



NEXA Advisors
A NEXA Capital Company



HELICOPTER OPERATORS EMBRACE ELECTRIC FLIGHT

Ten Reasons Why eVTOL Will Fuel Industry Growth and Profits

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About NEXA Advisors, LLC:

NEXA Advisors provides highly specialized transaction-focused advisory services to companies and management teams in the aerospace and transportation sectors in the U.S. and around the world. Committed to delivering enterprise value through innovation, NEXA Advisors collaborates with our clients to help them become high-performance businesses. For many years NEXA Advisors has worked with the aviation community to identify how aircraft can generate and sustain enterprise value for the companies they serve.

Our study, ***Urban Air Mobility (UAM) Economics and Global Markets 2020-2040***, first released in October 2019 and updated in January 2020, is a joint undertaking with NBAA, Aviation Week Network, the Vertical Flight Society and other respected industry

groups. The study analyzes 75 cities around the world, forecasting the financial and economic business case for Urban Air Mobility (UAM) in each, using thousands of geocoded data features, unique characteristics, and custom ArcGIS maps of each city. As part of our research, we developed a first-of-its kind, user friendly online tool, highlighting the potential of UAM in key global markets – including the benefit for helicopter and business aviation operators – at www.nexa-uam.com.

About UAM Geomatics, LLC:

NEXA's subsidiary UAM Geomatics is a new center aimed at accelerating unmanned aircraft systems and UAM investment through analytical tools and advanced models supported by geospatial data and business case analysis. We offer tools needed to begin designing airspace and infrastructure for those metro areas where electric vertical take-off and landing (eVTOL) operations can begin shortly. This includes capabilities such as identifying simple verti-pairs (flights between two vertiports) than can support profitable eVTOL operations; current and required ground infrastructure; UAM service demand, and Unmanned Traffic System (UTM) infrastructure. Helicopter operators and flight departments can use these tools to identify flight pathways for eVTOL aircraft on specific urban, regional and offshore missions.

Introduction

Helicopter operators stand at an inflection point, a powerful trifecta of looming societal crisis, technology and opportunity, where the past collides with the future, ushering in extraordinary benefits to the industry and society at large. In the coming years, traditional helicopters will, to a large extent, segue to electric vertical take-off and landing (eVTOL) aircraft: quieter, safer, and less expensive to own and operate.

And one of the biggest early beneficiaries of eVTOL aircraft will be the world's helicopter operators. This white paper, prepared for HeliExpo 2020, explains everything.



Figure 1 - Some Experts Believe NASA's Vision of Urban Air Mobility Will Become a Visible Option Beginning Late 2020, with Major Aerospace Companies Leading the Way in Vehicle Design and Certification, and Several Heavily Congested Cities are Stepping Up.

What Is Driving All This?

Several factors have created the interest in, and leap to eVTOL aircraft. The first is urban traffic congestion, which is growing across the globe. According to the UN, the world's urban population has grown rapidly from 751 million in 1950 to 4.1 billion in 2018. By 2050 over 6 billion people may be living in urban areas. Increased road congestion

means that the mobility of people, delivery of goods and services, and even Medevac services are delayed. Quality of life suffers, as do economic prosperity and job creation.

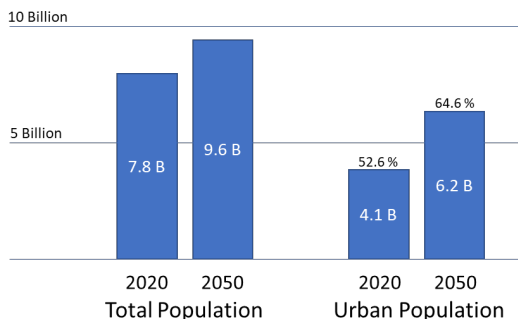
Take New York City, for example. Transportation experts believe that street congestion cost the City's economy over \$100 billion per year in 2018. That's six percent lost from its \$1.5 trillion economic engine.

