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Urban Air Mobility

Flying Cars: Investment Implications of Autonomous Urban Air Mobility

If you're bullish on autonomous cars, it's time to start looking at autonomous aircraft. To make this complex topic accessible, we collaborated across sectors and regions, using scenario analysis to size the addressable market – ~ $1.5tn in our base case by 2040. Logistics is leading the way.

alphawise α

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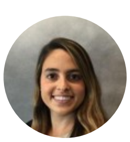
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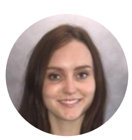
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Executive Summary

Mark my words: a combination airplane and motorcar is coming. You may smile, but it will come.

– Henry Ford (1940)

We're making investments in areas like urban mobility and flying taxis, if you want to call them that. As you think about future urban congestion, three-dimensional highways and cities are not all that far-fetched. The technology is doable, and we're working on prototype vehicles today.

– Dennis Muilenburg, Chairman, President & CEO of Boeing (MS Laguna Conference, September 2018)

Autonomous flying cars aren't π in the sky. In many ways, an autonomous aircraft is an easier software problem to solve than an autonomous car. Military drones have been around for years, and now electrified, autonomous vertical takeoff and landing vehicles (VTOLs) are gaining traction. In logistics, drone package delivery is in active testing. On November 1st, 2018, NASA launched a Grand Challenge to accelerate the development of Urban Air Mobility (UAM), which it defines as a "safe and efficient system for air passenger and cargo transportation within an urban area." NASA is following in the footsteps of the Defense Department's Defense Advanced Research Projects Agency (DARPA), which launched a Grand Challenge in 2004 to accelerate the development of autonomous vehicle technology for military usage. Many participants in that challenge went on to found and run major autonomous driving startups, including Waymo and GM Cruise. So we see a clear need to give investors a starting point for understanding how UAM may unfold.

Exhibit 1:

Notable Attendees of NASA's "Grand Challenge" Industry Day (Non-Exhaustive)

Source: NASA, Company Websites, Morgan Stanley Research

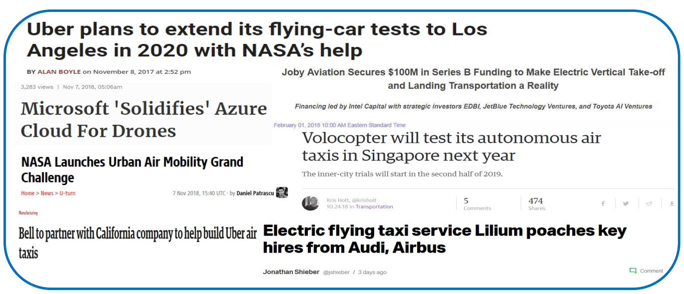
Capital is flowing into the space. We see the development of the UAM ecosystem as extremely long-dated and requiring up-front capital allocation, testing, and development in the short term, with increasing visibility. The intersection of many technologies, such as ultra-efficient batteries, autonomous systems, and advanced manufacturing processes are spawning a flurry of activity.

- **Aerospace & Defense majors are making investments.** Beyond Boeing, Airbus is investing in a helicopter ride-hailing service (Voom) in Brazil, and its electric VTOL (eVTOL) project A3 Vahana hopes to create a quieter extension of this platform in other urban areas. In January 2018, Vahana completed its first full-scale test flight, which reached a height of 16 meters. It has also launched Altiscope, a simulator for evaluating policy/operational options for air traffic management systems. Lockheed Martin is investing in eVTOL autonomous aircraft, and we believe Northrop Grumman is likely involved as well, while Raytheon and Harris are targeting air traffic control technology.
- **Startups are attracting capital.** Google cofounder Larry Page is funding a number of flying car start ups. Sebastian Thrun (who founded Google X and Google's self-driving car team) is leading Kitty Hawk and its subsidiary companies Cora and Flyer. Cora describes its mission as "bringing the airport to you" by eliminating the need for a runway and "combining self-flying software with expert human supervision, so you can enjoy the ride." Last month, the company struck a deal with New Zealand's domestic airline, establishing a long-term relationship to build the world's first autonomous air taxi service. Uber's autonomous air taxi project Uber Elevate has begun joint testing with Bell in the Dallas-Fort Worth area.

- **Megatech platforms are actively involved.** Google is developing autonomous drone prototypes and architecture in its Project Wing, as is Amazon with Amazon Prime Air (not to be confused with their planes). Shipping is Amazon's second largest cost, as we detailed in "Should Amazon Become a Larger Competitor Against Waymo?", and flying cars could reduce delivery costs in both rural and traffic-congested urban areas. For context, we estimate Amazon spends $28bn on shipping in '18 and $38bn in '19. For Google, flying cars represent a TAM expansion opportunity as another evolution of its self-driving car initiative, Waymo, which we believe is leading the space (Waymo: 3 Steps to $175 billion). A push into flying cars would partly mirror Uber's work with Elevate, which hopes to transport people in urban environments to avoid lengthy commutes.
- **We also believe national security concerns will buttress autonomous airborne technology**, ensuring the attention of multiple governmental constituencies.

Exhibit 2:

Urban Air Mobility Is Making Headlines



Source: Geekwire, Businesswire, Endagadget, Forbes, Autoevolution, TechCrunch, Morgan Stanley Research

UAM economics could be compelling. Think of a 20-mile Uber or Lyft ride home to the suburbs after a night in the city. At an average speed of 25 mph it takes you 48 minutes to get home at $1.50/mile for a total cost of $30. At 10 trips per shift (a busy day) this can bring in $300 of revenue for the driver or $75k per year. With an autonomous vehicle, that revenue flows to the company. But what if a large drone or autonomous aircraft could make the 20-mile trip at 100 mph and $2.50 per mile? Assuming you'd be willing to pay a premium for speed, you'd be home in 12 minutes for a $50 fee. Faster speeds mean more trips… as many as 40 in an 8-hour shift. Thus $2k of revenue per shift and more working hours could yield close to $1.5 million of revenue per year per flying car.

Exhibit 3:

UAM Economics Comparison

Economics Comparison	Ride Share Car	Flying Car
Distance	20 miles	20 miles
Speed	25 mph	100mph
Cost	$1.50/mile	$2.50/mile
Time/trip	48 mins	12 mins
Trips	10	40
Revenue/shift	$300	$2,000
Shifts/day	1	2
Days	365/year	365/year
Revenue/year	**$109,500**	**$1,460,000**

Source: Company websites, Morgan Stanley Research

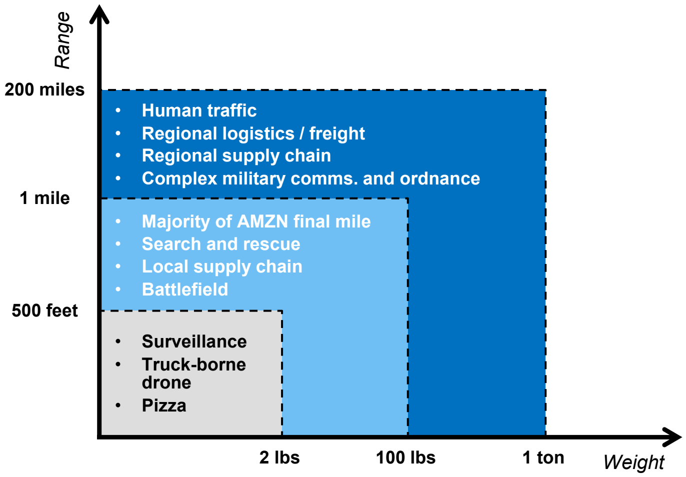
We would describe the current state of technology for electric autonomous aircraft as underdeveloped, but rapidly improving in areas of pilot substitution, safety, and efficiency. Widespread VTOL adoption faces a number of serious technological hurdles, including battery energy density and noise. Fully functional autonomous aviation may need to improve to a level significantly greater than that of conventional EVs/AVs for road transport over the next 10 years.

It's early days for UAM payloads and ranges, as well as information. The most detailed data we have on progress in human transport comes from German-based Volocopter. It began testing its electric VTOL aircraft prototype in Singapore this year. Currently, the maximum payload is 160 kg, with maximum range of 17 miles at an optimal cruise speed of 43 mph. Most other companies remain in stealth mode and keep their testing specifications close to the vest. Joby Aviation estimates that its Joby S4 prototype for human travel will be able to travel 150 miles on a single charge at ~200 mph with an estimated capacity of 5 people. Many private companies say they can achieve a maximum range of ~250 miles per charge at speeds of 150-200 mph with payload capacities of 4-5 people (including the pilot), which equates to about 600 lbs for mature eVTOL aircraft.

Most package drone prototypes can carry a maximum of ~10 lbs. Amazon has stated it plans to fly drones weighing 55 lbs at speeds of 55 mph for packages of 5 lbs or less. Sikorsky has begun testing autonomous flying technologies on its helicopters. A military-grade helicopter such as the Sikorsky CH53K, however, has a maximum payload of 15.9 tons and can carry up to 37 soldiers. The chasm between military grade aircraft and urban eVTOL and drone technology exists because battery technology (the primary noise mitigant) is extremely underdeveloped. A 50-fold increase in the global annual production of electric cars by 2030 and as much as $100bn or more of capital investment directed at the mass production of EV batteries (>100 gigafactories by 2040) could reasonably drive technology and costs to levels that significantly enable the e-VTOL market.

Exhibit 4:

VTOL Expected Weight and Range Limitations



Source: Company estimates, Morgan Stanley Research

The total addressable markets in our base and bull cases assume the same level of capacity and payload trajectories. Our model embeds the low-end projected speed range of 150 mph by 2040. For logistics, we assume freight payloads of >50 lbs beginning in 2035. Our Autos and Shared Mobility Model assumes steady average growth in occupancy/overall payload of 4% through 2040 for eVTOLs, yielding an average occupancy capacity of 3.3, slightly more conservative than what aircraft developers project for more mature eVTOL designs. In our "Airlines" model for longer distance flights we assume a maximum capacity of 10 people across our cases to account for potentially larger electric eVTOL aircraft with lower noise/regulatory restrictions along more traditional airline routes.

Battery technology and advanced propulsion architectures such as distributed electric propulsion will be critical to the UAM development. We believe that current Lithium-ion battery technology is largely workable and will near-term be "fit for purpose" to support EV adoption. However, we believe that a material change in battery technology will be needed to achieve the levels of charge rates, cycle life, and capacity that companies are targeting. Potential battery technologies include lithium sulfur or solid state lithium ion batteries, both of which are years away for operation in terrestrial vehicles, let alone electric aircraft. In our view, the push for electric vehicles to reach cost parity with internal combustion engine vehicles will accelerate the demand for advanced battery technologies over the coming decade.

Regulation and a host of other legal and behavioral factors create another set of obstacles. Nevertheless, we see the development and early commercialization of terrestrial autonomous networks (shared autonomous cars) as an incubator and accelerator for the framework of regulation and consumer acceptance of flying car tech.

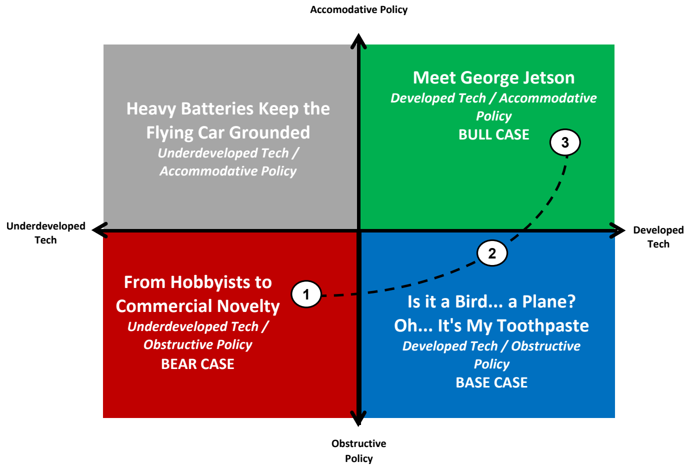
To assess the Global Total Addressable Market for UAM we began with our bottom up forecast of the US Total Addressable Market. Our forecasts are based on scenario analysis with bull, bear, and base total addressable market (TAM) outcomes, given the long-term time horizon and myriad unpredictable technological and policy vectors. We roll these vectors up into two broad parameters: (1) technology and (2) regulation. Our cases reflect several specific areas of technological capability, including payload, range, speed, noise, software, connectivity, battery, and unit cost. A number of regulatory inputs also shape our scenarios, such as state/local/regional government intervention, FAA/EASA oversight, infrastructure barriers, and most importantly public acceptance/acceleration.

To size the addressable markets in each scenario, we focused on three broad end markets + the supply chain: (1) transporting humans, (2) transporting goods, (3) military & defense, and (4) the enabling supply chain/content. More specifically, we look at markets directly relevant to personal urban/suburban transportation, final mile shipping/logistics, short-haul airlines, and defense. Our forecasts for components, sensors, compute, and software – the so called "arms dealers" of the autonomous aircraft ecosystem – are based on our bottom-up forecasts for the three end markets.

