

# ***Low-Altitude Economy: Development Trajectory, Policy Frameworks, and Paths to Sustainable Growth***

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**Abstract.** The low-altitude economy (LAE) has emerged as a transformative economic sector globally, particularly in China where it has been elevated to a national strategic priority. This paper examines the low-altitude economy by reviewing its development trajectory, analyzing evolving policy and regulatory frameworks, and evaluating key technological enablers and application domains. Employing a literature review and policy analysis approach, this study addresses three research questions: (1) What is the current state and developmental trajectory of the low-altitude economy? (2) How have policy and regulatory frameworks evolved to support or constrain LAE development? and (3) What are the primary challenges and opportunities for sustainable LAE growth? The findings suggest that the low-altitude economy has evolved from an industry-specific term into a broader economic sector, with market size projected to reach 1.5 trillion yuan in 2025 and 3.5 trillion yuan by 2035 in China. Key challenges include technological maturity gaps, fragmented market demand, lagging regulatory environments, and incomplete industrial ecosystems. The paper concludes that coordinated advances in standards development, digital infrastructure, airspace management reform, and institutional innovation are essential to realizing the potential of the low-altitude economy.

**Keywords:** low-altitude economy, unmanned aerial vehicles (UAVs), urban air mobility (UAM), policy framework, airspace management

## **1. Introduction**

The low-altitude economy refers to economic activities operating in airspace below 3,000 meters, a widely adopted standard in China's regulatory context, encompassing aerial logistics, emergency response, urban air mobility, and a wide range of commercial drone applications [1]. In recent years, driven by rapid advances in unmanned aerial vehicle (UAV) technology and growing demand for more efficient logistics and urban mobility solutions, the low-altitude economy has emerged as a transformative economic sector with significant growth potential [2]. China, in particular, has positioned the low-altitude economy as a national strategic initiative, with policy responses rapidly unfolding across all levels of government and the number of registered drones growing at an accelerated pace. As the market expands and pilot projects multiply, China is poised to become one of the world's largest LAE markets.

This paper systematically reviews the development trajectory of the low-altitude economy, examines the evolving policy and regulatory frameworks, and evaluates key technological enablers and application domains. Specifically, it addresses three research questions: (1) What is the current state and developmental trajectory of the low-altitude economy? (2) How have policy and regulatory frameworks evolved to support or constrain LAE development? and (3) What are the primary challenges and opportunities for sustainable LAE growth? this study aims to contribute to the development of a modernized low-altitude economic system and offer practical insights for policymakers, industry stakeholders, and researchers. The significance of this research lies in its systematic integration of fragmented knowledge across policy, technology, and application domains, contributing to a holistic understanding of this rapidly evolving field.

## **2. Development trajectory and current state of the low-altitude economy**

### **2.1. Conceptual evolution and definitional framework**

The low-altitude economy traces its roots to the general aviation and unmanned aerial vehicle (UAV) industries, and has over time expanded to cover a wide array of economic activities operating within low-altitude airspace. At present, there is no universally accepted definition of the LAE across academia and industry [3, 4]. However, the dominant conceptualization frames it as an integrated economic ecosystem driven by low-altitude flight operations, which extends to and deeply interconnects with upstream and downstream related sectors. The year 2024 is widely acknowledged as a landmark moment for LAE development, as the growing adoption of UAV technologies has unlocked substantial growth potential for the sector. The ongoing institutionalization process—ranging from top-level strategic planning to the establishment of legal safeguards—has given shape to a distinct new paradigm for the development of the low-altitude economy [4].

### **2.2. Market scale and growth projections**

The low-altitude economy has demonstrated remarkable growth trajectories across multiple regions. Globally, the Urban Air Mobility (UAM) market was valued at US\$1,421 million in 2024 and is projected to reach US\$3,680 million by 2031, growing at a compound annual growth rate (CAGR) of 13.8% [4]. The global low-altitude infrastructure market is expected to grow with a CAGR of 5.7% from 2025 to 2031, driven by growing emphasis on environmental sustainability and rising demand for efficient transportation solutions [5].

