AESA/EASA

2.2.2 Fundamental Principles

Civil aviation regulation is based on a series of principles aimed at ensuring operational safety, the interoperability of air systems, the protection of airspace as a public resource, and the efficiency of operations. These principles also apply to the integration of new users, such as UAS and eVTOL, whose operations present additional challenges in terms of surveillance, control, communication, privacy, physical security, environmental protection, and cybersecurity.

The regulatory framework is structured around four fundamental pillars:

- **Operational safety**, with the aim of ensuring acceptable levels of risk in all phases of operation.
- **Integration into shared airspace**, in line with the concept of Flexible Use of Airspace (FUA).
- **Technological neutrality and promotion of innovation**, facilitating the incorporation of advanced solutions.
- **International consistency and regulatory harmonisation**, in line with the regulations and references reflected in this document.

2.2.3 Alignment with other policies

The aviation regulatory framework has undergone significant evolution with the emergence of disruptive technologies such as UAS. Initially designed for conventional operations with manned aircraft, aviation regulations are in the process of being adapted to accommodate the emergence of new operations that present new challenges, such as:

- **The absence of a pilot on board**, considered a risk mitigation measure.
- **The high degree of automation**, which leads to the partial disappearance of human intervention (which, in turn, can be positive), but which introduces new systems that require validation and certification to demonstrate their reliability.
- **Operations at altitudes and in areas not traditionally occupied**, at very low altitudes (VLL: Very Low Level) or, conversely, above controlled airspace (>FL660).

This evolution has given rise to a new regulatory approach based on the risk-based model, which is best reflected in the European regulatory framework for UAS and in the SORA (Specific Operations Risk Assessment) methodology developed by JARUS.

At the same time, the development of concepts such as U-space, FUA, and Upper Class E Traffic Management (ETM) demonstrates a transition toward more dynamic, digital, and adaptable airspace management schemes.

2.2.4 Role of international, European, national, regional and local bodies

The complexity of the regulatory environment applicable to UAS requires a governance architecture at all levels, in which the competences and functions of different entities converge, whether:

Project	Type	Key area
Level	Entity/Institution	Duties / Responsibilities
International	ICAO	Establishes standards and recommended practices (SARPs) through Annexes and Technical Manuals, promoting global harmonisation.
European	EASA	Develops and applies common regulations and guidance material on airspace operation, certification and control, with a focus on UAS and U-space.

National (Spain)	Ministry of Transport and Sustainable Mobility / DGAC / AESA	Transposes, interprets and applies European regulations; legislates on non-harmonised matters. AESA supervises its application at national level.
Regional	Autonomous Communities	They have powers that may affect UAS operations: infrastructure, mobility, territorial, emergencies, environment, urban planning.
Local	Local councils or other local authorities	They have an impact on urban air mobility: safety, public order, urban planning, mobility, environment, among other delegated powers.

Once this institutional framework has been defined, there is a need for effective coordination between levels and sectors, as well as mechanisms for dialogue with industry and civil society. The aim is to establish a uniform, efficient, safe, and socially accepted regulatory framework, creating a global ecosystem whose progress will be reflected in all applicable areas, taking into account potential local particularities, as is the case in the city of Madrid.

The development of urban air mobility requires the regulation of a framework of competences that clearly determines the regulatory, management and control powers and responsibilities in those matters that the State decides to attribute, delegate or entrust to municipal and regional public administrations.

2.2.5 Methodology

This White Paper has been prepared based on a systematic review of current regulations and potential regulations under development, as well as other references, covering both primary legal sources (EU regulations, laws, royal decrees, international annexes, etc.) and technical guidance documents (policies, guides, manuals, roadmaps, etc.).

An approach has been adopted that enables the assessment of consistency between regulatory levels (international, European, national, and regional) and their applicability to various operational scenarios, considering objectives, influence, and relevance to the UAS and IAM fields, as well as their potential operations.

The conclusions have been drawn to identify the relationship between the potential operations expected in the Madrid area and the applicable regulations, from the technical field of aviation, as well as other aspects of regulatory importance at the local and regional level, derived from the technological and operational capabilities and needs of new airspace users, seeking their progressive integration into a common airspace and the new operational concepts associated with digital air traffic management.

2.2.6 Regulatory analysis

The following is a regulatory analysis of what is considered to be the most important applicable regulation for the current document.

Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and third-country operators of unmanned aircraft systems (OJEU of 11/06/2019)[4].

Context

- This regulation ensures that UAS comply with common technical criteria, essential in a dense and sensitive metropolitan environment such as the capital.

4 NOTE: Original text: Spanish: https://eur-lex.europa.eu/eli/reg_del/2019/945/oj/spa All languages: https://eur-lex.europa.eu/eli/reg_del/2019/945/oj
Text updated on 1 May 2025: Spanish: https://eur-lex.europa.eu/legal-content/ES/TXT/PD- F/?uri=CELEX:02019R0945-20250501

Relevance for the city

- Facilitates the interoperability and traceability of urban drone fleets for
- public or private services.
- In the medium term, the use of CE-marked and class C2-C3 drones may be required in areas of moderate risk (residential areas, school environments, etc.).
- Establishes a basis for limiting the use of non-compliant drones in protected or critical areas of the city of Madrid.

Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the use of unmanned aircraft (OJEU of 11 June 2019)[5].

Context

- This operational regulation allows urban UAS activities to be categorised according to their risk, which is crucial in an environment such as Madrid, where open and highly restricted areas coexist.

Relevance for the city

- Madrid can promote specific category operations with SORA (Specific Operations Risk Assessment)[6] evaluations6, tailored to its districts and specific areas.
- It enables long-term planning for the development of urban zones for certified category operations, such as air taxis or autonomous logistics operations.
- The operational framework enables the city to coordinate with AESA on registration and compulsory insurance policies for urban operators.

Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for U-space (OJEU No. 139, 23 April 2021, pages 161 to 183)[7].

Context

- Fundamental regulation for the design and implementation of U-space in the city of Madrid, which is key to managing urban airspace in coexistence with manned aviation and ensuring operational safety.

Relevance for the city

- It allows Madrid to work with ENAIRE and MITMA to designate volumes of urban U-space, starting with low-risk areas with a low number of air operations.
- It establishes requirements for implementing services such as geo-awareness. Real-time monitoring and tactical conflict resolution are essential in dense urban environments.
  In the medium term, the city could host functional U-space demonstrators, particularly in collaboration with logistics or healthcare operators.

Commission Implementing Regulation (EU) 2021/665 of 22 April 2021 amending Implementing Regulation (EU) 2017/373 as regards requirements for air traffic management/air navigation service providers navigation services and other air traffic management network functions in designated U-space in controlled airspace (OJEU No. 139, 23 April 2021, pages 184 to 186)[8].

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5 NOTE: Spanish: https://www.boe.es/doue/2019/152/L00045-00071.pdf English: https://eur-lex.europa.eu/eli/reg_impl/2019/947/oj/eng

6 NOTE: SORA Specific Operations Risk Assessment: https://www.seguridadaerea.gob.es/sites/default/files/apendice-f_0.pdf

7 NOTE: http://data.europa.eu/eli/reg_impl/2021/664/oj
Spanish: https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:32021R0664 English: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0664

8 NOTE: http://data.europa.eu/eli/reg_impl/2021/665/oj
Spanish: https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:32021R0665 English: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0665

Context

- This regulation reinforces the adaptation of the traditional air navigation system to integrate UAS operations into U-space areas.

Relevance for the city

- Essential for coordinating with ATM/ANS providers such as ENAIRE on the future activation of corridors or mixed traffic zones within the urban space of the city.
- In the long term, this regulation will facilitate a smooth transition between UAS operations and conventional ATM services, particularly in areas near Barajas.

Commission Implementing Regulation (EU) 2021/666 of 22 April 2021 amending Regulation (EU) No 923/2012 as regards requirements for manned aviation operating in U-space (OJEU No. 139, 23 April 2021, pages 187 and 188)[9].

Context

- Introduces obligations for manned aircraft flying over U-space, ensuring integrated traffic management.

Relevance for the city

- It facilitates the integration of general aviation or emergency services flying over the city without conflicts with UAS operations under U-space management.
- In the long term, this regulation is key to consolidating a hybrid urban airspace model, ensuring the safety of all users.

Law 21/2003, of 7 July, on Air Safety[10].

Context

- It applies to U-space and common information systems (Article 2.1).
- It prohibits aviation personnel involved in the operation of UAS systems from performing their duties under the influence of alcohol and psychoactive substances, and requires them to undergo alcohol and psychoactive substance testing as required by the security forces in the exercise of their duties, without prejudice to the measures adopted by operators or AESA (Article 34.4a).
- Classifies infringements relating to the use of unmanned aircraft systems (UAS) in terms of operator registration, aircraft identification, UAS operations, remote pilot training and UAS operations coordination (Article 45.ter).

Relevance for the city

- It implies an improvement in the safety of UAS operations in urban areas and greater guarantees for public safety.
- In its recent reform by Law 8/2025 of 29 September (BOE of 30 September)[11], it introduces a penalty system for the use of unmanned aircraft systems.

Royal Decree 517/2024, of 4 June, implementing the legal framework for the civil use of unmanned aircraft systems (UAS) and amending various regulations on the control of imports of certain products with regard to applicable product safety standards; civil aerial demonstrations; firefighting and search and rescue; airworthiness requirements and licences for other aeronautical activities; registration of civil aircraft; electromagnetic compatibility of electrical and electronic equipment; Air regulations and common operational provisions for air navigation services and procedures; and notification of civil aviation occurrences (BOE No. 136, of 5 June 2024, pages 65362 to 65436)[12].

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9 NOTE: Spanish: https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:32021R0666 English: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0666

10 NOTE: In its consolidated version following the reform introduced by Law 8/2025 of 29 September: https://boe.es/buscar/act.php?id=BOE-A-2003-13616

11 NOTE: https://www.boe.es/buscar/doc.php?id=BOE-A-2025-19339

12 NOTE: Consolidated text: https://www.boe.es/buscar/pdf/2024/BOE-A-2024-11377-consoli-

Context

- This Royal Decree develops the legal framework for the civil use of unmanned aircraft systems (UAS), complementing European provisions with those regulations that fall within the competence of the Spanish State.
- It provides the necessary legal framework for planning and enabling civil UAS operations within the municipal area of Madrid. It enables the City Council and the Community of Madrid to align their powers with those of AESA and ENAIRE, particularly in light of the requirements for operations in densely populated urban areas and in the vicinity of airports, such as Adolfo Suárez Madrid-Barajas International Airport, as well as for logistics or public operations.

Relevance for the city

- It enables operations such as urban infrastructure inspections, environmental control, urban surveillance and last-mile logistics.
- It allows for the configuration of specific authorisation mechanisms in the medium term, using applicable methodologies such as SORA, adapted to different types of neighbourhoods (e.g., Cortes vs. La Piovera vs. San Andrés).
- It establishes the legal basis for training urban pilots specialised in complex environments.
- It establishes the legal regime for "non-EASA activities and services", such as policing, search and rescue, firefighting, or similar activities undertaken in the general interest by or on behalf of a body vested with public authority, which are carried out, for example, by municipal emergency services (Articles 1.1.b and 14 to 19).

Commission Regulation (EU) No 139/2014 of 12 February 2014 laying down requirements and administrative procedures related to aerodromes pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council.

The legal framework applicable to vertiports, although not yet developed for future VCA and UAS operations, the current regulation for aeronautical infrastructure, combines European, national and regional regulations:

- Royal Decree 862/2009, which approves the technical standards for the design and operation of civil aerodromes and their certification.
- Royal Decree 1070/2015, which regulates airspace management and the coordination procedure with the air navigation authority.
- Law 3/2010 of the Community of Madrid, on urgent measures on planning and urban development, which conditions the implementation of new infrastructure in urban and peri-urban areas.

Context

- The implementation of vertiports in urban environments is a key component of the development of advanced air mobility (UAM), particularly for vertical take-off and landing (VTOL) aircraft. Their regulation must ensure operational safety, integration into the airspace and compatibility with urban planning.

Relevance for the city

The future network of vertiports could become a strategic infrastructure for urban air mobility, offering innovative and sustainable transport solutions. For Madrid, this means:

- Integrating urban planning with aeronautical and air safety regulations air safety regulations.
- Anticipating the certification and authorisation requirements for future locations.
- Assess the impact in terms of mobility, sustainability and competitiveness compared to other major European cities that are already making progress in this area.

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2.2.7 Regulatory analysis: Conclusions on the Regulatory Framework for UAS Operations and Innovative Air Mobility (IAM)

The main conclusions regarding the regulatory framework are listed below:

- **Robust and continuously evolving regulatory framework**: There is a complex but extensive regulatory basis for UAS and IAM operations, combining international (ICAO), European (Regulations 2019/947, 2021/664, 2021/665 and 2021/666) and national legislation (RD 517/2024), providing guarantees for the safe planning and execution of operations. In terms of regulating operations, European regulations establish a tiered system of categories (Open, Specific, and Certified) based on risk, with standardised procedures such as standard scenarios (STS) and the SORA methodology. Specifically, Regulation (EU) 2019/947 includes this methodology in its Acceptable Means of Compliance (AMC) and Guidance Material (GM), proposing the use of version 2.5 by September 2025 (ED Decision 2025/018/R). These frameworks enable technical and administrative requirements to be tailored to the complexity of operations, particularly in urban areas. The key is for both UAS operators and administrations to understand and apply these regulations in accordance with the required SAIL (Specific Assurance and Integrity Level) levels, ensuring safe, integrated air mobility that is compatible with the urban environment. Thus, the success of IAM will depend both on technological innovation and on the regulatory capacity and collaboration, cooperation and coordination of action between the different levels of government.
- **RD 517/2024 as a key element**: It is a key element in the development of IAM and Urban Air Mobility (UAM) because it regulates, at the national level, the operational, technical and coordination conditions that enable the planning of urban air corridors, U-space airspaces and special UAS use zones that facilitate the creation of specific scenarios addressing diverse UAS operations that allow their application in the development of heterogeneous purposes, from the provision of public services to the transport of goods (delivery by drones to eVTOL cargo flights) or passengers in urban environments.
- **Regional and local competences and regulations**: The development of UAM in urban and metropolitan areas and the practical viability of UAM require the involvement of regional and local authorities, both at the regulatory and administrative levels. Without prejudice to international and national aeronautical regulations on the development of U-space, UAS operations and their integration into air traffic, it is not possible to develop the UAM without taking into account the general interests constitutionally entrusted to the autonomous communities and legally to the municipalities, the competences attributed to each, as well as the regional and local regulations approved in the exercise of those competences. The deployment of UAS/IAM services must be carried out progressively, taking into account social and economic needs, in a manner compatible with the satisfaction of the overriding reasons of general interest legally entrusted to municipalities (protection of safety, health, civil protection, the urban environment and the conservation of public heritage) and the Autonomous Communities (land use planning, the environment, land and urban planning legislation), as well as with the guarantee of individual rights (protection of people's health against new safety risks and new sources of noise and air pollution, their personal and family privacy, the inviolability of their communications, and private property).
- **Madrid as a strategic hub for real operations**: The regulatory ecosystem, together with initiatives such as public-private partnerships, clusters such as SIAM, and the available infrastructure, positions the city of Madrid in an ideal position to lead:
    - The development of UAS operations for the provision of public services (municipal police, fire brigade, civil protection, infrastructure inspection, tree and green area inspection, riverbed inspection, among others).
    - Urban distribution with drones (healthcare, pharmacy and, where

appropriate, the possibility of their use in certain logistics activities).
    - eVTOL passenger and cargo operations from urban vertiports.
    - Pilot projects in U-space areas and demonstrators with ATM/UTM integration.

- **eVTOL aircraft certification**: The certification process for eVTOL aircraft in Europe is governed by Regulation (EU) 2018/1139 and its delegated and implementing acts, specifically adapting the Part-21 and CS-23 frameworks. EASA has defined specific criteria at the European level for aircraft with vertical take-off and landing capabilities (VCA: VTOL-Capable Aircraft), including technical requirements, airworthiness, safety systems and operation under new types of infrastructure such as vertiports. This regulatory basis is crucial to Madrid's ability to accommodate certified aircraft operating in densely urban environments, while meeting the high safety standards required in the aviation field.

- **Vertiports and aeronautical infrastructure**: The regulatory framework applicable to UAS operations and future Innovative Air Mobility (IAM) in relation to vertiports and specific infrastructure for this type of operation is currently in a transitional phase. In addition:

    - **Future specific regulations for eVTOL and UAS** will be decisive for the orderly and safe deployment of urban air mobility in Madrid.
    - It is strategic for the city **to anticipate and prepare for regulatory and urban planning integration** so that Madrid can position itself as **a pioneer in Innovative Air Mobility** in Europe.
    - Close collaboration between **AESA, EASA, the Community of Madrid and the City Council** will be key to defining a legal framework that allows taking advantage of the opportunities offered by Innovative Air Mobility, while ensuring safety, sustainability and integration with the rest of the urban transport system and, where appropriate, the metropolitan transport system.

Illustration 17
Puerta del Sol, Madrid.
Source: Madrid Municipal Police

Madrid has the opportunities and capabilities to become a benchmark city in UAS operations and sustainable urban air mobility through progressive and safe deployment, driven by collaborative activity between different levels of government, within the framework of state coordination derived

from exclusive competence in civil aviation, in accordance with current regulations and adapting to future regulatory changes.

In conclusion, the regulations on Innovative Air Mobility (IAM) in Spain show a clear need for multi-level collaboration. While the State retains exclusive powers over airspace and aerodromes for public use of general interest and the general regulation of aircraft, the autonomous communities, such as the Community of Madrid, and local councils, such as Madrid City Council, have powers and public functions that are essential for the development of IAM, which are analysed later in section 5.1.

The European legal framework, and its transposition into the National U-space Deployment Plan, requires mechanisms for collaboration and cooperation between the various public administrations which, from the state's competence in airspace and civil aviation and the regional competences in certain aeronautical infrastructures, and the essential state coordination in this area, allows for coordination between administrations at all levels for the management of U-space geographical areas and the implementation of services that use UAS in their provision. This makes local authorities essential players in the orderly, safe and efficient deployment of IAM and UAM.

3. Leading cities

EIn recent years, urban air mobility has begun to take its first steps towards implementation in cities.

Madrid has begun its journey into urban air mobility with a firm commitment to be at the forefront of cities preparing for the implementation of air mobility in the future. To this end, specific units have been created, and the city is participating in various initiatives and projects, including:

- **Madrid Municipal Police**: In December 2020, the Municipal Police Air Support Section was created, made up of officers trained to fly drones and equipped with a modern and functional fleet of aircraft. This unit actively participates in major city events (sports, social, cultural, and festive), in emergency situations, in accident reconstruction, in evictions, and in relevant events, providing security and support to the entire force, emergency services, the Judicial Police, and other municipal areas.
- **U-ELCOME Project**: The overall objective of this project is to support the implementation of services for the safe integration of drones and demonstrate how the use of unmanned aerial systems can help provide transport solutions. Madrid has participated in the development of pilot projects for medical transport between hospitals, which will enable the implementation of these services in the medium term.
- **Urban-Air-Mobility Initiative Cities Community (UIC2)**: UIC2, with its transition to the EU's CIVITAS Initiative, is a community focused on cities and regions, driven by the needs of citizens, and promotes collaboration between disciplines and sectors relevant to UAM to jointly define the future of services. Madrid participates by assisting in coordination within this network.
- **Innovative Air Mobility Hub (IAM HUB EASA)**: Digital platform promoted by the European Parliament and the European Commission through the EASA

authority, as part of the Drones 2.0 Flagship 7 Strategy, to address society's concerns regarding air mobility and facilitate the safe, efficient and sustainable implementation of these innovative services with real and concrete use cases in Europe, connecting various stakeholders, such as cities, regions, national authorities, the EU, operators and manufacturers, and providing comprehensive and up-to-date information, guidelines and data on air mobility issues. Madrid, in collaboration with AESA, has been participating in the IAM HUB since April 2025.

- **Developing Skills And Capabilities For Innovative Air Mobility (AIRMOB)**: This is a European initiative promoted by Italy, Ireland, Portugal, Spain, Turkey, Cyprus and Belgium to support vocational education and training and ensure high-quality skills and competences that lead to quality employment and career opportunities, meeting the needs of an innovative, inclusive and sustainable economy, through the creation of Vocational Centres of Excellence that will cooperate to develop the skills and capabilities of the innovative air mobility sector in Europe. In Spain, it is led by the UPM's Higher Technical School of Aeronautical and Space Engineering and the companies SENASA, ISDEFE, Crisalion and CRIDA. Madrid participates as an associate partner, supporting the Spanish group.
- **Spanish Innovative Air Mobility Cluster (SIAM)**: The SIAM Cluster was created with the aim of becoming an international benchmark for innovation and high technology in the Air Mobility sector in Spain. It is led by INECO, ITG, Expodrónica, NTT Data and Pinset Masons. Madrid has shown interest in actively participating in the Cluster's activities and joining it by signing a collaboration agreement.

It is therefore essential that pioneering cities not only advance technological experimentation, but also articulate innovation ecosystems, develop adaptive regulatory frameworks and promote a strategic vision of air mobility as an integral part of the urban future. Their experience shows that, with vision, planning and collaboration, it is possible to transform airspace into a new dimension of sustainable mobility.

The following table provides an overview of the main pioneering cities and their initiatives outside Spain:

City	Country	Recent milestones	Current initiatives & aspirations
Shenzhen	China	Shenzhen became the first city in the world where an unmanned eVTOL aircraft obtained authorisation to perform commercial flights. The company EHang operates its EH216-S aircraft within defined urban routes, making the practical beginning of IAM	China aims to deploy 100,000 flying vehicles in urban areas over the next six years. Shenzhen is acting as a model city for replicating the system in other metropolitan areas, consolidating an automated and autonomous urban ecosystem.
Dubai	United Arab Emirates	Skyports has begun construction of the city's first functional "vertiport" in the city, located at Dubai International Airport. This represents the tangible beginning of an urban air mobility network designed to integrate with public and private transport flows.	Dubai wants to position itself as a global hub for UAM. The strategy includes multiple vertiports connected to hotels, airports and financial centres, using both tourist and daily transport routes.

