Report
Identifying Top Launch Regions for Advanced Air Mobility

A collaborative, data-driven analysis of potential launch cities for AAM.

Lufthansa Innovation Hub

X2AIR

Roland Berger

UNISPHERE

Executive Summary

Key Highlights

1. Regional Dominance

The United States hosts four of the eight prime launch cities (Charlotte, Los Angeles, Orlando, Chicago), while Germany ranks second with the most promising locations being Munich, Hamburg, and Berlin.

2. United States Insights

Orlando, Charlotte, and Los Angeles are highly attractive for AAM given their favorable terrain, supportive regulatory environments, and significant travel time savings over traditional ground transport. Miami and San Diego also excel due to their advantageous weather conditions, boosting operational feasibility.

3. European Insights

Cities such as Munich, Zurich, and Paris stand out for their advanced aviation infrastructure and supportive governmental policies, facilitating readiness for AAM operations. Amsterdam and Rome also show substantial potential, benefiting from less complex airspace and favorable weather conditions.

Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

Purpose and Scope

This report, produced by Lufthansa Innovation Hub in collaboration with V2AIR, Roland Berger, and Unisphere provides a comprehensive analysis of the most viable global cities for launching Advanced Air Mobility (AAM) operations. Focusing on 42 cities across the United States and Europe—while excluding Asian and Middle Eastern cities due to data limitations—it aims to provide AAM operators, city officials, and other ecosystem stakeholders with crucial insights on optimal launch regions. This report is the first in a two-part series, focusing solely on the supply side of AAM. A second report, set for release later in 2024, will address the demand side.

Strategic Recommendations

The report recommends a strategic emphasis on routes that blend high viability and feasibility through a "Route-First Strategy." This approach advocates for close collaboration with regulatory bodies, operators, ecosystem participants, and the community to tailor AAM operations to specific urban contexts, overcoming current barriers to achieve high viability and feasibility.

Contact Us

The Route Attractiveness Study provides a detailed, data-driven foundation to support strategic decision-making and foster the growth of AAM across pivotal global cities. For more granular, route-specific insights, stakeholders are encouraged to request a detailed analysis. Contact us for additional details and a customized city analysis via reports@tnmt.com.

AAM Definition

Advanced Air Mobility represents a new era of air transport, encompassing a diverse array of innovative aircraft technologies designed to revolutionize how we connect within and between urban areas and transport hubs. This category includes not only electric Vertical Takeoff and Landing vehicles (eVTOLs) but also extends to electric Short Takeoff and Landing vehicles (eSTOLs) and electric Conventional Takeoff and Landing vehicles (eCTOLs). Our study explores the transformative potential of these technologies in creating new network possibilities, rather than focusing on the technical specifications of individual aircraft. It is essential to understand that “air taxis” encompass all these technologies, each contributing uniquely to the evolving landscape of AAM. It is crucial to clarify that Advanced Air Mobility does not merely involve electrifying traditional aircraft types to serve existing airline routes. Instead, AAM encompasses both urban air mobility and regional air mobility, focusing on routes not currently served by traditional airlines. The use cases for AAM are diverse, including intra-city travel, airport shuttles (which may also include airport-to-airport transfers), and intercity routes that are either too short or do not have sufficient demand to support conventional aircraft operations. This broader understanding helps distinguish AAM's unique role in reshaping the future transportation landscape.

Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

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Introduction

This section outlines the purpose and scope of our study, which encompasses an analysis of 42 metropolitan areas across the United States and Europe. These regions were selected based on their high potential for AAM operations. We evaluated various metrics critical to AAM deployment, including terrain, airspace complexity, weather conditions, local infrastructure, regulatory support, and potential time savings over existing ground transport options. Our objective is to provide stakeholders with a comprehensive understanding of the factors that influence AAM feasibility and viability. This in-depth analysis is intended to assist in strategic decision-making and planning, ensuring successful AAM implementation.