In China, the low-altitude economy has experienced particularly rapid expansion. According to the Civil Aviation Administration of China (CAAC), the market was valued at 670.25 billion yuan in 2024 and is projected to reach 1.5 trillion yuan in 2025, with expectations to surpass 3.5 trillion yuan by 2035. Within this broader landscape, China's UAM market was valued at USD 800.0 million in 2025 and is projected to reach USD 4,774.0 million by 2032, representing a compound annual growth rate (CAGR) of 29.1%. In the drone logistics sector, which has become an important driver of the low-altitude economy, China launched more than 140 new logistics routes in 2024 alone, with approximately 90% operating within city limits. By the first half of 2025, the number of registered drones in China exceeded 2.726 million, with cumulative flight hours surpassing 24 million hours. A total of 2.7 million packages were delivered via drones throughout 2024, ranging from food deliveries to life-saving medicine.

### 2.3. Regional development patterns and industrial clusters

China's low-altitude economy industry is geographically concentrated in four major core clusters: the Guangdong-Hong Kong-Macao Greater Bay Area (GBA), the Yangtze River Delta, the Beijing-Tianjin-Hebei (BTH) region, and the Chengdu-Chongqing economic circle. Each cluster leverages its unique resource endowments to form differentiated development trajectories. The GBA has taken a pioneering position nationwide in the commercialization of low-altitude logistics and local legislative practice, as Shenzhen and Zhuhai were the first cities in China to roll out dedicated local regulations for the low-altitude economy. The Yangtze River Delta boasts a complete industrial chain spanning research and development, equipment manufacturing, and application services, which has nurtured a vibrant startup ecosystem for UAV and electric vertical takeoff and landing (eVTOL) enterprises. The BTH region hosts a high concentration of leading research universities and policy think tanks, providing strong intellectual support for policy research and technological innovation in the LAE field. The Chengdu-Chongqing region, endowed with abundant airspace resources and relatively low population density in its surrounding areas, holds unique advantages for large-scale UAV flight testing and application scenario validation. By the end of 2024, 21 provincial-level administrative regions across China had issued action plans or supporting policies for the low-altitude economy, and over 300 cities and counties had rolled out corresponding policy measures. This widespread policy deployment across all levels of government reflects the broad recognition of the strategic significance of LAE development.

## 3. Policy and regulatory frameworks

### 3.1. National-level legislative and regulatory development

The policy and regulatory landscape for the low-altitude economy has evolved rapidly, particularly in China, progressing through three distinct stages of institutional development.

The first phase, marked by the establishment of the foundational regulatory framework, took place in 2024. The Civil Aviation Administration of China (CAAC) implemented regulations on unmanned aircraft management, which specified that micro, light, and small civil unmanned aircraft were not subject to certain prior approval requirements. This regulation laid the initial groundwork for a category-based drone management system, establishing a basic regulatory framework that classifies aircraft according to their size and operational risk levels.

Building on this foundation, the revised *Public Security Administration Punishment Law*, which took effect on January 1, 2026, explicitly incorporated "unauthorized drone flights" into its regulatory scope. This revision filled a long-standing gap in legal penalties for low-altitude flight violations, marking a critical transition from administrative oversight to law-based enforcement. It provides clear legal grounds for penalizing illegal UAV operations and strengthens deterrence against airspace security breaches.

The third phase came with the revision of the *Civil Aviation Law*, adopted by the National People's Congress and effective as of July 1, 2026. The amended law requires all entities engaged in the design, production, import, maintenance, and operation of drones to obtain airworthiness certification. It also mandates manufacturers to assign a unique product identification code to each individual drone to enhance traceability. In addition, the revision integrates multiple previously separate certificates, including air operator certificates, into a single unified license [6]. This legislative update represents a major milestone in the maturation of the policy framework, as it consolidates previously fragmented administrative measures into a comprehensive, legally binding

system covering the entire life cycle of drone operations, and establishes a complete regulatory ecosystem for the low-altitude economy.

### 3.2. Standardization and local policy initiatives

Beyond national legislation, standardization efforts have accelerated significantly. In February 2026, ten national departments jointly issued the "Low-Altitude Economy Standard System Construction Guide (2025 Edition)". The guide sets targets for establishing the standard system by 2027 and expanding it to include more than 300 standards by 2030. These standards span technology R&D, equipment manufacturing, infrastructure, and operational safety.