City	Country	Recent milestones	Current initiatives & aspirations
Rotterdam	Netherlands	The Port of Rotterdam has become a benchmark environment for daily drone operations, including automated surveillance, infrastructure inspection, emergency response and port logistics. These operations are carried out with specific category drones, under SORA and with advanced coordination with local and maritime authorities.	Rotterdam aims to scale these operations to a comprehensive "Drone as a Service" model for the entire metropolitan-port environment. Logistical air corridors connected to key infrastructure are being developed, and progressive integration with U-space services is being evaluated to extend operations beyond the port to the city. A future air connection with The Hague-Rotterdam Airport using cargo drones.
New York	USA	Joby Aviation and Delta Airlines have announced eVTOL flights that will connect JFK Airport with downtown Manhattan, offering a fast, traffic-free alternative to urban transfers.	New York plans to build a network of urban routes between airports and financial centres. Work is also underway on compatibility with dense airspace regulations and modular infrastructure at existing heliports.
Munich	Germany	Through the Air Mobility Initiative, the CityAirbus NextGen eVTOL is being developed with the intention of operating flights between Munich and Ingolstadt. System tests have already been carried out and development is progressing towards demonstration flights before 2030.	Germany is committed to integrating eVTOLs into the airport ecosystem and regional corridors. Urban vertiports and certified pilot routes are planned before 2032.
Brisbane	Australia	Archerfield Airport is being adapted to serve as the operational centre for autonomous air taxis during the 2032 Olympic Games. The project is in an advanced stage of planning with public and private stakeholders.	After the Games, there are plans to extend the routes to suburban and regional areas, connecting communities with poor rail coverage using autonomous and sustainable eVTOLs.
Geneva	Switzerland	It was the first city to join the European Urban Air Mobility Initiative, anticipating regulatory frameworks and consolidating its role as an urban laboratory for new aviation technologies.	Geneva is leading the way in regulating urban air routes, aiming to launch private and medical service eVTOL pilots and integrate flights into shared airspace zones.

City	Country	Recent milestones	Current initiatives & aspirations
Dallas	United States	Dallas was selected as one of the key nodes of the FAA UTM Pilot Programme. Multiple UTM service providers (UTM SPs) operate simultaneously in its urban and suburban airspace, coordinated through the FAA HUB's federated architecture. This allows for simultaneous UAS operations in complex environments with different operators, missions and requirements.	Dallas plans to become a permanent operational environment for the scaling of commercial UAS services, including delivery, inspection and urban air mobility. In addition to its role as a technical test bed, the city promotes commercial adoption through public-private partnerships, progressive certification of vertiports and the establishment of demonstration zones with tactical ATM/UTM integration. It is envisioned as a regional AAM hub for the southwestern United States.
São Paulo	Brazil	São Paulo leads innovation in air mobility in Latin America. In 2024, the first urban air traffic simulation with integrated eVTOLs, helicopters and drones was successfully completed. In 2025, the first propulsion engine of the Eve-100 eVTOL was fired up. In addition, commercial orders for more than 100 eVTOL aircraft were confirmed by Brazilian operators.	Eve Air Mobility and Embraer plan to begin pilot operations in 2026, with domestic production in Taubaté. Work is underway on urban and suburban routes, integration with medical services, and a digital urban air traffic management system that will be exported to other countries.
Dublin	Ireland	Dublin-based company Manna has led the commercial drone delivery operation, positioning the city as one of the first autonomous air delivery hubs in Europe.	The city actively collaborates with Manna to develop infrastructure and regulatory frameworks that facilitate the safe integration of drones into urban airspace, setting a benchmark in the management small-scale autonomous deliveries.
Miami	USA	Miami has entered into agreements with operators such as Eve Air Mobility to establish an ecosystem of electric air taxis in the city and southern Florida.	The city plans to deploy vertiports connected to airports and coastal areas, focusing on regional and tourist transport. Partnerships with infrastructure companies and private operators are being developed.
Helsinki	Finland	Manna and VTT have signed an agreement to work on last-mile logistics in the city.	The city is promoting the deployment of digital infrastructure and regulatory framework to facilitate U-space operations, promoting sustainable and safe urban air mobility, with a special focus on coordination between operators and aviation authorities.

City	Country	Recent milestones	Current initiatives & aspirations
Milan	Italy	Milan has pioneered the development of urban vertiports in collaboration with Skyports and SEA Aeroporti di Milano. It has conducted eVTOL demonstrations in the context of Expo and other international events.	The strategic plan seeks to enable a network of vertiports to connect Malpensa Airport, the city centre and major event venues, with a view to full implementation by 2030.
Zurich	Switzerland	Zurich is home to Switzerland's first operational U-space, currently in the real-world testing phase with drone operators as part of the national SUSI system managed by Skyguide (Swiss ANSP), including GEO zones and U1/U2 services.	Progress is being made in the gradual integration of drones into urban environments with digital coordination between operators and USSPs, and multimodal urban corridors are being explored based on academic studies and supervised testing.
Hamburg	Germany	Hamburg has stood out for its role in the European CORUS-XUAM project, leading studies on safe urban air routes and U-space interoperability U-space. It has also hosted public demonstrations with cargo drones and medical services.	The city is working to establish UAM corridors within the port and towards industrial areas, in collaboration with Airbus and the DLR. Hamburg is positioning itself as a living laboratory for UAM testing, prioritising logistics connectivity and sustainability.

Table 4- Cities related to IAM

4. Ecosystem of actors

In the process of integrating Innovative Air Mobility (IAM) into urban airspace, a complex and multidisciplinary ecosystem is emerging, composed of public and private actors who play interdependent and critical roles. National and local administrations are responsible for establishing regulatory frameworks, defining public policies and overseeing airspace management in urban environments.

From a global perspective, civil aviation authorities, such as EASA at the European level, DGAC and AESA at the national level, and FAA in the United States, ensure operational safety by certifying aircraft and operators and regulating air corridors. For their part, urban planners must integrate IAM infrastructure, such as vertiports, into existing transport systems, ensuring their compatibility with the urban environment and land use regulations.

IAM operators, such as Volocopter or Joby Aviation, are responsible for deploying and operating eVTOL services in coordination with the relevant authorities. At the same time, infrastructure developers and technology providers, including those related to UTM/U-space and their associated service providers in unmanned traffic management, as well as CISPs (Common Information Service Providers) and USSPs (U-space Service Providers), configure the technical and logistical elements that enable safe and efficient integration.

This network is complemented by public transport agencies, energy operators and local communities themselves, whose level of social acceptance and perception of aspects such as noise, sustainability and safety are decisive for the viability of the model.

Stakeholder	Role in IAM integration
National and Local Governments	Establish regulations, provide regulatory frameworks, oversee urban airspace management.
Civil aviation authorities (e.g., EASA, FAA)	Define certification standards, ensure safety compliance, and regulate flight corridors.
Urban planners	Integrate IAM infrastructure into existing transport networks, assess zoning laws for vertiports.
IAM operators (e.g., Vertical Aerospace, Joby Aviation)	Deploy and operate eVTOL services, collaborate with authorities for airspace access.
Infrastructure developers (e.g., Bluenest by Globalvia, Skyports, Ferrovial)	Design and build vertiports, develop cargo and maintenance facilities.
Public transport agencies	Ensure seamless multimodal connectivity between IAM services and ground transportation.
Technology providers and UTM	Develop air traffic management (UTM) solutions for the secure integration of IAM.
Energy suppliers and network operators	Support sustainable energy solutions for vertiport charging stations.
Público y Comunidades	Influir en la aceptación del proyecto, proporcionar comentarios sobre el ruido, la seguridad. Incluyendo la seguridad para el ciudadano, y las preocupaciones de sostenibilidad

Table 5 - Key stakeholders in IAM integration

4.1 Key agents

The consolidation of the Innovative Air Mobility (IAM) ecosystem depends on effective and sustained coordination between a diverse set of strategic actors, each with complementary roles that must be aligned to ensure successful, safe and economically viable implementation.

Firstly, manufacturers of eVTOL (electric vertical take-off and landing) aircraft play a key role in aeronautical certification and the industrialisation of technological solutions, ensuring that vehicles meet the highest standards of safety, reliability and operational efficiency. This stage is crucial for enabling large-scale commercial operations.

IAM operators, for their part, are responsible for designing, deploying, and managing sustainable and economically profitable services tailored to the mobility needs of urban environments. This includes route selection, interaction with air traffic management (ATM/UTM) systems and the provision of end-user-oriented services.

Public administrations and regulatory authorities have the task of establishing regulatory frameworks, certification standards and operating conditions that ensure the safe integration of these new operations into the existing transport system and airspace. Their role is critical in terms of public policy design, licensing and regulatory compliance oversight.

Infrastructure managers play a central role in the territorial integration of the IAM, participating in the design of infrastructure such as vertiports, ensuring compatibility with the existing urban fabric, and promoting intermodal solutions that facilitate connections between air and ground transport.

Finally, end users and civil society are at the heart of the IAM. Social acceptance, perceptions of safety, environmental sustainability and service usefulness are key factors in achieving mass adoption, which is why public involvement from the early

stages of design and deployment is strategic.

In the Spanish context, the State Aviation Safety Agency (AESA) plays a crucial role as the competent authority for supervising, approving, and certifying civil aviation. The following is the AESA organisational chart, showing the different departments:

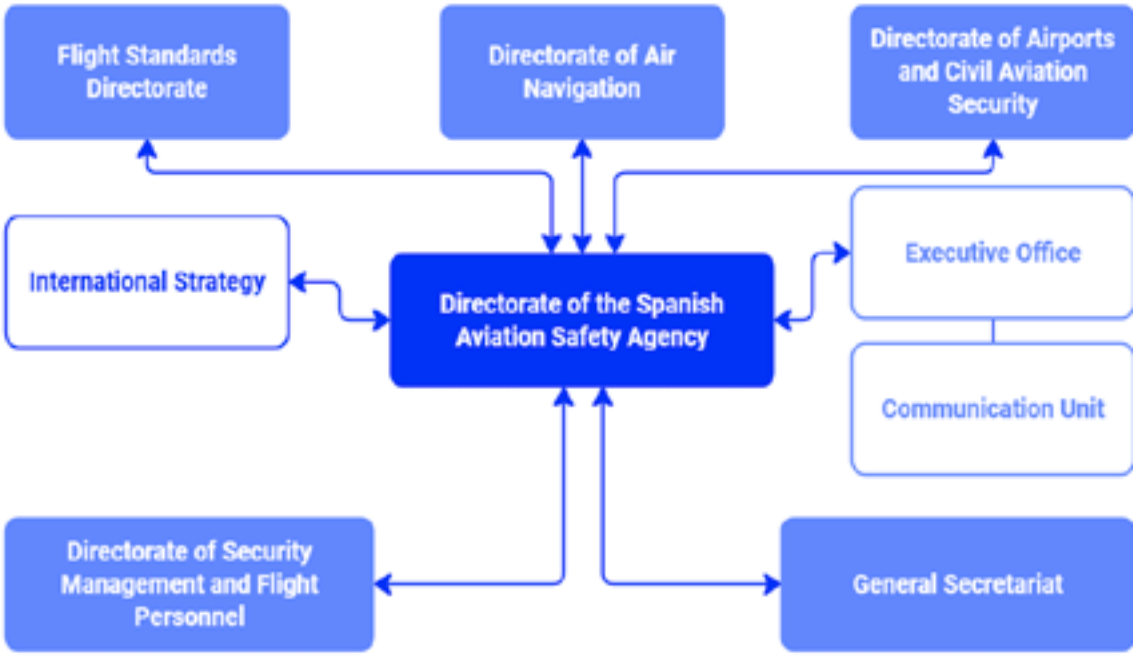

Illustration 18
AESA Organisational Chart – August 2025. Source: Own elaboration

Where:

- Aircraft Safety Directorate (DSA): Responsible for operational safety (issuing authorisations for drone operators in the specific category under the authorisation regime, among others) and aircraft maintenance, certification, air transport operations, registration management and emission rights supervision. It also includes flight safety offices.
- Directorate for Safety Management and Flight Personnel (DGSPV): Manages safety risks in civil aviation and supervises flight personnel, schools, aviation medicine and user protection, including accident victim assistance plans.
- Directorate of Airports and Civil Aviation Security (DASAC): Oversees airport security against unlawful acts, manages air transport facilitation and participates in the environmental assessment of airport projects.
- Air Navigation Directorate (DNA): Regulates and supervises all technical and operational aspects related to air navigation.

Similarly, the Directorate General of Civil Aviation (DGAC) leads regulatory development governing the safe operation of eVTOL aircraft and IAM services, ensuring the correct application of European frameworks defined by the European Union Aviation Safety Agency (EASA). Its collaboration with international organisations and industry allows for the harmonisation of requirements, facilitating cross-border interoperability and access to global markets.

The Regional Ministry of Housing, Transport and Infrastructure is the regional

department responsible for transport, mobility and aeronautical infrastructure in the Community of Madrid. Within this department, the Directorate-General for Transport and Mobility is the body that coordinates transport policy and its responsibilities include the prior authorisation and opening of regional aeronautical facilities, as well as inspection.

For the specific management of aeronautical facilities under regional jurisdiction, there is the Aeronautical Facilities and Cable Transport Area, which is responsible for opening procedures, inspections and sanctions. According to Decree 194/2021, the Regional Ministry of Transport and Infrastructure is structured, establishing senior and executive bodies up to the level of deputy directorate-general.

On the other hand, ENAIRE, the national air navigation manager, is a strategic player in the implementation of air traffic management systems adapted to new urban air mobility. ENAIRE is actively involved in the development and integration of U-space solutions, which will enable the automated and safe management of airspace for drone and eVTOL operations. Its experience and technical capabilities are essential to ensuring the harmonious coexistence of traditional aviation and new forms of air transport, promoting a robust and scalable operational framework.

4.2 Public-private partnerships

The effective implementation of Innovative Air Mobility (IAM) requires not only technological innovation and integrated urban planning, but also structured collaboration mechanisms between the public and private sectors, in addition to other factors of interest. In this context, public-private partnerships (PPPs) are emerging as key instruments for mobilising financial, technical and operational resources, enabling the agile and secure development of IAM solutions in complex urban environments.

Through these types of agreements, private entities can channel investments into the design, deployment, and operation of urban air mobility services, while public administrations provide the regulatory framework, regulatory oversight, and, in certain cases, the provision or co-financing of critical infrastructure, such as vertiports, electrical networks, and intermodal hubs. This synergy maximises efficiency in resource allocation and reduces development times.

One of the main benefits of public-private partnerships lies in the balanced distribution of risks associated with disruptive innovation. The phases of technology certification, air traffic management (ATM/UTM) system development, urban integration and infrastructure adaptation involve high levels of uncertainty. In a PPP framework, these risks are shared among the various parties involved, thereby mitigating the economic impact on any single party and facilitating more agile decision-making.

Furthermore, these strategic alliances promote proactive alignment between industrial developments and regulatory framework evolution, which is crucial in emerging sectors such as the IAM. Examples of this can be seen in European initiatives, such as the implementation of U-space, where close collaboration between regulatory agencies, operators, and technology providers has enabled the establishment of governance models, technical validation, and harmonisation of standards for the safe management of unmanned aircraft in urban airspace.

Another decisive factor is the acceleration towards commercial maturity of the IAM. Well-structured collaborations enable the shortening of the time required to reach key proof-of-concept milestones, both technically and commercially, thereby facilitating certification and operational authorisation processes. This, in turn, reduces barriers to entry for new operators and helps to build trust among investors, users and competent authorities.

In short, public-private partnerships are not only a means of financing and implementing the necessary IAM infrastructure, but also an essential institutional and operational catalyst for its viability, scalability and social acceptance.

The following table compares the advantages and disadvantages of this public-private partnership model:

Advantages	Disadvantages
Sharing of financial and operational risks between the public and private sectors.	Contractual complexity: PPP agreements require robust legal frameworks and lengthy negotiations.
Acceleration of IAM solution development and implementation timelines.	Power imbalance: the private sector may have greater influence over key decisions.
Mobilisation of private capital for infrastructure and emerging technologies.	Dependence on external financing, which may compromise continuity if market conditions change.
Early regulatory and technical alignment with regulatory developments (e.g., U-space).	Risk of regulatory capture, where private interests condition the evolution of the regulatory framework.

Better use of the private sector's technical and innovation capabilities.	Lack of transparency and accountability, especially in environments with weak institutional governance.
Greater public legitimacy when projects are developed with institutional support.	Reputational risks for the public administration in the event of technical or financial failures.
Flexibility in the implementation of pilot projects and proof of concept.	Difficulty in balancing public objectives (accessibility, sustainability) with commercial interests.

Table 6 - Advantages and disadvantages of public-private partnerships

Examples of public-private partnerships in the field of R&D

The consolidation of the European IAM ecosystem is supported by strategic projects funded by programmes such as SESAR and Horizon Europe, which enable solutions to be tested, validated and deployed in real-world scenarios. These projects not only facilitate technological and regulatory maturity but also constitute genuine pillars for the structuring of a robust, scalable and harmonised IAM model at the continental level. In addition, they serve to define and establish procedures between the main players in the ecosystem, acting as elements for the dissemination and structuring of the different layers of governance.

Some of the main activities in which the actors mentioned in this chapter are involved are described below:

- U-ELCOME (U-space European COMmon dEpLoyment): Initiative seeking the harmonised deployment of U-space infrastructure and services in Europe. Key participants include Eurocontrol, ENAIRE, ENAV, ITG, INECO, Leonardo and DLR. This project is crucial to establishing a common roadmap that enables the consistent implementation of U-space across different Member States, promoting interoperability and trust between service providers and authorities. Part of the U-ELCOME project is being developed in the city of Madrid.
- CORUS-XUAM: Project focused on developing operational concepts (ConOps) for integrated and safe urban air mobility management. Key players include EUROCONTROL, DSNA, NATS, ENAIRE, DLR, Unifly, Boeing, Honeywell and Airbus, as well as pilot cities such as Paris and Helsinki. Its relevance is critical in defining common standards and protocols, which serve as the basis for the regulation and coordination of eVTOL flights in densely populated areas.
- EUREKA (European Key solutions for vertiports and UAM): Project focused on developing solutions for the implementation of vertiports and UAM operations in cities. The solutions focus on defining the entire process of arrival, departure, and stopovers at vertiports, as well as collaborative traffic management, emergency and disruption management, and network flow, capacity, and corresponding operational management. The EUREKA project is a key element in the standardisation of operational processes at vertiports and the development of urban air mobility.
- CORUS five: Building on the previous CORUS and CORUS-XUAM projects, CORUS five focuses on updating the concept of operations for urban air mobility, aligning with the latest regulatory developments and addressing crucial outstanding issues related to UAS and VCA operations. The project will propose a more advanced U-space framework to facilitate safer and more efficient operations, with a focus on integrating manned and unmanned aircraft in the same airspace. This project is one of the main pillars for the implementation of UAM and U-space in Europe, thanks to its work on the fifth edition of the U-space concept of operations in Europe.
- EALU-AER (Enhanced Automation for U-space/ATM integration): European demonstration project that will build a platform using cutting-edge technological solutions for drone traffic management, including a fully operational vertiport, a U-space platform, a return network, communications and surveillance equipment, and advanced three-dimensional phased array radar. The platform developed in the project will be key to driving future developments and lines of work on U-space and UAM operations.

- BURDI (Belgium - Netherlands U-space Reference Design Implementation): aims to implement a U-space concept capable of managing diverse, dense and complex UAS operations in controlled, uncontrolled and urban air mobility environments. BURDI is a key project for defining best practices, standardisation, harmonisation and the definition of interoperability requirements, supporting the operational deployment of U-space airspaces across Europe. BURDI also seeks to ensure that the solutions implemented are both economically sustainable and socially acceprable, benefiting the citizens.
- DALI-LAB: seeks to develop detailed requirements for establishing the engagement and governance structure of living labs for drone-assisted medical services. This will provide guidance on how to develop this type of medical living lab, integrating drones into medical operations while safeguarding societal acceptance/socialisation, commitments, and concerns about safety and security, as well as compliance with medical protocols and the protection of individuals/patients, including privacy and sustainability dimensions.

Together, these projects represent key platforms for advancing technical knowledge, regulatory validation, and effective collaboration among industry, regulatory authorities, and pilot cities. They constitute a backbone in the progressive deployment of the European IAM ecosystem, driving both the innovation and social and institutional acceptance necessary for its definitive adoption.

5. Working groups

On 31 January 2024, promoted by Mayor José Luis Martínez-Almeida, Madrid City Council established the Urban Air Mobility Commission. This body brings together technical and strategic representatives from different municipal areas to study in depth the impact of this new form of mobility and lay the foundations for an ordinance that will allow its deployment in a safe, efficient and sustainable manner. Urban air mobility poses challenges that go far beyond technology: it requires rethinking regulations, safety, citizen coexistence, environmental impact, infrastructure and the economic model that makes it viable. With this, Madrid aspires to become the first major European city with specific regulations on urban air mobility.

To tackle the work effectively and in a specialised manner, the Commission has organised its internal functioning into six working groups, each focusing on a key area of urban air mobility development: Regulation, Operations, Environment and Citizenship, Safety, Economic Operators, and Infrastructure. These groups allow the various technical, legal, social and logistical aspects to be addressed in a segmented but coordinated manner. Their role is not only to draw up proposals or collect diagnoses, but also to generate shared knowledge among the various actors involved: administration, security forces, private operators, technical experts and representatives of the social fabric.

Each working group acts as a space for analysis and debate, and has been designed to facilitate the development of realistic proposals, adapted to the Madrid context and with the capacity to scale up to future regulations. In addition, the cross-cutting approach between groups ensures that critical aspects such as sustainability, safety and public acceptance are considered from the outset and not as an afterthought.

This chapter presents the work carried out by each of the groups, their main lines of analysis and the initial conclusions reached after the meetings maintained to date. This is not merely a descriptive exercise, but rather a strategic contribution to the roadmap that will define the future of urban air mobility in Madrid.

5.1 Group 1. Regulations

The aim of the Regulatory Working Group of the Madrid Urban Air Mobility Commission is to analyse current regulations and the regulatory framework, as well as to identify areas where approval of state, regional, or municipal regulations is necessary for the development of urban air mobility.

It has focused on analysing the current European and national regulations and competences in order to better understand this new dimension of urban mobility and to be in a position to ensure, within its strict municipal competence, the satisfaction of the general interests whose promotion and defence have been legally entrusted to Madrid City Council.

Objectives of the Regulatory Working Group.

The Regulations Group has set itself the following fundamental objectives:

1º) To analyse current European, national and regional regulations on urban air mobility and their impact on Madrid's general and special local regulations, as well as on Madrid City Council's ordinances.

2º) Monitor EU, national and regional regulatory procedures, providing the technical knowledge necessary for the eventual participation of Madrid City Council in the appropriate public information procedures.

3º) Analyse the municipal powers necessary for the development of urban air mobility, as well as the powers, functions, procedures and actions that EU, state and regional regulations attribute to municipalities in general, and to Madrid City Council in particular, in the field of urban air mobility.

4º) Identify and analyse the needs and problems related to UAM that may require a regulatory solution within the scope of municipal powers in force at any given time.

5º) Generate technical and legal knowledge on UAM and IAM, which is essential both for the exercise of the powers, authorities and functions that the legal system assigns to municipalities at any given time and for the analysis of the impacts that the development of UAM and IAM will have on the dynamics of cities and the lives of their inhabitants.