By routing transportation into the third dimension—the airspace above cities—Urban Air Mobility (UAM) will provide a new modality to help decongest city streets. But the new world of UAM would not be possible without other factors:

Improved Energy Use and Storage: Powerful batteries making use of lithium ion technologies—which have recently made Nobel Prize-winning headlines—along with hydrogen fuel cells and hybrid charging, now can provide hours of electricity to power vehicles.

Motors Using a “System of Systems”: Advances have been made with motors that work with each other to transform battery power into high torque,

World Population and Urbanization Growth 2020 - 2050



Source: United Nations World Economic Prospects, 2018

rotor-induced lift more effectively, efficiently and quietly than ever before. These lightweight, multi-rotor designs provide an unprecedented degree of safety and performance.

Emerging, Super-Light and Safe Vehicle Composites:

Composites not available even a decade ago offer greater design freedom, enabling the creation of complex aerodynamic shapes, and requiring less maintenance, while operating at a safety level characteristic of the highest aviation standards.

Next-Gen Avionics: Electric vehicles will make use of precision navigation capabilities, with GPS augmentation through kinematic accuracy improvements, embedded inertial sensors and high precision independent ground beacons.

Advanced Pilot Assistance and Flight Automation: Certified sense-and-avoid technologies, predetermined “tunnels in space” and pilot assistance modes will provide safer flight operations. Traffic management monitoring systems embedded

in city infrastructure ensure safe separation of all traffic.

In combination, these developments are poised to produce some of the safest, greenest and most efficient air vehicles imaginable.

UAM and Regional Air Mobility (RAM) open up new possibilities for flight departments and charter operators that cater to business travelers. This new class of vehicles will be capable of solving the “last mile” or the “door-to-door” segment of a business trip.

The 10 Reasons to Electrify

Below are the ten reasons why helicopter operators are beginning to embrace electric flight in 2020.

1. Easy Transition and Adoption: Most significantly, experienced helicopter operators operating under Part 135 or Part 91 will be among the first to obtain permission to use eVTOL aircraft. Already experienced in rotary wing operation, they have

trained pilots, safety systems and training in place and will find it easy to transition to electric vehicles.

2. Societal Benefits: In a world where the word “green” is increasingly appealing to consumers, eVTOL aircraft offer reduced congestion, wear and tear on streets, and emissions compared to trucks and helicopters. Their impact on street congestion is a huge benefit that will help assure acceptance by residents and city mayors.

3. Medevac Use: The smaller footprint of eVTOL aircraft compared to that of helicopters means they will be able to land in areas where helicopters cannot to rescue patients. Moreover, many hospitals that currently have restrictions on the use of helicopters due to noise or weight or jet fuel use will welcome eVTOL Medevacs, ferrying patients, organs, and



Figure 2 - The Bell NEXUS Six Rotor, Five Passenger Hybrid Electric VTOL Aircraft Can Cruise at 200 Miles per Hour.

blood quietly and efficiently, and saving countless lives.

4. Increasing Revenues for Operators: UAM offers the industry a potential \$100 billion resulting from new markets. This is a type of “Windfall” that will add incremental top line growth for urban air taxi operations, airport shuttles and other use cases.

5. Dramatic Operating Cost Reduction: An eVTOL with comparable performance should cost less than half of what it costs to operate a turbine powered helicopter. There will be no need for jet fuel, and there will be less parts for maintenance and overhaul. Insurance rates will be lowered.

5. External Investments Driving Costs Ever Lower: Because of sustained multi-billion-dollar investments in the automotive sector, electric propulsion systems and technologies are evolving on their own, ensuring that eVTOL performance will continually improve and their costs will decrease. For example, Li Ion batteries are improving at a rate of about 5-10 percent each year, all driven by automotive industry needs.

6. Reduced Noise: eVTOLs will be 20+ dB quieter than helicopters, meaning that populations and cities will be more receptive to this kind of vertical flight and will permit the opening of new routes, even in densely populated areas where surface congestion is tough.