We then extrapolated this US only bottom-up model globally to estimate the TAM in China, Europe, and ROW. We did this by taking the relative percentage of GDP our US UAM TAM forecast represents in the US and adjusted across regions for factors such as shared, autonomous, and electric vehicle penetration to arrive at the respective GDP percentages for each region. While we recognize comparing terrestrial ground transportation penetration to UAM may not be entirely apples to apples, we believe they are solid proxies, given the overlap of AV / UAM technologies. **The markets that are relevant to the UAM ecosystem represent just shy of $1.5tn of potential global economic value in our base case.**

Exhibit 5:

UAM TAM Scenario Framework



Source: Morgan Stanley Research

Base Case: Is It a Bird... a Plane? Oh... It's My Toothpaste: Advanced technology but obstructive policy. Technology outpaces regulations, infrastructure, and budgets. VTOL and drone adoption is snarled by red tape and moves down on the legislative priority list, limiting uptake even though the technology is readily available. **Global Total Addressable Market: ~$1.5tn by 2040 (~1.2% of projected Global GDP).**

Bull Case: Meet George Jetson: Advanced / developed technology with accommodative policy. VTOL / drone transportation of goods and people achieves mass acceptance and adoption. Technology accelerates and becomes cost effective for both consumers and businesses; it proves more efficient than existing transportation models. Policy is flexible and infrastructure is readily available or easily adapted. Regulations permit "easy" VTOL / drone usage and adapt to changing consumer / business demands. **Global Total Addressable Market: ~$2.9tn by 2040 (~2.2% of projected Global GDP).**

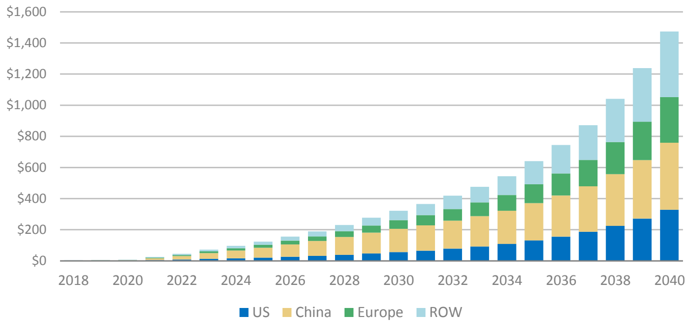
Bear Case: From Hobbyists to Commercial Novelty: Underdeveloped / unsuccessful technology combined with obstructive policy. Mass rejection / minimal adoption of VTOL / drone transport of goods and people. Technology stagnates as it is not cost effective for consumers or businesses. It is less efficient than current transportation models and encounters critical technological barriers to adoption (weight, noise, range, payload, safety, etc.). Policy is restrictive and infrastructure cannot support adoption. Regulations hinder VTOL / drone usage and impede widespread global adoption. **Global Total Addressable Market: $615bn by 2040 (~0.5% of projected Global GDP) .**

Our base case Global Total Addressable Market of $1.5tn by 2040 assumes significant technological advancement coupled with obstructive policy and neither supportive nor negative social response.

- **Autos and Shared Mobility ($674bn) and Airlines ($177bn) – *Transporting humans:*** We assess the opportunity for a growing fleet of electric, shared, and autonomous VTOL aircraft or other large terrestrial drones. We see the market beginning as an ultra-niche add-on to existing transportation infrastructure, similar to how helicopters operate today. It eventually transforms into a cost-effective, time-efficient method of traveling short to medium distances, eventually taking share from car and airline companies.
- **Freight Transportation ($413bn) – *Transporting goods:*** The opportunity is much nearer term than transporting humans, especially with smaller, more lightweight drones. We utilize AlphaWise in our model to inform our urban vs. rural drone penetration. AlphaWise shows that 80% of the US population lives in 28% of the zip codes. Our model shows the bulk of the revenue opportunity will come from the urban parcel market; however, this is also the most risky, and we model lower urban drone penetration due to regulatory concerns. We value additional revenue opportunity and cost savings for larger electric VTOL aircraft that can use excess capacity to fulfill trips that are too long and too heavy for smaller drones.
- **Military & Defense ($12bn) – *Transporting troops/supplies:*** The total addressable market for Military and Defense is much smaller than the other sectors because we model the market as a function of US military (DoD) spend. On a relative basis, this is a much smaller revenue pool (~$1bn today) versus the potential for operating a fleet of autonomous aircraft at a cost of $2 mile. We still view military and defense applications as an extremely important accelerant for UAM technologies, similar to what DARPA and the military did for autonomous driving in the early 2000s.
- **Key Accelerants ($198bn) – *Enabling Technology/Services*:** Growth in autonomous, connected, and electric flight systems creates a significant demand opportunity for batteries (and battery materials), hardware, communications equipment, and software. Using our bottom-up autonomous aircraft model, we constructed a framework to assess the market opportunity for content in urban air mobility.

Exhibit 6:

UAM Global Total Addressable Market (Base Case)

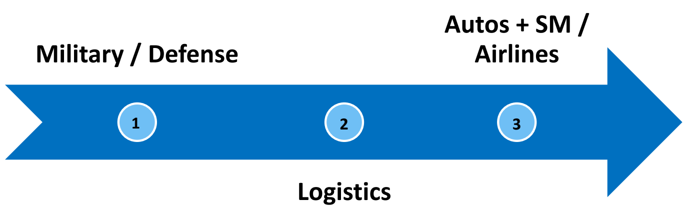


Source: Morgan Stanley Research

The UAM adoption curve varies across the core sectors we explore, as we outline in Exhibits 12-14. VTOL aircraft is already being used extensively in the military, and we believe that the adoption curve will continue to move logarithmically at the fastest rate, given lower societal and technological barriers. Transporting goods to rural and urban areas should follow an S-curve, as we believe adoption will start aggressively in rural areas, followed by urban areas, where regulatory hurdles will be higher. We believe widespread commercial adoption for transporting humans will take the longest, primarily due to more stringent safety regulations and higher technology requirements for autonomous aviation systems.

Exhibit 7:

UAM Adoption Overview – Military & Defense Leading the Way



Source: Morgan Stanley Research

The Morgan Stanley Flying Car 50: In a collaborative effort across Morgan Stanley Research, we've constructed a diversified list of stocks that, in our collective view, represents the best exposure to the growth of Urban Air Mobility. We created the list irrespective of 12-month recommendations, hence it includes some Underweight-rated stocks, in addition to Equal-weight and Overweight-rated names.

Freight Transportation: Names in logistics with most exposure include UPS, FDX, USPS, and DPW. We also highlight NEX, SGC, and FGP as European bus/rail companies with exposure to VTOL short-haul flight operations.

Airlines: We highlight AAL, DAL, and UAL with regional feeds that represent 10-20% of revenues as the emergence of UAM could pose a risk as it targets short-haul airline routes. We also highlight JBLU as a name with exposure to and investment in UAM, including a Series B round in Joby Aviation.

Aerospace and Defense: Best positioned names include: TXT, BA, LMT, NOC, AIR, SAF, and RR.

Autos and Shared Mobility: Best positioned names include: TSLA, LEA, ADNT, and APTV.

Tech Hardware: UAM aligns with the "data era" thesis. It will grow hardware TAM as edge computing and storage requirements increase. It could also further automate technology maintenance. **Best positioned names include: STX, HPE, NTAP, NTNX, APPL, and GRMN.**

Telecom and Networking Equipment: UAM will leverage autonomous vehicle technology; growth in cars as networked computers vs. independent vehicles generally benefits the networking universe. Companies such as Cisco and Qualcomm help provide the network connection, with BlackBerry supplying the secure kernel for system development. Names like Lumentum, IIVI, and Finisar (pending acquisition by IIVI) help enable LiDAR technology through 3D sensing technology, fundamental to autonomous driving (and eventually flying). **Best positioned names include: CSCO, QCOM, BB, LITE, and II-VI.**

We expect connected UAM aircraft to layer additional capacity needs onto wireless networks. As providers of passive network infrastructure, Towers offer the best play on this theme in Telecoms. Towers should benefit from any network deployments to serve UAM aircraft, whether via traditional wireless carriers or emerging companies. **Best positioned names include: AMT, CCI, and SBAC.**

Clean Tech: Within the UAM ecosystem, we're focused on composite vehicle bodies, with TPI Composites the lone pure play. Clean Tech companies could be involved at many levels – directly applying wind, solar, and battery storage to create and/or store the electrons used to charge eVTOL aircraft. **We believe TPI is best positioned for next-gen aircraft.**

Software: UAM represents a TAM expansion opportunity. Like autonomous vehicles, they represent new endpoints, chock full of CPUs and throwing off a ton of data to be managed and optimized, with the potential of new applications to be built on top of their networks. **We believe MSFT is best positioned in Air Traffic Management cloud service and data management.**

We also highlight DSY as a leader in terms of software used in 3D printing and designing advanced material systems.

Internet: Wide range of interest from mega-tech platforms. We expect continuing involvement as UAM evolves. **Best positioned names include: GOOGL, AMZN.**

Gaming/Lodging: Flying cars should be a positive for Vegas casinos, while a potential risk to corporate-focused hotel companies. They would give gaming and nightlife customers easier access to Las Vegas, which suffers from infrastructure headwinds (e.g., no direct train service and heavy traffic from LA on busy weekends). **Best positioned names include: CZR, MGM.**

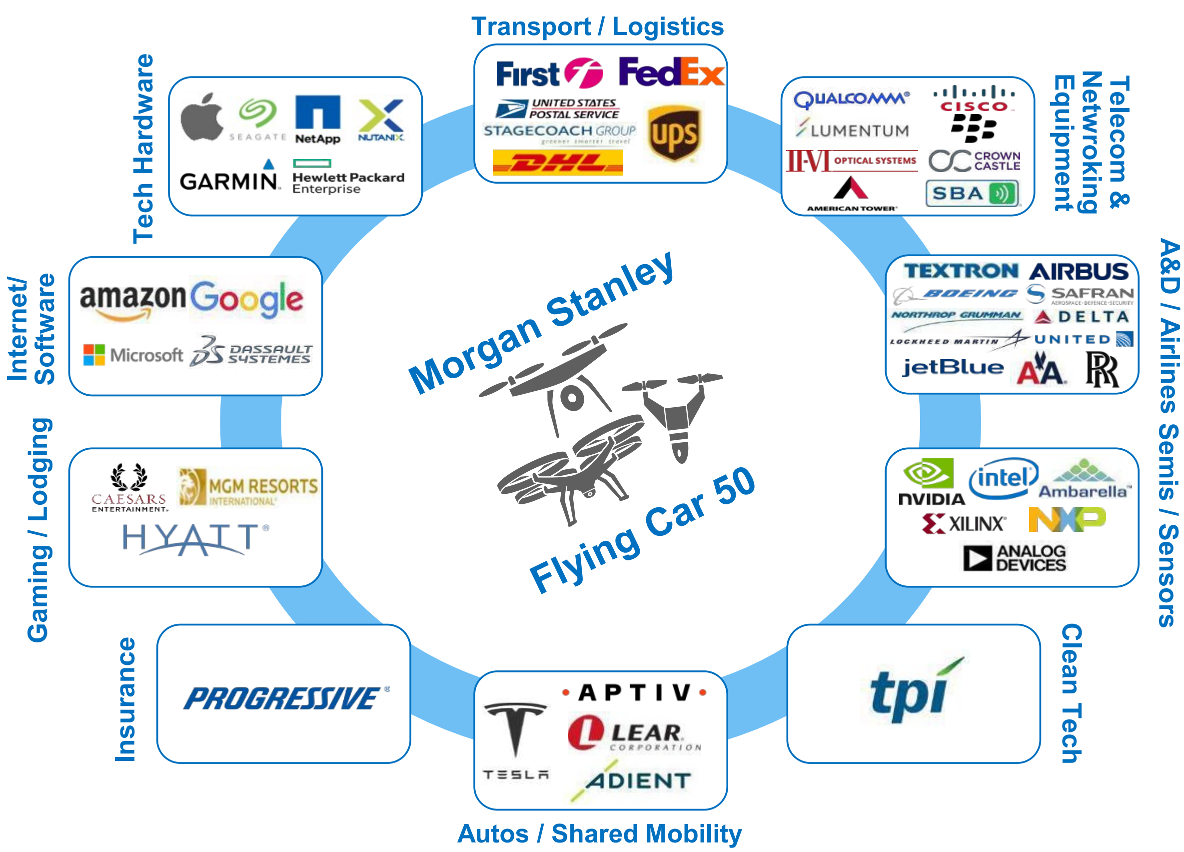
Greater ability to travel long distances would likely hurt hotels across the country. "Road warriors" and other corporate travelers (70% of US hotel room nights), would likely choose to stay in their own homes when practical (or employers would require it) vs. paying for lodging. **Names with potential exposure include: DRH, HLT, H, HST, MAR, SHO, and XHR.**

Semis and Sensors: In Semis, computer vision is a key enabling technology for UAM. Innovation in machine learning has accelerated "machine vision," or extracting information from video images – key to autonomous driving/flying. Long term beneficiaries among semiconductor suppliers include Nvidia, Intel, Ambarella, Xilinx, as well as sensor providers (for radar/LiDAR/machine vision) like NXP Semiconductors, Analog Devices, and ON Semi. Near term, DJI's consumer drone dominance may limit opportunities for US semiconductor companies, as DJI is pursuing ASIC designs for their devices. **Best positioned names include: NVDA, INTC, AMBA, XLNX, NXPI, ADI, ON.**

Insurance: UAM represents a TAM expansion for insurers, but a risk in terms of cannibalizing insurance on traditional ground vehicles. **We believe PGR is best positioned for potential Insurance TAM expansion.**

Exhibit 8:

The Morgan Stanley Flying Car 50



Note: The "Morgan Stanley Flying Car 50" is a label our analysts will use to discuss the concept of Urban Air Mobility as a theme. The actual number of names on the list may fluctuate over time.
Source: Shutterstock, Company websites, Morgan Stanley Research

What's *not* included in this report?

- **Conventional helicopters** – we do not believe traditional ICE helicopters will be allowed to ever operate in urban environments on a large scale
- **Small hobbyist drones** – hobbyist drones have little to no impact on the UAM ecosystem, except to the extent they need to interact with other aircraft via ATM systems
- **Long distance autonomous aircraft/hypersonics** – these are beyond the scope of the electrified aircraft technologies we explored
- Adjacent applications such as agriculture, security, utilities, etc. – while each have potentially substantial TAMs they are not core parts of the UAM ecosystem

Urban Air Mobility: Where Are We Now?

Why Now?