Identification of needs for the development of the UAM and the application of the IAM in the urban environment.

The Regulatory Working Group has identified the following areas in which regulation by the competent regulatory development authorities is required:

1º) **Clarification of the framework of powers** of the various public administrations with concurrent powers and general interests whose promotion and defence have been attributed by the legal system.

2º) **Development of mechanisms for collaboration and cooperation between public administrations** with general interests, concurrent powers and functions that are essential for the development of the UAM, which must act with the utmost institutional loyalty, collaborating in the exercise of their respective powers.

3º) **Regulation and practical implementation of state coordination mechanisms** in matters reserved for the State and in which the State considers it necessary to coordinate the actions of the various public administrations, in accordance with the law and constitutional jurisprudence.

4º) To have a legal framework that provides the necessary **legal certainty** to all legal operators, including public administrations, citizens and private individuals who wish to develop economic initiatives that require the use of UAS, eVTOL and UAM services.

5º) Establish regulations governing insurance coverage for the various types of non-contractual civil liability risks that may arise as a result of the use of UAS, both in the air and on the ground. This may require the relevant state regulatory authorities to analyse the advisability of reviewing and, where appropriate, updating aeronautical and non-aeronautical regulations (to regulate the risks of certain activities in which UAS and eVTOL are used).

6º) On the other hand, and aside from regulatory requirements, the development of the UAM requires the provision of resources and sustained investment over time for the construction of infrastructure, research, development and innovation, and the technical development of UAS and eVTOL aircraft, the management of U-space services, the construction of vertiports, and the management of services associated with the inspection, maintenance, operation, and provision of essential services associated with the operation of UAS and eVTOL, as well as the training of qualified personnel for all of the above.

EThe development of exclusive 5G communication protocols or frequencies is essential for the practical implementation of U-space and communications with UAS themselves, which requires state regulation, practical developments and private funding efforts for the deployment and use of real 5G networks.

It also requires the appropriate sizing of battery charging points, which implies an increase in the number of electrical stations and substations and in the infrastructure for electricity generation, transport and transformation. This affects both infrastructure and the urban environment and, therefore, municipal competencies.

Inadequacy and complexity of the distribution of Powers for the development of the UAM.

1º) Exclusive state powers.

The vast majority of aeronautical powers related to the development of the IAM and the UAM correspond to the State, by virtue of its powers in matters of *"airports of general interest; airspace control, air traffic and transport, meteorological services and aircraft registration"* (Article 149.1.20 of the Spanish Constitution).

The State also has other exclusive powers that are essential for the regulation, implementation and development of the IAM and the UAM, in the areas of:

a) Defence and the Armed Forces (Article 149.1.4 of the Spanish Constitution).

b) Public safety, without prejudice to the possibility of the creation of police forces by the Autonomous Communities in the manner established in their respective Statutes within the framework of the provisions of an organic law (Article 149.1.29 of the Spanish Constitution).

c) Basic legislation on environmental protection, without prejudice to the powers of the Autonomous Communities to establish additional protection standards (Article 149.1.23 of the Spanish Constitution).

d) And insurance (Article 149.1.11 of the Spanish Constitution).

The exclusive state competence in matters relating to "airports of general interest; airspace control, air traffic and air transport" has two essential regulatory advantages: on the one hand, it facilitates regulatory uniformity throughout the national territory; and on the other, it adds value in terms of guaranteeing market unity and competition, reducing the operating costs of economic agents when developing private initiative and investment.

The National Action Plan for the Deployment of U-space 2022-2025[13] (hereinafter PANDU), led by the Directorate General of Civil Aviation (DGAC), co-authored by the State Aviation Safety Agency (AESA) and ENAIRE, and with the notable collaboration of the Ministry of Defence and other public and private entities, plans the implementation of U-space, expressly contemplating the collaboration, cooperation and, where appropriate, coordination of the actions of municipal administrations.

Among the four objectives of the aforementioned PANDU, the "establishment of mechanisms for cooperation and collaboration between administrations" (page 5) stands out.

2º) **Exclusive regional powers**.

Article 148 of the Constitution empowers the Autonomous Communities to assume, through their respective statutes of autonomy, powers in the following areas:

a) Sports airports and, in general, those that do not carry out commercial activities (Article 148.1.6 CE).

b) Management of environmental protection (Article 148.1.9 CE).

c) Land use planning, urban planning and housing (Article 148.1.3 of the Spanish Constitution).

d) Coordination and other powers in relation to local police forces under the terms established by organic law (Article 148.1.22 of the Spanish Constitution).

Through its Statute of Autonomy, approved by Organic Law 3/1983 of 25 February[14], the Community of Madrid has assumed, under the terms set out in Articles 147 to 150 of the Constitution, a wide range of powers, some of which are exclusive (Article 26 of its Statute), others relating to regulatory development (legislative and regulatory) and the implementation of basic state legislation (Article 27 of its Statute), and others relating to the implementation of state legislation (Article 28 of its Statute).

With regard to the development of the UAM and the IAM, it is necessary to distinguish between the powers relating to airports (in accordance with Article 148.1.6 of the Spanish Constitution and Articles 26.1.7 and 28.1.7 of the Statute of Autonomy of Madrid), which are more directly related to civil aviation, from other powers and functions whose application is necessary for the development of the UAM and the IAM (land use planning, urban planning, the environment, among others), as well as those that may be impacted by the development of the UAM and the IAM or are related to the services that could be provided through the operation of UAS systems (for example, inter-hospital transport of organs within the framework of the National Transplant System and medicines).

The Community of Madrid has exclusive competence in the following matters under the terms established in Article 26 of the Statute of Autonomy of the Community of Madrid:

a) Airports and heliports for recreational use, as well as those that do not carry out commercial activities (Article 26.1.7 of the Statute of Autonomy of Madrid).

b) Land use planning, urban planning and housing (Article 26.1.4 of the Statute of Autonomy of Madrid).

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13 NOTE: Initial version: https://cdn.mitma.gob.es/portal-web-drupal/aviacion/220208_plan_de_despliegue_u-space_vfinal_acordada.pdf
Version 2.1 updated in October 2024: https://cdn.transportes.gob.es/portal-web-transportes/aereo/organizacion_sector_aereo/u-space/plan-de-despliegue-u-space_v2.1_definitiva.pdf

14 NOTE: BOE No. 51, dated 01/03/1983. Text updated on 17/07/2010: https://www.boe.es/buscar/act.php?id=BOE-A-1983-6317

c) Coordination and other powers in relation to local police forces, under the terms established by the Organic Law (Article 26.1.28 of the Statute of Autonomy of Madrid).

d) Installation for the production, distribution and transport of any form of energy, provided that the transport does not leave its territory and its use does not affect another Community. All of the above is without prejudice to the provisions of sections 22 and 25 of paragraph 1 of Article 149 of the Constitution (Article 26.1.11of the Statute of Autonomy of Madrid).

e) Meteorological service of the Community of Madrid (Article 26.1.34 of the Statute of Autonomy of Madrid).

f) Historical, artistic, monumental, archaeological, architectural and scientific heritage of interest to the Community, without prejudice to the State's competence to defend such heritage against export and plundering (Article 26.1.19 of the Statute of Autonomy of Madrid). The IAM and the UAM must be regulated in such a way as to guarantee the protection of such heritage.

Within the framework of basic State legislation and, where applicable, under the terms established therein, the Community of Madrid is responsible for legislative development, regulatory power and the implementation of the following matters:

a) a) Environmental protection, without prejudice to the power of the Community of Madrid to establish additional protection standards (Article 27.7 of the Statute of Autonomy of Madrid).

b) Health and hygiene, hospital coordination and pharmaceutical establishments (Article 27, sections 4, 5 and 12 respectively of the Statute of Autonomy of Madrid).

c) Protected natural areas (Article 27.9 of the Statute of Autonomy of Madrid).

d) Public domain and heritage assets owned by the Community, as well as public easements within its jurisdiction (Article 27.13 of the Statute of Autonomy of Madrid).

The Community of Madrid is also responsible for implementing State legislation in the following areas.

a) Airports and heliports classified as being of general interest whose direct management is not reserved for the State (Article 28.1.7 of the Statute of Autonomy of Madrid).

b) Transport of goods and passengers originating and terminating in the territory of the Community of Madrid, without prejudice to the direct execution reserved to the State (Article 28.1.13 of the Statute of Autonomy of Madrid). This competence refers to land transport carried out entirely within the territory of the said Community, in application of Articles 148.1.5 of the Spanish Constitution and Article 26.1.6 of the Estatute of Autonomy of Madrid.

In exercise of the powers conferred by Articles 148.1.6 of the Spanish Constitution and 26.1.7 and 28.1.7 of the Statute of Autonomy of Madrid, the Madrid Assembly has approved Law 3/2010 of 22 June on aeronautical facilities in the Community of Madrid[15], which aims to "regulate the authorisation, construction, management and use of aeronautical facilities in the Community of Madrid, as well as the inspection and control regime for these facilities and their complementary and auxiliary services" (Article 1.1).

The development of certain aspects of the UAM may exceed the urban term in order to meet the air transport needs within a metropolitan area of a large city, or even

15 NOTE: BOCM No. 154, of 29/06/2010, BOE No. 238 of 01/10/2010: https://www.boe.es/buscar/act.php?id=BOE-A-2010-15029

to connect two cities within the same province or neighbouring provinces within the same Autonomous Community by means of interurban transport.

In this regard, the state legislator may consider, within the scope of the UAM, specifically with regard to the development of transport services by "air taxis", the possibility of state regulations attributing regulatory powers to all Autonomous Communities or to those which, having the necessary capacity to do so, request it, with regard to the regulation of certain aspects of an air taxi service that is developed entirely within the territory of the Autonomous Community, whether it is urban or interurban air taxi transport, but always within the territory of the respective Autonomous Community.

3º) **Powers of municipalities.**

The exclusive nature of state regulatory competence in aeronautical matters facilitates and promotes the practical achievement of market unity and the defence of competition, but it should not be forgotten that it is within the municipal boundaries of cities and towns that the UAM will develop, generating positive and negative externalities for the people who live or are present there. Therefore, the regulatory power in each competent case must consider and address all of this in order to guarantee individual rights and satisfy the general interests legally attributed to municipalities.

The implementation of U-space by state authorities, beyond the planning and management of UAS airspace, determines the configuration of urban air mobility, having a significant impact on cities and on the exercise of municipal powers in areas such as traffic and road safety, urban mobility and land transport (Article 25.2.g) of Law 7/1985, of 2 April, Regulating the Bases of Local Government, hereinafter LBRL), safety (Article 25.2.f) of the LBRL), protection of the urban environment (Article 25.2.b) of the LBRL), and municipally owned mobility infrastructure (Article 25.2.d) of the LBRL), in accordance with special and general local government legislation and sectoral legislation.

The development of unmanned aircraft systems (UAS) activities and the deployment of the U-space system in the municipality of Madrid requires:

1º) On the one hand, the exercise by Madrid City Council of certain actions within the exclusively municipal sphere of competence, in collaboration with other public administrations within the framework of state coordination and in accordance with EU U-space regulations. In this regard, the municipal exercise of functions and powers in the areas of urban planning, management, execution and discipline, as well as the protection and management of historical heritage, as attributed by Article 25.2.a) of the LBR.
The legal regime for the civil use of unmanned aircraft systems (UAS), developed by Royal Decree 517/2024 of 4 June, establishes without prejudice the obligation to comply with the requirements and means of administrative intervention that may be required in accordance with the applicable state, regional and local regulations in each case, particularly in matters of public safety, protection of privacy and personal data, environmental protection, industrial safety, telecommunications, public radio spectrum, "by reason of the powers of other public administrations, whether state, regional or local, or the ownership of the land to be used for the operation" (Article 1.2 of RD 517/2024).

2) On the other hand, the development of the IAM and the UAM in accordance with state aeronautical regulations, and specifically the definition of UAS geographical areas and their designation as U-space airspace by state authorities, affects certain general interests whose promotion and defence has been attributed to Madrid City Council in the terms provided for by law, in the exercise of certain powers of its own, including:

a) Mobility and urban public passenger transport, pursuant to Articles 25.2.g) of the LBRL, 38 to 40 of Law 22/2006, of 4 July, on the Capital City and Special Regime of Madrid (hereinafter LCREM), and 7 of the revised text of the Law on Traffic, Motor Vehicle Circulation and Road Safety, approved by Royal Legislative Decree 6/2015, of 30 October, which approves the (hereinafter

LTSV).

b) Security, local police, civil protection, fire prevention and extinguishing pursuant to Articles 25.2.f) of the LBRL and 35. 2 and 3 of the LCREM.

c) Protection of the urban environment, including protection against noise, light and air pollution, pursuant to Article 25.2.a) of the LBR..

The development of the UAM requires essential collaboration, cooperation and coordination between public administrations.

The National Action Plan for the Deployment of U-Space 2022-2025 (PANDU) provides for the necessary transparency and dissemination to "regional and local administrations, as the system will have a marked urban character".

In order to facilitate collaboration and cooperation between public administrations, in application of the second additional provision of Ordinance 10/2021, of 13 September, amending the Sustainable Mobility Ordinance of 5 October 2018, the Madrid City Council has created the Urban Air Mobility Commission, by Decree of the Mayor of the City of Madrid, of 20 September 2023, regulating the composition and functioning of said Commission (BOAM of 22 September 2023). This White Paper is one of the activities of the aforementioned Commission.

The exercise of municipal functions and powers is relevant to the implementation of U-space and essential for achieving, from a broader and more inclusive perspective of municipal powers as a whole, the integration of the UAM into the framework of urban mobility as a whole, in a manner that is fully compatible with guaranteeing citizens' rights and the general interests that the Madrid City Council has been legally mandated to promote.

Therefore, the state legal system must recognise a clear framework of competences that allows municipalities to participate, under the terms expressly provided for in state and regional regulations, in essential matters to facilitate the effective development of urban air mobility that affect municipal competences and the satisfaction of legally attributed general interests.

For example, in express consultation with municipalities in the definition of airways, taking into account both the safety conditions of the population and the possible impacts on people's lives and the urban environment (noise and air pollution, among others), or the possibility of assigning to the Municipal Police of those municipalities that fall within the category of "large population" in Article 121 of the LBRL and those municipalities for tourism, agricultural, beach and coastal rescue reasons, or other reasons related to their municipal powers, have the necessary personnel and technical resources, training and experience to carry out this function under the terms and conditions regulated by Organic Law 4/2015 of 30 March on the protection of public safety, including the control of security risks that may be posed by UAS, without limitation by specific weight. In this regard, Royal Decree 517/2024 on UAS already makes express reference to Law 4/2015.

Identification of regulatory developments that would be necessary for the development of the UAM within the scope of state competence.

The Regulatory Working Group has begun various discussions to identify some of the material areas in which the development of the UAM raises needs and problems that may require regulatory solutions, on the understanding that regulations, not only aeronautical regulations, which may be approved in the future by the competent regulatory authority or authorities in each case, should take into consideration:

1º) The type of unmanned aircraft system (UAS) to be operated, taking into account its technical characteristics such as dimensions, mass, load capacity and power source, among others.

2º) The type of infrastructure required for its operation, take-off and landing in accordance with state aeronautical regulations, and the type of UAS systems

that will use such infrastructure.

3º) The type of service provided or activity carried out by the UAS operation: passenger transport, freight transport, security and surveillance, search and rescue, civil protection, photography and filming, cartography, phytosanitary control, technical inspection of buildings and public works infrastructure, inspection of trees and green heritage, pest control and fumigation, among others.

4º) The risks, not only of aeronautical operations, but also on the ground and in the service or activity carried out using UAS systems, which could involve the management of infrastructure and the provision of the service or activity carried out by the specific operation of UAS systems.

5º) Consider the territorial scope of operations carried out using eVTOLs, in order to assess the impact on municipal powers in urban air mobility, and on regional powers in the case of interurban, provincial and regional air mobility within their respective regional territorial scope.

6) Assess the environmental impact, ensuring the involvement of the public administrations effectively affected, always considering the municipalities in the MAU and the autonomous communities in metropolitan and interurban air mobility within the provincial or regional scope within the territory of the same autonomous community to be affected.

By way of example, and without claiming to offer an exhaustive list, the following issues may be mentioned:

1º) Regulation of third-party **risk insurance** that may arise from the development of different **activities using UAS and eVTOL.**

Aviation insurance is intended to cover the risks inherent in navigation that affect the aircraft, goods, passengers and cargo, as well as the liabilities arising from damage caused to third parties by the aircraft on land, water or in flight in accordance with the provisions of Article 126 of Law 48/1960 of 21 July on Air Navigation (Boe of 23 July 1960[16]).

Without prejudice to the obligation to insure against damage caused to third parties on the ground by aircraft weighing less than 500 kg, as regulated by Community and national aviation regulations, the performance of certain activities or services using UAS may involve risks and cause damage to persons and property, which must be insured in advance in order to facilitate legal proceedings and ensure the protection of the personal and property rights of third parties.

Article 7.1 of Regulation (EC) No 785/2004 of the European Parliament and of the Council of 21 April 2004 on insurance requirements for air carriers and aircraft operators (OJEU of 30 April 2024[17]), establishes, in relation to liability to third parties on the ground, the minimum accident insurance cover for each drone with an MTOM[18] of up to 500 kg, in the amount of 750,000 SDRs Special Drawing Rights[19].

While the minimum amount to be covered, as regulated by Article 4.1 of Royal Decree 37/2001 of 19 January, which updates the amount of compensation for damages provided for in Law 48/1960 of 21 July on Air Navigation[20] for aircraft with a gross weight

16 NOTE: Text updated on 2 August 2022: https://www.boe.es/buscar/pdf/1960/BOE-A-1960-10905-consolidado.pdf

17 NOTE: https://www.boe.es/doue/2004/138/L00001-00006.pdf

18 NOTE: MTOM: Maximum take-off mass, which corresponds to a specific certified amount for all aircraft types, as stated in the aircraft's airworthiness certificate

19 NOTE: SDRs are a potential claim on the freely usable currencies of the member states of the International Monetary Fund (IMF) (the euro, the dollar, the yen, the pound sterling and the Chinese yuan), which are assets created in 1969 to supplement the reserves of member states. It is currently regulated by the Convention for the Unification of Certain Rules for International Carriage by Air, done at Montreal on 28 May 1999 (BOE of 20 May 2004)

20 NOTE: https://www.boe.es/buscar/pdf/2001/BOE-A-2001-2343-consolidado.pdf

of up to 500 kilograms is the equivalent in euros of 220,000 SDRs, covering damage caused to persons or property on the ground by the action of the aircraft, in flight or on the ground, or by anything falling from or thrown from it.

Therefore, there is a need for the competent European and national regulatory authorities to analyse the advisability and appropriateness of regulating a specific compulsory insurance system for the UAM, which ensures liability for damage to persons and property that may be caused, but setting amounts in euros rather than SDRs and establishing an effective system to guarantee prompt and adequate compensation for any damages that may have been caused.

2º) Regulate the integration into territorial and urban planning of the infrastructure used by UAS systems, as well as the regime governing works on such infrastructure.

Law 48/1960 of 21 July on Air Navigation, as amended by Article 51 of Article 16 of Law 8/2025 of 29 September[21], regulates the Master Plans for air navigation and for each airport of general interest, which define service areas, easements and reserve spaces, also incorporating strategic environmental assessment.

For its part, Article 51 bis of the aforementioned law regulates the integration of airports, their service areas, as well as the facilities and reserve spaces included in urban planning as a general airport or air navigation system, imposing the mandatory compatibility of the special plan or equivalent urban planning instrument with the Air Navigation Master Plan.

On the other hand, Article 51 ter of the same Air Navigation Law regulates the execution of works and activities within the general airport or air navigation systems, distinguishing between:

> a) Those directly linked to airport or air navigation system operations, which are not subject to the municipal preventive control measures provided for in Article 84.1.b) of the LBRL, such as authorisations, permits or licences for construction or initial installation, operation or opening, as they constitute actions of general interest.
>
> b) All other works and activities must comply with the special plan or equivalent urban planning instrument and be subject to a municipal urban planning report, which shall be deemed favourable if no response is issued within one month. If the urban planning has not been approved, the works must comply with the master plan regulated in Article 51 of the same Law.

Given the differences between an airport and the various types of infrastructure envisaged for UAS operation, it is considered that state legislation should specifically regulate the integration of the infrastructure necessary for the take-off, landing and operation of UAS systems into land-use and urban planning, as well as the regime governing the works and activities carried out therein, based on the consideration that there will be infrastructure for the operation of UAS systems that is publicly and privately owned, permanent and temporary, for public and private or restricted use, and above all, that the classification of "general interest", which implies exclusive state competence, must be clearly regulated by state legislation because it affects not only the form of integration into territorial and urban planning and the regime of works, but also the attribution of competence itself through the application of Articles 149.1.20 and 148.1.6. CE, in relation to articles 26.1.7 (airports and heliports for sports, as well as those that do not carry out commercial activities) and especially 28.1.7 (airports and heliports classified as being of general interest whose direct management is not reserved to the State) of the Statute of Autonomy of the Community of Madrid.

All of this is without prejudice to the essential guarantee of preventive control measures provided for in Article 84.1.b), in relation to Article 84.bis of the LBRL for reasons of public order, public safety, public health or environmental protection under Article 84.bis.1.a), and the concurrence of risks due to the electrical or energy power of the installation,

21 NOTE: BOE No. 235, of 30/09/2025. https://www.boe.es/buscar/doc.php?id=BOE-A-2025-19339

the capacity or size of the facility, noise pollution and the existence of flammable or polluting materials in letters a), b) c) and e) of Article 84.bis.2 of the LBRL, which require vertiports to be subject to municipal licensing, unless they are expressly declared by the state aeronautical authorities to be of "general interest".

3º) The amendment of **technical building regulation**s (Law 38/1999, of 5 November, on Building Regulations and the Technical Building Code, approved by Royal Decree 314/2006, of 17 March[22]) to regulate the technical requirements that must be met by buildings to be constructed in the future, as well as by buildings already constructed, so that the possible use of the roofs of certain buildings as take-off and landing points for UAS can be authorised, depending on their mass and category. All of this is without prejudice to the necessary regulation of additional technical building requirements to the aeronautical requirements for the certification or authorisation of vertiports as aerodrome infrastructure.

4º) The storage, recharging and handling of electric batteries for UAS and eVTOL requires electrical infrastructure designed for this purpose and fire protection facilities. These requirements may necessitate the installation of fire protection systems appropriate to the difficulty of extinguishing lithium battery fires, particularly on building roofs, due to the high fire load and the challenges of extinguishing fires at high altitudes, as well as the risks of building collapse.