Study Coverage: Analysis of 42 Cities Across the United States and Europe

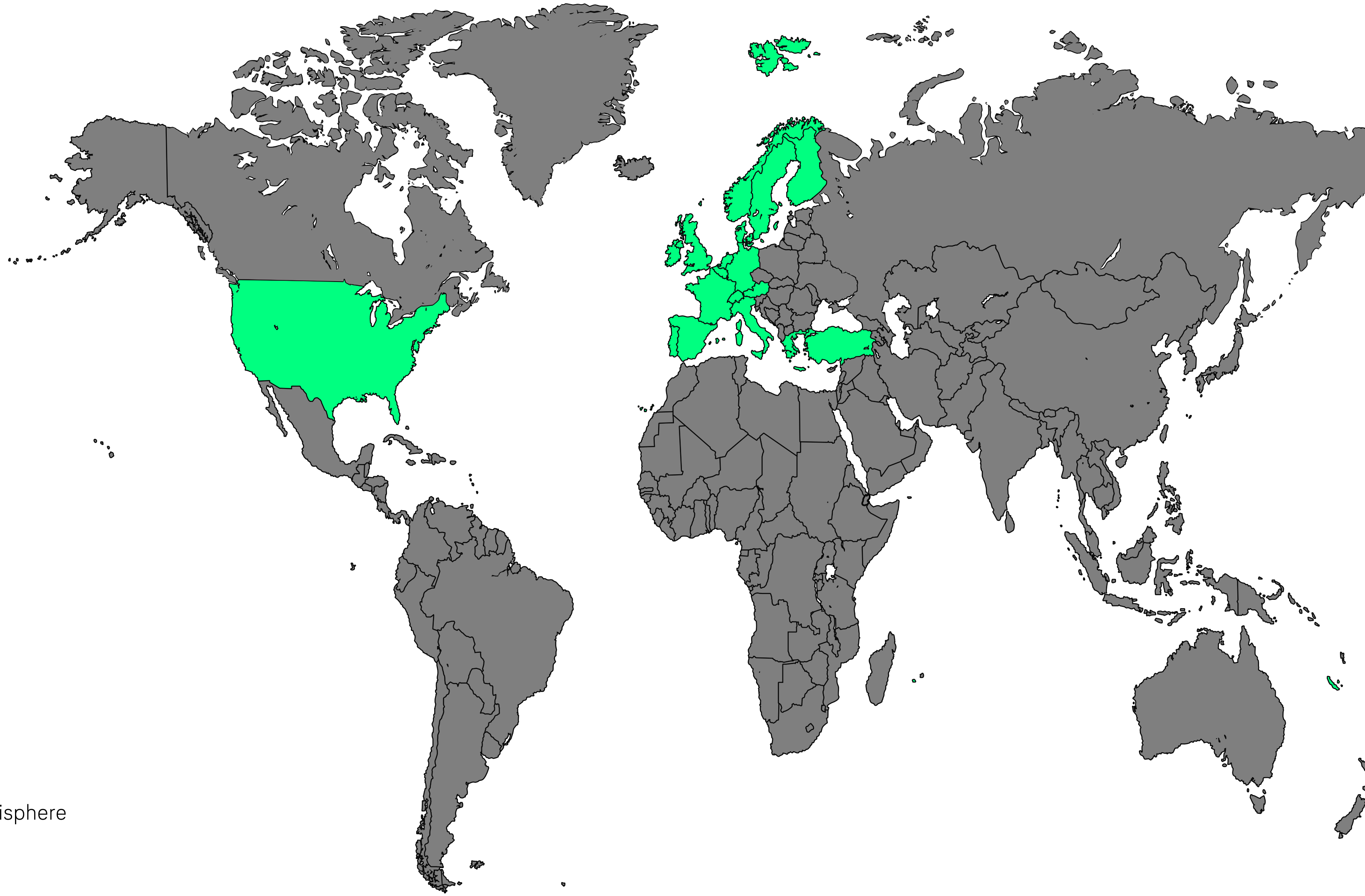
Overview of covered regions

The study delivers comprehensive insights into the viability and feasibility of AAM operations in each city, which collectively indicate the overall attractiveness of a location. These insights are designed to assist operators, and other ecosystem stakeholders in selecting optimal launch regions. Additionally, they equip city officials with the necessary information to position their regions as leaders in innovative air mobility operations. Moreover, the study highlights specific areas where cities can improve to enhance their attractiveness for AAM operations.

For stakeholders seeking more granular, route-specific insights, such as identifying the most and least favourable routes for operations, the study offers deep-dive analyses available upon request.

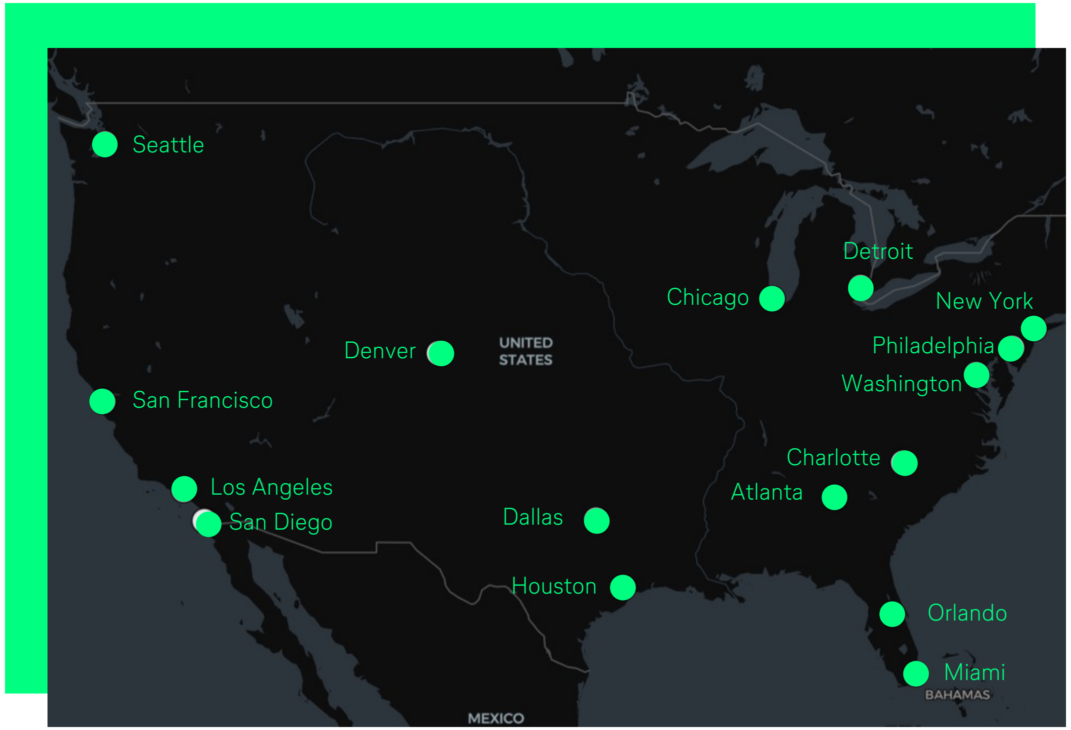
→ CONTACT US NOW

Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

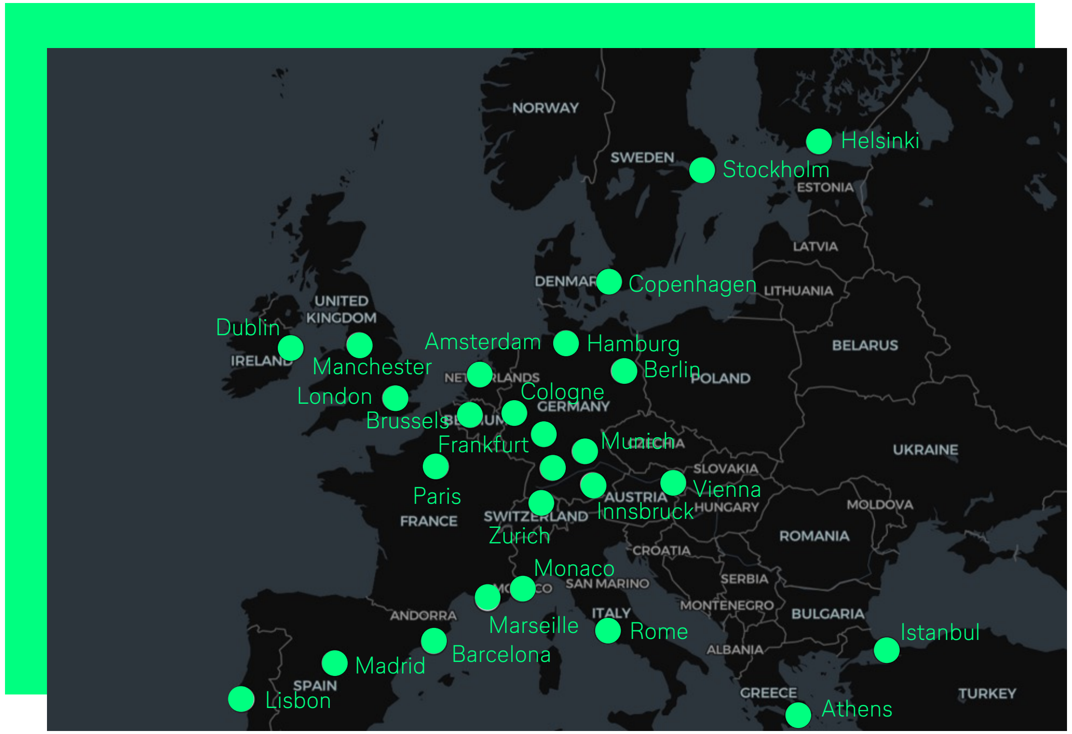


The Study Encompasses 16 Cities in the U.S. and 26 Cities in Europe

Overview of covered cities in the United States



Overview of covered cities in Europe



Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

Six Key Metrics Define the Attractiveness for AAM Operations

1 Terrain Analysis

- Identify and map geographical features impacting flight paths.
- Consider potential hazards including tall structures and natural obstacles.

2 Airspace Analysis

- Review airspace availability and other limitations like military needs.
- Estimate the impact of these restrictions on potential routes.