7. Increased Safety: eVTOL aircraft will be far more stable than rotary-wing aircraft, lighter-weight, smaller, and more survivable.

8. Lower Acquisition Costs: eVTOLs will be far more affordable to purchase or lease than traditional rotary-wing aircraft.

10: Opening Major New Markets: With regards to business and commercial aviation, the world’s top CEOs heading to their private jets are stuck on the same roads as everyone else. In the near future, they will fly to the airport in their eVTOL, and will also fly



Figure 3 - Joby Aviation 4 Seat Electric Vertical Take Off and Landing Air Taxi Prototype. Toyota Invested \$590 Million in Joby in January 2020.

short trips to other urban locations. A second major new market is on-demand air taxis. Travelers will find it inconvenient to taxi from one regional airport to another—JFK to La Guardia, say—and often wait hours at their transfer airport for the next flight. eVTOL airport-to-airport shuttles will be a new market and early use at that. Airports are already set up with air traffic control, helipads, passenger and baggage facilities, and security.

How Do We Know What We Know?

In October 2019, NEXA Advisors, supported by the National Business Aviation Association, Aviation Week Network, JETNET, the Vertical Flight Society and other sponsors, published the results of a trailblazing investigation into what is in store for helicopter operators over the next twenty years.

The study, *Urban Air Mobility Economics and Global Markets, 2020-2040*, provides the basis for many of the forecasts shared in this white paper. We focused on 75 of the world’s most populous cities, nearly half of them in the U.S., and examined each one’s needs with regards to UAM, including infrastructure, regulation, GDP, congestion, current transportation networks, and dozens of other factors to determine likely early users. Each city report, accessed through

an interactive web portal, offers custom ArcGIS landscapes of the metropolitan area, thousands of geocoded data features and characteristics, and our estimation of the city’s or region’s potential for UAM.

Our key findings for each city include existing heliports, projected vertiports, estimated yearly UAM passengers through 2040, total operator revenues, total infrastructure costs, total urban air traffic management (UATM) costs, total vehicle costs, and total airports. We detail cumulative UAM passenger demand growth, vertiport buildout timelines, and cumulative revenues by market. Results are found below, and present exciting opportunities for the helicopter operator community. Some of our findings -- For the cities studied over 20 years between 2020 and 2040, are in the table below:

Global Cities Analyzed	75
75 City Urban-Regional GDP	\$22.5 trillion (26% of World Total)
eVTOL 20 Year Cumulative Operator Revenues	\$214 billion
eVTOL 20 Year Cumulative Fleet Costs	\$41 billion

In part through the use of first-of-its kind research, this white paper examines the value of using electric helicopters and services to solve the “last mile” or “door-to-door” challenge, complementing the flight department’s existing aircraft with electric or hybrid vehicles capable of moving a team of key people quickly from the home office to a meeting in a city center, or to an outlying airport to depart on a business aircraft or scheduled airline flight.

Our study is a valuable tool for the helicopter industry, and answers important questions outlined below.

Overcoming UAM Obstacles

Before investing in any aspect of UAM, the prudent helicopter operator must understand obstacles in the path of a large-scale production and even city-wide operation. Technological developments, such as vehicle design, longer-lasting batteries, and hydrogen cells, are just one concern. How will the burgeoning UAM industry deal with regulatory barriers, safety issues, noise concerns, privacy matters, and public perception?

Interpreting Investment Opportunities

Where should a company or financial institution make strategic investments in the rapidly growing, constantly changing UAM industry? Which opportunities will pay off sooner rather than later? Which cities and countries will be leaders in the field, and which will be latecomers? Which technologies and business models will yield early and substantial returns on investments? In an industry beset by many unknowns, the UAM Market Study is designed to help your company make wise investment choices.