Affected by a possible fire of this type. To this end, it is necessary to analyse the **Regulations on fire protection installations** approved by Royal Decree 513/2017 of 22 May (BOE of 12 June 2017[23]).

5º) The exponential increase in UAS operations and the emergence of operators outside civil aviation who see UAS as a suitable means for developing new business models may require adaptation to new realities as they arise, both in terms of the system of infringements and penalties and the penalty procedure, raising the need to evaluate Law 21/2003 of 7 July on Aviation Safety to ensure its effectiveness, as well as to regulate provisional measures and effective mechanisms for restoring legality.

Similarly, it may be necessary to evaluate the Criminal Code approved by Organic Law 10/1995 of 23 November[24] November24and Organic Law 4/2015 of 30 March on the protection of public safety[25].

From a non-regulatory point of view, it may be necessary to strengthen the human and technical resources for monitoring, investigating and penalising this type of infringement.

6º) Regulate, by means of a legal provision, the possibility of establishing quantitative limitations on the use of UAS and eVTOL when necessary, based on compelling reasons of general interest.

7º) Title V of Law 21/2003, of 7 July, on Aviation Safety (BOE of 8 July 2003)[26] regulates infringements (Chapter 1), penalties and other measures (Chapter 2), the limitation period for both (Chapter 3) and the penalty procedure.

Articles 43 to 49 of the Act define offences relating to civil aviation safety, air transport and air operations, passenger assistance and compensation, the transport of dangerous goods by air, noise regulations, the use and coordination of airports, air traffic control, noise, air traffic flow management and slot coordination.

Some of these provisions could be incorporated, with varying degrees of adaptation, but there are issues that are not applicable to the UAM, just as the regulation does not

22 NOTE: Text updated on 3 September 2025: https://www.boe.es/buscar/pdf/2017/

23 NOTE: Regulations established by Law 38/1999, of 5 November, on Building Regulations, and Royal Decree 314/2006, of 17 March, approving the Technical Building Code.

24 NOTE: https://www.boe.es/buscar/pdf/1995/BOE-A-1995-25444-consolidado.pdf

25 NOTE: https://www.boe.es/buscar/pdf/2015/BOE-A-2015-3442-consolidado.pdf

26 NOTE: Updated on 2 August 2024: https://boe.es/buscar/pdf/2003/BOE-A-2003-13616-consolidado.pdf

cover all the situations and problems that will arise as a result of the development of the IAM and the UAM. This will certainly require consideration by the state legislator.

This regulation must consider extending the cases of liability regulated in Article 52 of the Aviation Safety Act to regulate the liability of both remote pilots and fully automated UAS operations, regulating the various liabilities that may arise (UAS manufacturers, take-off system manufacturers, flight and landing system manufacturers, remote manual operators, as well as their interaction with other conventional aircraft).

Given the absolute priority of safety in aviation, it is essential to regulate the additional penalties of disqualification set out in Article 56.2 of the LSA, and the revocation of licences, ratings or authorisations set out in Article 56.2, second paragraph, of the LSA.

Equally important are the extraordinary measures, under the jurisdiction of the Directorate General of Civil Aviation, exercised by its Director General, to immobilise an aircraft and suspend licences, ratings or authorisations when irregularities have been found that have a certain, serious and immediate impact on aviation safety, which in the case of UAS and eVTOL may require some regulatory adaptation.

Likewise, it is considered appropriate and necessary to analyse the disciplinary procedure regulated in Articles 61 to 67 of the Aviation Safety Act and evaluate it from the perspective of the UAM, to have a flexible and adequate procedure for managing a large number of proceedings.

Apart from the disciplinary procedure and without prejudice to it, the regulation of appropriate legal instruments to ensure the restoration of legality, such as prior provisional measures, and measures to restore the previous state (Article 57.1.a) LSA) and compensation equal to the value of the destroyed property or the damage caused, as well as the damages incurred (Article 57.1.b) LSA).

The attribution of competence to the State Aviation Safety Agency (AESA) enables the centralised unification of this essential public function. This entity must be provided with the necessary human and technical resources, regulations, and budgetary allocation to carry it out.

8º) Just as land vehicles can be used to commit crimes against road safety, public safety, trafficking in prohibited substances, and even terrorist attacks, UAS and eVTOLs could also be used to commit crimes. Therefore, the organic legislator could analyse the possibility of introducing certain innovations into the Criminal Code.

9º) Protecting public safety may require analysing the advisability of reviewing Organic Law 4/2015 of 30 March on the protection of public safety[27], Article 36.22 of which classifies *"failure to comply with restrictions on the navigation of high-speed vessels and light aircraft"* as a serious offence.

Without prejudice to the legal authorisation of the temporary seizure of any objects, instruments or means of aggression, " to prevent the commission of any crime, or when there is a danger to the safety of persons or property" under Article 18.2.2 of the Organic Law on the Protection of Public Safety.

10º) A sustainable mobility bill is currently going through Parliament that aims to regulate a sandbox in the field of mobility which, although it does not specifically address urban air mobility, could be used in conjunction with Madrid City Council's sandbox ordinance to develop pilot tests in safe environments that help identify the uses, benefits and risks of potential activities and services to be developed using UAS and eVTOLs to evaluate possible solutions, both non-regulatory and regulatory, and in the case of the latter, to facilitate the development of potential regulations.

11º) The deployment of Urban Air Mobility (UAM) in Spain requires an adapted legal framework that overcomes the limitations of current regulations, which were designed primarily for conventional aeronautical infrastructure. At the national level, it would be

27 NOTE: Updated on 23 February 2021: https://www.boe.es/buscar/pdf/2015/BOE-A-2015-3442-consolidado.pdf

necessary to promote the development of specific regulations for urban and peri-urban vertiports, covering their design, certification, operating procedures and requirements for integration with urban infrastructure.

This regulation should establish differentiated technical and safety standards for eVTOL and UAS operations, taking into account the specific characteristics of operations in dense urban environments.

The deployment of vertiports and UAM nodes has an impact on urban planning, which requires the coordination of national aviation regulations with regional urban planning legislation and local urban planning.

In the case of the Community of Madrid, Law 3/2010 and the exclusive powers in matters of land use and urban planning determine that any vertiport project, within the scope of its powers, must be validated by it.

Likewise, the Community exercises powers over aeronautical facilities that are not of general interest, including sports aerodromes, heliports and other non-commercial infrastructure, which conditions the implementation of local vertiports.

It is essential to establish mechanisms for cooperation and, where appropriate, coordination between the State (AESA and the Ministry of Transport), the Community of Madrid and Madrid City Council to ensure that, within their respective areas of competence, the regulations on vertiports are adapted to the local urban planning framework.

Identification of regulatory developments that would be necessary for the development of the UAM within the regional sphere of competence.

To ensure the orderly, safe and efficient development of Air Mobility in the Community of Madrid, the following regulatory developments are identified within the framework of regional competences:

1º) Regulation in regional areas related to air mobility

It will be necessary to adapt and develop specific regulations in areas that affect

directly involved in the implementation of the MAU, among others, it is worth highlighting:

Urban planning and land use: regulating the applicable regulations, to ensure the compatibility of land use with the aeronautical and non-aeronautical infrastructure associated with this new mode of transport, within the scope of the Community of Madrid's powers.

Aeronautical facilities (for UAS use): by updating current regulations (Law 3/2010, of 22 June, on Aeronautical Facilities in the Community of Madrid) to incorporate new facilities linked to air mobility, defining the technical requirements, authorisation procedures and supervision mechanisms that guarantee regulatory compliance, within the scope of the Community of Madrid's powers.

These regulations must comply with the international, European and national legal framework, acting on matters within the exclusive competence of the Community of Madrid.

2º) Development of a Mobility Law that includes air mobility:

The Community of Madrid is considering the possibility of promoting a Mobility Law that explicitly incorporates air mobility as part of the multimodal mobility ecosystem within its sphere of competence.

3º) Other possible regulatory developments that would enable the establishment of a regional framework allowing for:

a) The establishment of testing and validation areas.
It is considered appropriate to define and enable specific areas for testing

and validating operations with unmanned aircraft systems (UAS), as well as to promote innovative use cases in the autonomous region. If necessary, the possibility of developing a regulatory framework to enable their safe and legal implementation would be assessed.

b) The administrative simplification of operating applications (one-stop shop).

It is proposed to reduce the current bureaucratic burden on operators of unmanned aircraft systems (UAS) when carrying out operations in the Community of Madrid. To this end, it will be essential to establish a single window to centralise the necessary procedures and coordination, in accordance with Royal Decree 517/2024, of 4 June, which regulates the legal regime for the civil use of UAS. If necessary, the possibility of developing a regulatory framework to streamline this process would also be assessed.

Identification of regulatory developments that would be necessary for the development of the UAM within the municipal sphere of competence.

Without prejudice to the exercise of municipal powers legally attributed in the areas previously analysed of urban planning, municipal policing, mobility and urban environmental protection, it is considered appropriate to identify the following possible regulatory developments:

1º) Regulation of certain non-aeronautical conditions and requirements and legal guarantees for the exercise of municipal functions through the use of UAS and eVTOL.

In line with the municipal ordinances that several municipalities have approved to regulate the use of drones, it is considered necessary for the Madrid City Council to address the regulatory initiative of an ordinance that regulates certain aspects of the provision of services or the development of municipal actions necessary for the satisfaction of the general interests legally entrusted to it.

Although the bulk of the regulation would concern non-EASA operations carried out by the Municipal Police and other municipal emergency services, it is planned to include the regulation of certain non-aeronautical aspects of the use of drones for the performance of public functions within the EASA sphere.

2º) Municipal regulation of material areas necessary for the development of the UAM, such as the regulation of certain urban planning regulations[28], the drafting and processing of urban planning, the regulation of those means of administrative intervention that are required for both prior control (authorisations) and subsequent control (affidavits and communications) and the approval of the appropriate tax ordinances.

These regulations would govern matters falling within the exclusive competence of municipalities, within the framework of applicable state and regional sectoral regulations, without prejudice to the participation of other public administrations, such as regional approval of certain urban planning instruments under the terms provided for in land and urban planning legislation (Article 61 of Law 9/2001, of 17 July, on land in the Community of Madrid[29]) , accordance with Law 2/2002 of 19 June on environmental assessment in the Community of Madrid[30] and municipal ordinances.

3º) Development of practical tests in a controlled testing environment (**sandbox ordinance**), which would be used for innovation and improvement of municipal

28 NOTE: Section Three of Chapter 7.15 Urban Planning Regulations of the 1997 Madrid General Urban Development Plan regulates the specific conditions for the use of public facilities for air transport, regulating urban planning decisions for airports, aerodromes and heliports in the city of Madrid. Compendium updated on 24 September 2025: https://transparencia.madrid.es/UnidadesDescentralizadas/UDCUrbanismo/PGOUM/Compendi- oNNUU/Compendio_2025_septiembre/_COMPENDIO_MPG_NNUU_24_09_2025.pdf

29 NOTE: BOCM No. 177 of 27/07/2001 and BOE No. 245 of 12/10/2001. Updated on 27/12/2024: https://www.boe.es/buscar/act.php?id=BOE-A-2001-18984

30 NOTE: BOCM No. 154 of 01/07/2002 and BOE No. 176 of 24/07/2002. Updated on 27/12/2024: https://www.boe.es/buscar/act.php?id=BOE-A-2002-14841 https://www.boe.es/buscar/pdf/2002/BOE-A-2002-14841-consolidado.pdf

regulations.

The Madrid City Council has Ordinance 1/2025, of 28 January, which regulates the controlled testing environment for innovative projects in the city of Madrid (BOCM No. 36, of 12/02/2025, pp. 119-13[31]), which allows the development of temporary trials of innovative projects in a temporary controlled environment in municipal public spaces within the municipal area of Madrid, ensuring the safety of individuals and satisfying the principles of equality, transparency and competition, without prejudice to the application of European, national or regional regulations that are mandatory in each case depending on the material scope of the tests to be carried out (therefore, the development of these tests requires compliance with the requirements and authorisations required by EU, national and regional regulations).

Therefore, the "sandbox ordinance" may permit a practical test to be conducted in the public space of the municipality of Madrid. Still, the project and its practical application must comply with all the national and regional authorisations and requirements necessary in accordance with the different sectoral regulations.

The assessment of the test results is used to evaluate current regulations, identify problems and needs, and possible regulatory solutions to improve municipal planning.

4º) **Recognition of new municipal powers** linked to the deployment of U-space, including, on the one hand, the possibility for Madrid City Council, in accordance with Royal Decree 517/2024, to request the delimitation of UAS Geographical Areas within its municipal boundaries, and, on the other hand, the potential consideration of the City Council as the U-space Coordinator in the urban environment, which would allow it to integrate airspace management with the exercise of its powers in the areas of safety, mobility, urban planning and environmental protection.

5.1.1 Conclusions of the Regulatory Working Group

The work carried out by the Regulatory Working Group of the Madrid Urban Air Mobility Commission has laid a solid foundation for addressing the future regulation of this emerging issue through a comprehensive analysis of the regulations applicable at the various levels of competence: European, national, regional and local.

The complexity of the legal framework applicable to urban air mobility has been confirmed, especially concerning the distribution of powers between the State, the Community of Madrid and the Madrid City Council, making effective coordination between the various public administrations involved essential in order to avoid regulatory overlaps and ensure regulatory consistency.

Likewise, the need has been identified to establish mechanisms for collaboration and cooperation, and to carry out the corresponding actions in the effective exercise of state decisions, and where appropriate, regional decisions, for coordination in accordance with the terms set out in the Constitution and the rest of the legal system, in accordance with constitutional jurisprudence.

It is considered essential to have a regulatory framework that guarantees legal certainty – essential for practical application by legal operators and for the development of the private initiative and investment necessary for the development of the UAM – which, at the same time, provides sufficient flexibility for the development of tests in safe environments, and which responds to a continuous effort of evaluation and regulatory improvement that allows, thereby integrating this new mode of transport in an orderly, efficient and sustainable manner into the overall sustainable urban mobility system, establishing the necessary relationship between the land and air dimensions of urban mobility.

Therefore, it is considered a priority to advance the technical and legal work proposed in the short, medium and long term, in order to develop a regulatory framework that allows the Madrid City Council to:

31 NOTE: https://www.bocm.es/boletin/CM_Orden_BOCM/2025/02/12/BOCM-20250212-32.PDF

a) Guarantee the satisfaction of the general interests legally entrusted to it and exercise the powers legally attributed to it by special and general local legislation and by the various sectoral regulations;
b) Guarantee, within the strict scope of municipal powers, the individual rights that may be affected by the development of the UAM;
c) Benefit from the functionalities and utilities offered by the use of UAS and eVTOL in the performance of public functions and the exercise of municipal powers, both through "non-EASA operations" and "EASA operations", with maximum legal certainty;
d) Exercise its legally assigned powers in non-aeronautical areas, which are essential for the practical development of urban air mobility with full legal certainty and in a manner that is fully consistent with the rest of the applicable regulations, especially European and national regulations on aeronautics, public safety, personal data protection, and the environment, among other matters..

5.1.2 Proposed short, medium and long-term actions

Cross-cutting actions throughout the period

- Assess current municipal regulations at all times in order to identify problems, needs and possible improvements.
- Propose a regulatory calendar, identifying current or possible municipal ordinances that the Madrid City Council considers necessary to modify or approve ex novo, and evaluate their evolution on a multi-year basis in accordance with the terms of the previous paragraph.
- Include regulatory amendments in the Madrid City Council's Regulatory Plan for each legislative term.

Short-term actions (0-2 years)

- Conduct a detailed analysis of the distribution of powers, identifying the powers constitutionally and legally attributed to the State and the Community of Madrid, and those legally attributed to the Madrid City Council.
- Draft a reasoned proposal for a framework of powers in which the powers that, in accordance with the principles of subsidiarity, effectiveness and efficiency, it would be reasonable for the Community of Madrid and the Madrid City Council to exercise for the development of urban air mobility, under the terms considered and determined by the State, are identified.
- Conduct a comprehensive analysis of the existing legal framework governing urban air mobility.
- Identify the areas in which the approval of regulations would be necessary, identifying the competent regulatory authority for their approval.
- Monitor the progress of Community and State regulatory projects. If possible, monitoring would be extended to international regulatory projects that may affect urban air mobility.
- Participate in the public information procedures for regulatory projects related to urban air mobility that will be processed in the future by EU, national and, where appropriate, regional authorities, by making comments and, where appropriate, by participating in qualified hearing procedures.
- Identify those groups or associations which, due to their special involvement in the development of urban air mobility, their impact on the interests that the associations defend or promote, or their special impact on their legitimate rights or interests, may be considered when holding preparatory meetings for the future drafting of a possible ordinance.
- Include in the Madrid City Council's Regulatory Plan the provision for the approval

of an ordinance regulating the use of UAS by the Madrid City Council and propose possible modifications to urban planning regulations strategic and general urban planning regulations.

Medium-term actions (2-5 years)

- Draft, process and submit for public consultation a draft ordinance regulating the use of UAS by Madrid City Council, providing legal coverage for the use of different types of UAS by municipal services in EASA and non-EASA operations (municipal police, emergencies, etc.). It is proposed that this draft legislation be submitted for approval, where appropriate, to the Madrid City Council Plenary.
- In view of the regulatory developments that will take place in the coming years, and depending on the powers legally attributed or delegated to Madrid City Council at that time, if the powers to do so are attributed, to begin drafting, processing and submitting for public information a draft ordinance regulating urban air mobility, within the scope of municipal powers and in accordance with applicable European, national and regional regulations.
- Draft, process and submit for public consultation any draft ordinances as required, such as tax ordinances and the approval of public prices.
- Analyse amendments to municipal urban planning regulations, in accordance with develop state and regional aeronautical, land use and urban planning regulations.

Long-term actions (5-10 years)

- Adapt the future ordinance regulating the use of UAS by the Madrid City Council to any changes in EU, national or regional regulations that may have occurred since its approval, as well as any improvements in regulatory techniques and regulations that may arise as a result of the ex-post evaluation of the results of its application.
- Adapt, where appropriate, the PGOUM Urban Planning Regulations.

Draft, process and submit for public information the draft ordinances that are required, such as tax ordinances and the approval of public prices.

5.2 Grupo 2. Seguridad

The Safety Group is responsible for ensuring that urban air mobility is deployed in accordance with strict standards of public protection. Its main task is to identify and establish no-fly zones, emergency protocols and preventive measures against incidents that could affect both people and urban infrastructure. Given the complexity of operating unmanned aircraft over a dense city such as Madrid, this group plays an essential role in minimising risks.

The group also develops response scenarios for contingencies such as technical failures, unauthorised access or deliberate threats. To this end, it works closely with law enforcement agencies, emergency services and cybersecurity experts. This comprehensive approach aims to protect both the physical and digital spaces of the urban air ecosystem, thereby reinforcing public confidence in its implementation.

In summary, the group's objectives are as follows:

- Definition of flight safety requirements.
- Definition of exclusion zones.
- Definition of protocols for action in the event of security breaches.

The compilation of the work is structured into seven blocks, within which measures have been defined, regulatory and operational shortcomings have been identified, and specific proposals have been formulated.

Sanctioning procedure

Regarding the disciplinary procedure, the working group has identified two fundamental lines of action to strengthen the City Council's disciplinary capacity in the event of conduct contrary to current regulations governing UAS.

On the one hand, it is considered essential for the Municipal Police to have its own distinct administrative identity, enabling it to act autonomously and effectively in processing disciplinary proceedings before the State Aviation Safety Agency (AESA).

This administrative identity would guarantee both traceability and agility in the process, providing the local corporation with a formal tool to exercise its competence in controlling urban airspace.

On the other hand, the need to develop a standardised form for complaint reports was raised, designed in accordance with European regulations, which systematically collects all the necessary elements for initiating disciplinary proceedings. This form would not only standardise the criteria for action among the responsible agents, but would also facilitate its integration with national record interconnection systems, allowing for automated and consistent management of complaints issued in the context of urban air mobility.

Streamlining of Administrative Procedures

Concerning streamlining administrative procedures, the working group has emphasised the importance of the Madrid City Council playing an active role in managing the airspace that affects its territorial jurisdiction. To this end, the council must have priority, real-time access to the main national databases that contain critical information on authorised flights, registered operators and the characteristics of unmanned aircraft. This information is vital for planning, authorising or intervening in UAS operations within the municipality.

Likewise, emphasis has been placed on the need for all flight operations reported to the Ministry of the Interior, especially those affecting the urban space of Madrid, to be automatically notified to the Directorate General of the Municipal Police. This automated procedure would avoid duplication of administrative communications and reinforce the principle of information unity, allowing local authorities to act effectively and with full knowledge of the facts.

Another critical aspect addressed in this section is access to Direct Remote Identification (D.R.I.) systems.

Although some of this information is already publicly available, the group considers it essential that the City Council, through its security forces, also have access to confidential data that enables the complete identification of operators, aircraft, flight paths, and flight purposes. This level of access, currently reserved for bodies with national powers, is considered essential to ensure a safe and controlled urban environment, where the presence of unmanned aircraft can be effectively monitored by the local administration.

Taken together, these measures aim to provide the City Council with a real operational capacity to manage, supervise, and, if necessary, intervene in UAS operations within the urban environment, ensuring that regulations are complied with and that municipal resources can act in accordance with national and European regulatory frameworks.

Infrastructure Supervision

In the section on the supervision of infrastructure for urban air mobility, the working group has addressed in depth the need to establish a clear framework for regulation, inspection and control for new facilities that will house UAS operations. Work has been done on classifying and characterising the most relevant types, differentiating between vertiports, mainly intended for eVTOL aircraft for the transport of passengers or goods, notably Vertistops, Vertihubs and Dronehubs; Dronepads, designed as a specific area or surface for drones, normally portable and small in size; and Drone-in-a-box or nest systems, autonomous solutions that allow continuous and remote operations without

direct human intervention, with varied applications and the use of light drones, notably lockers, designed for automated last-mile parcel delivery. This differentiation is crucial for adapting regulatory, operational, and safety requirements to the specific functions of each type of infrastructure.

As a result of this work, a first draft inspection protocol has been drawn up, covering the technical, administrative and operational aspects to be verified by the competent authority in each review. This protocol is being refined and validated by the group members with a view to its implementation in a pilot phase.

At the same time, progress has been made in defining the municipal licensing regime applicable to this type of infrastructure. The advisability of differentiating between planning licences, responsible declarations and specific technical authorisations has been discussed, depending on the type of infrastructure, its ownership (public or private) and the degree of operational risk. For example, it is envisaged that publicly owned vertiports will require mandatory reports from bodies such as the fire brigade or municipal police, while lockers could be authorised by means of a responsible declaration under certain requirements.

A particularly relevant aspect has been the recognition of the need to regulate not only public facilities, but also privately owned facilities that offer public services or have an impact on the urban environment. In this regard, the supervision of facilities located on the roofs of corporate or logistics buildings, where drones could operate for commercial deliveries, has been discussed.