A confluence of economic and technological factors are intersecting, such as improved battery efficiency, artificial intelligence, and satellite communication along with a need for more convenient transportation with 0 emissions. These considerations, coupled with large amounts of capital infusion, should accelerate the adoption of autonomous, electrified urban air mobility over our 2040 time horizon. Ride-sharing and aerospace companies are leading the charge and showing that there are more ways to transport people and goods in a more efficient and economic fashion. **In our view, if you are bullish on autonomous and electric vehicles, then you are bullish on Urban Air Mobility as the technologies are extremely complementary.**

Urban Air Mobility adoption comes down to 5 primary drivers:

1. Technology (Autonomy, 5G, Energy Storage)
2. Regulation/Consumer Acceptance
3. Capital Formation
4. Sustainability/Building Road Congestion
5. National Security

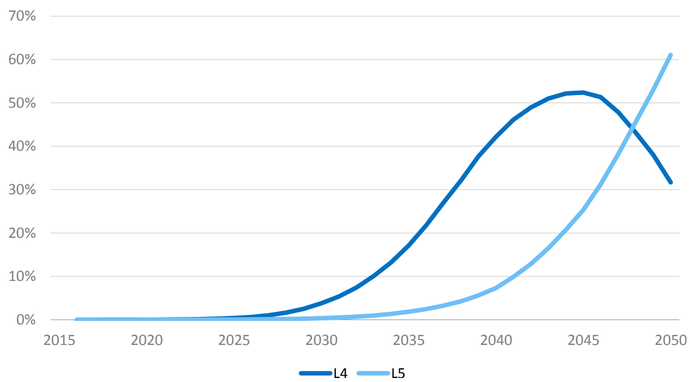
Exhibit 9:

The 5 Core Drivers of Urban Air Mobility Acceleration

Source: Shutterstock, Morgan Stanley Research

Exhibit 10:

US Level 4 and 5 Autonomous Penetration (% of Miles Traveled)



Source: Morgan Stanley Research

Where Is Urban Air Mobility *Today*?

NASA, who hosted an Industry Day on November 1st, 2018 to discuss the evolution of Urban Air Mobility, defines UAM as: *a safe and efficient system for air passenger and cargo transportation within an urban area, inclusive of small package delivery and other urban Unmanned Aerial Systems (UAS) services, that supports a mix of onboard/ground-piloted and increasingly autonomous operations.* Urban Air Mobility, we acknowledge, is clearly in its early innings, but technological as well as regulatory advances have progressed differently across the sector stack that we explore in this report. **We outline below where we currently stand with development across the different sectors and use cases.**

Exhibit 11:
Notable Attendees of NASA's "Grand Challenge" Industry Day (Non-Exhaustive)

Source: NASA, Morgan Stanley Research

Autos and Shared Mobility and Airlines (Transporting Humans)

This year has seen a great number of developments in UAM, especially for the long-term goal of transporting humans quickly and efficiently, using electrified VTOL technology.

Exhibit 12:
2018 UAM Developments (Transporting Humans)

Recent Developments
May 2018: Uber Elevate hosted its 2nd annual summit with over 1,000 people in attendance. Announced 6th vehicle development partner (Karem Aircraft). Over 10k people in attendance via livestream. Plans for working with number of partners across regulatory, technology, and infrastructure bodies
July 2018: Boeing announces Boeing NeXt to lead advancement in UAM. Goal is to utilize HorizonX (Boeing's venture arm) and acquisition of Aurora Flight Sciences to accelerate progress and solidify position within theme
November 2018: Microsoft further details Azure usage for Air Traffic Management
July 2018: Rolls Royce and Aston Martin announce plan to develop UAM vehicles
May 2018: Airbus forms a new UAM business unit
February 2018: Joby Aviation secures $100mm Series B funding round (one of the largest funding rounds for a UAM company)

Source: NASA, Forbes, Businesswire, Morgan Stanley Research

Development in UAM, especially for human transport, is in its early stages, with many questions surrounding technology (primarily battery and advanced propulsion technology) and regulation. In 2004, DARPA began its first "Grand Challenge" to advance the development of autonomous vehicles, primarily for military usage. On November 1st, 2018, NASA announced its newest Grand Challenge for the development of Urban Air Mobility. We view UAM in a similar way to how we viewed autonomous driving only a few years ago. The only difference today is that much of the technology is already there because of the advancement in electrified, autonomous driving. Technologies such as processing/compute power, battery technology, and advanced composite systems have a great deal of overlap with future eVTOL aircraft manufacturing. We believe the ultimate gating factors will not come from the technology itself, but rather the regulatory and societal concerns surrounding the technology, not unlike the dilemma faced by autonomous driving companies today. For more on our views on the ethical and legal concerns facing AVs please see our report ***Autos & Shared Mobility: Autonomous Vehicle Accidents: An Examination of the Progress and Risks (31 Oct 2017).***

Military and Defense (Transporting Troops and Supplies / Surveillance / Strike)

The U.S. military has been pursuing drone technology for decades, and today has an extensive fleet of aircraft used to perform various missions, along with a number of development programs for emerging missions. This technology shares many fundamental building blocks with eVTOL or flying cars, including advanced avionics, sensors, and autonomy. And while there are some technological differences between these aircraft and the eVTOL platforms we envision used for civilian applications, they do provide a fairly mature starting point. Below we highlight a number of in-production aircraft as well as ongoing technology development programs to illustrate the extent of today's military technology:

- **Gray Eagle:** Gray Eagle is an unmanned propeller driven aircraft built by General Atomics for the US Army and has been in service since 2009. The aircraft has an endurance of 25 hours, a speed of ~170 miles per hour, can operate at an altitude of up to 29,000 feet, and carries a ~1,000 pounds of payload, including four Hellfire missiles. Gray Eagle features a fault-tolerant control system and triple-redundant avionics, with "airworthiness" as a primary consideration. It also features an automatic takeoff and landing system that allows the aircraft to be launched and recovered without any operator interaction. Its mission set includes: wide-area surveillance; convoy protection; IED detection and defeat; close air support; communications relay; and attack missions.
- **Fire Scout:** Fire Scout is an autonomous helicopter built by Northrop Grumman that provides real-time intelligence to the US Navy. The aircraft has been deployed from multiple ships, as well as land bases in Afghanistan where it's been utilized to detect road-side bombs. It has completed more than 16,600 flight hours and over 6,200 sorties. The Navy has integrated radar and tested weapons onboard the aircraft, while also demonstrating its ability to operate concurrently with manned aircraft.

- **Global Hawk:** This aircraft is used for reconnaissance missions, providing the US Air Force high-resolution imagery of large land areas in near-real-time, day and night. Global Hawk accomplishes this via its ability to fly at high altitudes (~60,000 feet) and loiter for extended periods of time (30+ hours). The aircraft was initially developed by DARPA in conjunction with Northrop Grumman, achieving its first flight in 1998 and since then amassing more than 200,000 flight hours.
- **ARES:** Aerial Reconfigurable Embedded System (ARES) is a DARPA-led project, in conjunction with Lockheed Martin, to develop a modular VTOL aircraft that can transport 3,000 pounds of payload at a range of 250 nautical miles on a single tank of fuel. It will be used to support a variety of missions, including cargo resupply, casualty evacuation, reconnaissance, weapons platforms, and other types of operations. The aircraft is currently undergoing flight tests at the US Army's Yuma Proving ground and will be transitioning to the Marine Corps.

Freight Transportation (Transporting Freight and Packages)

We believe drones and VTOLs can be part of the evolving solution of last-mile parcel delivery challenges and lower eCommerce logistics costs. **Compared to today's individual B2C delivery model, we have long been of the view that retailers could move to the omni-channel model (ship from store) which could be a secular headwind to the legacy Parcel companies, as moving a box a couple of miles from the store to the customer does not need the expertise (and cost) of a UPS/FDX and can be easily insourced instead.** With consumers increasingly unwilling to pay for shipping, retailers are doing everything they can to cut their delivery costs down to zero.

Companies are scrambling to figure out last mile delivery, sometimes even incentivizing the customer to pick up from store. Companies have also experimented with low cost last mile alternatives such as sidewalk robots, autonomous vans, and delivery drones. In September, ***Flytrex*** partnered with the Federal Aviation Administration to begin drone deliveries in North Carolina while ***Workhorse*** has made residential drone deliveries in the Cincinnati area since May. In July, ***An post*** delivered the first parcel over water by drone to an island off the coast of Ireland and ***JD.com*** used drones to deliver e-commerce packages to Chinese villages. These are just a few examples of early drone initiatives which help cut delivery costs (and times), especially to remote areas where land transport is too expensive or slow. In the US, we see drone deliveries becoming more frequent in rural areas (where they are already being used) and expanding into urban areas once regulations and technologies evolve. **We believe further development of VTOLs with the range and reliability to handle large scale deliveries will help solve the expensive last-mile problem for retailers while putting pressure on UPS/FDX.**

Scenario Introductions – Assessing the TAM for Urban Air Mobility

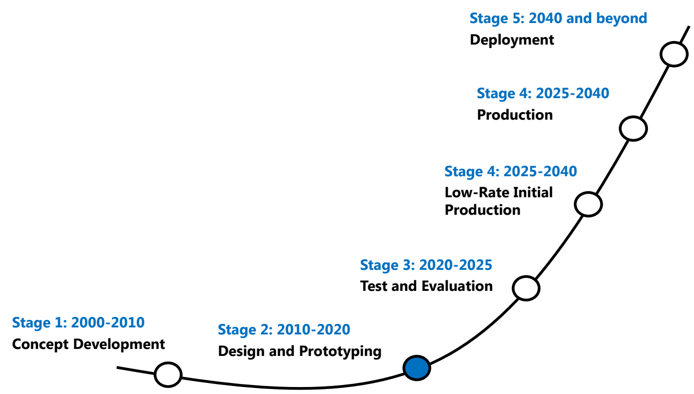
What Do the UAM Sector Adoption Curves Look Like?

Urban Air Mobility comes down to performing 2 core functions: *transporting goods and transporting humans.* While the gating factors for each use case are relatively similar, we view the adoption curves for each differently, due to the uncertainties surrounding regulation and overall societal acceptance.

1. **Transporting goods:** Transporting goods, in our view, will have significantly greater near term adoption because of the lower degree of technological barriers (weight, size, etc.) as well as fewer regulatory hurdles (especially in rural areas) regarding safety and redundancy that human transportation will have to jump. Small and large VTOL aircraft can be used for many things such as last-mile delivery, fertilization of crops, and emergency transport. Companies such as Amazon (covered by Brian Nowak), JD.com (covered by Grace Chen), and Alphabet (covered by Brian Nowak) have had autonomous drone programs for years in order to capitalize on the potential cost savings and incremental revenue opportunities. Technologically speaking, drone technology has advanced rapidly, but barriers still exist. The primary driver of drone adoption and usage will be the level of autonomy, speed, and efficiency that shipping drones are able to operate under.
2. **Transporting humans:** The second, and longer-term use case is transporting humans in electric, autonomous, and urban VTOL aircrafts. We estimate the 2040 addressable market for the human transport (categorized by Airlines and Autos/SM in our model) market to be $851bn, stealing share away from cars, planes, and public transit. The UAM market is precipitated by the increasing adoption of ride sharing and we see urban air mobility operating in a multimodal, ride-share fleet model. Urban Air Mobility represents business opportunities within infrastructure, fleet management, software, hardware, and content, much like the market opportunity for AVs. We see the UAM ecosystem building off of existing EV as well as helicopter infrastructure. Initially, UAM services will likely start off as a complementary method to already existing modes of transportation, with operations primarily at airports and in dense city systems. But over time, we see infrastructure evolving to a point with more dense vertiport buildout across cities, with trips becoming progressively longer, driving cost per mile down to more affordable levels.

Exhibit 13:

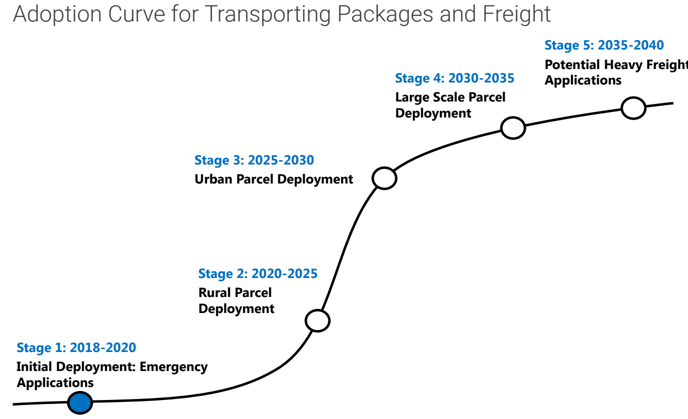
Adoption Curve for Military and Defense Usage



Source: Morgan Stanley Research

Exhibit 14:

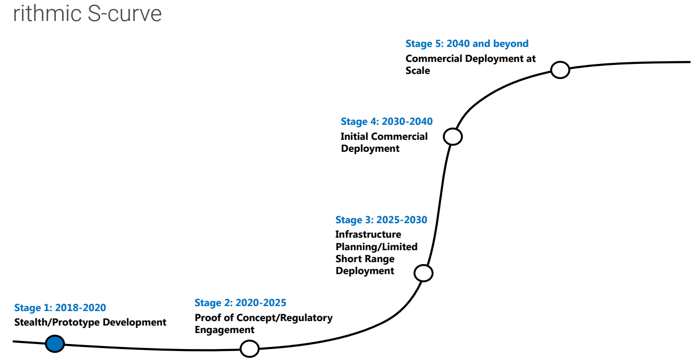
Adoption Curve for Transporting Packages and Freight



Source: Morgan Stanley Research

Exhibit 15:

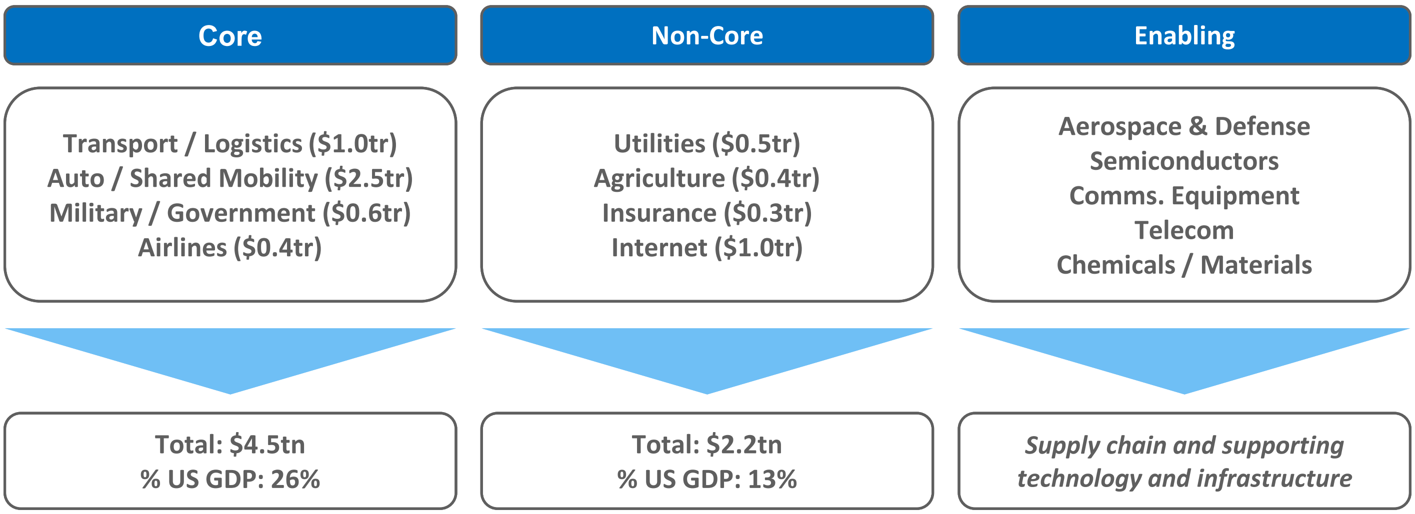
Adoption Curve for Transporting Humans – A slower, but more logarithmic S-curve



Source: Morgan Stanley Research

Exhibit 16:

Potential UAM "Pies" Up for Grabs



Source: Morgan Stanley Research

Total addressable market analysis: Scenario framework ranges from $615bn in our bear case to $2.9tn in our bull case by 2040.