Recognizing Infrastructure Needs

New Infrastructure will be key to UAM viability: vertiports, UATM infrastructure services, passenger



Figure 4 - German Design Company Lilium’s All-Electric Five Passenger Vertical Lift Vehicle Designed Specifically for Inter-City Operations.

facilities, lighting and weather systems, airspace planning, and certification. How much will this cost? How many vertiports will each city require in the next five to twenty years and how will they be phased in? How much existing infrastructure—such as helipads and heliports—already exists in each city? Where will new vertiports be built? Who will pay for infrastructure, and how will investors recoup their investment?

Urban Access: Aviation and Heliports

Existing heliport infrastructure, particularly outside of commercial and general aviation airports, provides eVTOL users with access to highly convenient urban destinations. Many existing heliports have the operating certificates and air

rights to begin stationing eVTOL aircraft immediately, though some heliports will need to undergo modification to offer recharging stations, hybrid vehicle refueling, passenger shelters, and other amenities. We estimate the cost to retrofit a simple landing pad into an eVTOL vertiport to be very affordable.

In **UAM Global Markets – 2020 to 2040**, we identified and geo-coded some 4,200 heliports within the seventy-five cities examined (Figure 5). Curiously, 40% were not registered with regulators; we found them through intensive research supported by satellite imagery and registry searches. Some were built for emergency purposes only or fell victim to local concerns about noise and safety. There are probably thousands more heliports throughout the U.S. that remain, for the time being, unregistered. Yet they present hundreds of millions