In these cases, key elements to be controlled have been identified for inclusion in the aforementioned inspection protocol, such as: the safe storage of batteries (including protocols for electrical or fire hazards), adequate signage and marking of operating areas, the existence of designated areas for handling goods, the availability of recharging systems, the traceability of aircraft maintenance and control systems, and the training and authorisation of personnel responsible for operations. It is essential to emphasise the importance of coordination among various competent authorities to ensure the proper supervision of infrastructure at all levels, distinguishing between the aeronautical dimension (under state or regional jurisdiction in each case) and municipal powers in matters of urban planning and building.

This comprehensive and preventive approach aims to ensure that all infrastructure associated with urban air mobility, regardless of ownership, complies with minimum standards of safety, sustainability, and legality, thereby guaranteeing the protection of both users and citizens in the urban environment where operations take place.

Urban Airspace Management and Coordination

In the section dedicated to coordination with aerodromes and aeronautical infrastructure, the working group has recognised the need to establish a dynamic, transparent and continuous system for the exchange of information between local councils and airspace operators. This coordination should not only cover aerodromes close to the metropolitan area, but also service providers such as ENAIRE, entities responsible for the deployment of the U-space ecosystem and security forces with aeronautical powers.

It is considered a priority to implement operational protocols that enable real-time data sharing on UAS operations, including those that may interfere with or cross conventional air routes. The aim is to avoid risky situations, minimise incidents and ensure the smooth flow of urban and peripheral air traffic. In addition, the group has proposed that, until the full implementation of U-space and advanced remote identification (D.R.I.) systems, it is essential that local authorities have access to tools that offer comprehensive monitoring of all unmanned aircraft in flight, both collaborative and non-collaborative.

In this context, the active participation of the City Council in the National Action Plan for the Deployment of U-space (PANDU) has been proposed, ensuring its integration in the design, approval and management of urban airspace volumes. This participation would enable the council to serve as a direct link with USSPs (U-space Service Providers), validating flight plans and establishing restrictions or conditions in accordance with

public safety circumstances or urban planning considerations.

Likewise, the need to establish clear procedures for intervention in the event of incidents involving unauthorised aircraft has been discussed, including threat mitigation plans and response protocols for accidents involving damage to people, property or infrastructure. These procedures must be coordinated between airspace operators, the municipal police and emergency services, anticipating critical scenarios such as drones falling in pedestrian areas, fires caused by lithium batteries, or interference with mass events. Similarly, it will be essential to consider specific evacuation protocols that allow for a rapid and orderly response in the event of an incident or accident, minimising additional risks to the affected population.

Finally, the group emphasised the importance of establishing variable no-fly zones that can be activated or deactivated based on specific contexts (such as events, adverse weather conditions, official visits, or forest fires). It was proposed that these zones be managed through an automated notification system for UAS operators and that the municipal authorities approve their boundaries as the competent authority in urban areas. This vision will provide the municipality with a real capacity to control and manage the airspace that overlaps with urban life and the city's critical infrastructure.

Flight Information System

Regarding the flight information system, the working group has emphasised the importance of providing local councils with advanced digital tools that enable them to manage urban airspace proactively, safely, and effectively. In such a dynamic environment as densely populated cities, where recreational, logistical, public service, and potential emergency flights converge, it is essential to have systems that integrate and visualise information relating to UAS operations in real-time.

One of the main objectives identified is to ensure that the council has direct and continuous access to air traffic management platforms specifically designed for unmanned aircraft. This requirement includes both current systems and future developments associated with the U-space ecosystem, particularly those that provide strategic visualisation services, dynamic authorisations, route monitoring and safety alerts. In this context, it is considered essential for the council to establish collaboration agreements with authorised USSPs to ensure its access to critical local airspace information.

The group has also raised the need to develop a specific municipal flight control tool that allows detailed route visualisation, aircraft identification, operator traceability and urban geofencing, i.e. the digital definition of perimeters and no-fly zones. This platform should be designed according to the principles of interoperability with state and European systems, integrating early warning functionalities, flight plan validation, regulatory compliance control and automatic notification of incidents or violations of restricted space.

Additionally, there has been discussion of creating a municipal ordinance that would regulate the use of urban space in detail, outline the conditions for operating unmanned aircraft, and apply differentiated administrative fees based on the level of risk, type of operator, flight zone, and purpose of the operation. This regulation would give the City Council greater control and revenue-raising capacity, while promoting regulatory compliance among private and public operators.

In short, the development and consolidation of a flight information system managed, or at least monitored, by the municipal administration is a key condition for ensuring that urban air mobility is deployed with guarantees of safety, institutional coordination and protection of public space.

Municipal UAS Operations

With regard to municipal UAS operations, the group has focused particularly on identifying the current and future needs of the various departments of the City Council that already use, or intend to use, unmanned aircraft as part of their public services. This work has revealed the existence of a growing number of operational applications,

from environmental monitoring and infrastructure inspection to the supervision of mass events or emergency assistance by security and civil protection forces.

Faced with this reality, the creation of an operational governance model that allows for the standardisation and coordination of these activities within the current regulatory framework has been proposed as a priority. To this end, it has been proposed to establish a system of well-defined roles, including profiles such as authorised operator, technical supervisor, administrative licence manager, aviation safety coordinator and maintenance manager. This standardisation would not only facilitate the operation and traceability of each flight, but would also allow for the application of common quality and control procedures to all areas of the City Council, under the supervision and control of the Directorate-General of the Madrid Municipal Police (DGMMP).

Likewise, the need to establish a municipal register of UAS operations has been identified, where all authorised missions, those responsible, the equipment used and the objectives of each intervention would be recorded. This register would serve as a documentary basis for both accountability and strategic planning of future operational capabilities.

Another important aspect addressed was the development of emergency response protocols to ensure a rapid, coordinated and effective response. These protocols must cover situations requiring immediate deployment (e.g., fires, accidents, or evacuations), as well as complex scenarios in which it is necessary to integrate the operation with other security forces, emergency services, or regional and national institutions.

Additionally, the need to ensure the continuous training of municipal personnel involved in UAS operations has been emphasised. This training should include both technical and regulatory content as well as practical training and drills, ensuring that municipal units operate in accordance with the highest standards of safety, efficiency and legality.

In summary, the development of municipal UAS operations requires cross-cutting planning that encompasses staff training, standardisation of roles, interoperability between services, and the formalisation of communication channels and joint intervention. These measures will consolidate the use of drones as a strategic public management tool, in line with regulatory and technological developments in urban air mobility.

Communication Frequencies

With regard to communication frequencies, the working group has addressed a fundamental issue for the safe and effective operation of unmanned aircraft: the management of the radio spectrum used in communications between operators, drones and control centres. In a dense and technologically complex urban environment, ensuring the integrity of communications is crucial to prevent interference, signal loss, or interruptions that could compromise operational safety.

The group has identified the need to establish specific, protected frequencies for operations carried out by municipal services and emergency services, such as the municipal police, fire brigade and medical emergencies. These dedicated frequencies would ensure continuity of communications in critical situations, where any failure in data transmission, video or remote control could have serious consequences. Unlike general-use frequencies, these protected bands would be reserved for priority uses and monitored through quality protocols and periodic verification.

It has also been proposed that frequency allocation should be coordinated with the Secretary of State for Telecommunications, and that network operators and UAS manufacturers should be able to adapt to this framework through specific approvals. This institutional collaboration would facilitate the creation of a solid regulatory environment that legally protects the exclusive use of frequencies in certain bands of the spectrum, minimising the risks of electromagnetic collision.

Additionally, it has been deemed advisable to develop redundancy and backup systems to ensure continuity of operations, even in the event of a failure in the main

frequency. These backup systems would include alternative encrypted channels and automatic switching mechanisms, especially in aircraft operating in sensitive areas or carrying critical cargo.

Finally, the group has recommended that, in parallel with technical implementation, specific training be provided to operating and supervisory personnel on the proper use of frequencies, interference management, transmission equipment maintenance and compliance with current regulations. This preventive and training approach will be crucial in ensuring the responsible use of the spectrum and anticipating potential technical conflicts arising from the exponential growth of connected devices in urban areas.

5.2.1 Conclusions of the Security Working Group

The analysis carried out by the Security Working Group has revealed a series of fundamental conclusions that structure a strategic vision of the challenges and needs faced by the Madrid City Council in the deployment of urban air mobility.

Urgent need for local governance

One of the main conclusions, in line with the sections dedicated to municipal UAS operations and the sanctioning procedure, is that city councils must assume an operational role within the U-space ecosystem. This involves defining clear local competences, establishing formal channels of action with other actors (ENAIRE, AESA, USSP, Community of Madrid), and creating internal organisational structures with defined roles, specific procedures and support technology.

Insufficient inter-administrative coordination

Based on the work carried out in the areas of streamlining procedures and coordination with aerodromes, there has been evidence of duplication of communications between administrations and a lack of access to critical information by municipal authorities. It is urgent to implement cooperation mechanisms and shared protocols that allow Madrid to have a comprehensive view of the airspace under its jurisdiction.

Lack of local regulation

The lack of a specific municipal ordinance on urban air mobility creates legal uncertainty and limits the council's ability to regulate the use of urban airspace, impose fees or manage licences. The infrastructure, operations and flight information system working groups have highlighted the urgent need to develop specific regulations that bring together all these elements at the local level.

Need for digital and integrated tools

The safe and efficient deployment of urban air mobility requires the City Council to have advanced technological platforms. These tools must enable real-time visualisation of authorised flights, remote identification management (D.R.I.), control of restricted areas and issuance of alerts. Their development is a priority drawn from the flight information system and operational coordination blocks.

Local managers without adequate technical resources

Currently, municipal services lack the technical infrastructure and technological means to detect, monitor or respond to incidents involving UAS. This shortcoming, particularly evident in the areas of infrastructure and communication frequency control, poses a risk to public safety and must be addressed through public investment and the transfer of capabilities from higher levels of government.

Relevance of training and common protocols

Finally, there is a clear need to establish a common training framework for all municipal areas involved in the management or use of drones. From infrastructure supervision to emergency response, every intervention must be based on harmonised procedures, interoperable systems and adequately trained personnel. This aspect has been

common to all the areas analysed.

These conclusions constitute an initial roadmap for the institutional transformation necessary for the effective integration of these technologies into a new model of safe, sustainable, and well-managed urban air mobility.

5.2.2 Proposed short-, medium- and long-term actions

Short-term actions (0-2 years)

- Creation of a unit specialising in Urban Air Mobility management within the Air Support Section of the Madrid Municipal Police.
- Creation of a group of experts to guide the City Council towards the safe implementation of innovative air mobility.
- Development and approval of an infrastructure inspection protocol (vertiports, dronepads, drone-in-a-box) addressing technical, administrative and operational aspects to be verified by the competent authority during each review.
- Direct access to the Ministry of the Interior's flight databases.
- Drafting of standard notification and penalty forms.
- Initiation of consultation processes with ENAIRE and USSP to prepare for U-space..

Medium-term actions (2-5 years)

- Drafting and approval of a Municipal Ordinance on urban air mobility.
- Development of a digital flight control tool with route visualisation and geofencing.
- Establishment of exclusive frequencies for emergency UAS.
- Formal participation in the National U-space Plan (PANDU).
- Creation of dynamic exclusion zones (events, fires, official visits).
- Internal training campaigns and training of municipal inspectors to fulfil the functions of the City Council within the framework of the infrastructure inspection protocol.

Long-term actions (5-10 years)

- Full integration as a local USSP service provider or contracting one.
- Consolidation of a municipal system for the detection, management and control of UAS.
- Coordination with aerodromes and regional airspace in metropolitan areas.
- Development of specific observation, control and emergency infrastructure.
- Comprehensive review of safe flight zones, corridors, and evacuation plans.
- Consolidation of protocols for responding to UAS aircraft accidents.

5.3 Grupo 3. Operaciones

The Operations Group addresses all technical and logistical aspects that will enable urban flights with drones and other unmanned aircraft to become a reality. Its mission is to define the operational requirements necessary for these flights to be carried out safely, efficiently, and in coordination with other urban mobility services. This includes everything from flight routes and weather conditions to the planning of special or emergency operations.

One of its key functions is coordination with air navigation service providers, such as ENAIRE, to integrate low-altitude flights into existing airspace without interference.

Additionally, this group examines technologies and platforms for automated urban air traffic management (U-space), enabling real-time control and tracking of flights. Its work will be crucial to making the system operationally viable.

In summary, the group's objectives are as follows:

- Definition of operational requirements.
- Liaising with air navigation providers.
- Definition of operational safety and emergency procedures in the event of incidents.

This summary document synthesises the main topics addressed during the group's work, highlighting the regulatory, operational, strategic and technological elements that are fundamental to the deployment of these operations.

Current status of drone operations in Madrid

Currently, drone operations within the municipality of Madrid occur on an ad hoc basis, with little institutional coordination and no common strategy for their development in the medium or long term. Existing authorisations, generally linked to uses such as audiovisual filming or technical inspections, are managed by different departments of the City Council in isolation, with criteria that do not always reflect a comprehensive view of operational risk. For example, the usual procedure involves granting authorisation to occupy 50 m² of public space, without this guaranteeing complete traceability of the flight or prior coordination with ENAIRE or other airspace managers.

Communication between the City Council and the Municipal Police regarding these operations is limited to notification of permits granted, without a digital system that allows for real-time monitoring, integrated planning, or systematic collection of data on the number, type, and location of flights carried out. This situation highlights the need to review current procedures and move towards greater inter-administrative coordination, facilitating the safe and efficient deployment of recurring operations.

Strategic vision and municipal powers

From a strategic perspective, the Madrid City Council views itself as a facilitator of urban air mobility development, without assuming direct aeronautical powers, but rather taking on a central role in the habilitation of public space and managing the ground-based risks associated with these operations. This position involves actively working on the definition of municipal regulations, designing authorisation processes consistent with the European regulatory framework, and coordinating with entities such as ENAIRE, AESA, and future U-space service providers.

One of the keys to this vision is to clearly define the scope of municipal responsibility. The City Council should focus on assessing and mitigating risks to people and property on the ground, leaving airborne risk management to flight operators and the relevant aviation authorities. To achieve this objective, it is essential to have detailed knowledge of the deadlines, criteria and operational capabilities of national actors, as well as to establish stable collaboration mechanisms that guarantee the interoperability of technical and administrative systems.

Viable use cases and associated technologies

Throughout the group's work, a series of use cases with high potential for implementation in the short and medium term have been identified, particularly those that can be directly led by municipal services. Among the most relevant applications are police surveillance using autonomous take-off and landing systems (drone nests), control and supervision of infrastructure conditions such as bridges, pavements, and facades, environmental and forest monitoring in urban and peri-urban areas, as well as traffic control and detection of illegal dumping at facilities.

To implement these use cases viable, specific technologies must be incorporated, such as collision detection systems, remote aircraft identification, reliable C2 communication links in complex urban environments, and U-space service platforms in both their basic

(U1-U2) and advanced (U3-U4) versions. Additionally, standard operating scenarios must be established for each use case, classifying operations according to their level of risk (SAIL I-VI), and allowing for proper assessment by the competent authorities.

Classification of operations

Urban air operations can be classified according to two complementary approaches: by aircraft type (manned or unmanned) and by regulatory category (open, specific or certified). In the case of manned aircraft, such as eVTOLs, it is expected that they will require certification in accordance with civil aviation regulations, following standards similar to those for helicopters. These vehicles will be able to provide emergency services, medical transport, logistics or even air taxi services, although their implementation in urban environments is projected to be a long-term project, from 2030 in regional scenarios, and beyond 2040 in dense urban areas.

For their part, operations with unmanned aircraft offer a wider range of possibilities in the short and medium term, especially in the open and specific categories. The open category, corresponding to low-risk operations (SAIL I-II) and visual line of sight (VLOS) flights, already permits the development of applications such as surveillance, technical inspections, and audiovisual filming. In this context, the role of the City Council focuses on authorising the occupation of public space and verifying possible environmental impacts.

In the specific category, which covers medium-risk operations (SAIL III-IV) and both VLOS and beyond visual line of sight (BVLOS) flights, possibilities are opening up for more complex services such as police surveillance, medical transport and large-scale environmental data collection. These operations will require a greater degree of technological support and the presence of fully operational U-space services. Finally, the certified category includes high-risk operations (SAIL V-VI), mainly associated with manned aircraft, whose urban implementation is expected in the long term.

Proposal for process improvement and coordination

One of the key areas identified by the group is the need to review and optimise current operational authorisation and supervision processes. In this regard, it is proposed to move towards the creation of a one-stop shop that integrates the main actors, such as ENAIRE, the Municipal Police, the Ministry of the Interior, the Ministry of Defence, the Community of Madrid and the various areas of the City Council involved, to simplify administrative procedures and improve the traceability of operations.

A review of current municipal regulations is also proposed, particularly with regard to the occupation of public space, which currently requires a minimum area of 50 m² without differentiating between types of operation or level of risk. A more flexible system could replace this approach adapted to the actual risk, incorporating technical criteria based on the type of aircraft, the urban environment, the operator's profile and the type of service provided.

Additionally, it is necessary to provide municipal services with technical capabilities to support operations, including digital elevation models, microclimate prediction systems, and dynamic population density analysis tools. These resources will enable the City Council to more accurately assess the risk on the ground and establish safe operating areas for different types of missions.

Interaction with economic operators

The group has emphasised the importance of establishing a clear strategic framework to facilitate interaction between the City Council and economic operators interested in developing business models linked to air mobility in Madrid. This framework must offer legal certainty, transparent processes, and a stable roadmap that allows companies to plan their investments and deployments with confidence.

To this end, it is proposed to establish a formal channel that allows operators to submit service proposals, which will be evaluated by a technical advisory body based on criteria such as technological maturity, financial solvency, clarity of the operational

roadmap, estimated economic impact, and expected volume of operations. This mechanism will enable the identification of viable pilot projects, prioritisation of the most relevant ones, and support for them during their deployment phase.

As a natural evolution of the current group, the creation of an advisory structure is proposed, bringing together technical representatives from the municipal areas involved, together with external experts, and with the capacity to select use cases to be developed on an annual basis, promoting an orderly and scalable strategy for the integration of air mobility in the city.

5.3.1 Conclusions of the Operations Working Group

Urban air mobility represents a strategic opportunity for Madrid, not only because of its technological and economic potential, but also because of its capacity to transform the way essential public services are provided and urban space is managed. Throughout the work carried out by the Operations Group, it has become clear that the orderly and safe deployment of air operations in urban environments requires coordinated action between administrations, operators, and technology providers, with the Madrid City Council playing a key facilitating role.

Firstly, it has been noted that, although current drone operations in the city are still limited and fragmented, there is ample scope for their expansion in cases of high public value, such as surveillance, infrastructure inspection or environmental monitoring. However, for these operations to scale up, it is essential to review existing administrative processes, update municipal regulations and provide technical services with tools that enable them to adequately assess and manage risk on the ground.

Secondly, interaction with the economic ecosystem will be decisive in creating a solid and sustainable market. This involves defining a clear roadmap at the municipal level, with transparent procedures for selecting and evaluating projects that will attract private investment, promote high-impact pilot projects, and consolidate Madrid as a benchmark city in advanced air mobility.

Thirdly, there is a clear need to establish a single operational window that integrates ENAIRE, the Municipal Police, the Ministry of the Interior, the Ministry of Defence, the Community of Madrid, and the various technical departments of the City Council into a unified workflow. This structure should facilitate not only the processing and authorisation of operations, but also their real-time monitoring, the traceability of information and the availability of data for impact analysis and future planning.

Finally, the gradual implementation of U-space services nationwide presents an opportunity to build an urban architecture that is interoperable with digital airspace. Madrid must prepare to be one of the first cities to take advantage of this transition, establishing preferred flight zones, clear authorisation criteria and a solid technological foundation that guarantees safe, sustainable operations aligned with the city's objectives.

The group's work has laid the foundations for building this shared vision, identifying the main challenges and proposing specific lines of action. The next step is to consolidate this approach into a municipal strategy that combines long-term vision, progressive piloting of use cases and institutional capacity building, to integrate urban air mobility as a new layer of public service for the city of the future.

5.3.2 Proposed short, medium and long-term actions

Short-term actions (0-2 years)

- Create a technical coordination group comprising the City Council, ENAIRE, the Ministry of the Interior, the Ministry of Defence, the Community of Madrid, and the Municipal Police, among others, to streamline authorisations and facilitate operational cooperation.

- Review municipal procedures for the occupation of public space by drones, incorporating criteria for ground risk, environmental and geographical conditions.
- Develop internal pilots for the City Council in cases of viable use under current regulations (remote surveillance, tree inspection, etc.).
- Design a sandbox procedure to evaluate and facilitate the development of experimental proposals from private operators in controlled environments.
- Begin drafting a technical and regulatory roadmap for UAS operations at different SAIL levels.
- Collect municipal technical and urban planning requirements to integrate them into future urban airspace regulations.

Medium-term actions (2-5 years)

- IImplement a single digital window for processing authorisations, in coordination with ENAIRE and local and regional authorities.
- Develop a digital model of the urban terrain and hyperlocal weather forecasting systems, which are key to risk assessment.
- Define standard operating scenarios for different types of missions (authorised areas authorised areas, technical conditions, mitigations, etc.).
- Expand active municipal use cases, incorporating BVLOS operations in SAIL III/IV and cases with greater technical complexity.
- Consolidate light UAS infrastructure such as drone nests, logistics boxes or shared landing areas at different points in the city.
- Establish an advisory group of economic operators with evaluation, advisory and strategic guidance functions.

Long-term actions (5-10 years)

- Establish a mature institutional infrastructure for urban airspace management, coordinated with ENAIRE and U-space services.
- Enable preferential zones and urban air corridors, defined by the type of mission, safety and compatibility with the environment.
- Deploy the first vertiports or specific take-off areas for regular or certified operations, integrating them with urban and regulatory requirements.
- Adapt urban planning and environmental regulations to regulate land use, acoustic and visual impact, and associated social requirements.
- Assess the impact of urban air mobility using indicators of sustainability, efficiency, public acceptance and economic return.
- Position Madrid as a European benchmark in the advanced integration of the third dimension in urban planning and public services.

5.4 Group 4. Infrastructure

The Infrastructure Group focuses on the design and urban planning of the physical elements that will make air mobility possible: vertiports, electric charging stations, logistics centres, etc. Its objective is to identify suitable locations within Madrid's urban fabric for the installation of these infrastructures, taking into account factors such as accessibility, visual impact, compatibility with the environment and urban planning regulations.