3 Authority Analysis

- Assess regional and national aviation legislation.
- Gauge acceptance level of aviation authorities for AAM services.
- Monitor location initiatives supporting AAM.

4 Weather Analysis

- Assess prevailing and seasonal weather patterns in the region.
- Estimate impact of weather conditions on AAM aircraft operability.

5 Area Analysis

- Study local factors such as congestion and corruption.
- Analyze aviation infrastructure, incl. number of airports.
- Evaluate the cost of m^2 for the area to understand economic factors.

6 Time Savings Analysis

- Analyze the efficiency of ground-based vehicles and public transport.
- Compare these alternatives to AAM in terms of speed and convenience.

Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

Methodology Breakdown

Feasibility

1. 25% **Terrain**
2. 25% **Airspace**
3. 50% **Authority** (the most critical enabler from feasibility point of view)

Viability

1. 25% **Weather**
2. 25% **Area Impact**
3. 50% **Time Savings** (the most relevant criterion for launching AAM operations)

Route Attractiveness Score
Combination of the variables "Feasibility" and "Viability"

Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

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The Results

In this section, we present the findings from our comprehensive Route Attractiveness Study for Advanced Air Mobility operations. The results offer key insights into the feasibility and viability of various metropolitan regions in the United States and Europe. We categorize the cities into four primary zones based on their total Route Attractiveness scores, providing a clear framework to support strategic decision-making for AAM stakeholders.

Assessing Advanced Air Mobility’s Most Promising Locations

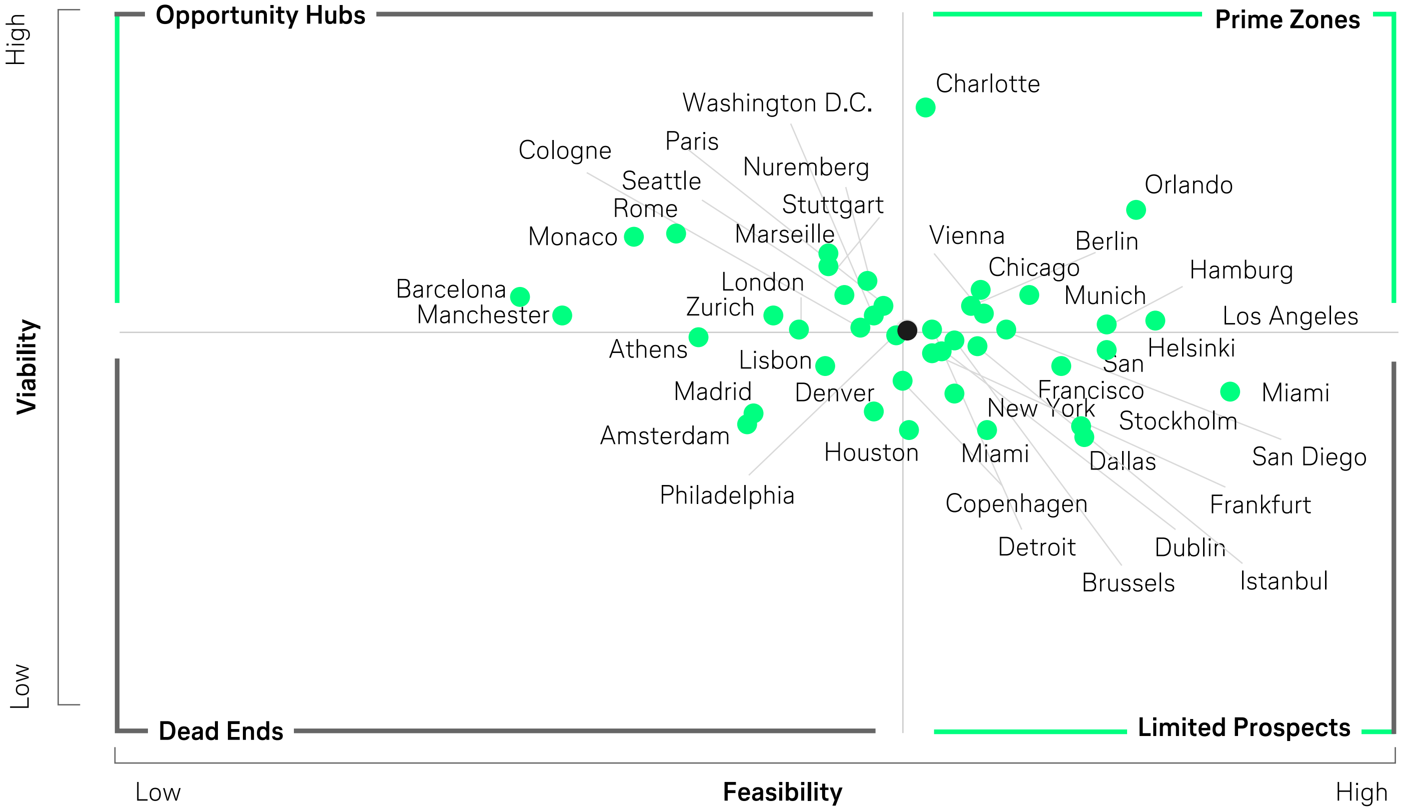
The AAM Route Attractiveness Matrix

Opportunity Hubs
▲ High Viability
▼ Low Feasibility

→ These cities may offer rich opportunities if feasibility challenges can be mitigated.

Dead Ends
▼ Low Viability
▼ Low Feasibility

→ These cities are currently not attractive for AAM operations.



Prime Zones
▲ High Viability
▲ High Feasibility

→ These locations represent ideal market entry points for AAM operations.

Limited Prospects
▼ Low Viability,
▲ High Feasibility

→ These cities are technically feasible for AAM but offer low viability.

Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

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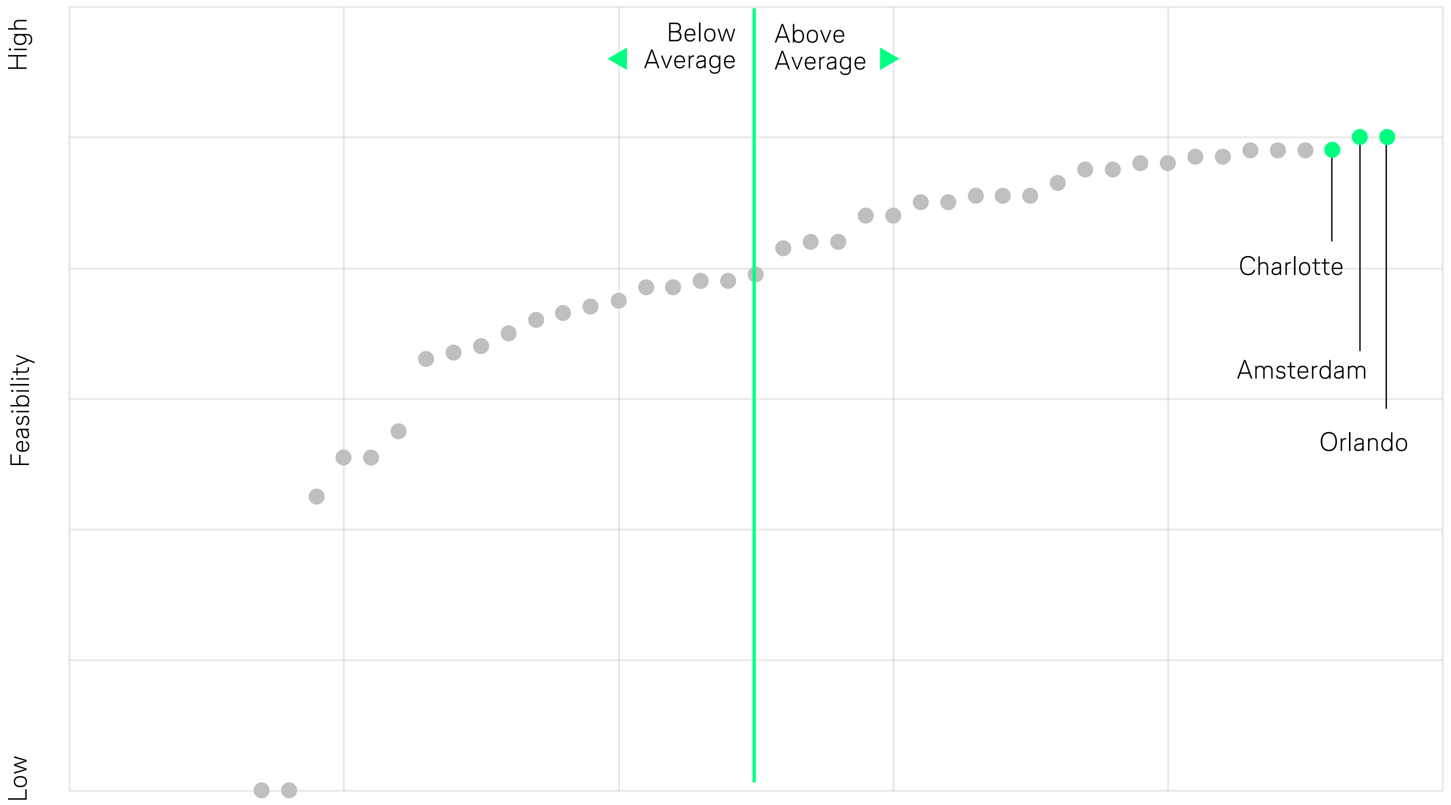
The Results

Feasibility

In this initial subsection of “The Results,” we explore the feasibility of Advanced Air Mobility operations across the analyzed cities. We will examine three critical elements—terrain characteristics, airspace complexity, and the readiness and support from local authorities. By evaluating these factors, we aim to provide a comprehensive understanding of the operational challenges and opportunities each city presents for AAM operations.

Flat Terrain Environments Are Best Suited for AAM

Terrain Impact Ranking across all cities



Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

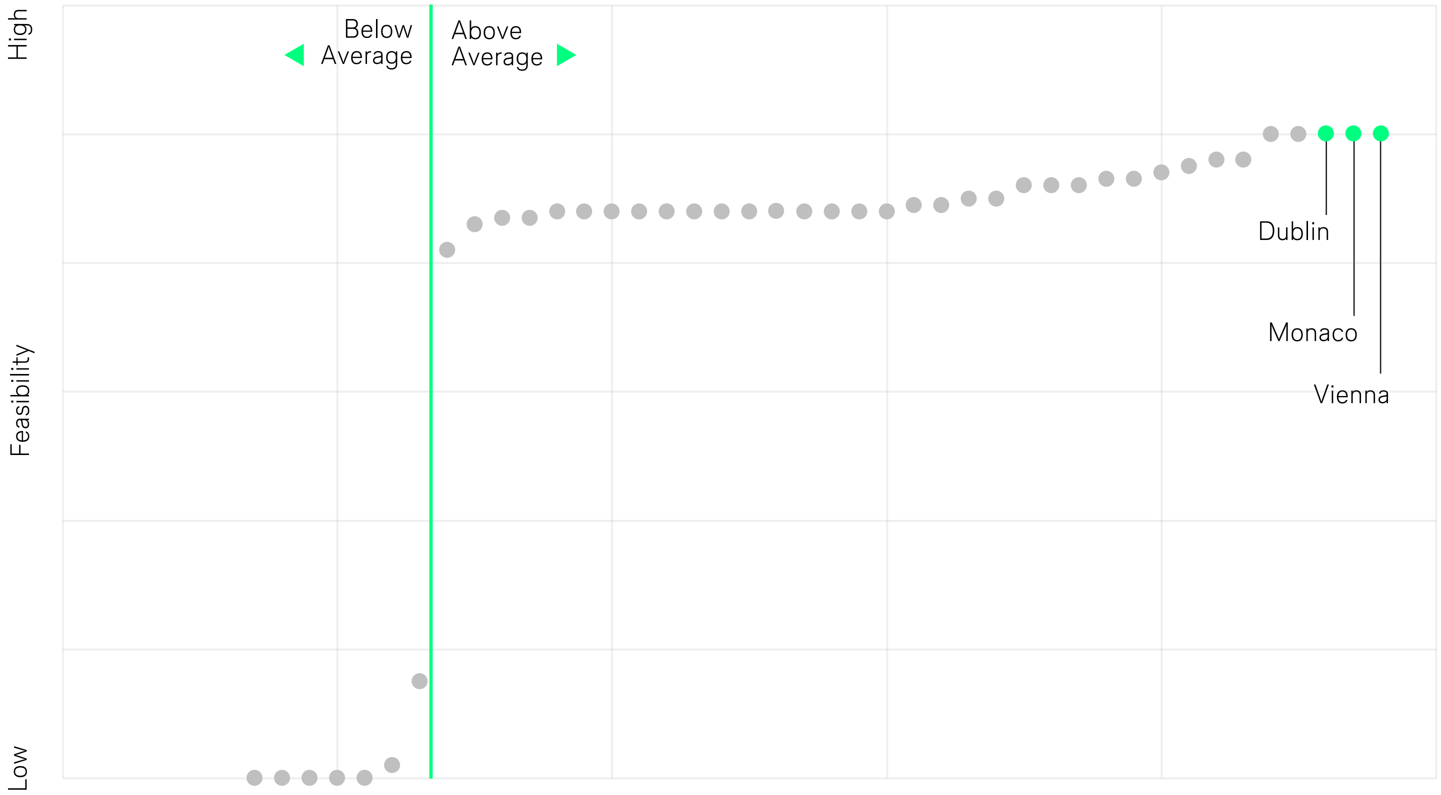
The top cities for terrain suitability in our analysis are Orlando, Amsterdam, and Charlotte.

These cities exhibit the most favorable terrain variations among the 42 cities studied, characterized by significantly lower vertical ascents and descents. This geographic advantage leads to reduced energy consumption for future AAM aircraft, as more homogeneous route profiles result in fewer altitude changes and diminished impact from thermal currents.

The findings underscore that cities with favorable terrain offer substantial operational benefits. With less need for rigorous energy management strategies, operators in these cities can offer more frequent flights or extend the range without frequent recharges. This not only enhances operational efficiency but also improves the unit economics for operators, making these cities prime candidates for AAM deployment.