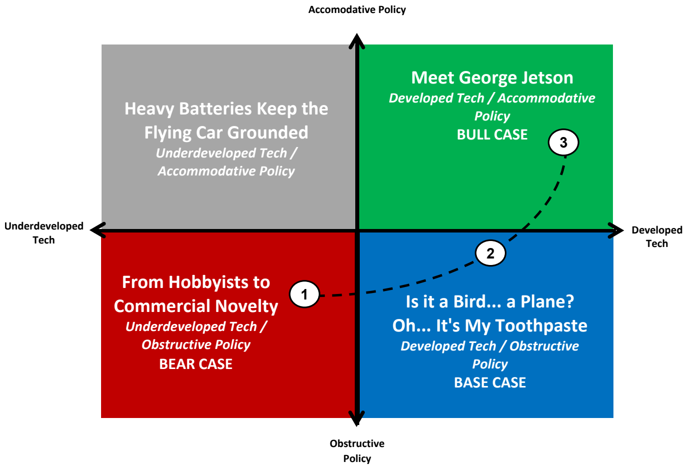
Given the extremely wide range of outcomes, unpredictable evolution of enabling technology, and consumer acceptance/regulatory issues that are not possible to model, we resort to scenario analysis to help frame investor thinking on the adoption and TAM of the flying car model. **The autos, transport/logistics, airlines and aerospace, and defense teams considered a number of vectors when determining the bear and bull case ranges for the TAM including:**

- **Battery technology.** Improvement in battery energy density is critical to enabling range, payload, and mitigating the emission of noise from the aircraft. Improving power to weight through lighter and more powerful batteries enables a greater magnitude of freight and/or numbers of human passengers for any distance of flight. Increased payload and range unlocks larger portions of addressable market to be exploited. A super heavy flying car with room for 1 passenger and a range of 1 mile would offer only novelty/limited commercial application. An unmanned passenger aircraft with a 50 mile range and room for only 3 passengers would require large numbers of aircraft in operation at any one time, which would compound ATC complexity and erode the economic payback periods.
- **Regulation/Societal acceptance.** Flying cars will be subject to a host of regulations and permitting/licensing considerations, including FAA/EASA approval, crashworthiness, software and hardware certification, infrastructure development, and environmental standards around emissions, noise, and privacy. We acknowledge that the realization of even our base and bull cases will require a substantial development of regulatory and operating standards from today's level. We see the development and early commercialization of terrestrial autonomous networks (shared autonomous cars) as an incubator and accelerator for the framework of regulation and consumer acceptance of flying car tech.
- **Other factors.** Beyond technological and regulatory factors, we believe macro-economic factors and the pace of private investment by companies and governments will impact the pace of adoption and the ultimate level of penetration. We see NASA's early involvement as a great positive for UAM ecosystem funding and organization. Dual-purpose and national security concerns may also play a role.

We have divided our scenarios for the Global UAM TAM into Bull, Base, and Bear cases. **Our framework to derive our scenarios is primarily driven by 2 primary vectors: (1) Technology and (2) Regulation.** Our cases assume a number of specific areas of technological capability (payload, range, speed, noise, software, connectivity, battery, unit cost, etc.). We also assume varying scenarios levels of regulatory inputs (local government, FAA/EASA, infrastructure, and public acceptance).

Exhibit 17:

UAM TAM Scenario Framework



Source: Morgan Stanley Research

We separated our bottom-up Urban Air Mobility model into 5 sections, which drive our estimates for the US Total Addressable Market in our Bull, Bear, and Base cases.

The sections are as follows:

1. **Autos and Shared Mobility:** Transporting humans shorter distances in heavily populated urban environments, such as a commute to work
2. **Airlines:** Transporting humans longer distances along more traditional short-haul airline routes, allowing for potentially larger, noisier aircraft.
3. **Freight Transportation:** Transporting goods, small and large, in both urban and rural environments
4. **Aerospace and Defense:** Using VTOL aircraft on the battlefield for the transportation of troops and supplies.
5. **The Content/Technology Opportunity:** Based on our bottom-up estimated unit sales for the above sectors, what is the content opportunity for hardware, software, telecom, and batteries?

We then extrapolated this US only bottom-up model globally to estimate the TAM in China, Europe, and ROW. We did this by taking the relative percentage of GDP our US UAM TAM forecast represents in the US and adjusted across regions for factors such as shared, autonomous, and electric vehicle miles penetration to arrive at the respective GDP percentages for each region. While we recognize comparing terrestrial ground transportation penetration to UAM may not be entirely apples to apples, we believe they are solid proxies, given the overlap of AV/EV and UAM technologies.

Bull Case: Meet George Jetson

Advanced / Developed Technology and Accommodative Policy:

- Mass adoption / acceptance of transportation of goods and people by VTOL / drone
- Technology accelerates – is cost effective for both consumers and businesses; is more efficient than current transportation models
- Policy is flexible and infrastructure is readily available / amendable – regulations permit "easy" VTOL / drone usage and adapt to changing consumer / business demands
- **Global Total Addressable Market: $2.9tn (~2.2% of 2040E Global GDP)**

Bear Case: From Hobbyists to Commercial Novelty

Underdeveloped / Unsuccessful Technology & Obstructive Policy:

- Mass rejection and fear/ minimal adoption of transportation of goods and people by VTOL / drone
- Technology stagnates – is not cost effective for consumer or businesses; is less efficient than current transportation models; encounters critical technological barriers to adoption (weight, noise, range, payload, safety, etc.)
- Policy is restrictive in nature and infrastructure is unable to support adoption – regulations hinder VTOL / drone usage and impede widespread adoption.
- **Global Total Addressable Market: $615bn (~0.5% of 2040E Global GDP)**

Base Case: Is It a Bird… a Plane? Oh… It's My Toothpaste

Advanced Technology & Obstructive Policy:

- Technology outpaces regulation / infrastructure / budget capabilities;
- VTOL / drone adoption is affected by red tape and falls on legislative priority list, hindering usage though technology is readily available
- Some societal concerns surrounding autonomous aerial control contributes to restrictive policy
- **Global Total Addressable Market: $1.5tn (~1.1% of 2040E Global GDP)**

Gating Factors for Urban Air Mobility – What Do We Need and Where Are We Now?

Technology

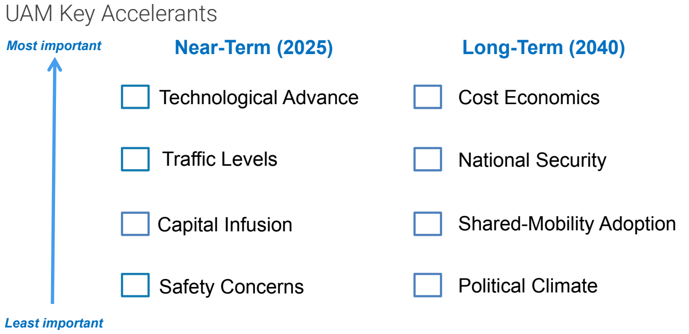
Unmanned aircraft technology has been a domain for military application for decades. In recent years, there have been a number of startups and efforts by established aerospace and technology firms who have directed resources towards all-electric unmanned aircraft. To our knowledge, battery technology as applied in drones and unmanned aerial vehicles is near parity with the cost, safety and energy density of lithium-ion battery technology used in electric cars. However, the force required to move a car on wheels and axles against its 2 primary forces of friction (rolling resistance and aerodynamic resistance) enable rather massive batteries to provide power and range. In short, if you want to add range to an electric car… just add a bigger battery (with cost… or financial friction… being the primary barrier).

For aircraft, batteries are an unorthodox choice of stored energy because the energy density of gasoline is roughly two orders of magnitude higher than lithium-ion batteries. The energy required to lift the same mass of a car off the ground vertically (without Bernoulli's principal in an airfoil) are far higher than to move a car along a road. As such, today's applications for electric flying cars are only in the development stage, with small payload (parcel delivery) and short distances (line of sight). Advancements in solid state battery technology (2x the power/50% of the mass of current lithium ion batteries), battery chemistry, and software are eking out improvements in battery technology in likely a non-linear manner. Electric motor size, weight, and advanced propulsion techniques are meant to help compensate for the inherent disadvantages in battery energy density vs. gasoline that are more limiting in aircraft applications than in automotive applications. Sensors, compute power, and software are much further developed, to our knowledge, due to military applications, and current advancements in autonomous vehicle technology. This leaves the problem of noise, which is a function of all aspects of the aircraft's design, including mass, number of rotors, rotor design, rotor material, propulsion, speed, altitude, etc.

In summary, we would describe the current state of technology for electric autonomous aircraft as underdeveloped, but rapidly improving in areas of pilot substitution, safety, and efficiency. While limited by battery technology, which may need to improve to a level significantly greater than that of conventional EVs for road transport over the next 10 years, we believe that the pathway to widespread adoption is clear, with billions in public and private investment set to occur over the next few years.

Exhibit 18:

UAM Key Accelerants

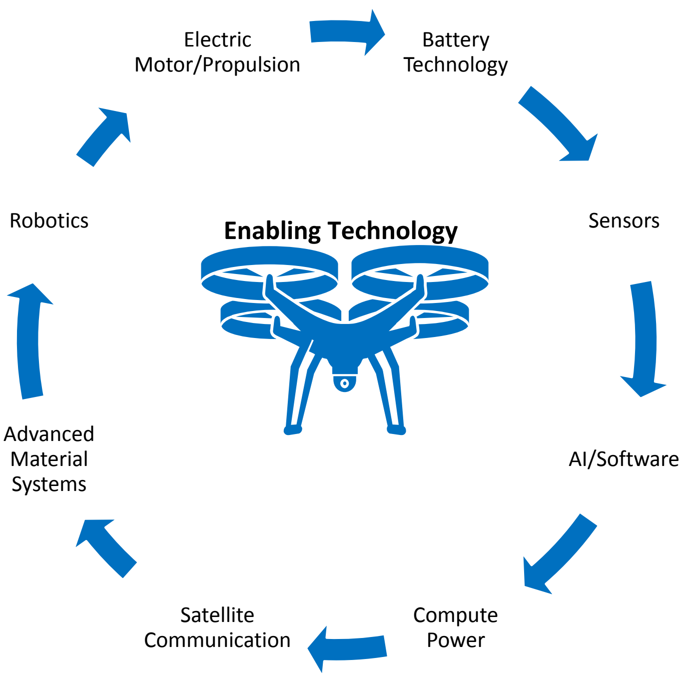


Source: Morgan Stanley Research

In order for heavily adopted, economically feasible, electric, autonomous Urban Air Mobility – many advancements need to be made technologically. Below, we have identified 8 core technologies that, in our view, are currently "gating factors" for bringing Urban Air Mobility to the masses, while making it both time and energy efficient.