In addition to identifying these spaces, the group is exploring ways to integrate this infrastructure into existing public buildings or new constructions. It is also studying how to adapt urban space to accommodate and manage passenger and freight flows

linked to air transport. Ultimately, this group's mission is to ensure that air mobility is not only functional but also fits harmoniously into the city.

In summary, the working group's objectives are as follows:

- To analyse the deployment of urban air mobility infrastructure from an urban planning and safety perspective.
- To analyse the procedures for establishing infrastructure for different needs:
    - o Passenger transport.
    - o Freight transport.
- Analysis of the use of drones (landing/take-off) in buildings and public spaces.

The Infrastructure Working Group of the Madrid Urban Air Mobility Commission has produced a comprehensive multidisciplinary analysis of the needs, types, locations, management and regulations related to the infrastructure that will enable the development of urban air mobility (UAM) and regional air mobility (RAM). Through a technical, legal, urban planning and operational approach, the document delves into the creation and adaptation of infrastructure for UAS and eVTOL aircraft.

Innovative Air Mobility (IAM) represents a revolution in urban and regional transportation through aircraft that take off and land vertically (VTOL), many of which are electric (eVTOL), and unmanned systems (UAS). This new mobility consists of two fundamental branches:

Urban Air Mobility (UAM): focused on dense metropolitan environments, with solutions such as air taxis and last-mile deliveries.

Regional Air Mobility (RAM): geared towards transport between nearby cities or regions.

Within these two areas, an analysis is carried out of the most important factors to be taken into account for the integration of these infrastructures into the urban framework:

Types of infrastructure

Urban adaptation to advanced air mobility requires a new generation of specific

infrastructure. The main ones are as follows:

- **Vertiports**: complete, certified infrastructures for eVTOL operations, including take-off/landing areas, loading areas, passenger terminals and technical services. They are the urban equivalents of airports and heliports. Within vertiports, some have specific types (EASA, 2022), such as:
    - o **Vertistops**: lightweight, modular facilities designed for rapid operations. They are ideal for urgent transport, healthcare services and areas with limited space.
    - o **Vertihubs**: large-scale logistics or transport centres, strategically located, with multiple FATOs (Final Approach and Takeoff Areas) and complementary services.
- **Dronepads and temporary heliports**: a fixed, temporary or mobile spaces designed for specific small drone operations.
- **Drone-in-a-box**: an autonomous system that integrates a station for the deployment, recovery, charging and storage of drones. It enables continuous, remote operations without direct human intervention, with applications ranging from inspection and security to logistics and emergencies. Notable examples in this category include:
    - o Logistics lockers: automated urban lockers for the collection/delivery of parcels by drones, integrated into urban logistics.

Each type responds to different levels of demand, budget and urban conditions, and can form part of interconnected functional networks.

Urban design and integration criteria

The design of aeronautical infrastructure in urban environments requires rigorous planning that takes into account multiple strategic factors. First, the location must maximise social utility, so vertiports should be located in areas with high functional value, such as hospitals, intermodal transport hubs or logistics areas.

This choice must be accompanied by strict regulatory compliance, both with aviation legislation, under the supervision of bodies such as EASA, AESA or the Autonomous Community, and with current urban planning and building regulations. Another essential aspect is the minimisation of visual, acoustic and environmental impact, encouraging the reuse of existing infrastructure, such as rooftops or car parks, and the adoption of clean and silent technologies. In addition, these facilities must be designed with a high degree of scalability and flexibility to adapt to progressive growth in operational demand, incorporating electrical charging systems, digital control, navigation and security.

All of this must be integrated with an intermodal approach that guarantees direct and seamless connections with other modes of transport, such as buses, underground, bicycles or shared vehicles, thus facilitating the efficient transit of passengers and goods within the urban ecosystem.

Legal Framework

The current regulatory framework does not specifically address the infrastructure required for urban air mobility, which creates uncertainty and hinders its development. The Working Group's document proposes legally recognising vertiports as specific aeronautical infrastructure adapted to the urban environment and developing specific technical regulations for their design, certification and operation, distinct from those applied to traditional heliports or aerodromes.

It also proposes the creation of a "one-stop shop" to streamline and centralise administrative procedures for UAS operations, given the current dispersion of competences among different administrations. emphasisesAdditionally, it insists on the importance of integrating vertiports into local urban plans to facilitate their implementation and ensure compatibility with other land uses.

The legal framework must be adapted to new operating models, such as autonomous flights, eVTOL certification and digital airspace management (U-space). Finally, the importance of harmonising these measures with European and international regulations is emphasised in order to ensure interoperability and global recognition.

5.4.1 Conclusions of the Infrastructure Working Group

Differentiation of types

The infrastructure required for air mobility must clearly differentiate between the facilities required by eVTOL aircraft and those used by light UAS. While eVTOLs, which are designed for passenger and cargo transport, require complex, certified vertiports with recharging services, air traffic control and terminals, smaller UAS used for logistics, surveillance, or public services can operate from simpler infrastructure such as temporary or mobile drone pads, without such demanding regulatory requirements. This distinction responds to operational, regulatory and urban impact differences and allows for more flexible, scalable and secure development of the air mobility ecosystem.

Need for a specific regulatory framework

There is an urgent need to define national and European regulations that legally recognise vertiports as aeronautical infrastructure adapted to the urban environment. This legislation must consider technical, operational and urban planning aspects to facilitate their implementation with legal certainty, and also clearly define the competences, operations permitted in these infrastructures and authorisation procedures when necessary. Likewise, this regulatory framework should establish requirements applicable not only to vertiports, but also to smaller UAS operating

areas, such as dronepads, thereby ensuring a coherent, safe and harmonised urban ecosystem for air mobility.

Vertiports are strategic infrastructure

They are not ancillary elements, but critical nodes for enabling urban air mobility. Their presence will enable better connections between cities, respond to emergencies and relieve congestion on other transport infrastructure.

Social acceptance and effective governance

To be successful, this new mobility model needs public support, participatory processes and transparent management, with a one-stop shop to simplify and coordinate all procedures between administrations and operators.

5.4.2 Proposed short, medium and long-term actions

Short-term actions (0-2 years)

- Piloting of sandbox projects and urban demonstrators.
- Establishment of municipal units formed by teams specialising in infrastructure planning and control.
- Identification of potential locations.

Medium-term actions (2-5 years)

- Deployment of initial physical infrastructure for UAM
- Establishment of certified procedures.
- Consolidation of collaboration agreements

Long-term actions (5-10 years)

- Progressive automation of flights.
- Construction of the first vertiports.
- Regulatory and technical developments.
- Full integration into smart cities.
-

5.5 Group 5. Environment and Citizenship

The purpose of this group has been to analyse in depth the impacts from different perspectives, the possibilities and challenges involved in introducing unmanned aircraft technologies in the urban context of Madrid, as well as to propose responsible integration that is accepted by the public.

The first phase of the work consisted of defining the scope and nature of urban air mobility (UAM), understood as a transport system complementary to land transport that uses unmanned aircraft, such as drones and eVTOLs, to provide services and transport goods and people. This emerging technology promises to profoundly transform the urban ecosystem, offering solutions to problems related to traffic congestion, emergencies, logistics and environmental monitoring, among others.

Regarding the aircraft involved, the most recent regulatory classification is provided, which categorises them into three levels of risk: open, specific, and certified. Each category includes specific requirements related to the drone's weight, the type of operation (with or without a visual line of sight), and the need for authorisations or certifications. The vast majority of drones currently operating in Madrid fall into the open and specific categories, with uses mainly linked to surveillance, infrastructure inspection and emergency support.

Use cases

The working group considers it essential to identify and catalogue the different use cases, distinguishing between those of general interest (such as emergencies, surveillance, health logistics or public services) and those of a private nature (such as leisure, entertainment or personal transport). This classification is key to assessing the ethical, legal and technical constraints associated with each operational context, as well as to understanding the possible social perception and levels of acceptance or rejection that each use may provoke.

According to surveys from other countries or cities analysed, there is greater public acceptance for uses that can be classified as being in the general interest. Currently in Madrid, drones are used for surveillance, filming events and some environmental monitoring tasks.

When assessing the potential social acceptance and environmental impact of new mobility, the analysis of the infrastructure required for implementing urban air mobility has been considered highly relevant. It has been concluded that, to operate drones on an urban scale, it will be essential to have a network of vertiports, infrastructures similar to aerodromes, adapted to urban environments, which may vary in scale and function (transport of people, goods, technical services, etc.).

In addition, these vertiports must comply with requirements regarding accessibility, energy, traffic control, safety, compatibility with the urban fabric, and respect for the environmental and social surroundings. Municipal regulatory development must take into account the specific characteristics of the facilities, which must be aligned with the needs of the industry, their urban integration, and the constraints derived from Madrid's consolidated environment, as well as its protected natural spaces, when allowing their implementation in the city.

The methodology adopted by the working group has been fundamentally collaborative. Through regular meetings and the sharing of technical documentation, regulations and legislative proposals, it has been possible to generate a comprehensive and rigorous body of documentation. This approach has enabled the active participation of experts, municipal technicians and representatives of the private sector, consolidating a plural and cross-cutting view of the UAM phenomenon.

Likewise, an exhaustive compilation of existing regulations has been carried out, both at European Union level (where the European Green Deal stands out as the general framework) and at national, regional and local levels. At the municipal level, the Madrid 360 Environmental Sustainability Strategy has been identified as a valuable starting point for the integration of environmental criteria into future urban air mobility regulations, highlighting the following thematic categories: visual, noise and electromagnetic pollution, impact on birdlife and the landscape, privacy and data protection, among others.

The compilation of regulations contains regulatory aspects that must be considered as a starting point for detecting possible impacts on citizens' rights and the environment.

The objectives that have guided the group's work have been: to understand the environmental and social impacts of drone use, to encourage citizen participation in the design of solutions, and to promote a regulatory framework tailored to the city's real needs. This documentary and methodological basis constitutes the pillar on which the recommendations and conclusions developed in the following sections are based.

5.5.1 Conclusions of the Environment and Citizenship Working Group

The preparation of the White Paper on urban air mobility in Madrid has provided a comprehensive and critical overview of the current state of this technology, its potential development in the city, and the challenges it poses from an environmental, regulatory, and social perspective. Based on documentary analysis, technical meetings and a

review of existing studies, the following key conclusions can be drawn:

The city of Madrid is at an early but strategic stage for the development of urban air mobility.

The SWOT analysis carried out by the working group shows that, although there is still no significant operational implementation of UAM in the municipality, except for the usual surveillance operations carried out by the city's security services and specific pilot projects, there is a solid institutional basis, through the Urban Air Mobility Commission, which allows progress to be made towards specific regulations adapted to the urban context. The existence of general European and national regulations provides an important foundation; however, it is necessary to develop specific local regulations that address the uniqueness of Madrid's consolidated urban environment, its protected natural spaces, its spatial limitations, and its particular social and environmental conditions.

Public acceptance will be a decisive factor in the success or failure of the technology.

Despite growing technical interest in the use of drones, the surveys and studies analysed (such as publications by EASA, SESAR and the Multidisciplinary Digital Publishing Institute - MDPI) show clear public concern about the impact of the technology on privacy, physical and cyber security, and noise. Mitigation measures, such as information campaigns, regulatory transparency, and live or virtual pilot projects with public participation, are essential tools for building trust among the population. The prior public consultation, planned on the DecideMadrid participation platform, will be a key step in this regard.

It is essential to ensure the physical safety of citizens through robust protocols and tools such as U-space, to minimise incidents and build trust in the sector. The determination of an acceptable threshold for accidents or incidents should be left to the competent European or national regulator, as this is a technical area that requires specialised and harmonised criteria at the supranational level.

There are real environmental benefits, but these are conditional on responsible and regulated use.

The document includes technical evidence, such as a study by Cranfield University (Cranfield, 2024), which demonstrates that the use of drones can reduce CO_2 emissions compared to conventional vehicles, particularly in logistics operations that utilise electric propulsion systems. However, it also warns of new sources of noise, light and electromagnetic pollution, as well as the impact on urban wildlife, particularly birds. This requires the establishment of noise thresholds, operating protocols in sensitive areas and integrated mapping that combines environmental data with potential flight paths.

Likewise, the industry is developing alternative fuel propulsion systems that enable greater endurance than current technology, but has yet to focus on the life cycle of the materials and energy used.

The lack of specific local regulations limits technological planning and deployment technological.

The working group identifies a clear weakness: a division of competences over airspace below 120-150 m among the different administrations, including state, regional, and local.

Once the areas of competence of the different administrations in the field of urban air mobility have been clearly defined, it would be possible to draw up a municipal ordinance specifically regulating operations within the city. Without this, legal uncertainty arises for operators, citizens and authorities.

It is necessary to establish criteria for the location of vertiports, acceptable noise levels, the layout of air corridors and environmental impact requirements.

The approval of Ordinance 1/2025, which regulates the **controlled testing environment**

for **innovative projects** in the city of Madrid (Sandbox Madrid), is a positive step, but it is insufficient for the structured deployment of this technology on an urban scale, given the lack of an operational competence framework.

Current urban infrastructure needs to be adapted to integrate new modes of air mobility.

The implementation of vertiports poses significant technical challenges. The document identifies the lack of space in the consolidated city, the need to define what a vertiport is in regulatory terms and how it should connect with the rest of the urban transport system.

It also highlights the importance of adapting urban planning regulations and defining the technical requirements for their implementation, such as energy supply, accessibility and the structural capacity of buildings.

The experience of EASA and the **Spanish Innovative Air Mobility Cluster** (SIAM) in designing vertiports could serve as an initial reference.

Pilot projects are key tools for testing the technology and analysing public perception.

The three pilot projects analysed (MUSE SESAR, ALE-HOP, and U-ELCOME) demonstrate that experimentation in controlled environments allows for the collection of useful data on noise, visibility, response times, public acceptance, and operational feasibility. In the case of Madrid, it is considered a priority to carry out pilot projects in outlying neighbourhoods and with public services (health, emergencies, police) as a first step towards a phased and transparent implementation that can enjoy greater social acceptance. These trials should incorporate environmental measurements, perception surveys, regulatory analyses and real and virtual simulations of urban air mobility.

Governance and transparency institutional are essential for socially legitimate implementation.

The need to create a clear institutional structure with as few intermediaries as possible to manage urban air mobility, resolve incidents, channel citizen queries and centralise public information is highlighted. Proposals such as a UAM Information Portal, a citizen app, information campaigns and suggestion boxes are outlined as essential measures to ensure participatory governance. In addition, the importance of defining legal responsibilities for data processing, infrastructure management, and flight operations is emphasised to avoid insecurity for both citizens and users.

Urban air mobility can become a driver of innovation and technological employment in the city.

From a strategic perspective, the working group highlights the potential of the UAM as a lever for economic development, professional training and attracting investment. Madrid, due to its size, infrastructure and technological ecosystem, can position itself as a European benchmark in air mobility if it adopts a coherent, sustainable and inclusive strategy. To this end, it will be essential to link the deployment of this technology with policies on sustainability, renewable energy, the circular economy and specialised training.

5.5.2 Proposed short, medium and long-term actions

Short-term actions (0-2 years)

- Participatory processes to identify citizens' concerns and opinions:
    - o Through the DecideMadrid platform
    - o Through other tools such as surveys segmented by age, district, and employment profile.
- Small-scale pilot projects:
    - o Flight tests in peripheral areas.

  - o Measurement of noise and vibrations in real situations.
  - o Virtual simulations

- Outreach campaigns:
  - o Presentations, seminars, training courses, etc.
  - o Communication campaign with explanatory videos on the benefits and risks.

- Integrated municipal map:
  - o Unify municipal thematic maps of the subjects involved, such as noise, SPAs (Special Protection Areas for Birds) and low emissions, with those that show flight routes and prohibited or restricted areas currently defined by the State for UAS.
  - o Compilation of regulatory restrictions relating to the areas mentioned above in a single digital map.

- Legal clarification:
  - o Definition of areas of competence in the field of air mobility: State, autonomous communities and municipalities.
  - o Establish limits on privacy, video surveillance and new noise levels.
  - o Standardise the data or images that may or may not be captured.

Medium-term actions (2-5 years)

- Municipal Regulatory Development:
  - o Specific ordinance on urban air mobility in Madrid.
  - o Inclusion in the City Council's Regulatory Plan.

- Implementation of pilot vertiports:
  - o Pilot projects in outlying neighbourhoods.
  - o Assessment of technical aspects, including structures, vibrations, and access to the electricity grid

- Digital Governance Platform:
  - o Portal with institutional roles, regulations, incidents and results.
  - o Citizen app.

- Environmental standardisation:
  - o Establishment of noise thresholds and protocols.
  - o Guidelines for operation in areas with birdlife.

- Academic and professional training:
  - o Programmes at universities, R&D centres and technical schools on UAM.

Long-term actions (5-10 years)

- Urban network of vertiports":
  - o Integration with public transport and intermodal hubs.
  - o Modular vertiports powered by renewable energy.

- Coordinated U-space system in Madrid:
  - o Digital and intelligent control of drone air traffic.

- Sustainable local industry:
  - o Encouraging R&D for quieter drones with a smaller carbon footprint.

- Continuous updating of regulations:
  - o Based on pilot experiences, new technologies and social developments.

o Mandatory citizen participation in every substantial modification.

5.6 Group 6. Economic operators

Within the framework of the Madrid City Council's Urban Air Mobility Commission, the Economic Operators Working Group has focused on identifying the challenges, opportunities, and needs associated with integrating economic actors into the emerging urban air mobility (UAM) ecosystem. This work has enabled the establishment of an initial, structured vision of the economic operators and their roles in the development, validation, and implementation of innovative, sustainable, and safe services in Madrid's urban airspace.

During the process, it has been found that private sector participation is essential to accelerate the maturity of the UAM ecosystem, facilitate technological innovation, attract investment and deploy solutions that respond to real urban needs. However, it has been found that, for the time being, there are no mature business models for implementation in the short or medium term related to urban air mobility, beyond the experimental trials currently underway, which will probably make it possible to address and resolve the problems detected to launch businesses that are profitable for economic operators and beneficial for citizens. Therefore, it is expected that, within a reasonable timeframe, the current situation will evolve towards the introduction of business models related to urban air mobility that are beneficial to both economic operators and citizens.

Similarly, it has been found that the large number of actors involved in establishing a business model related to urban air mobility, as well as its multidisciplinary nature (aeronautics, land infrastructure, telecommunications, land transport, involvement of various administrations, etc.), can be a further obstacle to the development of business models. Therefore, it makes particular sense to maintain a working team that can facilitate the implementation of a sustainable business model in the city of Madrid. Throughout the work carried out, the fundamental elements that should guide the development of economic operators, whether public or private, in the city have been defined:

- **Identification of interested economic operators** to forecast demand and supply for potential services, thereby developing a strategy that enables the adaptation of deployment plans.
- **Identify the city's real needs** that can already be met with drones or where drone technology can be applied to improve a process or business model.
- **Need for a stable and transparent strategic framework** that allows companies to submit proposals with legal and operational guarantees.
- **Creation of a formal channel of interaction** through which operators can submit their service models for technical and strategic evaluation by a specialised advisory body.
- **Promotion of viable pilot projects** that allow solutions to be validated in real conditions and contribute to the phased development of urban air mobility in Madrid.

As a result of the working group, it is proposed to evolve towards a governance structure that includes a permanent multidisciplinary advisory body with expertise in all areas involved in the process and with the capacity to prioritise the most relevant use cases annually and accompany their deployment, thus reinforcing the role of the City Council as a facilitator of safe, efficient urban air mobility that is open to public-private collaboration.

5.6.1 Conclusions of the Economic Operators Working Group

The work carried out by the Operations and Economic Operators Working Group of the Madrid City Council's Urban Air Mobility Commission has highlighted the strategic

importance of having a structured and proactive framework for integrating economic operators into the urban air mobility ecosystem.

Firstly, it has been demonstrated that public-private collaboration is a crucial factor in the successful deployment of urban air services, particularly in the early stages of implementation. Economic operators contribute not only the necessary technology and operational capacity, but also innovative business models that can respond to specific urban needs, such as surveillance, infrastructure inspection or light goods transport, as well as evolving some of the services that local authorities provide to their citizens.

However, the current situation has significant shortcomings in terms of knowledge transfer, institutional coordination, operational traceability, and regulatory clarity. To reverse this situation and enable an environment conducive to investment, it is a priority to establish integrated administrative procedures, transparent technical criteria and evaluation mechanisms that offer legal certainty to interested operators.

Similarly, there is a clear need to create a formal channel of communication between the City Council and economic operators, facilitating the presentation and analysis of proposals, the promotion of pilot projects, and the strategic selection of use cases aligned with municipal priorities.

In this regard, the City Council must assume a facilitating role, acting as a guarantor of safety on land and social acceptance, a promoter of enabling urban environments and a coordinator of intermodal, sustainable and inter-institutional processes. To this end, it will be essential to equip itself with technical capabilities and analytical tools that allow for the proper assessment of the impact and viability of operations.

Finally, the group proposes moving towards a stable and scalable governance structure based on needs and developments, which integrates the municipal technical vision with sector knowledge and enables the definition of a progressive and scalable roadmap for integrating urban air mobility into the city. This strategy should attract serious operators, encourage responsible innovation and ensure that the economic and social benefits of these new forms of mobility materialise for the benefit of citizens.

5.6.2 Proposed short, medium and long-term actions

Short-term actions (0-2 years)

- Conduct a municipal inventory of potential economic activities in the UAS sector to assess the potential volume of operations and services.
- Conduct demand studies and analyses of priority use cases for urban air mobility, along with defining their implementation timeframe.
- Prepare information material by the Madrid City Council for operators interested in developing UAS services, allowing interested parties to learn in advance about municipal administrative procedures and the bodies to which they should apply.
- Establish the operational, regulatory and dialogue bases to facilitate the entry of economic operators into the urban air mobility ecosystem.
- Creation of a formal channel for dialogue with economic operators, allowing them to submit proposals and technical queries and establishing a framework for ongoing dialogue.
- Design a technical and strategic project evaluation procedure based on criteria such as technological maturity, solvency, urban impact and operational viability.
- Launch a call for pilot projects to validate proposals submitted by economic operators in a real-world environment, particularly in sectors such as surveillance, infrastructure inspection, and light logistics.

Medium-term actions (2-5 years)

- Once the analysis of economic operations has reached a sufficient degree of maturity, formalisation of a permanent advisory structure, made up of municipal technicians and external experts, to guide the operator integration strategy and prioritise use cases on an annual basis.
- Creation of an office to assist and support companies in the sector that wish to incorporate UAS activities.
- Promotion of sustainable business models aligned with urban needs, seeking to simplify and streamline administrative procedures.
- Publication of annual activity and evaluation reports, including aggregate data on economic operators, use cases deployed, incidents and lessons learned.