At the local level, following Shenzhen and Zhuhai's pioneering low-altitude economy regulations, Guangzhou, Wuxi, and Suzhou successively issued their own LAE promotion regulations in 2025. These local legislative efforts share three main characteristics: (1) refinement of operational rules to reflect regional industrial conditions, (2) the establishment of government–industry coordination mechanisms, and (3) the introduction of innovative measures that may provide useful experience for national LAE legislation. By October 2024, more than 25 provinces and cities had incorporated the low-altitude economy into their local government work reports, reflecting the widespread recognition of LAE's strategic importance.

### 3.3. International regulatory comparisons and coordination

On the global stage, major economies are developing their LAE regulatory systems in parallel. In the United States, NASA and the European SESAR project have long been engaged in the development of regulatory frameworks for unmanned aircraft systems [7]. The U.S. Federal Aviation Administration (FAA) has issued the *UAM Integration Guide*, which aims to streamline airworthiness certification procedures and accelerate the commercialization of eVTOL aircraft. For its part, the European Union has advanced a series of policies focusing on areas such as sustainable aviation fuels, to promote the low-carbon transition of low-altitude transportation. The International Civil Aviation Organization (ICAO) has also developed relevant regulatory frameworks, yet significant challenges remain in the harmonization of global regulatory standards and airspace management practices [2].

In contrast to China's top-down policy-driven approach, which emphasizes rapid legislative action and large-scale pilot deployments across multiple provinces, the U.S. and European frameworks tend to follow a more bottom-up pathway centered on safety certification. The FAA's focus on airworthiness certification and the EU's emphasis on sustainable aviation fuel and environmental compliance reflect a regulatory philosophy that prioritizes gradual risk mitigation and technological maturity verification before commercial scaling. While China has pursued parallel advancement of legislation, standardization, and infrastructure construction to accelerate market formation, Western approaches exhibit a comparatively cautious commercialization rhythm, with greater weight placed on incremental safety validation and public acceptance. These divergent pathways underscore the trade-off between speed-to-market and risk aversion, offering complementary lessons for global LAE governance.

## 4. Technological enablers and application domains

### 4.1. Core technologies and innovation drivers

The development of the low-altitude economy rests on the convergence of five foundational technological pillars: low-altitude aircraft manufacturing, remote communication and control of drones, environmental sensing coupled with navigation and positioning, route planning and airspace governance for low-altitude operations, and the integration of big data, cloud computing, and artificial intelligence [4]. Through what are commonly described as "radiation effects," "traction effects," and "network effects," these technologies jointly lay the groundwork for the entire low-altitude industry [4].

Breakthroughs are unfolding across several fronts. In battery technology, for instance, EHang's solid-state batteries have demonstrated 48 minutes of continuous flight at an energy density of 480 Wh/kg, pushing operational ranges further. Meanwhile, AI-optimized path planning is making Level-4 autonomous flight operations possible. Intelligent airspace management platforms—China's "Tianxing" central system among them—enable end-to-end management of low-altitude traffic and can issue conflict warnings up to 30 minutes ahead. The ongoing fusion of AI, machine learning, and automation continues to raise safety benchmarks and to make more complex operations in adverse conditions feasible [7].

### 4.2. Unmanned aircraft system traffic management (UTM)

Conventional air traffic management (ATM) systems were designed principally for manned aircraft in medium- and high-altitude airspace, and therefore cannot adequately support large-scale UAV operations at low altitudes. Specifically, these legacy systems fall short in capacity, level of granularity, and real-time responsiveness—capabilities that are indispensable when managing dense, heterogeneous drone traffic amid complex urban environments. As a result, the construction of an efficient, safe, and intelligent unmanned aerial system traffic management (UTM) framework has become a central focus of research worldwide.

The core technical elements of UTM encompass multi-UAV communication networks, cooperative control, capacity and flow management, conflict detection and resolution, and swarm-level autonomous traffic operations. It is only when these elements function in concert that safe, scalable drone operations across varied application settings can be realized.