Exhibit 19:

Enabling Technologies



Source: Shutterstock, Morgan Stanley Research

Exhibit 20:

Urban Air Mobility Tech Developments

UAM Technology Developments	
Technology	**Developments**
Satellite Communication	• Launch costs falling dramatically • Rising demand for bandwidth • Significant levels of capital formation • Estimate Space economy to be $1.1tn by 2040
Compute Power/ Availability	• Price of processing power and memory at all-time lows • Increased speed and capacity likely coming from new 5G infrastructure • Moore's Law
AI/Software	• Large amount of investment and development in autonomous driving • AI derived business value is expected to reach $3.9 trillion by 2022
Sensors	• Increased usability/cost efficacy of LiDar and other sensor technology • Companies using sensors in a range of use cases, such as smart cities or autonomous driving/flying
Advanced Material Systems	• Becoming a cheap and practical method of manufacturing complex parts • This technology can create lighter and more durable parts that are not possible with traditional metallurgical methods
Battery Technology	• $/kWh coming down steadily - target of $100/kWh by 2020 • Increased EV adoption accelerating need for better battery technology
Electric Motor	• Cost, weight, and volume decreasing significantly with improved performance • Cost targets for 2022 50% below current prices
Robotics	• Companies continue to develop different use cases for robotics, combining developments in AI/machine learning • Allows for faster assembly of more complex mechanics systems

Source: Shutterstock, Medium, Dept. of Energy, Morgan Stanley Research

Battery Improvement

We believe that current Li-ion battery technology is largely workable and will near-term be "Fit for Purpose" to support EV adoption in a world supported by emission regulations and government incentives, as the battery pack cost ($/kWh) migrates toward $100/kWh. However, the cost parity with an ICE vehicle is between $50 and $75/kWh. For battery cost to reach this level, we believe a material step change in the evolution of battery materials will be required. This holds true for eVTOL aircraft, where the battery requirements will likely be more demanding to achieve optimal levels of lift, speed, and distance. **This push to reach cost parity with ICE vehicles will only accelerate battery technology advancement over the next 5-10 years.**

There are three primary factors to consider when thinking about battery technology in the context of electric, urban air mobility:

- **Charge rate –** This is extremely important for the business model, especially over the long run, as the length of time to charge batteries affects the idle time of the vehicle. As a baseline for operation models, Uber Elevate is targeting an all-in idle time of 8-9 minutes between flights. Charlie Webb on our European battery team believes that there would need to be a substantial technological breakthrough in order improve charge times meaningfully from where EVs are today (~25 minutes).
- **Energy Capacity –** Improvements in cathode technology (energy density) are paramount to maintain stable pricing ($/kg). Auto OEMs today target $100/kWh by 2020, which

implies ~20% decline from today's standard (estimates vary by company). Apart from the current highly adopted Li-ion batteries, potential battery disruption can come from one of the following emerging technologies:

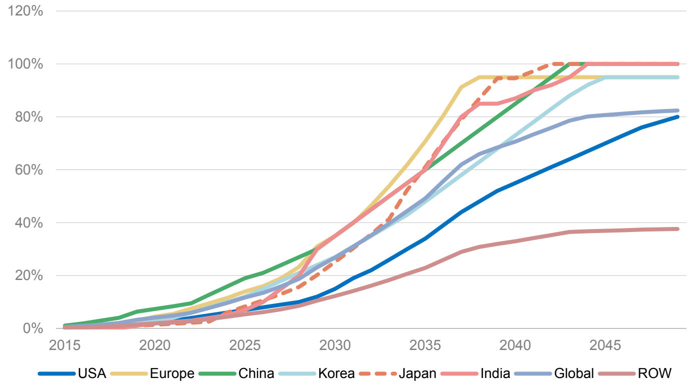
- **Lithium-sulfur -** High specific energy of 550 Wh/kg (3x Li-ion battery). Other advantages include low-cost raw materials, specific power density (2,500 W/kg), and low temperature charging. However, Li-S has high material degradation with low cycle life and self-discharge.
- **High-voltage Li-ion -** There is a great deal of research going into increasing the operational voltage (energy density) of next-gen Li-ion batteries. The issue is that doing so is compromising the stability of the cathode material. The limitations include reduced cycle life and material degradation at high voltages.
- **Lithium air:** Lithium air is believed to offer 5-10x the energy density of a conventional Li-ion battery. The theoretical specific energy of Li-air is 13 kWh/kg (roughly on par with an ICE vehicle) It is widely acknowledged to be at least 10 years from commercialization and only some of the material challenges can be overcome. Some limitations include degradation of the anode, short cycle life, poor thermal operating range.
- **Solid-state lithium:** This is often perceived as the natural progression from current Li-ion batteries, with the ability to store twice the energy, although there are some concerns over the loading capabilities. Some limitations include material degradation of the anode, short cycle life, and poor thermal operating range.
- **Fuel cells:** Fuel cells typically run off hydrogen and while range and power are less of a limitation, the infrastructure build-out remains the greatest hurdle. Material limitations include fueling infrastructure and energy efficiency (liquifying hydrogen/transportation.)

- **Cycle life –** Cycle life will be important for the long-term economics of both human/goods businesses, as the higher level of battery replacement, the higher level of costs and less time the vehicle can be airborne (generating revenue). As seen with the emerging battery technologies, cycle life tends to be one of the larger concerns as batteries become more efficient.

Many questions still remain for battery advancement, which leads to our additional concerns around the range and safety of urban electric aircraft. For more information on evolving battery technology please see *Will Cathode Evolution Drive the EV Revolution*(June 28, 2018) from our European Chemicals Team.

Exhibit 21:

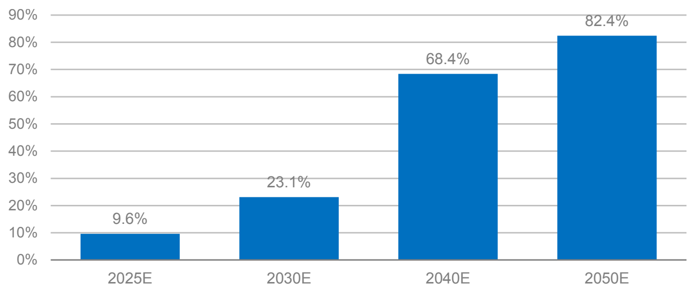
BEV Sales Penetration by Country



Source: Morgan Stanley Research

Exhibit 22:

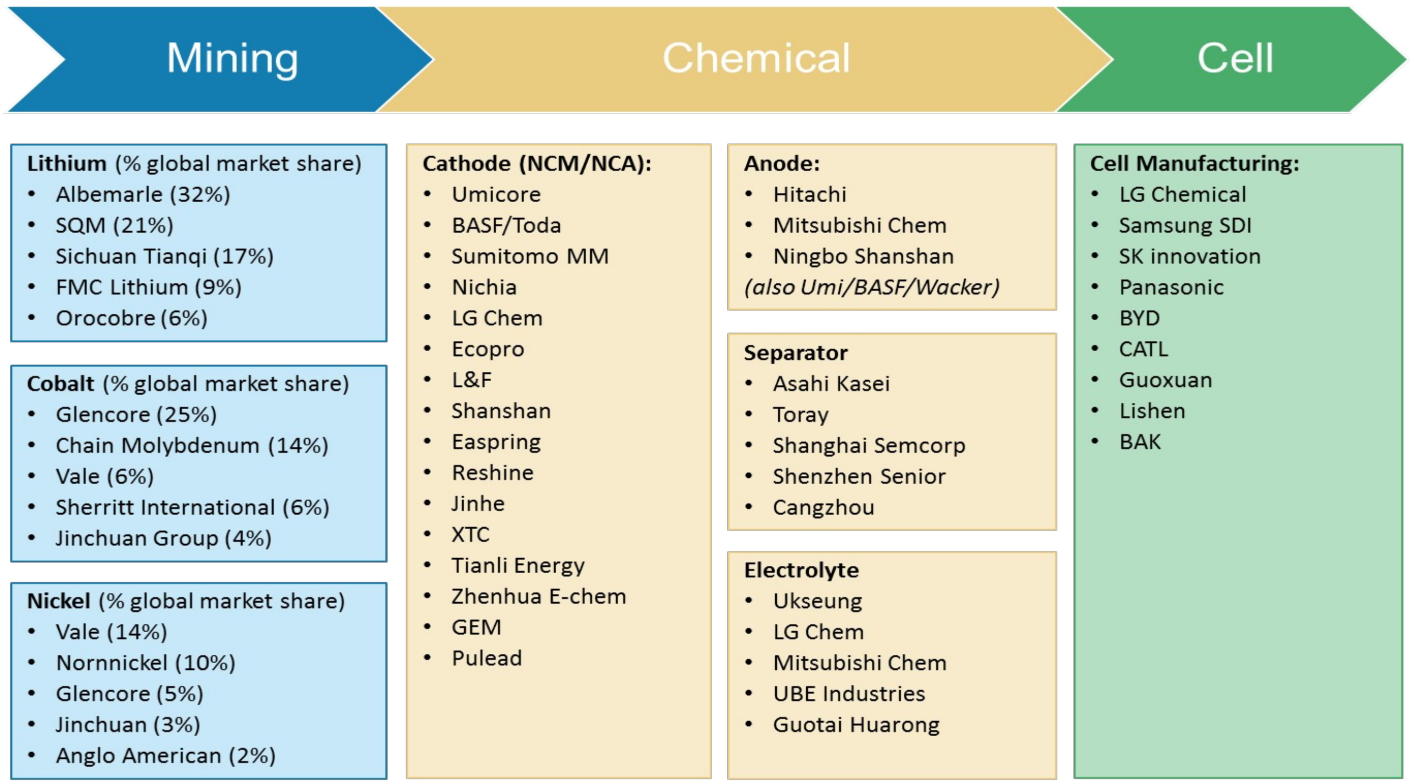
Global BEV Sales Penetration (Milestone years)



Source: Morgan Stanley Research

Exhibit 23:

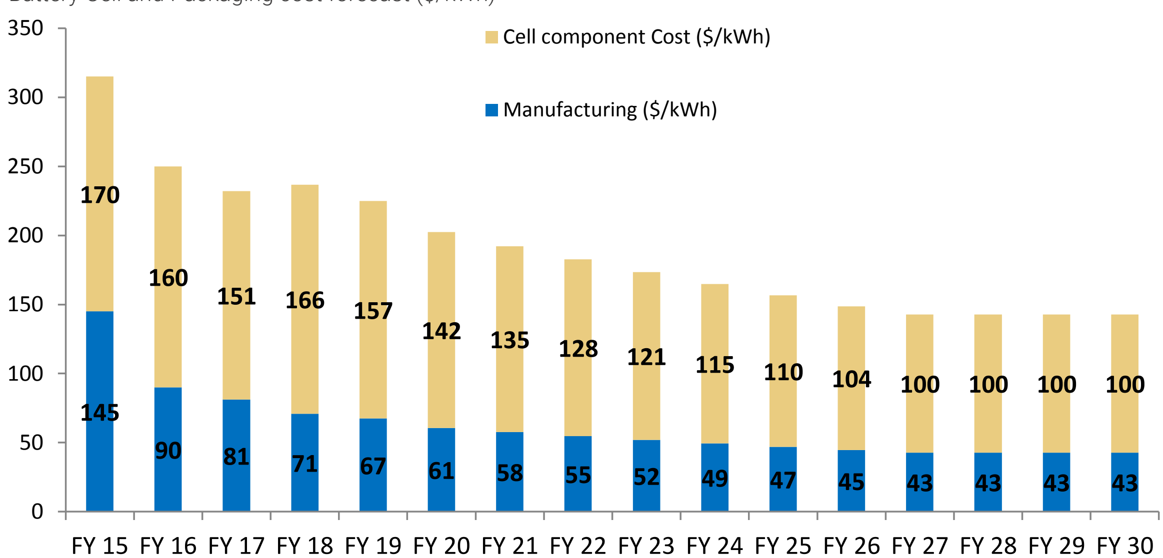
Battery material value chain and market participants



Source: Morgan Stanley Research

Exhibit 24:

Battery Cell and Packaging cost forecast ($/kWh)



Source: Morgan Stanley Research

Distributed Electric Propulsion (DEP)

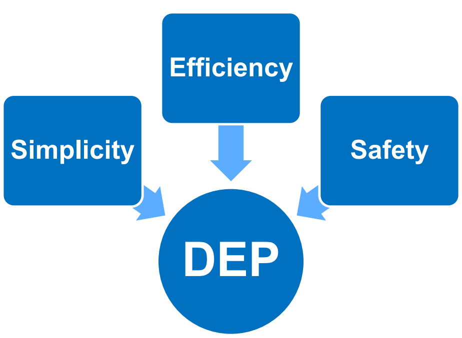
Distributed electric propulsion has important ramifications for safety, efficiency, and reliability of Urban Air Mobility. There are many different designs ranging from aircrafts with 10+ medium sized rotors to aircrafts with no rotors at all. Rotors are the primary cause of noise on helicopters today, which is why in San Francisco, out of the 40 helipads in the city, *only 1* is active (except for emergencies).

DEP provides three main components that are imperative to the realistic use of small, commercial aircraft in dense city centers: **(1)** Simplicity, **(2)** Efficiency, and **(3)** Safety.

- **Simplicity –** DEP allows electrical systems architectures to interact well without relatively more complex mechanical parts. Using a fully electrified system allows controls to be far simpler than what helicopter or plane controls are today, which means less certification requirements for pilots. The goal is for pilots (if there is a pilot) to have to only control the vehicle in a situation such as poor weather. Coordination of the powertrain and autonomous functionality will be crucial for economic efficiency, safety, and technological improvement such as payload weight and maximum trip distances.
- **Efficiency –** DEP allows aircraft designers to use several smaller motors rather than one large one, but also allows the mechanical architecture to increase the total number of electric motors without a trade-off in terms of weight. Each motor produces enough thrust to compensate for its own weight as they are positioned in such a way that allows the aircraft to achieve the optimal level of thrust spread across the aircraft. Studies by NASA and Joby Aviation show that DEP has reached levels of power similar to helicopters but with nearly 3x the efficiency.
- **Safety –** The number one cause of helicopter accidents today is engine failure. DEP creates an interlinked network of electric motors motors, controls, and battery architecture that allows redundancy across the aircraft. This level of redundancy allows, in the event of a failure, the vehicle to lose efficiency, but "fail gracefully" and mitigate the risk of accidents. DEP, in turn, will allow electric aircrafts to become much safer than helicopters today.