Long-term actions (5-10 years)

- Concession or tendering of strategic public air services, such as urban surveillance, health logistics, environmental control, mobility management or emergency services, in collaboration with certified operators.
- Development of an advanced local regulatory model that includes public-private partnership models for the operation of associated infrastructure (vertiports, drone stations, etc.) or services.
- Development of municipal management mechanisms and the necessary IT systems to promote the implementation of models that are orderly, sustainable, safe and integrated with the existing urban transport system.
- Attracting international investment and positioning Madrid as a hub for innovation at the UAM through promotion programmes, institutional presence at international forums and collaboration with technology hubs.
- Evaluating the integration of manned aircraft (eVTOL) for higher-impact services, such as air taxis or inter-city transport, under certified regulatory frameworks and with specialised operators.

6. Roadmap

The transition to functional, safe and sustainable urban air mobility will not happen immediately or spontaneously. It requires planning, coordination and a shared strategic vision for the medium and long term.

For this reason, developing a roadmap for the city of Madrid becomes a strategic tool for aligning the efforts of the Urban Air Mobility ecosystem, from its current situation to a scenario in which this new dimension of mobility is a reality integrated into the urban and metropolitan system.

This roadmap is not a fixed timetable, but rather a framework that establishes milestones, priorities and necessary conditions for the orderly development of urban air mobility. Aligned with the latest version of the National Action Plan for the Deployment of U-space (PANDU), particularly with regard to the administrative part of objective 4 of that document, this roadmap integrates regulatory, technological, operational, social and environmental aspects, with a cross-cutting perspective that allows synergies to be identified and obstacles to be anticipated. It is a dynamic instrument that must be able to adapt to technological developments, regulatory advances at both national and European levels, and, above all, the needs and expectations of Madrid's citizens.

The design of this roadmap has been informed by the work carried out within the Urban Air Mobility Commission and its working groups, as well as by the analysis of international experiences and the lessons learned from the first pilot projects in urban environments.

The following chapter presents the roadmap for the progressive deployment of urban air mobility in Madrid until 2035. Organised according to the working groups and divided into three distinct phases – short term (2026-2028), medium term (2029-2031) and long term (2032-2035) – it will need to be revised in line with developments in key areas such as regulations, technology and social acceptance, in order to adjust the deployment plan to developments in the sector.

The following tables present the activities identified, grouped by each of the categories defined for analysis in this White Paper. This is a summary prepared by the working groups, which does not exhaustively cover all the actions discussed, but rather those considered most relevant to the roadmap.

The inclusion of activities in the roadmap has no legal relevance or effectiveness and does not imply any specific commitment on the part of Madrid City Council or the administrations and institutions that form part of the Urban Air Mobility Commission. Its value is limited to that of a qualified exercise in reflection and analysis that sheds light on the future development of this new reality.

In addition to the categories of analysis, a new category called "Governance and Ecosystem" has been included, which encompasses those cross-cutting actions that do not clearly fit into any of the thematic categories. In implementing the roadmap, activities may be merged where synergies exist, or, conversely, actions may be subdivided in cases where a separate approach is considered more effective.

6.1 Proposed actions by category

6.1.1 Legislation and regulation

	Action	Description	Time Horizon
N1	Analysis of the current regulatory framework	Conduct an exhaustive study of European, national regional and municipal regulations related to urban air mobility, not only from an aeronautical perspective, but also from the perspective of the different sectors of the legal system.	Phase 1: 2026 - 2028
N2	Periodic evaluation of current municipal regulations	Assess the municipal regulations in force at any given time, including urban planning, environmental, tax and mobility, taking into account the perspective of urban air mobility. As a result of this assessment, regulatory procedures could be initiated for the approval of new ordinances or amendments to existing ones. This is a cross-cutting action in the three time phases	Phase 1: 2026–2028 Phase 2: 2029 – 2031 Phase 3: 2032 - 2035
N3	Active contribution to the development of the national regulatory framework on UAS	Collaborate with state entities to convey the municipal perspective on the possibilities, advantages, risks and externalities that the operation of UAS systems may entail in the municipal area, by drafting possible regulatory proposals and issuing observations in the procedures for drafting state and, where appropriate, regional regulations. This is a cross-cutting action in the three time phases.Related to activity G2.Participation in PANDU	Phase 1: 2026 – 2028 Phase 2: 2029–2031 Phase 3: 2032–2035
N4	Municipal ordinance on the use of UAS in the provision of municipal public services	The use of UAS in the provision of municipal public services will be regulated by municipal ordinance, both by the Municipal Police and emergency services (Fire Brigade, Civil Protection), which constitute NON-EASA operations, and in the use of all the functionalities that the technology allows in UAS operations (control of the state of trees, municipal public infrastructure, pest control, cartography, among many others).	Phase 1: 2026–2028 Phase 2: 2029 - 2031
N5	Analysis of the need to adapt urban planning regulations	The advisability of adapting municipal urban planning regulations within the regional legislative framework will be analysed.	Phase 2: 2029–2031 Phase 3: 2032–2035
N6	Analysis of the need to adapt municipal environmental regulations	The advisability of adapting municipal environmental regulations within the regional and basic state legislative framework will be analysed.	Phase 2: 2029–2031 Phase 3: 2032 - 2035
N7	Analysis of the need to adapt municipal tax regulations	The advisability of adapting municipal tax regulations (rates) within the state legislative framework will be analysed.	Phase 2: 2029–2031 Phase 3: 2032–2035

	Action	Description	Time Horizon
N8	Analysis of the need for a Municipal Ordinance on urban air mobility.	In view of the evolution of the regulatory framework and the state and regional regulations in force at any given time, study the need, scope and content of municipal regulations on urban air mobility. According to the work carried out in activity N1	Phase 2: 2029–2031 Phase 3: 2032 - 2035

6.1.2 Safety

	Action	Description	Time Horizon
S1	Information exchange system with the Ministry of the Interior	Implement real-time communication channels and protocols to ensure the safety and traceability of air operations.	Phase 1: 2026 - 2028
S2	Design of standard notification forms and penalty system	Unify administrative procedures related to air mobility, from flight communication to reporting infringements.	Phase 1: 2026 - 2028
S3	Consolidation of a unit specialising in the management of Urban Air Mobility within the Municipal Police Force	Specialise a police team within the Air Support Section, specifically trained to monitor, inspect and manage urban air mobility.	Phase 1: 2026 - 2028
S4	Implementation of a municipal system for surveillance, control and management of UAS incidents	Consolidate an urban drone air traffic control platform so that law enforcement agencies can visualise, act and coordinate responses to UAS events.	Phase 2: 2029 - 2031
S5	Propose the allocation of exclusive frequencies for UAS air emergencies	Ensure that emergency services have dedicated communication channels to avoid interference in critical situations by requesting specific frequencies for emergency operations.	Phase 2: 2029 - 2031
S6	Protocols for activating dynamic exclusion zones	Design protocols and tools to enable the immediate activation of air restriction zones in the event of special events, natural disasters or official visits.	Phase 2: 2029–2031
S7	Training and education campaigns for municipal inspectors	Develop specific training programmes for technical and police personnel who interact with UAS operations.	Phase 2: 2029–2031
S8	Participation in flight zone review and planning procedures , corridors and evacuation	Participate in the analysis and redesign of urban airspace to establish safe zones, flight routes and emergency plans.	Phase 3: 2032–2035

6.1.3 Operations

	Action	Description	Time Horizon
O1	Development and review of municipal procedures for drone operation in Madrid	Standardise and update municipal administrative procedures related to drone operation in the city, including both the application for and granting of permits and the occupation of public space. This will be in line with the City Council's remit, ensuring a clear, transparent and safe framework for operators and citizens.	Phase 1: 2026 - 2028
O2	Review of municipal procedures for the use of drones in public spaces	Update municipal procedures for the occupation of public space by drones, incorporating ground risk criteria and environmental and urban conditions.	Phase 1: 2026–2028
O3	Definition of the role of municipal drone pilot municipal drone pilot	Define the requirements and procedures for the operation of drones by municipal personnel.	Phase 1: 2026 - 2028
O4	Develop a technical and regulatory roadmap for UAS operations at different SAIL levels, incorporating the technical and urban planning requirements necessary for the regulation of urban airspace.	Compile and define local technical and urban planning requirements for integration into future urban airspace regulation.	Phase 1: 2026 - 2028
O5	Creation of a U-space coordination figure in the City Council	Appoint a municipal official as a point of reference to integrate and support the implementation of U-space in Madrid, facilitating coordination with AESA, ENAIRE and other actors, and supervising its adaptation in the urban and local administrative sphere. This figure will act as a liaison and facilitator, without assuming regulatory powers, but ensuring the monitoring and consistency of municipal participation in the Deployment and subsequent operation of U-space.	Phase 1: 2026 - 2028
O6	Pilot tests of routine autonomous operations	Integration of autonomous and subsequently automatic operations into normal city operations and development of specific protocols for their management.	Phase 2: 2029 - 2031
O7	Collaborate in the deployment of pre-U-space airspace to facilitate initial recurring operations	Coordinate with AESA and ENAIRE to enable controlled airspace prior to U-space to enable recurring urban air mobility operations and prepare for the transition to full implementation of U-space.	Phase 2: 2029 - 2031
O8	Maintain the necessary coordination and collaboration relationships with ENAIRE and U-space service providers.	It is planned to establish an infrastructure with dedicated personnel to enable management and coordination with ENAIRE and the U-space service provider(s), as well as with other authorities with assigned competences.	Phase 2: 2029 - 2031
O9	Participation of Madrid City Council in conducting an airspace risk assessment.	Participate in the development of a study on airspace risk assessment in accordance with current guidelines and submit requests and coordinate with the relevant authorities.	Phase 2: 2029 - 2031

	Action	Description	Time Horizon
O10	Participation in the deployment process of the first U-space service provider (USSP)	Accompany and facilitate the deployment of the first USSP in Madrid, coordinating with AESA, ENAIRE and the designated operator. The City Council will assume a role of dialogue and urban facilitation, supporting the integration of this service in the city, but without direct responsibility for its provision or management.	Phase 2: 2029 - 2031

6.1.4 Infrastructure

	Action	Description	Time Horizon
I1	Protocol for the authorization and supervision of urban air mobility infrastructure, in the exercise of non-aeronautical powers and in collaboration with the competent aeronautical authorities	Collaborate, in the exercise of municipal powers, with the competent aeronautical authorities in the uthorization and supervision procedures for vertiports, drone pads and other urban air facilities.	Phase 1: 2026 – 2028
I2	Study of potential network of vertiports in the city	Analyse possible strategic locations for the deployment of take-off and landing areas.	Phase 1: 2026 – 2028
I3	Clarification of competences and coordination in the supervision of UAM infrastructure	Identify the competent authority for the inspection and supervision of UAM infrastructure, differentiating between the aeronautical dimension (under state or regional jurisdiction in each case) and municipal competences in urban planning and building matters, promoting coordination between administrations.	Phase 2: 2029 – 2031
I4	Analysis of needs and participation in the deployment of specific infrastructure for regular or emergency operations: meteorology, communications, sensors	Assess the technological requirements for safe and efficient urban airspace operation. Participation in the deployment of relevant infrastructure.	Phase 2: 2029 – 2031
I5	Participation in the deployment of initial prototypes and pilots of physical infrastructure for UAM.	Participation in the deployment of initial prototypes of physical infrastructure for UAM (e.g. vertiports, dronepads or drone-in-a-box) for logistics, healthcare or experimental operations.	Phase 2: 2029–2031
I6	Participation in the deployment of the first vertiports or specific take-off area for regular or certified operations, with urban and regulatory integration.	Participation in the deployment of the first vertiports or specific take-off area for regular or certified operations, with urban and regulatory integration, either on the initiative of the local council or on private initiative.	Phase 3: 2032 – 2035
I7	Incorporation of the vertiport network into Madrid's General Urban Development Plan	Integrate the strategic location of an initial network of vertiports into urban planning and establish guidelines for its future expansion into districts and metropolitan areas, ensuring compatibility with the urban fabric, existing mobility and advanced air connectivity needs.	Phase 3: 2032 – 2035

	Action	Description	Time Horizon
I8	Participation in the integration of manned eVTOLs for commercial operations.	Integration of electric unmanned aircraft with passenger transport capacity, especially on metropolitan routes.	Phase 4: +2035

6.1.5 Environment and Citizenship

	Action	Description	Time Horizon
C1	Carry out participatory processes with the Urban Air Mobility ecosystem	Organise participatory processes to analyse the future of urban air mobility with citizens and the rest of the city's ecosystem of stakeholders.	Phase 1: 2026 – 2028
C2	Awareness campaigns on Urban Air Mobility	Launch information campaigns focused on explaining real-life cases of UAS use of UAS and their benefits through pilot projects. Develop educational materials and awareness campaigns to promote general knowledge about UAS technology and regulations.	Phase 1: 2026 – 2028
C3	Integrated municipal map of territorial factors (noise, SPAs, LEZs, UAS, etc.)	Create a geographic viewer that combines environmental, legal and operational information for UAM planning.	Phase 1: 2026 – 2028
C4	Environmental standardization for UAS operations	Establish common criteria for environmental impact assessment (noise, birdlife, sensitive areas) in the deployment of UAM.	Phase 2: 2029 – 2031
C5	Promotion of academic and professional training in the UAS sector	Collaborate with educational institutions to develop specific training programmes on air mobility and drone technology.	Phase 2: 2029 – 2031
C6	Impact assessment of urban air mobility from an environmental and socio-economic perspective.	Assess the impact of urban air mobility using indicators of sustainability, efficiency, public acceptance and economic return.	Phase 3: 2032 – 2035

6.1.6 Economic operators

	Action	Description	Time Horizon
E1	Develop an inventory of potential economic activities of the UAS sector.	Develop a comprehensive database on economic activities related to urban air mobility, including local companies interested or already active in urban air mobility at that time.	Phase 1: 2026 - 2028
E2	Preparation of informational material for operators interested in developing urban air mobility services.	Create practical guidelines on regulations and entrepreneurs.	Phase 1: 2026 - 2028

	Action	Description	Time Horizon
E3	Formalise an advisory group of economic operators for evaluation, asessment and strategic guidance.	Formalise an advisory group of economic operators for evaluation, asessment and strategic guidance.	Phase 2: 2029 - 2031
E4	Office for urban air mobility support and assistance	Establishment of a single point of contact for companies, providing assesment, information and procedure services.	Phase 2: 2029 - 2031
E5	Conducting demand studies and analysing priority use cases for urban air mobility	Conduct technical and social studies to understand the interest, need and viability for the different urban air mobility use cases at the municipal level. This includes identifying the use cases with the most significant added value and evaluate the demand foresights on short, medium and long-term.	Phase 3: 2032 - 2035

6.1.7 Governance and Ecosystem

	Action	Description	Time Horizon
G1	Consolidation of the Municipal Urban Air Mobility Commission (UAM)	Consolidate the UAM Commission as a permanent body for interdepartmental coordination and public participation.	Phase 1: 2026 - 2028
G2	Creation of specialised urban air mobility units	Establish specialised units dedicated to the planning, management and promotion of urban air mobility within the municipal organisation of Madrid City Council.	Phase 1: 2026–2028
G3	Definition of an internal coordination mechanism for Madrid City Council in relation to drones	Establish a coordination mechanism between the different municipal areas involved to ensure integrated management of drone use in the city. This coordination will enable criteria to be aligned, duplication to be avoided and joint decision-making to be facilitated, ensuring that the City Council's participation in external initiatives is backed by a coherent internal strategy. Linked to G2.	Phase 1: 2026 - 2028
G4	Analysis of the potential use of drones in the different activities carried out by the departments of Madrid City Council	Analyse the potential use of drones in the different activities carried out by Madrid City Council departments, identifying the most relevant areas of application, the benefits they would bring in terms of efficiency, safety and cost reduction, as well as any technical, regulatory or economic limitations that may exist.	Phase 1: 2026 - 2028
G5	Development of guidelines for the use of drones in Madrid City Council	Establish guidelines for the use of drones in Madrid City Council and for the contracting of services that use drones.	Phase 1: 2026–2028

	Action	Description	Time Horizon
G6	Formal participation in the National U-space Plan (PANDU).	Formally request participation in the development and implementation of the National U-space Plan (PANDU), ensuring participation in technical and geographical decisions that affect strategic definition at the national level.	Phase 1: 2026–2028 Phase 2: 2029 - 2031 Phase 3: 2032 - 2035
G7	Promoting the creation of an experimentation and demonstration ecosystem	The implementation of an urban experimentation and demonstration ecosystem will be promoted, enabling operators and companies to test innovative air mobility prototypes and services in real conditions. The municipal role will focus on enabling test spaces, generating collaboration frameworks and supporting cooperation with the relevant actors, thereby promoting the maturation of commercial solutions and the creation of a local environment conducive to innovation.	Phase 1: 2026 - 2028
G8	Communication plan	Conduct information campaigns aimed at the general public.	Phase 1: 2026–2028
G9	Creation of a local inter-institutional technical coordination group	Establish a technical coordination group between the City Council, ENAIRE, AESA and the Municipal Police to strengthen institutional cooperation at the local level.	Phase 1: 2026 - 2028
G10	Development of a portal for urban air mobility	Design and implement a digital platform that centralises procedures, information and notifications on urban air mobility, integrated with national and European systems. Implement a single digital window for processing authorisations, in coordination with ENAIRE and local authorities.	Phase 2: 2029 - 2031
G11	Position Madrid as a European benchmark in advanced integration of the third dimension in urban planning and public services.	Promote an international outreach strategy that consolidates Madrid as a leading city in the integration of the aerial dimension into urban planning, promoting cooperation with European networks, innovation projects and smart mobility platforms.	Phase 2: 2029–2031
G12	Registration of Madrid City Council as a drone operator	Registration of Madrid City Council as a drone operator, if carried out from different areas, a volume of activities that cannot be covered by the Municipal Police Air Support section.	Phase 2: 2029 - 2031
G13	Establish monitoring and evaluation mechanisms	Periodically evaluate municipal regulations to identify problems and possible regulatory improvements.	Phase 3: 2032 - 2035

6.2 Conclusions

The proposed activities outline a comprehensive strategy for developing urban air mobility (UAM) in the city through a clear, phased, and multidimensional roadmap. In the short term (2026-2028), priority will be given to establishing robust governance structures, developing municipal regulations, coordinating with regional, national, and European frameworks, and launching pilot projects and controlled testing environments. This initial phase will lay the regulatory, operational and technological foundations necessary for the safe and efficient deployment of UAM, ensuring citizen participation and inter-institutional integration.

Illustration 19
Aerial view of the Puerta de Alcalá. Source: Madrid Municipal Police of Madrid

In the medium term (2029-2031), actions will focus on consolidating the management framework, enhancing institutional cooperation, and expanding technological capabilities, such as the deployment of U-space or the enabling of initial infrastructures and operational pilots. It also seeks to regulate environmental and urban impacts, promote the standardisation of safety criteria, and strengthen relations with economic operators through consultative groups, support offices, and demand studies. This stage aims to create a mature industrial and technological ecosystem that positions the city as a European benchmark in managing the third urban dimension.

Finally, in the long term (beyond 2032), the emphasis will be on the expansion and maturation of the system, incorporating more complex operations, the full integration of manned eVTOLs, the development of air corridors, and the expansion of strategic infrastructure. Constant regulatory updates are expected based on regulatory assessment and the experience gained from data collection and pilot projects, as well as the strengthening of sustainability and public acceptance indicators. In this phase, the city would have made substantial progress toward the full integration of the UAM as a structural part of its mobility network, connected to other smart cities, and ensuring long-term economic, environmental, and social The actions for each axis in relation to the proposed timeline are summarised below:

Policies and regulations

In the short term (2026-2028), the use of UAS in the provision of municipal public services, both by the Municipal Police and emergency services (Fire Brigade, Civil Protection), which constitute NON-EASA operations, as well as in the use of all the functionalities that the technology allows in UAS operations (control of the state of trees, municipal public infrastructure, pest control, cartography, among many others), offering maximum legal certainty both for the exercise of public functions and the guarantee of

individual rights. A Municipal Ordinance will be drafted to establish the regulatory basis for supporting, within the scope of its powers, aerial operations, infrastructure and the protection of citizens' rights, especially with regard to privacy and noise. Likewise, collaboration with the DGAC, AESA, ENAIRE and the Community of Madrid, among others, will be strengthened, collaborating on both regulatory and non-regulatory solutions.

In the medium term (2029-2031), work will be done to create a specific municipal legal framework for urban air mobility, establishing the regulatory basis for supporting air operations, infrastructure and the protection of citizens' rights within the scope of its powers, particularly with regard to privacy and noise. If necessary, municipal urban planning and environmental regulations will be adapted within the state and regional legislative framework. The implementation of technical standards for vertiports, charging stations and other associated infrastructure will be evaluated, informing the competent state and regional authorities and regulatory bodies with a view to proposing regulatory improvements.

In the long term (2032-2035), the regulatory framework is expected to be continuously updated based on the results of pilot tests and technological developments. The city will actively participate in the process of drafting European, national and regional regulations in order to best serve the general interests entrusted to it by.

Safety

In the short term (2026-2028), the priority will be to establish a solid governance and response structure for incidents related to air mobility. An information exchange system will be implemented with the Ministry of the Interior, and standardised notification forms and a uniform penalty system will be developed to ensure traceability and administrative consistency. At the same time, a unit specialising in Urban Air Mobility management will be established within the Municipal Police, responsible for inspecting, surveilling, and controlling UAS operations, as well as coordinating in emergency situations.

In the medium term (2029-2031), technological and operational capabilities will be strengthened with the implementation of a municipal system for the surveillance, control and management of UAS incidents, which will enable real-time monitoring of urban air traffic. The allocation of exclusive frequencies for UAS air emergencies and the development of protocols for activating dynamic exclusion zones will also be promoted to respond immediately to special events or critical situations. Additionally, training and education campaigns targeting technical and police personnel will be promoted.

In the long term (2032-2035), the aim will be to consolidate a proactive safery ecosystem capable of anticipating risks and responding automatically to contingencies, in which the City Council, among other initiatives, will participate in the review and planning procedures for flight zones, corridors and air evacuation plans in coordination with the competent authorities.

Operations

In the short term (2026-2028), progress will be made in defining the municipal operational framework for managing drones and UAM aircraft within the city. Administrative procedures related to permit applications and the occupation of public space will be reviewed and standardised, adapting them to the City Council's area of competence and ensuring a clear and secure regulatory environment. The role of municipal drone pilot will be defined, and a technical and regulatory roadmap will be drawn up incorporating the local requirements necessary for the integration of UAS operations into urban airspace. Likewise, a U-space coordination figure will be designated within the City Council, responsible for facilitating relations with AESA, ENAIRE and service providers, ensuring consistency and monitoring of the implementation process.