AAM Relying on Smart Route Planning to Address Airspace Restrictions

Airspace Impact Ranking across all cities



Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

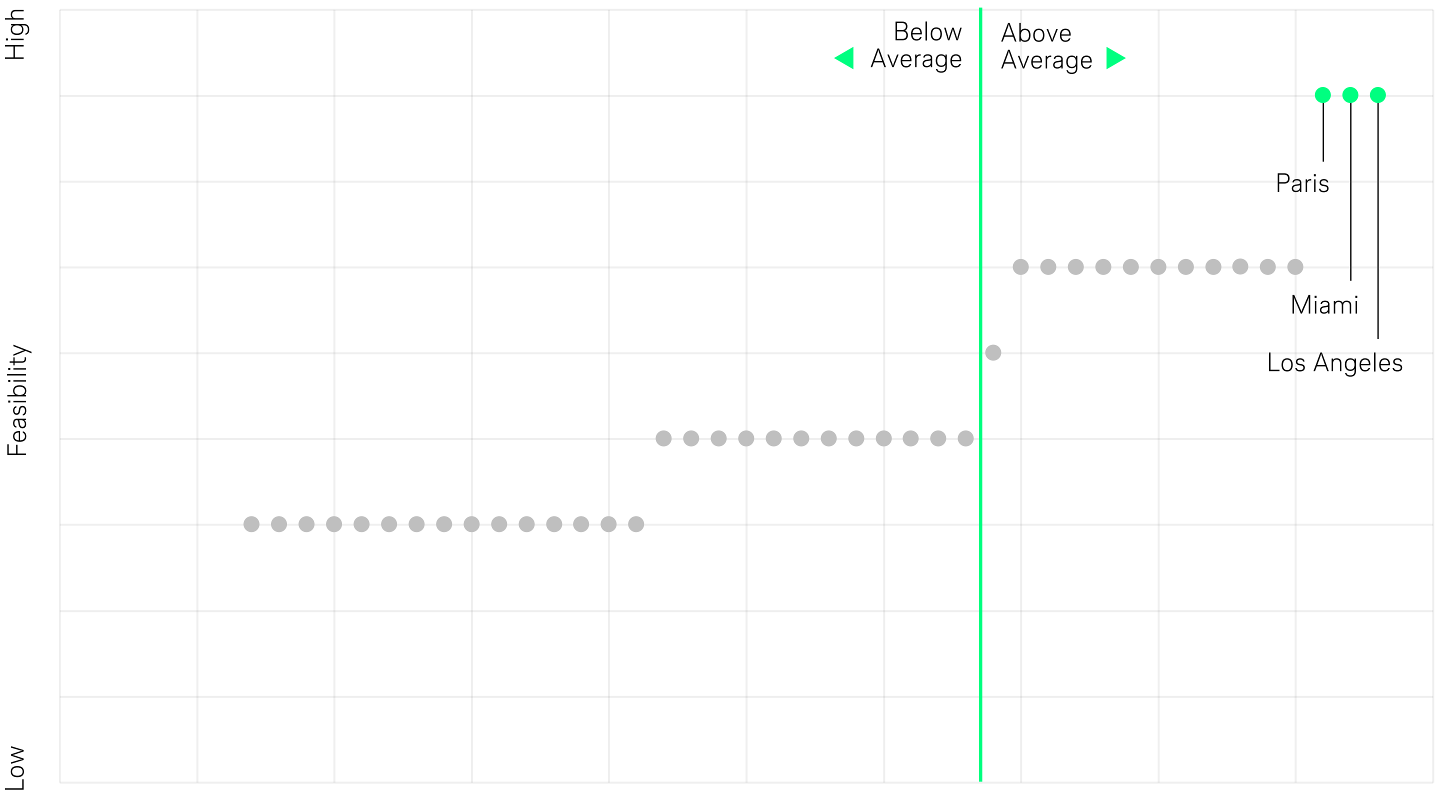
The most favorable airspace environments are found in Vienna, Monaco, and Dublin.

Our analysis considered several airspace categories: Class A, B, C, D, and military. The complexity of operations is assessed based on the degree of overlap among these categories; higher overlap indicates more complex or restricted operations, especially in zones with military airspace. It's crucial to note that this analysis focuses on specific routes within the analyzed network, rather than general airspace conditions over the entire cities.

Vienna and Dublin excel in this regard; despite the presence of restricted military airspace, the specific routes analyzed navigate around these areas effectively, ensuring minimal operational constraints. Monaco, also impacted by significant military airspace, benefits from route configurations—particularly northbound—that allow for “clean” departure paths. This underscores the importance of strategic route planning in managing airspace complexity.

Only 15 Cities Uniquely Located Within Supportive Regulatory Contexts

Authority Impact Ranking across all cities



Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

Los Angeles, Miami, and Paris excel in securing favorable local government support, which is pivotal for advancing AAM operations. Such support encompasses strategic partnerships, public fundings, and backing for pilot projects.

These three cities are at the forefront due to their proactive AAM-focused innovation agendas. Los Angeles has partnered with Urban Movement Labs to explore the potential benefits of AAM and to develop the necessary infrastructure and regulations for its safe and equitable implementation. In Miami, the Florida Department of Transportation (FDOT) has established an Advanced Air Mobility working group. The state collaborates with various stakeholders to formulate a comprehensive AAM integration plan. Paris has initiated the “Paris-Saclay Autonomous Lab” project, aiming to develop and test autonomous air transportation systems within the region. Additional significant initiatives include Re:Invent Air Mobility, and the establishment of a testbed at Pontoise-Cormeilles airfield.