Among emerging approaches, hierarchical, categorized, zoned, and grid-based management schemes—together with novel "pipeline-style" three-dimensional route-network designs—are being proposed to optimize airspace allocation and to accommodate future large-scale autonomous UAV operations. Real-time airspace tracking, automated conflict resolution, and intelligent flight-path generation are likewise under development, with the aim of permitting drones to operate safely in densely populated areas.

Nevertheless, the bulk of existing research concentrates on airspace access and conflict detection, leaving fine-grained route allocation for logistics applications comparatively underdeveloped. Dynamic route optimization under uncertainty, scalable traffic-flow management during peak periods, and integration with urban infrastructure all remain insufficiently explored. Such gaps point to the need for further research and development before UTM can progress from theoretical frameworks to operational readiness [8].

### 4.3. Key application domains: logistics, urban air mobility, and beyond

The low-altitude economy spans a wide array of application areas, among which logistics and urban air mobility (UAM) stand out most prominently. Low-Altitude Logistics: Drone-based logistics has grown into a vital component of urban supply chains and emergency transportation systems. During 2024 alone, China rolled out more than 140 new low-altitude logistics routes, roughly 90% of which operated within city boundaries. By circumventing road congestion, drones shorten delivery times; studies indicate that delivery efficiency can be twice that of conventional ground transport [9]. E-commerce and food-delivery leaders such as JD.com and Meituan have made substantial investments in drone logistics—JD Logistics, for example, has trialed drone-delivery networks across multiple provinces and has cut shipping times for rural customers by as much as 70%.

Urban Air Mobility (UAM): UAM offers a transformative vision for transportation in densely built urban areas, employing small, highly automated aircraft—including eVTOLs and UAVs—to move passengers and cargo at lower altitudes within and around cities [9]. Point-to-point travel times fall by 30%–40% on average, with reductions of 40%–50% reported in major cities [10]. Widely seen as a cornerstone of future urban air-mobility systems and next-generation low-altitude transport networks, eVTOL aircraft now feature in UAM projects launched by roughly 46 cities globally. The environmental advantages are also significant: electrification can cut carbon emissions by up to 70% relative to conventional helicopters. Other Applications: In addition to logistics and passenger transport, low-altitude uses extend to medical rescue (delivering emergency supplies within 30 minutes to remote areas), agricultural transport, infrastructure inspection, urban surveillance, and emergency response [8]. This breadth of use underscores the potential of the low-altitude economy to contribute across multiple sectors of both the economy and society.

## 5. Conclusion

This paper has systematically reviewed the low-altitude economy (LAE) from three perspectives: its development trajectory, policy and regulatory frameworks, and technological enablers and applications. In response to the research questions posed in the introduction, the study concludes that the LAE has indeed evolved from a niche concept into a nationally strategic sector, with China's market projected to reach 1.5 trillion yuan in 2025 and 3.5 trillion yuan by 2035. Policy frameworks have progressed substantially through revised aviation laws, standardization guidelines, and local regulations, yet gaps remain in airspace management coordination and real-time operational governance. Technologically, while core innovations such as UTM, autonomous flight, and battery systems are advancing rapidly, integrating these technologies into scalable commercial operations remains challenging. Overall, the LAE holds transformative potential, but sustainable growth depends on simultaneous progress in infrastructure, regulatory reform, and industrial ecosystem building.

This study, however, has several limitations. First, it relies entirely on secondary data and policy documents, lacking primary empirical validation or quantitative modelling. Second, the analysis is largely China-centric, with limited comparison to other major regions such as North America or Europe, which restricts the generalisability of some insights. Third, the paper addresses macro-level technological and regulatory issues but does not examine micro-level factors such as public acceptance, privacy, and social equity. Lastly, given the rapidly changing nature of the field, some market figures and policy details may already require updating.

To overcome these shortcomings, future research should pursue three main directions: (1) conducting empirical case studies in selected Chinese cities to collect operational and economic

data, (2) undertaking comparative analyses with the US and EU regulatory approaches to identify harmonisation opportunities, and (3) developing a multidimensional evaluation framework that incorporates social and environmental criteria alongside economic indicators. Future research could also employ dynamic simulation models to evaluate different policy scenarios. These enhancements will provide more robust, actionable guidance for both policymakers and industry stakeholders as the low-altitude economy transitions from pilot exploration to large-scale implementation.

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