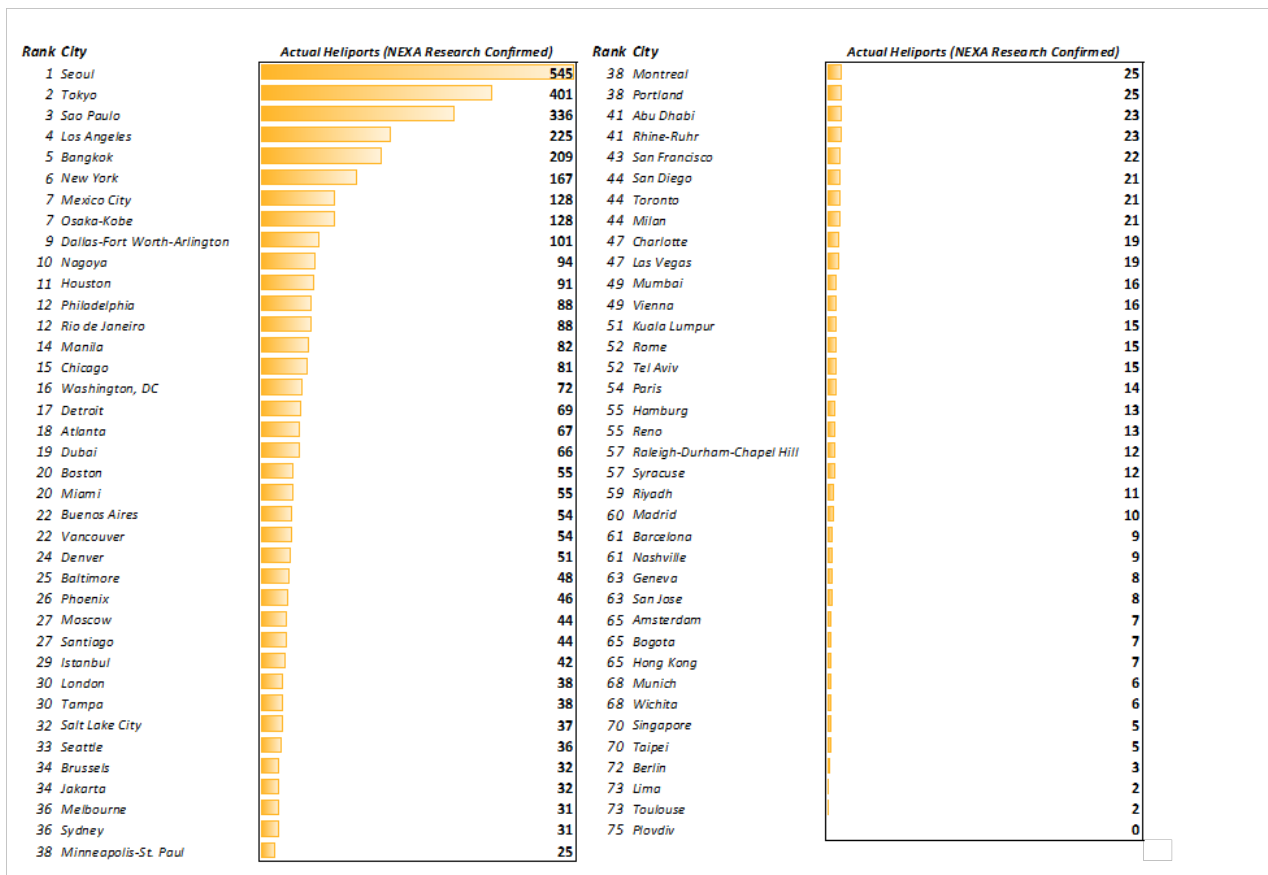


Figure 5 - Almost 4,300 Heliports Await an Urban Airspace Planning Cycle Over Top 75 Cities

of dollars of existing infrastructure with the potential for rapid development at reasonable cost. Those built for emergency purposes will suddenly become valuable real estate, and those shuttered for community concerns may well reopen.

With regards to trips from one company's office to another, the first certified hybrid eVTOL aircraft are likely to travel distances up to 150 miles between refueling/recharging. A team of business people will be able to board a vehicle at or near their office in,