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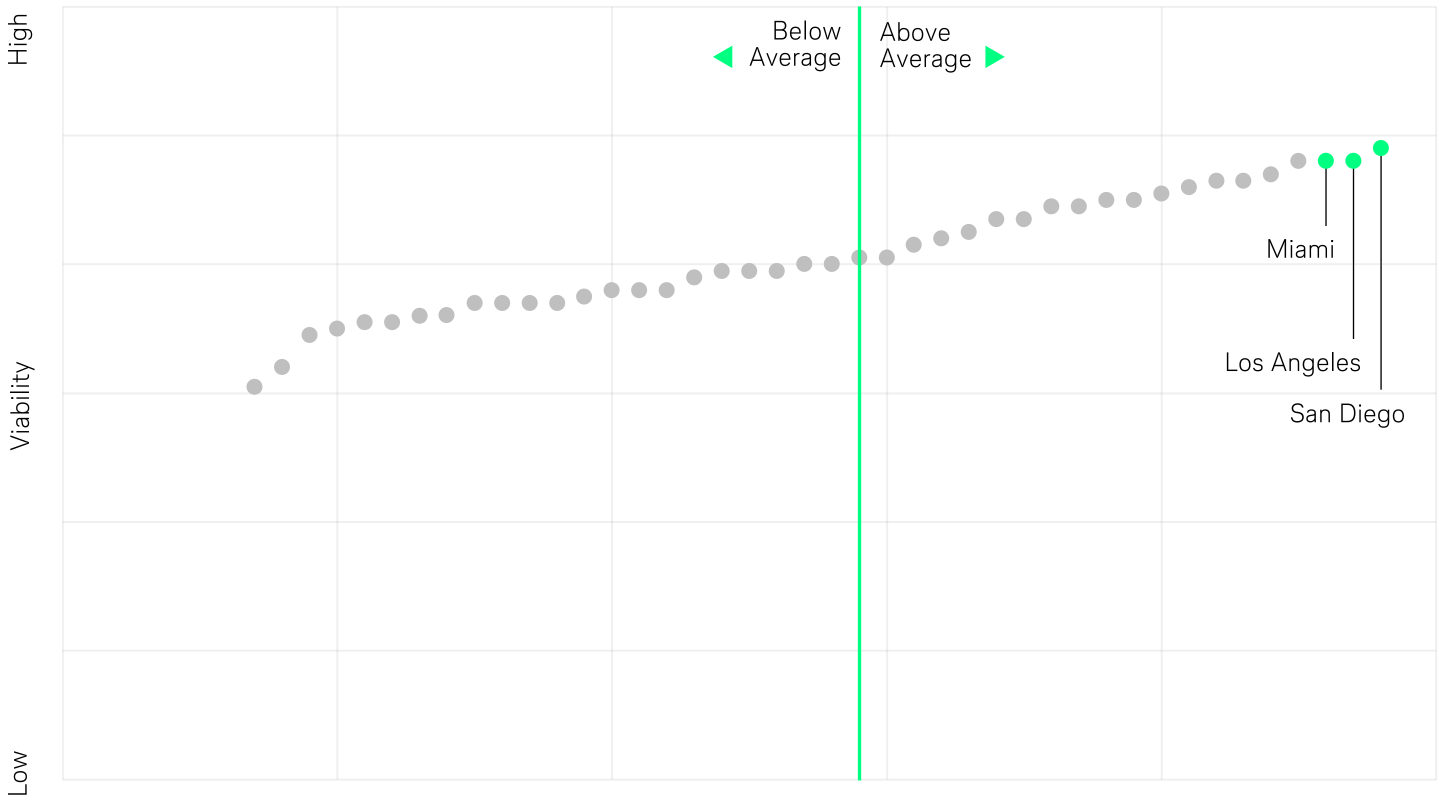
The Results

Viability

This second subsection delves into the viability of AAM operations across the selected metropolitan regions. We focus on assessing critical factors such as weather conditions, area-specific challenges like congestion and infrastructure, and the potential time savings AAM can offer over traditional transportation methods. These evaluations are crucial for stakeholders to identify cities that not only promise successful AAM launch but also sustain effective operations in the long term.

Optimal Weather Conditions Enhance AAM Service Availability in Key Cities

Weather Impact Ranking across all cities



San Diego, Los Angeles, and Miami boast the most favorable weather conditions for Advanced Air Mobility.

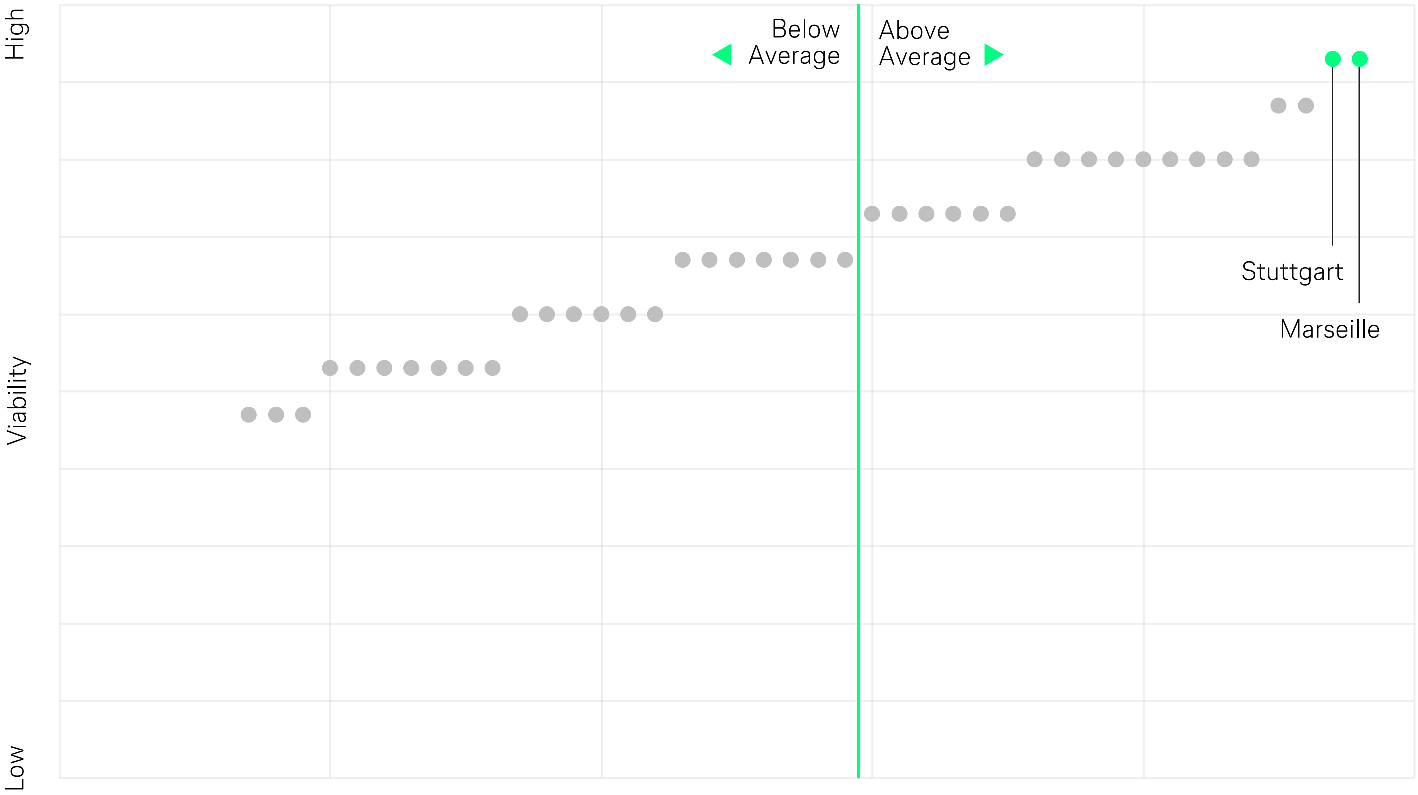
To determine this, we analyzed the annual weather patterns of each city, categorizing them into three clusters: excellent, moderate, and severe, to gauge their impact on future AAM operations.

The top three cities maintained excellent or moderate weather conditions for over 95% of the year, significantly higher than other cities analyzed. This consistent favorable weather translates to higher service availability, making these locations particularly attractive for AAM operations due to their enhanced revenue and profit potential.

Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

Multiple Airports and Heliports are Crucial for Launching AAM Operations

Area Impact Ranking across all cities



Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

Marseille and Stuttgart lead in area-specific viability due to their advanced infrastructure, significant ground congestion, and premium market condition, making them standout candidates for AAM initiatives.