Exhibit 25:

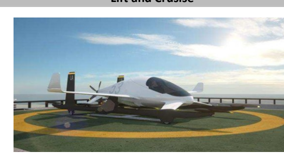
Benefits of DEP



Source: Joby Aviation, NASA, Morgan Stanley Research

Exhibit 26:

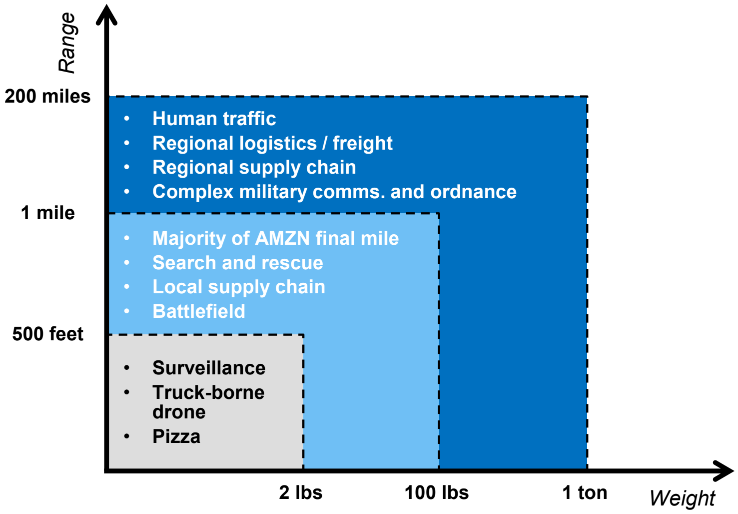
Three Categories of eVTOL Design

Urban Air Mobility Core Designs		
Multirotor (Wingless)	Lift and Cruise	Vectored Thrust
		
• Extremely high noise level • Travel Speed: ~60-110 km/hr • Will only be allowed on certain routes given noise levels • Likely capacity: 1-2 people	• Moderate noise level • Travel Speed: ~150-200 km/hr • Will likely be able to travel along a variety of routes • Likely capacity: 1-4 people	• Lowest noise level • Travel Speed: ~150-300 km/hr • Will likely be able to travel along a variety of routes • Likely capacity: 1-4 people

Source: Company websites, eVTOL News, Morgan Stanley Research

Exhibit 27:

VTOL Expected Weight and Range Limitations



Source: Company estimates, Morgan Stanley Research

Exhibit 28:

Levels of Autonomous Flying

Levels of Autonomous Flying	
L0	Human pilots responsible for safe operation of aircraft. Spacious, well defined distances in which planes can fly near eachother. Drones allowed to fly in visual line of sight (VLOS) of the pilot.
L1	Computer systems assist human pilots - automation is introduced in the form of autopilot, navigation in form of GPS/navigation aids. Drones can be used commerically, but with limited access to airspce.
L2	Onboard automation systems control the majority of activities. Pilots supervise the systems/take over when it is necessary. Aircraft/drones coordinate using ground based systems to coexist at low density levels.
L3	Automation systems perform the entirety of flight operations. Pilot control when certain performance conditions cannot be met. Drones and aircraft can operate in proximity with each other (i.e. near airports).
L4	Supervisors monitor fleets that coordinate amongst themselves rather than requiring a pilot for an individual aircraft. Drones can fly in large, automated fleets, while commercial aircraft is capable of flying with one pilot. Automation systems actively assess risk and provide advanced notice to human supervisors.
L5	Autonomous systems are certified for use in all conditions and during all phases of flight. Drones coexist with all forms of aviation in complex urban areas. Onboard systems combined with service providers determines when and how the airpsace is used.

Source: Airbus, Morgan Stanley Research

Exhibit 29:

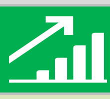
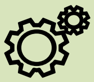
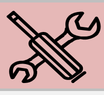
Content Needs for Vehicles are a relatively good proxy for UAM aircraft

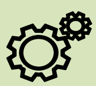
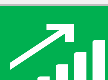
		Hardware - Tier-1 supplier	Software - OEM, Tier-1 supplier, other actor	
	Definition	**Sensors**	**Environmental model**	**System integration**
Level 1-2	Sensors provide information; **driver** monitors environment; **driver** responsible for decisions	Camera and radar 6-8 sensors/car	Not needed	Not needed
Level 3	Sensors provide information; **system** monitors environment; **driver** responsible for decisions	Camera, radar, early LiDAR 13-15 sensors/car	Fusion of sensor data with mapping and positioning information	Centralised electronic architecture Security and connectivity enabling OTA updates
Level 4-5	Sensors provide information; **system** monitors environment; **system** responsible for decisions	Camera, radar, LiDAR Wide range of expectations on sensors/car - 13-44	Same functions as level 3, but more processing power and fail-safes to allow car to take over	Full decision making model

Source: Continental, Aptiv, Magna, GM, Morgan Stanley Research

Exhibit 30:

Technology: What does development look like – what are areas that need improvement?

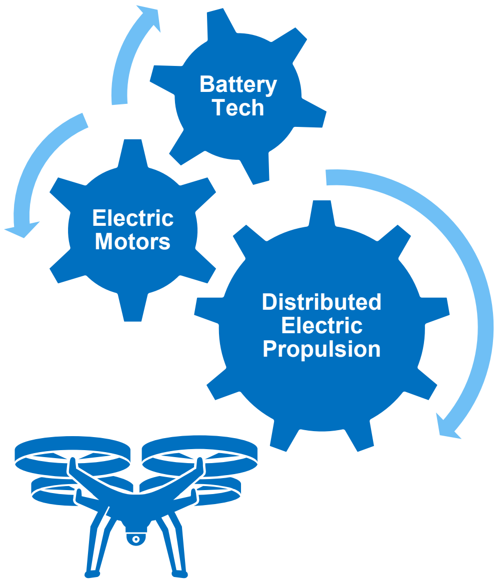
Development Framework System	
Relative Development	**Description**
	**Extremely developed technology**
	**Moderately developed technology**
	**Highly underdeveloped technology**
	**Moderately underdeveloped**
	**We cannot accurately say**

Key Technologies		
Technology	**Rating**	**Rationale**
Battery Density/Fast Charging		Currently represents, in our view, the largest technological barrier to UAM adoption in the near term. According to our European Chemicals team, it will require a significant technological breakthrough to reach range specifications UAM companies are targeting.
High Power Electric Motors		Electric motor architecture is fairly robust relative to other technologies on this list. Distributed electric propulsion provides enough redundancy to mitigate penalties for the failure of one motor. Even today, 3-4x more efficicent than ICE powertrains.
3D Manufacturing		3D manufacturing allows companies to more easily create parts with complex geometric structures. This technology has rapidly evolved over the past 5 years and is already being used in the design of many aircraft parts.
Advanced material systems (weight + weather)		Advanced materials are not as talked about as technologies such as batteries or autonomous systems, but designing an ultra lightweight super strong composite will be very important for making every ounce count and extending the range of electric aircrafts, especially if there is a pilot.
Comms Infrastructure		On a relative basis, we believe current comms infrastucture is relatively sufficient for connected aircraft and secure operating systems
Cybersecurity		We believe that due to future regulatory concerns surrounding UAM aircraft, cybersecurity will have to improve by orders of magnitude before a significant number of aircraft are allowed to fly at once
Autonomous Systems		A large amount of investment and resources are going into the advancement of autonomous driving systems, which is why we are ultimately constructive on autonomous aviation systems - the overlap between the two is immense, autonomous tech overall is still in its early innings.

Source: Morgan Stanley Research

Exhibit 31:

The Electric Propulsion Evolution

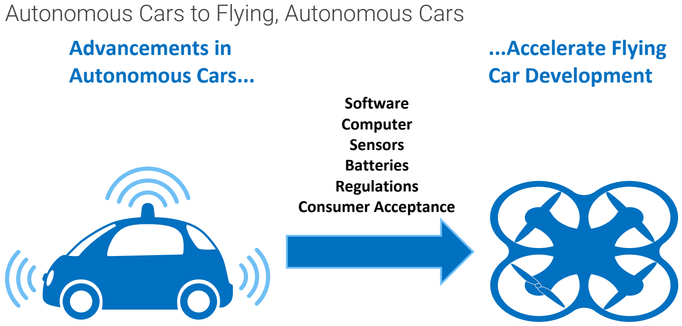


= More distance/efficiency + Less charge time

Source: Shutterstock, Morgan Stanley Research

Exhibit 32:

Autonomous Cars to Flying, Autonomous Cars



Source: Shutterstock, Morgan Stanley Research

Regulation

Similar to our views on autonomous vehicles – we believe that the Urban Air Mobility Market will be one that is highly regulated by two primary agencies: the Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA) – organizations that control 50% and 30% of air traffic, respectively.

When looking at aerial regulation, it is important to note the differences in certification processes for everything from the development to the infrastructure to the actual operations. Regulation is also in part determined by the type of aircraft that is being examined, whether it be a small hobby drone or a 747. We do note that current standards for aviation regulation may not necessarily be comparable for the commercial short distance transportation services that we are discussing in this report.

Historically, aviation legislation and certification processes have been a largely incremental, step-by-step processes, but technologies such as Distributed Electric Propulsion and autonomous sense and avoidance technologies will need to be addressed as they become fully developed. Companies such as Uber Elevate and Joby are constantly in contact with regulators to ensure a smooth transition from helicopters or airline flight today to a service where hundreds to thousands of trips per hour are being fulfilled.

To date, draft guidelines have been put forward by the European Aviation Safety Agency (EASA) to permit VTOL's to operate within the EU28 member states, however their passengers will be capped at 5, the cabin not pressurized, and the vehicle itself below 2000kg. Under such parameters, we don't believe such vehicles would have any meaningful impact on short haul markets of the airlines, however, could see negative impacts on journeys carried out on the city transport networks of buses, metro and overground rail.

Exhibit 33:

DoT Notional UAS Vehicle Classification and Categorization:

UAS Description	Weight (lbs)	Overall Size (ft)	Mission Altitude (ft)	Mission Speed (mph)	Mission Radius (mi)	Mission Endurance (hrs)
Nano	< 1	< 1	< 400	< 25	< 1	< 1
Micro	1 - 4.5	< 3	< 3,000	10 - 25	1 - 5	1
Small UAS	4.5 - 55	< 10	< 10,000	50 -75	5 - 25	1 - 4
Ultralight Aircraft*	55 - 255	< 30	< 15,000	75 - 150	25 - 75	4 - 6
Light Sport Aircraft*	255 - 1,320	< 45	< 18,000	75 - 150	50 - 100	6 - 12
Small Aircraft*	1,320 - 12,500	< 60	< 25,000	100 - 200	100 - 200	24- 36
Medium Aircraft*	12,500 - 41,000	TBD	< 100,000	TBD	TBD	TBD

Source: Unmanned Aircraft System (UAS) Service Demand 2015-2035, Morgan Stanley Research

Exhibit 34:

DoD UAS Group Descriptions

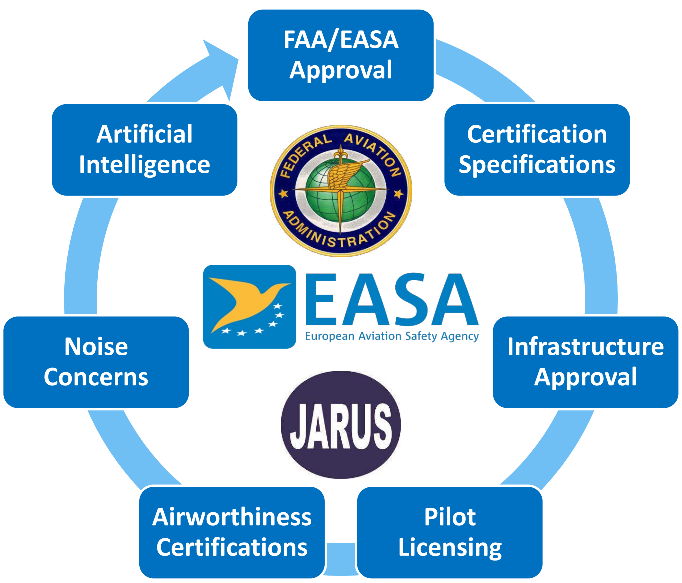
Group	Classification/Description	Weight (lbs)	Altitude (ft)	Speed (kts)
5	Penetrating	>1,320	> 18,000	Any
4	Persistent	> 1,320	< 18,000	Any
3	Tactical	< 1,320	< 18,000	<250
2	Small Tactical	21 - 55	< 3,500	<250
1	Micro/Mini Tactical	0 - 20	< 1,200	<100

Source: Unmanned Aircraft System Airspace Integration Plan, Morgan Stanley Research

Besides the aircrafts themselves – we have concerns around air traffic/airspace management systems. How will Urban Air Mobility services be able to handle the added capacity of hundreds to thousands of low to the ground, close proximity aircraft in dense urban environments? What are the cybersecurity and terrorist implications? These are all items that need to be addressed. **We forecast in 830,000 drones/eVTOL aircraft in the skies in the US alone by 2040 and recognize the significant regulatory risk that comes along with this.**

Exhibit 35:

UAM Regulatory Considerations



Source: FAA, EASA, JARUS, Morgan Stanley Research

Social Considerations

Noise

In order for urban air mobility to be possible in dense, heavily populated environments – aircraft need to emit socially acceptable levels of noise. Based on companies we have spoken to, the current goal for eVTOL is to be as quiet or quieter than general background noise. We have heard many arbitrary targets for what exactly this means, but without technological advance in electric motors, DEP, and quiet propulsors, noise will be of great concern for consumers and regulators. The FAA currently has noise standards surrounding acceptable levels of noise for fixed wing aircraft and helicopters. However, smaller, autonomous, electric urban aircraft will likely need to be held to a higher standard of noise regulation if the number of aircraft in a given city is to reach levels for the economics to work in a commercial ridesharing model.

Uber Elevate has been working with regulators for the past three years to come up with a framework to address acceptable noise levels for urban air mobility. They have divided regulatory requirements into four key vectors that need to be properly addressed:

1. **Noise level objective –** Elevate's current goal is for half of a truck on a residential road at 50 feet away (75-80dBs). This is approximately 1/4 as loud as the smallest four-seat helicopter
2. **Long-term annoyance –** UAM operations shouldn't contribute to any additional background noise
3. **Short-term annoyance –** UAM operations cannot exceed a maximum 5% increase in nighttime awakenings in surrounding communities
4. **Case by Case analysis –** VTOL operations need to be monitored to establish day and night time acceptability levels

In our opinion, these noise objectives seem fairly arbitrary and will need to be assessed further as more prototypes begin to hit the market. Next year, Volocopter plans to test its new aircraft in Singapore. We believe that this will be a good indicator of where we currently stand in terms of technology and what the long-term design of electric aircraft will need to be. Volocopter's aircraft is a rotor-based system, which is a large contributor to the high noise levels of helicopters currently. Overall, we believe noise is a regulatory and social concern that should not be taken lightly as adoption of UAM continues to progress.