In the medium term (2029-2031), pilot tests of autonomous operations will be promoted, along with coordination with competent authorities to enable controlled airspace that will serve as a transition towards the full deployment of U-space. Permanent channels of collaboration will be established with ENAIRE and U-space service providers, as

well as mechanisms for joint management of urban airspace. In addition, the City Council's participation in airspace risk assessment and in the process of deploying the first U-space service provider in the city will be promoted, playing the role of urban facilitator and institutional liaison.

In the long term (2032-2035), the operating system will reach a level of maturity that will allow for the integration of automated operations and fully functional U-space services. Madrid will consolidate its role as a benchmark in urban airspace management, with a coordinated and secure operating framework that aligns with European policies on innovative air.

Infrastructure

In the short term (2026-2028), studies will be conducted to identify strategic locations for vertiports, and collaboration will be established with other competent authorities on official procedures for authorising and supervising vertiports, drone pads, and other urban air facilities.

In the medium term (2029-2031), the development of infrastructure for urban air mobility will be promoted through three lines of action: the creation of, analysis and collaboration in the deployment of supporting technological infrastructure such as meteorology or communications, and participation in the first prototypes and pilots of vertiports, dronepads or drone-in-a-box systems.

In the long term (2032-2035), an urban and interurban network of vertiports designed for complex operations with manned eVTOLs will be consolidated. During this stage, participation in the deployment of the first certified vertiports or take-off areas, driven by public or private initiatives, is expected, as well as the integration of this network into Madrid's General Urban Development Plan, which will define its strategic location and compatibility with existing mobility. From 2035 onwards, progress will be made in integrating manned eVTOL aircraft for regular commercial operations, thereby consolidating the city's advanced air connectivity.

Environment and Citizenship

In the short term (2026-2028), the focus will be on informing and raising awareness among citizens about urban air mobility. Participatory processes will be organised with citizens, and the ecosystem of stakeholders involved to analyse the future of this new form of mobility, and awareness campaigns and educational materials will be launched to explain real-life examples of the use and benefits of drone operations. Additionally, an interactive municipal map will be developed that integrates environmental, territorial, and regulatory data to support urban air mobility planning.

In the medium term (2029-2031), collaboration will take place with relevant state bodies to transfer criteria related to urban environmental impacts, considering factors such as noise, the impact on wildlife, and the protection of sensitive areas. Collaboration with educational institutions will also be promoted to encourage academic and professional training in the sector, favouring the development of local and specialised skills.

In the long term (2032-2035), the aim is to consolidate a sustainable and participatory city model in which air mobility is integrated in a balanced way with the urban environment. An assessment of the environmental and socio-economic impact of urban air mobility will be carried out, incorporating indicators of sustainability, efficiency and public acceptance, to guide public policies towards responsible development of the sector.

Economic operators

In the short term (2026-2028), an inventory of economic activities linked to the UAS sector will be drawn up, identifying local companies that are active or interested in urban air mobility. At the same time, informational materials and practical guides will be developed for operators and entrepreneurs, explaining the procedures, regulatory requirements, and business opportunities. Meeting spaces will also be promoted to

facilitate the participation of start-ups, SMEs, and large operators in the new ecosystem.

In the medium term (2029-2031), progress will be made in formalising an advisory group of economic operators with evaluation, advisory, and strategic guidance functions, and in establishing a business support and assistance office to serve as a single point of contact for the sector. Likewise, demand studies and analyses of priority use cases will be promoted to identify the applications with the greatest economic, social and territorial impact at the municipal level.

In the long term (2032-2035), a competitive and sustainable business ecosystem will be consolidated, capable of generating skilled employment and attracting national and international investment. Madrid will position itself as a hub for innovation and technological development in urban air mobility, promoting the export of solutions and the growth of its economic fabric linked to the sector.

Governance and Ecosystem

In the short term (2026-2028), the priority will be to consolidate a solid governance structure that allows all stakeholders involved in urban air mobility to collaborate. The work of the Municipal Urban Air Mobility Commission will be strengthened, establishing it as a permanent body for coordination and public participation, and specialised units and internal coordination mechanisms will be created between the different municipal areas to ensure integrated management of drone use in the city. Guidelines for the use of drones at the municipal level will be developed, and the potential for using drones in the City Council's various activities will be analysed, identifying benefits and limitations. This stage will also promote the launch of an urban experimentation and demonstration ecosystem, enabling operators and companies to test innovative prototypes and services in real conditions, and will encourage formal participation in the National U-space Plan (PANDU), ensuring the continuity of this collaboration in the following phases.

In the medium term (2029-2031), the aim will be to consolidate a public-private partnership ecosystem, involving businesses, universities and citizens in the development of urban air mobility. Plans are in place to establish a single digital point of contact to centralise procedures and notifications related to air mobility, in coordination with ENAIRE and the relevant authorities. In addition, a technical group for inter-institutional coordination between the City Council, ENAIRE, AESA and the Municipal Police will be formalised, and the City Council's registration as a drone operator will be assessed if demand requires it.

In the long term (2032-2035), the objective will be to position Madrid as a European benchmark for integrating the third dimension into urban planning and public services. Governance will be fully consolidated, with permanent structures for monitoring and cooperation with international networks of cities and innovation projects. In addition, monitoring and evaluation mechanisms will be established to ensure transparency, continuous improvement and the adaptation of municipal regulations to technological and regulatory advances.

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Acronyms

AAM: Advanced Air Mobility

AESA: State Aviation Safety Agency: Spanish civil aviation authority

AIP: Aeronautical Information Publication

AMC: Acceptable Means of Compliance

ANSP: Air Navigation Service Provider

AOC: Air Operator Certificate

ATM: Air Traffic Management

BVLOS: Beyond Visual Line of Sight

C2: Command and Control

C-UAS: Counter-Unmanned Aircraft Systems: Anti-Drone Systems / Anti-UAS

CBO: Community-Based Organisation (for recreational operators)

COA: Certificate of Authorisation

CONOPS: Concept of Operations

CTOL: Conventional Take-Off and Landing

EASA: European Union Aviation Safety Agency

EVLOS: Extended Visual Line of Sight

eVTOL: Electric Vertical Take-Off and Landing

EUROCONTROL: European Organisation for the Safety of Air Navigation

FAA: Federal Aviation Administration (USA)

GCS: Ground Control Station

GM: Guidance Material

IAM: Innovative Air Mobility

ICAO: International Civil Aviation Organisation

LUC: Light UAS Operator Certificate

NAA: National Aviation Authority

NOTAM: Notice to Airmen / Notice to Air Missions

OEM: Original Equipment Manufacturer

PDRA: Pre-Defined Risk Assessment

RPAS: Remotely Piloted Aircraft System

ANNEXES

ANNEX 1

List of working groups and participating entities

Working group: Regulations

- Chair: David Agrait (Directorate-General for Traffic Management and Surveillance)
- Objectives:
  - To analyse existing regulations – European, national and regional – and their impact on local regulations.
  - Define the legal requirements and authorisation procedures for activities related to urban air mobility (authorisations, fees, etc.).
  - Drafting of regulatory and management proposals.
  - Liaise with other administrations.
  - Internal training at Madrid City Council.
- Participating entities: Madrid City Council, Community of Madrid, EMT, Eversheds Sutherland, Murzilli Consulting, Pinsent Masons, ETRAIR (ETRA group), Expodrónica.

Working group: Security

- Chair: Pablo Enrique Rodríguez (General Director of the Municipal Police)
- Objectives:
  - Definition of flight safety requirements.
  - Definition of exclusion zones.
  - Define protocols for action in the event of security breaches.
- Participating entities: Madrid City Council, EMT, Globalvia/Bluenest, UPM, UP Valencia, SENASA, Sousa Consultores, Community of Madrid

Working group: Operation

- Chair: José Javier Rodríguez (Deputy Director General for Traffic Regulation and Taxis)
- Objectives:
  - Definition of operational requirements.
  - Liaise with air navigation providers.
  - Definition of operational safety and emergency procedures in the event of incidents.
- Participating entities: Madrid City Council, EMT, Community of Madrid,
- SACYR, GESNAER, Murzilli Consulting, Globalvia/Bluenest, UPM, ENAIRE, SENASA, ITG

Working group: Infrastructure

- Chair: María Dolores Ortiz (Director General for Planning and Mobility
- Infrastructure)
- Objectives:
  - Analyse the deployment of urban air mobility infrastructure from an urban planning and safety perspective.
  - Analyse the procedures for establishing infrastructure for different needs:
  - Passenger transport.
  - Freight transport.
  - Analysis of the use of drones (landing/take-off) in public buildings and spaces.
- Participating entities: Madrid City Council, EMT, Community of Madrid,
- CITET, A T Kearney, SENASA, ENAIRE, INECO, ACS / IRIDIUM, University of Alicante.

Working group: Environment and Citizenship

- Chair: Margarita Torres (Director General for Strategic Planning)
- Objectives:
    - Analyse the environmental requirements (noise, emissions, electrical load, etc.) of drone infrastructure and operation.
    - Conduct the necessary studies for the implementation of air mobility services in the city and their acceptance by citizens (privacy, noise, safety, etc.).
    - Define models for interaction with citizens: channels, content,
    - incident management, public communication, etc.
- Participating entities: Madrid City Council, EMT, Ventor Innovations, Globalvia/ Bluenest, Pinsent Masons, SENASA, ITG, NTT Data, Community of Madrid.

Working group: Economic Operators

- Chair: Marta Alonso (Director of Traffic Management and Surveillance)
- Objectives:
    - Analysis of proposals from economic agents in the field of air mobility.
    - Identification of areas and projects of interest.
    - Development of pilot projects. E.g. Bluenest (Openvia) for the transport of medical samples between Ramón y Cajal Hospital and Carlos III Hospital.
- Participating entities: Madrid City Council, Ventor Innovations, Globalvia/Bluenest, EMT, CITET, AT Kerney, Madrid Mobility Lab, INECO, UPM, ANRA Technologies, NTT Data, ENAIRE, Crea MNN, ITG.

ANNEX 2

Proposed template for inventory of economic activities and use cases for urban air mobility services in the city of Madrid

FILE Nº xxxx

Name of use case: *(Service or economic activity for which the use of urban air mobility is necessary. Example: Transfer and transport of medicines)*

Description of the proposed service: *(As detailed a description as possible)*

Are there any pilot projects in development and/or completed?

If so, please describe. *(Description as detailed as possible)*

If not, do you believe that a pilot project is necessary?

(As detailed a description as possible)

Are regulatory changes necessary for the development of the use case? If so *(provide as detailed a description as possible and an estimate of when these changes will come into effect).*

Are there already authorised drones/eVTOLs on the market capable of providing the

Urban Air Mobility service?

If so, indicate the essential characteristics they must have.

If not, indicate whether the estimated time frame for availability is known.

Is the full implementation of the UAS space necessary to start the service? *(Description as detailed as possible).*

What infrastructure or services would be needed to develop the proposed service? *(Provide as detailed a description as possible, identifying whether these would be provided by economic operators or whether the participation of Madrid City Council or other administrations would be necessary)*.

Would a complementary logistics or land transport service be necessary? If

If so, please describe *(as detailed as possible)*.

Are you aware of any companies or administrations that are working on implementing this service? If so, please provide contact details if available.

In what time frame do you think the service could become a reality? Provide any documentation and information you deem appropriate.

ANNEX 3

Applicable Regulations

- [Ref. 1] Law 48/1960, of 21 July, on Air Navigation – Air Navigation Law.
- [Ref. 2] Instrument of ratification of the Protocol relating to the authentic trilingual text of the Convention on International Civil Aviation (Chicago, 1944), signed in Buenos Aires on 24 September 1968 – ICAO Convention or Chicago Convention.
- [Ref. 3] Royal Decree 57/2002, of 18 January, approving the Air Traffic Regulations (RCA) – RCA.
- [Ref. 4] Law 21/2003, of 7 July, on Aviation Safety – Aviation Safety Law.
- [Ref. 5] Law 37/2003, of 17 November, on Noise.
- [Ref. 6] Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 laying down the framework for the creation of the single European sky – the framework regulation.
- [Ref. 7] Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky – Airspace Regulation.
- [Ref. 8] Commission Regulation (EC) No 2150/2005 of 23 December 2005 laying down common rules for the flexible use of airspace – FUA Regulation.
- [Ref. 9] Commission Regulation (EU) No 748/2012 of 3 August 2012 laying down implementing rules for the airworthiness and environmental certification or declaration of conformity of aircraft and related products, parts and appliances, as well as for the approval of design and production organisations.
- [Ref. 10] Commission Implementing Regulation (EU) No 923/2012 of 26 September 2012 laying down air traffic regulations and common operational provisions for air navigation services and procedures, and amending Implementing Regulation (EU) No 1035/2011 and Regulations (EC) No 1265/2007, (EC) No 1794/2006, (EC) No 730/2006, (EC) No 1033/2006 and (EU) 255/2010 – SERA Regulation (Standardised European Rules of the Air).
- [Ref. 11] Law 21/2013, of 9 December, on environmental assessment.
- [Ref. 12] Commission Implementing Regulation (EU) 2017/373 of 1 March 2017 laying down common requirements for providers of air traffic management/air navigation services and other functions of the air traffic management network and their oversight, repealing Regulation (EC) No 482/2008 and Implementing Regulations (EU) No 1034/2011, (EU) No 1035/2011 and (EU) 2016/1377, and amending Regulation (EU) No 677/2011.
- [Ref. 13] Royal Decree 1036/2017, of 15 December, regulating the civil use of remotely piloted aircraft, and amending Royal Decree 552/2014, of 27 June, implementing the Air Regulation and common operational provisions for air navigation services and procedures, and Royal Decree 57/2002 of 18 January, approving the Air Traffic Regulation – Royal Decree on RPAS (Remotely Piloted Aircraft System).
- [Ref. 14] Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010 and (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council and repealing Regulations (EC) No 552/2004 and (EC) 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) 3922/91 – Basic Regulation.
- [Ref. 15] Royal Decree 1180/2018, of 21 September, implementing the Air Traffic

Regulations and common operational provisions for air navigation services and procedures and amending Royal Decree 57/2002, of 18 January, approving the Air Traffic Regulations; Royal Decree 862/2009, of 14 May, approving the technical standards for the design and operation of public aerodromes and the Regulations on the certification and verification of airports and other public aerodromes; Royal Decree 931/2010, of 23 July, regulating the certification procedure for civil air navigation service providers and their regulatory control; and the Operational Air Traffic Regulations, approved by Royal Decree 601/2016, of 2 December.

- [Ref. 16] Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and third-country operators of unmanned aircraft systems.
- [Ref. 17] Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on rules and procedures for the operation of unmanned aircraft.
- [Ref. 18] Commission Implementing Regulation (EU) 2020/469 of 14 February 2020 amending Regulation (EU) No 923/2012, Regulation (EU) No 139/2014 and Regulation (EU) 2017/373 as regards requirements for air traffic management and air navigation services, the design of airspace structures, data quality and runway safety, and repealing Regulation (EU) No 73/2010.
- [Ref. 19] Commission Delegated Regulation (EU) 2020/1058 of 27 April 2020 amending Delegated Regulation (EU) 2019/945 as regards the introduction of two new classes of unmanned aircraft systems.
- [Ref. 20] Commission Implementing Regulation (EU) 2020/639 of 12 May 2020 amending Implementing Regulation (EU) 2019/947 as regards standard scenarios for operations conducted within or beyond visual line of sight.
- [Ref. 21] Commission Implementing Regulation (EU) 2020/746 of 4 June 2020 amending Implementing Regulation (EU) 2019/947 as regards the postponement of the dates of application of certain measures in the context of the COVID-19 pandemic.
- [Ref. 22] Resolution of 4 December 2020, of the Directorate of the State Aviation Safety Agency, approving national standard scenarios (STS-ES) for UAS operations in the "specific" category under an operational declaration in accordance with Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on rules and procedures for the use of unmanned aircraft.
- [Ref. 23] Commission Implementing Regulation (EU) 2021/664 of 22 April of 2021, on a regulatory framework for U-space – U-space Regulation.
- [Ref. 24] Commission Implementing Regulation (EU) 2021/665 of 22 April 2021 amending Implementing Regulation (EU) 2017/373 as regards requirements for providers of air traffic management/air navigation services and other functions of the air traffic management network in the U-space designated in Controlled Airspace.
- [Ref. 25] Commission Implementing Regulation (EU) 2021/666 of 22 April 2021 amending Regulation (EU) No 923/2012 as regards requirements for manned aviation operating in U-space.
- [Ref. 26] Commission Implementing Regulation (EU) 2021/1166 of 15 July 2021 amending Implementing Regulation (EU) 2021/947 as regards the postponement of the date of application of standard scenarios for operations conducted within or beyond visual line of sight.
- [Ref. 27] Commission Implementing Regulation (EU) 2022/425 of 14 March 2022 amending Implementing Regulation (EU) 2019/947 as regards the postponement of the transition dates for the use of certain unmanned aircraft systems in the 'open' category, as well as the date of application of standard scenarios for operations conducted within or beyond visual line of sight.

- [Ref. 29] Royal Decree 310/2022 of 3 May, completing the legal framework for the approval of airspace changes and civil flight procedures.
- [Ref. 30] Commission Implementing Regulation (EU) 2023/1770 of 12 September 2023 laying down provisions on aircraft equipment necessary for the use of the single European sky airspace and operational rules associated with the use of the single European sky airspace, and repealing Regulation (EC) No 29/2009 and Implementing Regulations (EU) No 1206/2011, (EU) No 1207/2011 and (EU) No 1079/2012.
- [Ref. 31] Regulation (EU) 139/2014, which establishes technical and operational requirements for aerodromes, applicable by analogy to vertiport infrastructure.
- [Ref. 32] Royal Decree 517/2024, of 4 June, implementing the legal framework for the civil use of unmanned aircraft systems (UAS) and amending various regulations on the control of imports of certain products with regard to applicable product safety standards; civil aerial demonstrations; firefighting and search and rescue, and airworthiness and licensing requirements for other aeronautical activities; civil aircraft registration; electromagnetic compatibility of electrical and electronic equipment; air traffic regulations and common operational provisions for air navigation services and procedures; and civil aviation incident reporting – Royal Decree on UAS.
- • [Ref. 33] Royal Decree 862/2009, approving the technical standards for the design and operation of civil aerodromes and their certification.
- • [Ref. 34] Royal Decree 1070/2015, regulating airspace management and the
- coordination procedure with the air navigation authority.
- [Ref. 35] Law 17/2015, of 9 July, on the National Civil Protection System.
- [Ref. 36] Decree 244/2023, on the organisational structure of the Regional Ministry of Housing.
- [Ref. 37] Law 3/2010 on aeronautical facilities in the Community of Madrid.
- [Ref. 38] Decree 235/2023, on the organisational structure of the Regional Ministry of Environment, Agriculture and the Interior.
- [Ref. 39] Law 9/2001 on land in the Community of Madrid.
- [Ref. 40] Law 16/1995 on Forestry and Nature Protection in the Community of Madrid.
- [Ref. 41] Law 7/1985, of 2 April, Regulating the Bases of Local Government.
- [Ref. 42] Legislative Act 6/2015, of 30 October, approving the revised text of the Law on Traffic, Motor Vehicle Circulation and Road Safety.
- [Ref. 43] Sustainable Mobility Ordinance, of 5 October 2018.
- [Ref. 44] Ordinance on Protection against Noise and Heat Pollution, of 25 February 2011.
- [Ref. 45] Ordinance on Protection against Noise and Heat Pollution, of 25 February 2011.

Other References Considered

A continuación, se listan otras referencias tenidas en cuenta:

- [Ref. 46] Annex 2 to the ICAO Convention: Rules of the Air.
- [Ref. 47] Annex 4 to the ICAO Convention: Aeronautical Charts.
- [Ref. 48] Annex 6 to the ICAO Convention: Aircraft Operation.
- [Ref. 49] Annex 10 to the ICAO Convention: Aeronautical Telecommunications.
- [Ref. 50] Annex 11 to the ICAO Convention: ATS Services.
- [Ref. 51] Annex 14 to the ICAO Convention: Aerodromes.
- [Ref. 52] Annex 15 to the ICAO Convention: AIS Services.
- [Ref. 53] Annex 19 to the ICAO Convention: SMS.
- [Ref. 54] ICAO Document 4444: Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM).
- [Ref. 55] ICAO Document 8168: Procedures for Air Navigation Services – Aircraft Operation (PANS-OPS).
- [Ref. 56] ICAO Document 9426: Airspace Planning Manual.
- [Ref. 57] ICAO Document 9859: SMS Manual.
- [Ref. 58] ICAO Document 10019: Manual on Safety Management Systems. Air traffic management/information management (ATM/IM).
- [Ref. 59] ICAO Document 10066: Performance-Based Airspace Design Manual (PBN).
- [Ref. 60] ICAO Document 10088: Manual on the Integration of Unmanned Aircraft into Airspace.
- [Ref. 61] ICAO 40th Assembly Document A40-WP/86: Integrating new entrants into the aviation system.
- [Ref. 62] FAA – UAS UTM Concept of Operation (ConOps).
- [Ref. 63] SESAR – ECHO2 European Concept for Higher Altitude Operations Phase 2: Towards the integration between Air Traffic Management and Higher Altitude Operations (HAO).
- [Ref. 64] SESAR/EUROCONTROL – ConOps of the CORUS-XUAM Project.
- [Ref. 65] EUROCONTROL – Specification for the application of the FUA.
- [Ref. 66] EUROCONTROL – European Route Network Improvement Plan (ENRIP) Part 3 – ASM (Airspace Management) handbook.
- [Ref. 67] EASA-EUROCONTROL – UAS-ATM Integration Operational Concept.
- [Ref. 68] EASA – Proposal for a Roadmap on Higher Airspace Operations.
- [Ref. 69] Ministry of Transport and Sustainable Mobility – National Action Plan for the Deployment of U-space 2022-2025 (v2) – PANDU.
- [Ref. 70] 2024/1108: Modify Part 21 for Type Certified UAS and associated modification to 2019/945.
- [Ref. 71] 2024/1110: Modify Part 21 to introduce competent authority requirements in the case of UAS and associated modifications of 2019/947.
- [Ref. 72] 2024/1107: Create a Part M Light and a Part CAO (Continuing Airworthiness

Organisations) for the continuing airworthiness of certified UAS operated in the Specific category.

- [Ref. 73] 2024/1109: Create competent authority requirements for continuing airworthiness in the case of UAS.
- [Ref. 74] 2023/203: Information Security.
- [Ref. 75] 2023/2117: Repository.
- [Ref. 76] 2024/1689: AI Act.
- [Ref. 77] Regulation (EU) No 376/20 Occurrences reporting.
- [Ref. 78] Vertiports Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category (PTS-VPT-DSN).
- [Ref. 79] ARTIFICIAL INTELLIGENCE ROADMAP 2.0 Human-centric approach to AI in aviation.


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