This area analysis assessed the attractiveness of locations based on several crucial variables, each contributing to an area's potential for successful AAM operations including:

A) Locations with higher scores suggest less perceived corruption, facilitating smoother setup and expansion of AAM operations.

B) High congestion scores highlight severe traffic issues, underscoring the efficiency AAM can provide as an alternative mode of transportation.

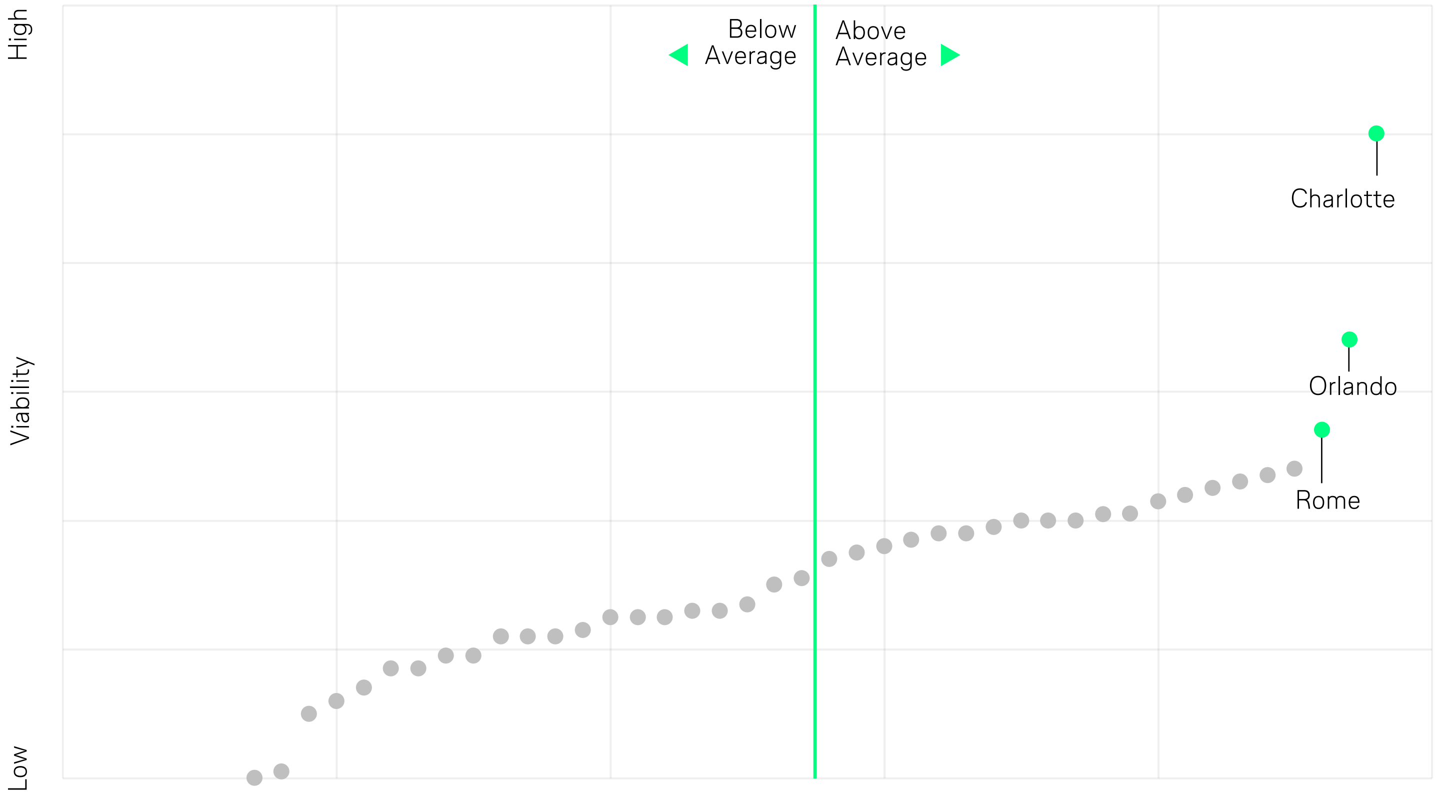
C) A higher number of helipads indicates a solid infrastructural foundation for AAM, increasing overall ranking of cities.

D) Numerous airports signal a robust existing aviation infrastructure, which can be leveraged for seamless AAM integration, boosting a city's ranking.

E) Elevated real estate costs denote premium market conditions, influencing both operational tactics and pricing strategies for AAM.

Minimal Time Advantages Over Cars Question the Value Proposition of AAM

Time Savings Impact Ranking across all cities



Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

Charlotte, Orlando, and Rome emerge as the top cities from a time savings perspective, primarily due to their high traffic congestion and inadequate public transportation infrastructure.

This is especially significant in Charlotte, where the contrast between AAM and public transport is stark. The comparative time savings when flying, as opposed to using public transport for our selected routes, are:

- → Charlotte: 85%
- → Orlando: 78%
- → Rome: 73%

However, the time savings when comparing flying to driving are less pronounced. It's important to note that in most cases, the time saved by opting for AAM over driving is minimal, and can sometimes result in even longer travel times.

This raises a critical question: Are travelers willing to switch to AAM under these conditions?

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What‘s next

In this final chapter, we outline strategic steps and recommendations for pushing Advanced Air Mobility operations from concept to execution. This chapter covers critical areas such as strategic route selection, regulatory collaboration, community engagement, operational resilience, infrastructure optimization, performance monitoring, and global insight exchange. These actionable steps are designed to guide stakeholders through the effective implementation of AAM operations, helping them address challenges and leverage opportunities for growth and innovation in the field of advanced air mobility.

Adopting a “Route-First Strategy” to Prove AAM Viability and Feasibility

1 Strategic Route Selection

Leverage study insights to earmark routes offering the highest viability and feasibility for AAM, and compare these with demand metrics. Afterwards, select the routes with the best demand and attractiveness ratio.

2 Regulatory Collaboration

Collaborate with regulatory bodies to tailor policies and regulations specific to the operational needs of selected AAM routes to ensure a conducive legal environment in support of AAM operations.

3 Community Engagement

With clearly defined routes, engage local communities and stakeholders through tailored communication and collaboration initiatives to build understanding, address concerns, and foster support.

4 Operational Resilience

Implement strategies focused on minimizing operational challenges specific to selected routes by utilizing advanced weather prediction tools and terrain-adaptive technologies.

5 Infrastructure Optimization

Concentrate on infrastructure enhancements necessary to support identified routes, focusing on existing helipads, airfields, and other AAM-related infrastructure elements to ensure readiness.

6 Performance Monitoring

As pilot programs commence, implement a robust system for ongoing performance assessment of AAM operations by gathering data-driven and actionable insights to refine and improve the service offering.

7 Global Insight Exchange

Participate in global forums and partnerships to exchange learnings, challenges, and successes. This international dialogue enriches a city’s AAM initiatives with global best practices and innovations, reinforcing the city’s position as a thought leader in the AAM domain.

Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere

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Your Tailored Report

Contact Us for a Customized Deep-Dive Analysis of Your City

More regions to uncover

This AAM Route Attractiveness Study represents just a snapshot of our comprehensive analysis. We possess extensive insights into both the cities covered in this report and others that have not been included.

You can request detailed, route-specific insights for your city to make informed decisions about launching and operating Advanced Air Mobility.

Contact us today via reports@tnmt.com to request your personalized city analysis and position yourself as a leader in the future of Advanced Air Mobility.

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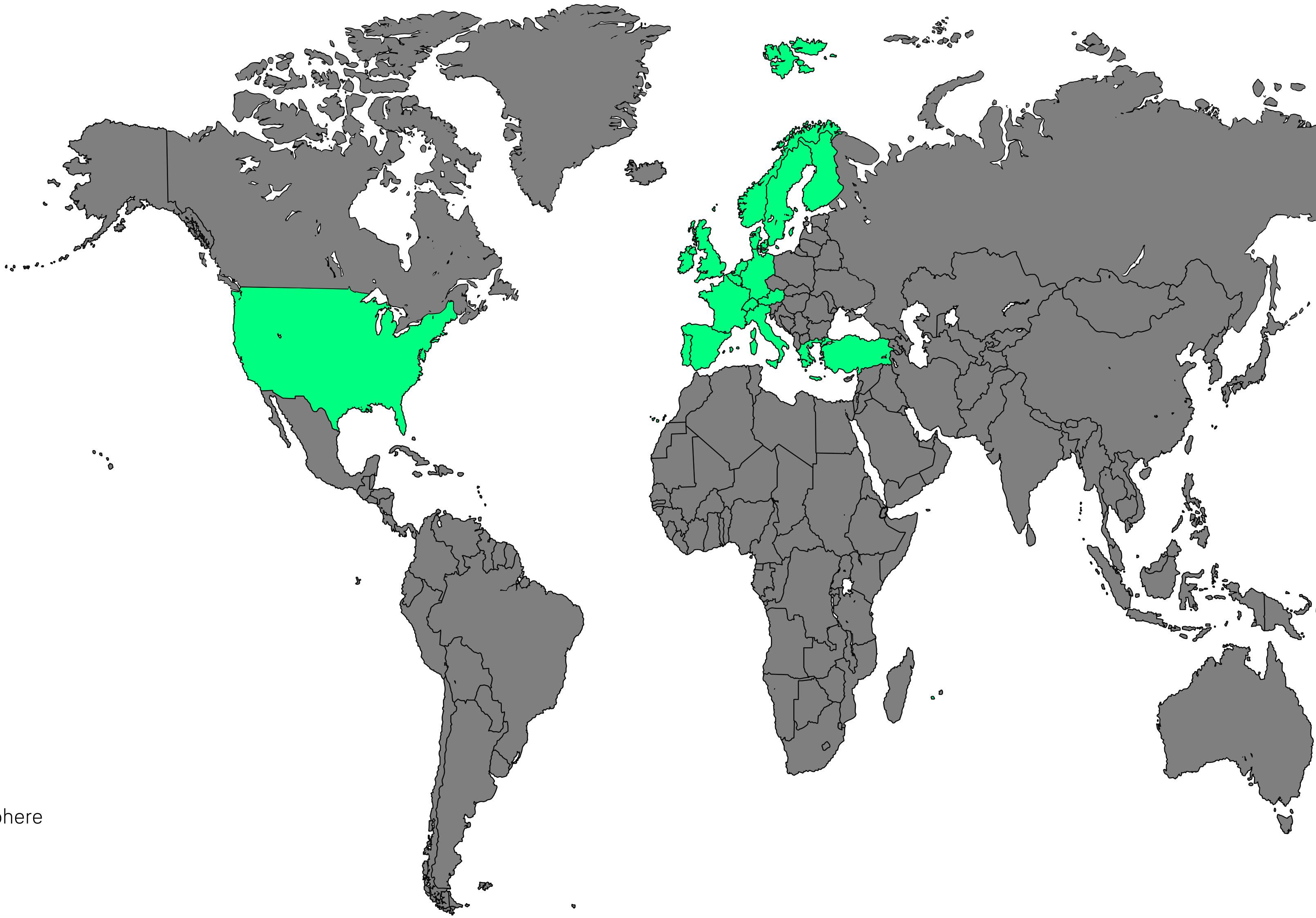
Source: Lufthansa Innovation Hub, V2AIR, Roland Berger, Unisphere



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Notes, Assumptions and Explanations

Page 6
Asia and Middle East not included due to lack of data for various metrics. For example, for air space availability.

Page 10
Viability includes the metrics: Weather (25% weighted), Area (25%), and Time Savings (50%), whereas Feasibility includes the metrics: Terrain (25%), Airspace (25%), and Readiness (50%).

Page 12
Ranking based on aforementioned metrics only, which include Weather (25% weighted), Area (25%), and Time Savings (50%), Terrain (25%), Airspace (25%), and Readiness (50%). It is to be noted that Readiness and Time Savings metrics have a higher impact on overall attractiveness score. Please also note that for boarding and disembarking of an AAM aircraft 15 min. each were assumed.

Page 15
The route is the ideal route not detour route as the latter would lead to increased travel time, hence, more energy consumption.

Page 16
For more information about the different airspace classes, please follow this Link. Currently, military airspace is prohibited for drones or any other air vehicle to enter or fly through. Hence, these routes either need to fly a detour or cannot be served at all, in case the departure/destination point is within military airspace.

Page 19
15 distinct weather parameters were analyzed over the past three years (2018-2020) using historic weather data. Definition weather conditions: (1) Excellent: Very good to conduct flight operations with selected aircraft type, (2) Moderate: Negative impact on operational performance, such as low visibility, medium rainfalls, etc., (3) Severe: No service can be offered. These phenomena include thunderstorms, heavy wind gusts, hail, etc.

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Time savings potential is higher, oftentimes when connecting cities which are currently underserved by public transit or requires the passenger to switch trains multiple times along the journey. Contrary, routes that are connected via high speed trains or other forms of fast transportation are potentially less attractive for an AAM service, due to limited or no time saving potential.

We used the Google API
(https://developers.google.com/maps/documentation/directions/overview) for point-to-point calculations in every network worldwide at the same local time, namely 08.00 AM peak-time. Modalities of public transportation include: train, subway, tram, suburban train, walking, bus, etc.). The data was retrieved in the period 27.08.2023-06.09.2023 - and always worldwide. The travel times for some connections are extremely long. For instance, in Munich and the surrounding area, one of the largest railroad line repairs was taking place at the time and major events happened around the metropolitan region causing general delays and detours, and hence, longer than usual travel times using public transport.

Disclaimer

This content is for general information purposes only and should not be used as a substitute for consultation with professional advisors. Data is current as of June 30, 2024 unless otherwise stated. The Lufthansa Innovation Hub and its partners have taken responsible steps to ensure that the information contained in the report has been obtained from reliable sources. However, neither the Lufthansa Innovation Hub nor its partners can warrant the ultimate accuracy and completeness of the data obtained in this manner. Results are updated periodically. Therefore, all data is subject to change at any time.