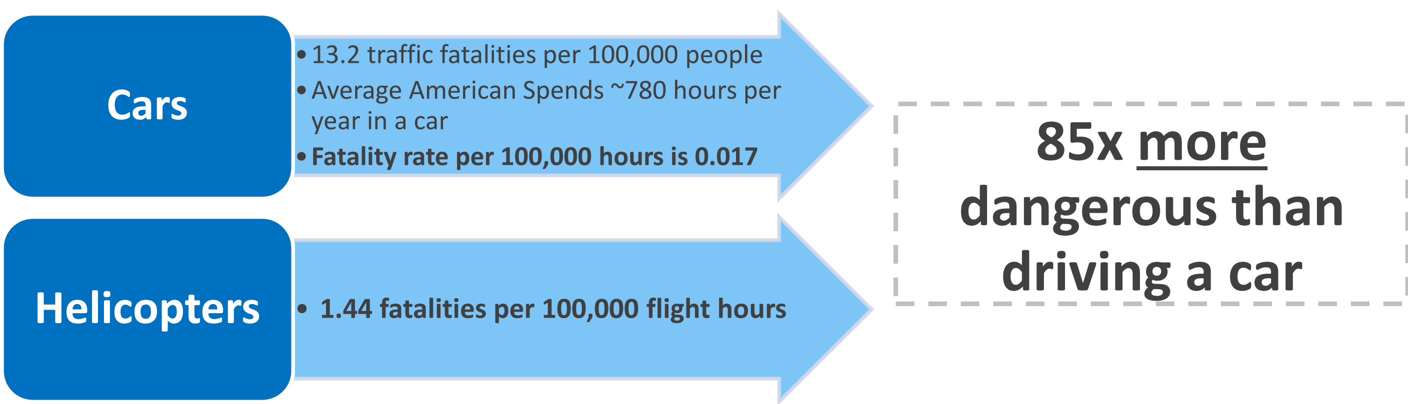
Elon Musk's Hyperloop is essentially an option on obstructive UAM regulation. When asked about the possibility of flying vehicles, Elon Musk said, "Obviously, I like flying things, But it's difficult to imagine the flying car becoming a scalable solution. If somebody doesn't maintain their flying car, it could drop a hubcap and guillotine you. Your anxiety level will not decrease as a result of things that weigh a lot buzzing around your head." We do not believe Mr. Musk is totally wrong. This will be a difficult obstacle to overcome and this likely general lack of societal acceptance will contribute to a more obstructive policy regime surrounding UAM.

Uber's CEO Dara Khosrowshahi, who has stated his support for Uber Elevate's flying car plans, did respond in a tweet, "Challenge accepted. Improved battery tech (thx 2 @elonmusk) and multiple smaller rotors will be much more efficient and avoid noise + environmental pollution."

There have been a number of studies on societal acceptance of "Flying Cars." At the recent NASA Industry Day on Urban Air Mobility, consulting firm Booz Allen Hamilton presented its findings from a survey on Urban Air Mobility:

- There are generally neutral to positive reactions about Urban Air Mobility
- Respondents generally felt comfortable flying with passengers they knew, but mostly uncomfortable with passengers they did not know – in our view, we expect this to change as ride sharing becomes more of a norm with traditional terrestrial transportation
- Mixed opinions on flying alone with an automated pilot
- **Strong preference for piloted operations**
- The presence of a flight attendant did increase willingness to fly with automated or remotely piloted operations
- There was a preference for longer flights (i.e. inter city - as we try to assess the TAM for in the "Airlines" section of our model)
- General concern around noise levels - especially as EVs become more prevalent (reducing ambient noise), making aircraft potentially more noticeable

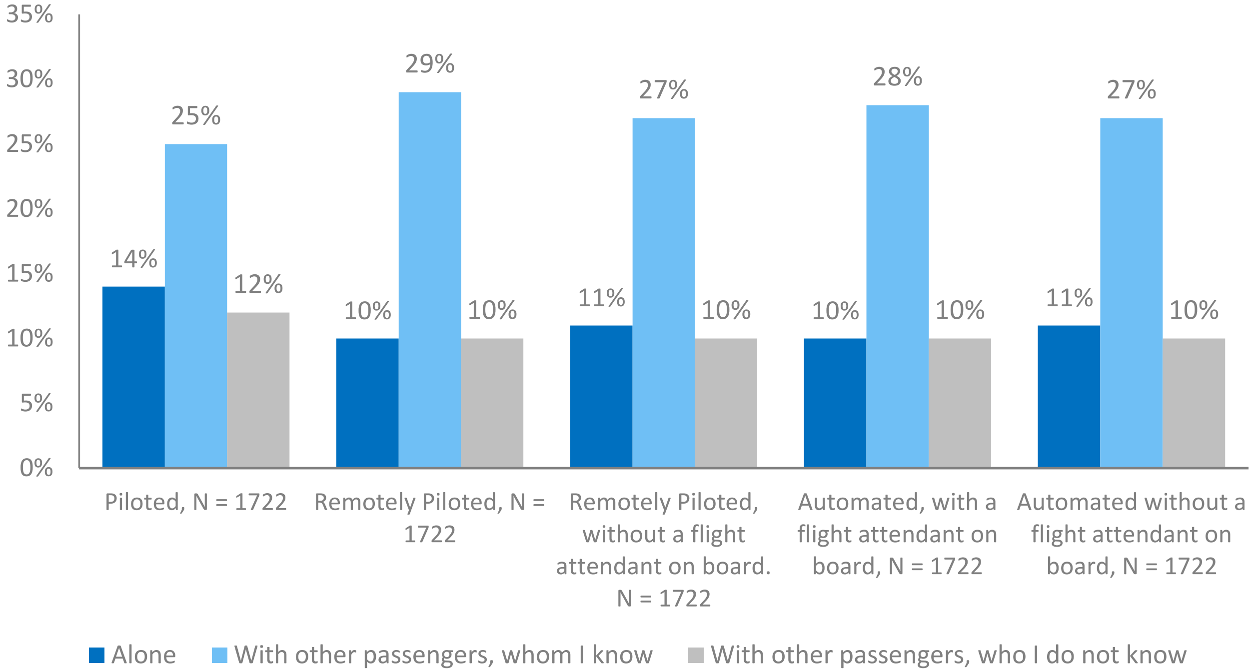
Exhibit 36:
Car vs. Helicopter Safety



Source: Bureau of Transportation Statistics, National Highway Traffic and Safety Administration, Morgan Stanley Research

Exhibit 37:

Would you be willing to travel in a UAM aircraft in the following situations?



Source: Booz Allen Hamilton survey data, Morgan Stanley Research

Exhibit 38:

Initial Reactions to the Concept of UAM

REACTIONS TO CONCEPT OF UAM								
	Excited	Happy	Neutral	Confused	Concerned	Surprised	Skeptical	Amused
GEOGRAPHIC LOCATION	SURVEY RESULTS							
Houston, N = 344	32%	24%	27%	8%	9%	11%	19%	3%
San Francisco Bay Area, N = 337	33%	25%	27%	8%	9%	11%	20%	3%
Los Angeles, N = 345	32%	24%	27%	8%	9%	11%	19%	3%
Washington, D.C., N= 341	32%	24%	27%	8%	9%	11%	20%	3%
New York City, N = 344	32%	24%	27%	8%	9%	11%	19%	3%

Source: Booz Allen Hamilton survey data, Morgan Stanley Research

Morgan Stanley UAM Total Addressable Market Model

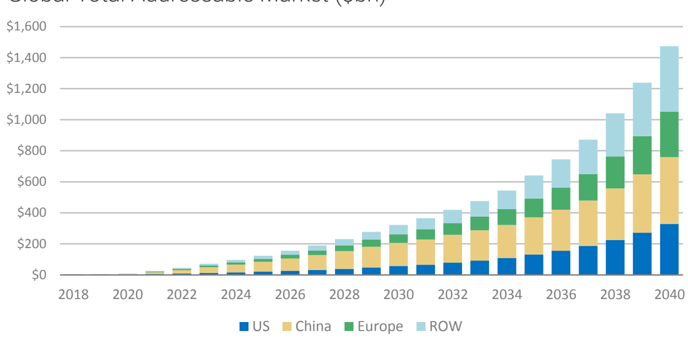
We believe that the opportunity in Urban Air Mobility is going to be substantial. To size the Total Addressable Market in the US, we focused on three broad end markets + the supply chain: (1) transporting humans, (2) transporting goods, (3) military & defense, and (4) the enabling supply chain/content. More specifically, we look at markets directly relevant to personal urban/suburban transportation, final mile shipping/logistics, short-haul airlines, and defense. Our forecasts for components, sensors, compute, and software – the so called "arms dealers" of the autonomous aircraft ecosystem – are based on our bottom-up forecasts for the three end markets.

We believe that our US TAM model provides an accurate illustration of the economics behind UAM ecosystem. To arrive at a Global TAM, we extrapolated our US TAM model using relative percentages of GDP, while adjusting for factors across China, Europe, and ROW such as shared, autonomous, and electric vehicle mile penetration. We believe that these factors are good proxy for UAM penetration across regions, since the technologies are highly complementary.

Global Total Addressable Market Summary

Exhibit 39:

Global Total Addressable Market ($bn)



Source: Morgan Stanley Research

Exhibit 40:

Global Total Addressable Market ($bn)

Model Summary	2020	2025	2030	2035	2040
US (Revenue $bn)					
Base	$2	$21	$56	$131	$328
Bull	$2	$32	$98	$253	$658
Bear	$2	$13	$31	$64	$137
China (Revenue $bn)					
Base	$2	$64	$149	$239	$431
Bull	$3	$95	$258	$461	$864
Bear	$2	$38	$83	$116	$180
Europe (Revenue $bn)					
Base	$1	$18	$56	$121	$292
Bull	$2	$27	$97	$234	$586
Bear	$2	$11	$31	$59	$122
ROW (Revenue $bn)					
Base	$2	$20	$60	$149	$422
Bull	$2	$30	$104	$287	$846
Bear	$2	$12	$33	$72	$176
Global Total Addressable Market ($bn)					
Base	**$7**	**$123**	**$322**	**$641**	**$1,474**
Bull	**$8**	**$185**	**$557**	**$1,234**	**$2,954**
Bear	**$8**	**$74**	**$178**	**$310**	**$615**

Source: Morgan Stanley Research

US Bottom-Up Model Summary

Our bottom-up US Model, in our view, provides an accurate representation of the different revenue opportunities and business models that will make up the UAM ecosystem.

Exhibit 41:

US UAM TAM Model Summary

Case Summary	2020	2025	2030	2035	2040
Revenue ($bn)					
Base	$2	$17	$45	$108	$284
Bull	$2	$25	$78	$211	$583
Bear	$2	$10	$26	$53	$118
Units					
Base	553	13,343	29,774	57,983	116,769
Bull	768	27,158	59,635	110,139	201,791
Bear	897	11,626	22,411	35,659	60,491
Parc					
Base	733	43,084	155,470	378,832	830,625
Bull	1,188	86,858	314,595	748,399	1,557,092
Bear	1,317	40,314	128,565	275,976	525,746

Source: Morgan Stanley Research

Exhibit 42:

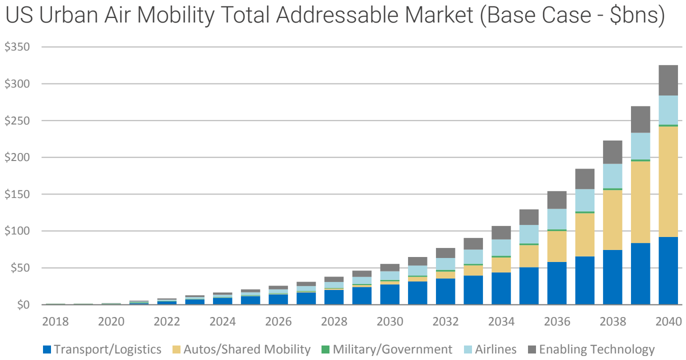
US UAM TAM Model Revenue Breakdown by Core Sectors ($bns)

Revenue Breakdown ($bn)	2020	2025	2030	2035	2040
Transportation/Logistics					
Base	$0.2	$11.7	$27.6	$50.9	$91.9
Bull	$0.2	$18.5	$45.0	$85.6	$148.6
Bear	$0.2	$8.3	$18.9	$34.2	$63.6
Autos/SM					
Base	$0.0	$0.4	$4.1	$29.8	$150.0
Bull	$0.0	$0.8	$10.4	$70.9	$344.0
Bear	$0.0	$0.3	$2.3	$11.1	$44.1
Airlines					
Base	$0.3	$3.8	$11.6	$25.1	$39.4
Bull	$0.3	$4.5	$19.1	$49.9	$84.5
Bear	$0.0	$1.2	$3.3	$6.5	$9.2
Military/Defense					
Base	$1.1	$0.9	$2.1	$2.5	$2.7
Bull	$1.1	$0.9	$3.2	$4.9	$5.4
Bear	$1.0	$0.7	$1.3	$1.2	$1.1

Source: Morgan Stanley Research

Exhibit 43:

US Urban Air Mobility Total Addressable Market (Base Case - $bns)



Source: Morgan Stanley Research

We estimate the content opportunity from UAM, using our bottom-up sector model and arrive at a US Total Addressable Market of $41bn by 2040.

Exhibit 44:

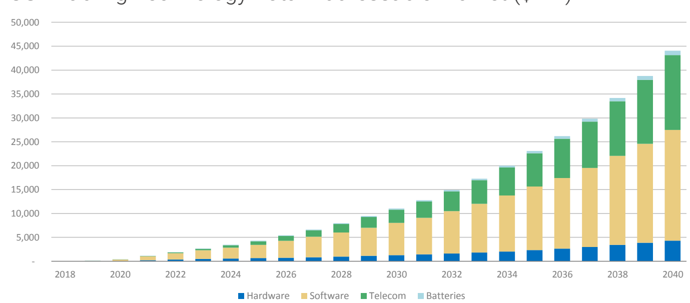
US Enabling Technology Model Summary (Milestone Years)

Case Summary	2020	2025	2030	2035	2040
Revenue ($bn)					
Base	$0.4	$4.3	$11.0	$23.1	$44.1
Bull	$0.5	$7.0	$19.9	$41.4	$75.0
Bear	$0.8	$2.3	$5.5	$10.5	$18.9
HARDWARE					
Base	$0.0	$0.6	$1.3	$2.3	$4.3
Bull	$0.1	$1.2	$2.4	$4.1	$7.0
Bear	$0.1	$0.6	$1.0	$1.5	$2.4
SOFTWARE					
Base	$0.3	$2.8	$6.7	$13.3	$23.2
Bull	$0.4	$4.0	$11.4	$22.6	$37.0
Bear	$0.7	$0.9	$2.0	$3.7	$6.2
TELECOM					
Base	$0.0	$0.8	$2.8	$7.0	$15.7
Bull	$0.0	$1.5	$5.6	$13.8	$29.4
Bear	$0.0	$0.7	$2.3	$5.1	$9.9
BATTERIES					
Base	$0.0	$0.0	$0.0	$0.0	$0.0
Bull	$0.0	$0.1	$0.2	$0.5	$0.9
Bear	$0.0	$0.2	$0.5	$0.9	$1.6

Source: Morgan Stanley Research

Exhibit 45:

US Enabling Technology Total Addressable Market ($mn)

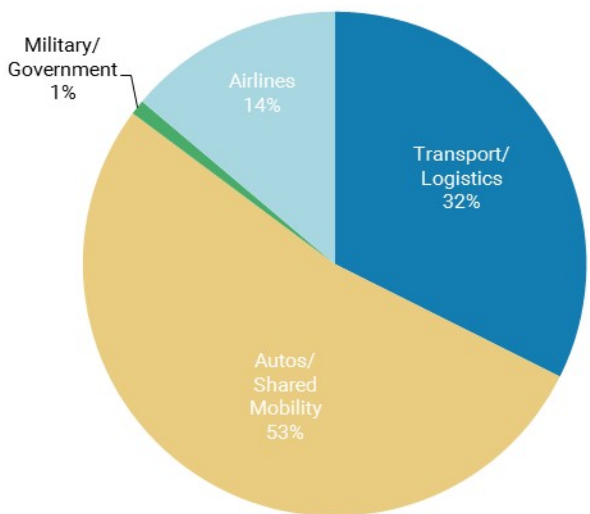


Source: Morgan Stanley Research

The incremental demand opportunity is there; it will be an execution game. Our model is driven by our base case assumption, which we believe to be the most likely path of **(1)** well developed technology **(2)** and moderately obstructive policy.