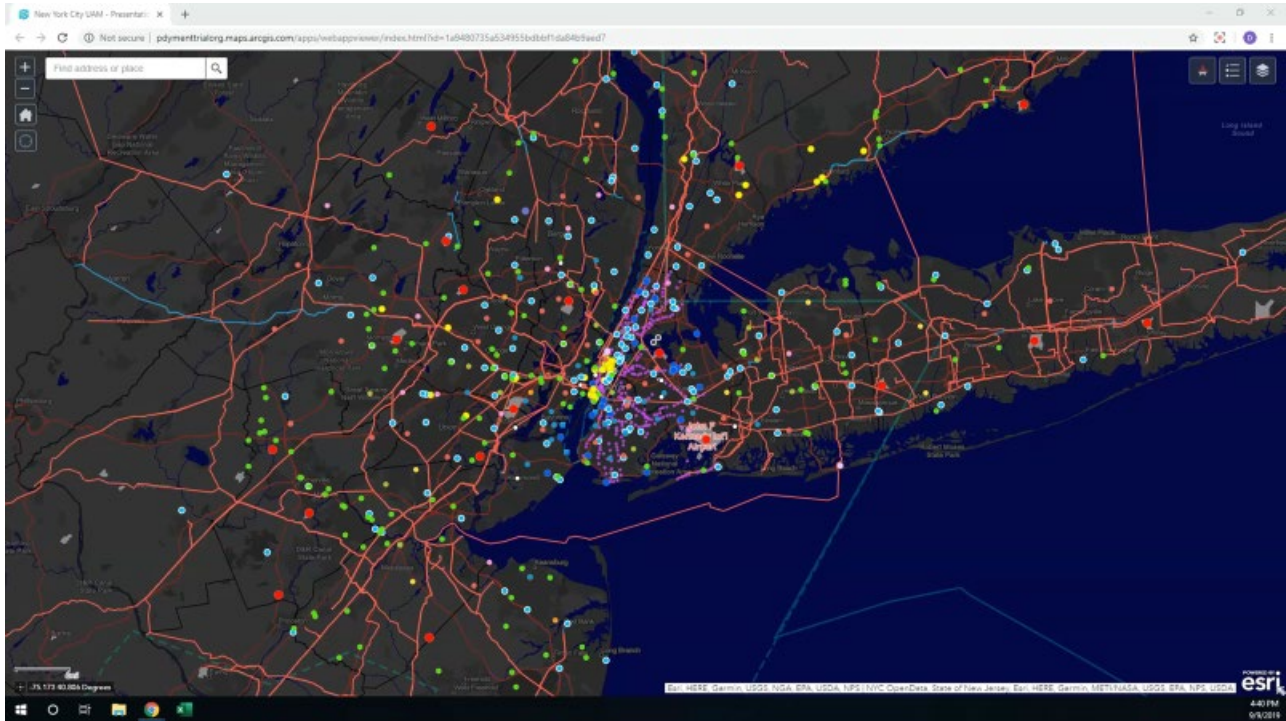


Figure 6 - New York Region Map with Important Geocoded Features is a Starting Point for eVTOL Flight Planning. 74 Other Cities Have Similar Detail and Can Be Accessed by the Flight Department: www.nexa-uam.com

eVTOL aircraft will create less noise than helicopters and offer greater safety; therefore, local municipalities will inevitably need to modify local ordinances. As a result, heliports currently in use will likely see the addition of and transition to eVTOL aircraft, and those heliports not in use—a goldmine in economic opportunity sitting idle—will obtain revised operating certificates and air rights for UAM use.

In terms of trips to an airport via eVTOL aircraft, most airports already have helicopter landing facilities which can be easily modified to support UAM. A well-run airport will seek to blend UAM with conventional airport operations to maximize the utility and convenience of its facilities. Airports are the logical point of ingress for eVTOLs into an urban transportation network.

say, Los Angeles, and fly directly to another office in San Diego, or from a suburb of Boston to a heliport in suburban New York (Figure 4), avoiding highways and airports altogether. If a flight department does not have its own vehicle, hailing an “air taxi” can fill the void and address the problem.

Regional Air Mobility Services

Some manufacturers of eVTOLs are investing in hybrid vehicles that have the ability to gain altitude from a vertiport under electric power, and then transition to vertical flight using lift from fixed wings. Powering and recharging batteries using small turbine generators while at altitude, these vehicles have the range and capability to fly point-to-point from one city to another and could do so using a new UAM infrastructure available at thousands of

locations, including existing heliports or newly constructed vertiports. A strong preference for short inter-regional travel finds new demand that airlines cannot serve, and that business travelers would greatly value.

For example, numerous studies¹ find that traveling by air using UAM for short inter-regional trips (e.g., a Reston, VA heliport to an outlying Baltimore-area heliport, or a downtown Los Angeles heliport to a suburban San Diego heliport) makes sense.

Regional air transport using eVTOLs is also potentially disruptive to today's commercial air transport model. *"We believe the regional transportation ecosystem is ripe for disruption and startups like Joby Aviation will revolutionize how people move across urban areas,"* stated Bonny Simi, President, JetBlue Technology Ventures.

As an example, the New York City region, including parts of New Jersey and Connecticut, offers about 167 existing heliports in addition to the 12 close-in airports. Figure 6 illustrates a geocoded, feature-rich

map of the region (heliports are in green) and is a starting point for flight departments to undertake route planning. It is possible to design routes representing "tunnels in space" that can avoid air traffic congestion and are configurable over ground that avoids residential areas.

The Future is Now

It should be clear that, with the advent of Urban Air Mobility and the electrification of flight, the helicopter industry stands poised to enter an exciting future. Rotary-wing operations have, to a certain, extent, remained stagnant for several decades, and in many cases have actually been reduced due to noise and flight restrictions. Those operators who, with due diligence, opt to embrace the change to eVTOL will see new markets, reduced costs, and increased profitability.

¹ *Urban Air Mobility (UAM) Market Study 2019*, Booz Allen & Hamilton, McLean, VA, USA (www.bah.com)

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