Exhibit 46:

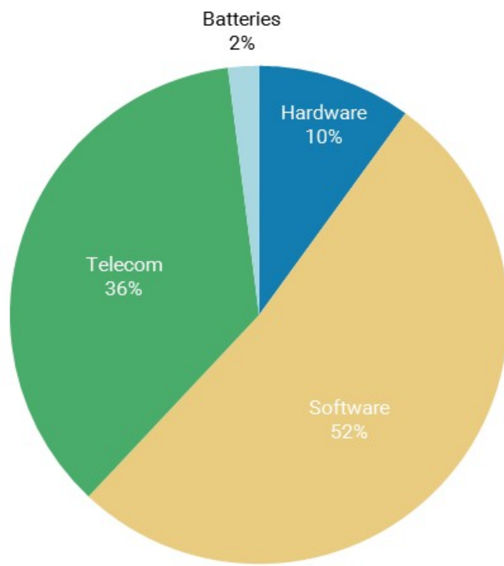
Sector % of Revenue by 2040



Source: Morgan Stanley Research

Exhibit 47:

Technology % of Revenue by 2040



Source: Morgan Stanley Research

Autos & Shared Mobility (US)

The business model of autonomous aircraft has the potential to be vastly superior to the terrestrial ride-sharing model.

- Compared to today's ride-sharing car, a flying car would be faster, could do more shifts, and could charge higher revenue/mile. The combination implies strong revenue generation.
- In our scenario analysis, we estimate that flying cars can conduct 4x the numbers of trips per day as a ride-sharing car with 4x the number of miles per trip (100mph for flying car vs. 25mph for ride-share car).
- We estimate the annual revenue for a highly utilized ride sharing car to be around $75k/year. We estimate a flying car can generate as much as 12x this revenue (>$900k/year).
- Assuming a 15% margin for flying cars vs. a 10% margin for terrestrial cars implies the flying car generates 18x the profit per unit.
- We note the economic outcomes of flying cars depend on a range of factors, including vehicle cost, useful life, residual value, interest rate, electricity cost, range (miles/KwH), maintenance cost, hangar/infrastructure costs, parking, SG&A, insurance, licensing, and other fees.

Exhibit 48:

US Autos and Shared Mobility UAM TAM Model Summary

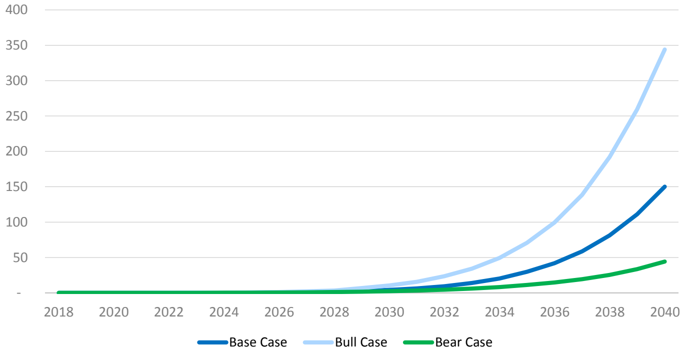
Case Summary	2020	2025	2030	2035	2040
UAM % of Vehicle Miles					
Base	0.0%	0.0%	0.0%	0.3%	1.3%
Bull	0.0%	0.0%	0.1%	0.4%	2.2%
Bear	0.0%	0.0%	0.0%	0.1%	0.4%
Production (units)					
Base	80	635	3,587	16,086	55,219
Bull	80	657	4,353	20,993	78,921
Bear	75	440	1,631	4,977	15,187
Hours of Operation/Day					
Base	2	4	5	6	8
Bull	2	4	6	8	10
Bear	2	4	5	6	8

Source: Morgan Stanley Research

Risk to demand by looking at miles traveled comparison. An investor may reasonably ask if long-term growth in the market for autonomous flying taxis could pose a risk to the market for road-bearing miles traveled by light vehicles and commercial vehicles. Our assessment of the addressable market through 2040 at least suggests the threat to automotive miles traveled would be very low. Our base case of US miles traveled by flying cars of 73 billion by 2040 is little more than 1% of our forecast of total US light vehicle miles traveled in that same year (5.7 trillion miles).

Exhibit 49:

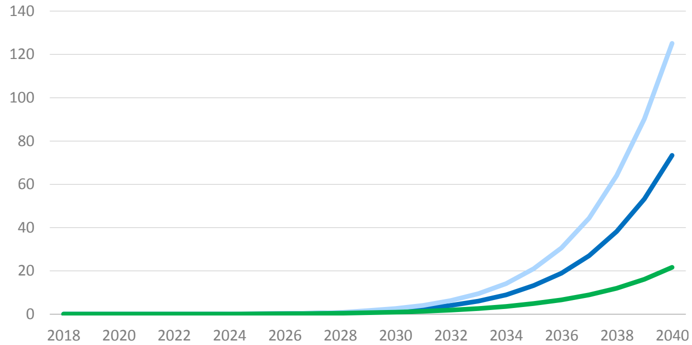
US Autos and Shared Mobility Total Addressable Market ($bn)



Source: Morgan Stanley Research

Exhibit 50:

US VTOL Total Miles Traveled – Autos and Shared Mobility (bns of miles)



Source: Morgan Stanley Research

alphawise α

Primary Research

See what others don't. Demographic data analysis shows roughly 80% of the US population lives in 28% of zip codes.

Methodology. We used 2018 Claritas US demographic estimates to evaluate the zip vs population coverage. Zip population was sorted and aggregated to understand the cumulative population trend.

Team Behind the Analysts. AlphaWise Primary Research gathers alternative data and generates unique insights via an innovative analytical and visualization platform.

Freight Transportation

From a Freight Transportation perspective, the first and most obvious application of VTOLs is for parcel delivery. Parcels are defined as any package that weighs under 50lbs for B2B or B2C delivery. We size the TAM for US parcel delivery at roughly $100bn today and growing at a rate faster than GDP. We see VTOL use in parcel delivery ramping up in the coming years in 4 phases:

1. **Phase 1: Extremely limited emergency applications.** This involves VTOL use in areas of extreme urgency and/or limited access such as medical supplies and disaster relief. This is already being done today in some parts of Africa (such as Rwanda) and we believe will achieve more widespread use in the US by 2020. However, this is an extremely limited application and will be used to test the viability of VTOL delivery more than anything else.
2. **Phase 2**: **Rural parcel delivery.** The first mass application of VTOL delivery is likely to be in rural parcel delivery applications. Density is the lifeblood of any parcel delivery network and some extra urban areas simply do not have the population density to allow for affordable package delivery especially in today's same-day delivery world. Most parcel delivery companies extensively use the USPS network that faces an uncertain future today and could see reduced service in the near future, if we see USPS reform. Parcel companies today likely subsidize rural deliveries with slightly higher pricing on Urban deliveries, which may not be sustainable in the future. VTOL delivery — from the nearest store or DC — could be the most cost effective, practical alternative. Current line-of-sight rules limit the ability of long-distance drone delivery but this could be relaxed over time with regulatory support, rural VTOL delivery off a truck (human/autonomous — similar to WKHS/UPS or Daimler solutions) could serve as an effective stop-gap mechanism and piloted VTOLs can avoid this problem in a way that drones cannot.

   We estimate the size of the rural parcel delivery market at roughly $22 bn today, growing to $32 bn by 2040. Based on our AlphaWise analysis, We estimate that roughly 80% of the US population lives in 28% of zip codes, mostly in urban areas along the coasts. We estimate that the other 20% of the population that lives in the other 72% of the zip codes are rural/extra urban residents for whom VTOL delivery would make practical sense. We estimate that commercial launch of these services will be in 2020 and will slowly ramp from 1% of the market that year to 20% by 2025 and 60% by 2040. We estimate the rural parcel TAM grows at roughly the rate of GDP growth.

3. **Phase 3: General parcel delivery.** As VTOLs improve and achieve more commercial traction, we could see their use extend to all parcel delivery. Designated drop off areas in urban apartment and office buildings (esp. on roofs) could be a relatively easy and workable solution. Once VTOLs are deployed for both rural and urban parcel delivery, the TAM will expand to cover the entire parcel market – which is roughly $100 bn today and we estimate growing to $320 bn by 2040. We estimate urban TAM grows slightly in excess of GDP growth over time vs. the current pace of LDD growth. We estimate that VTOL share of the urban market is smaller and ramps slower than the rural market given the more powerful rural use case. As such, we estimate the combined VTOL parcel delivery TAM launching by 2020 and growing to $12 bn by 2025 and $76 bn by 2040.

4. **Phase 4: Heavy/bulk goods.** Parcels are typically packages that weigh under 50 lbs, while packages that fall between 50-150 lbs are considered "big and bulky items" without being classified as heavy freight. We believe this will be the last potential market area that VTOLs will penetrate given the complexity of the operation. The heaviest duty drones today max out at roughly 100 lbs though 30-50 lbs is the more realistic limit. So we would need to see more development of drone capability before we can count this as an official category. However, we note that multi-passenger VTOLs should have a payload capability of several hundred pounds, which should bridge the capability gap between a drone and a truck. If we do see 500 lb payload VTOLs, we estimate them taking around 4% of LTL market share in 2035 and ramping to 20% share by 2040. We believe the Less-than-truckload (LTL) market with its palletized freight will be more ideally suited to VTOL delivery than other heavier, bulkier forms of truck freight. We estimate the LTL TAM grows at roughly the rate of GDP growth, making our estimated VTOL market share $16 bn in 2040. As a caveat to our growth projections, we note that even if we set aside public acceptance issues of refrigerators flying over neighborhoods, many of these "big and bulky" items like appliances, gun safes, lawn equipment etc. also need in-home installation – it is of little use for your new refrigerator to land in your front yard – and therefore will likely always need a human element. This will likely keep trucks as the most effective form of delivering "big and bulky" goods (although VTOLs could create an "omnichannel shift" where the drone delivers your fridge and your installation guy arrives in his personal car vs. an expensive company truck). We could also see B2B applications (inventory transfer, ready-to-ship last mile deliveries) of these items, if the VTOLs have the payload and range capabilities.

Exhibit 51:

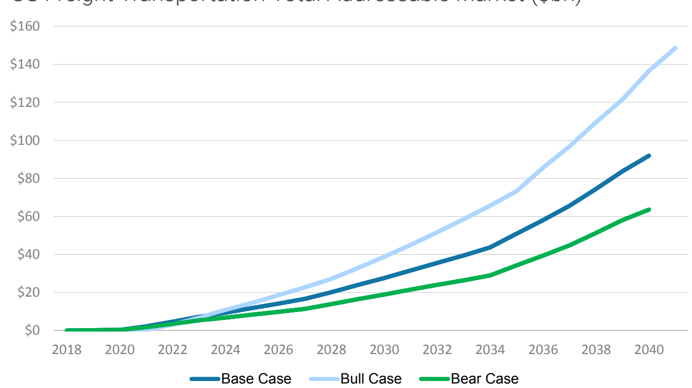
US Freight Transportation UAM TAM Model Summary

Case Summary	2020	2025	2030	2035	2040
Rural Parcel Drone Share (%)					
Base	1%	20%	38%	50%	60%
Bull	1%	20%	38%	50%	60%
Bear	1%	20%	38%	50%	60%
Urban Parcel Drone Share (%)					
Base	0%	5%	10%	15%	20%
Bull	0%	10%	20%	30%	40%
Bear	0%	3%	5%	8%	10%
Freight Market Drone Share (%)					
Base	0%	0%	0%	4%	20%
Bull	0%	0%	0%	6%	20%
Bear	0%	0%	0%	4%	20%

Source: Alphawise, Morgan Stanley Research

Exhibit 52:

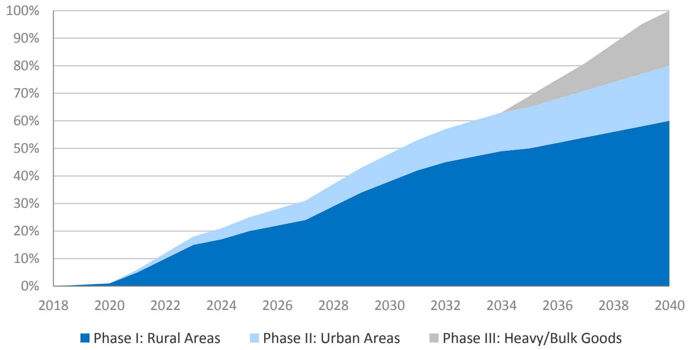
US Freight Transportation Total Addressable Market ($bn)



Source: Alphawise, Morgan Stanley Research

Exhibit 53:

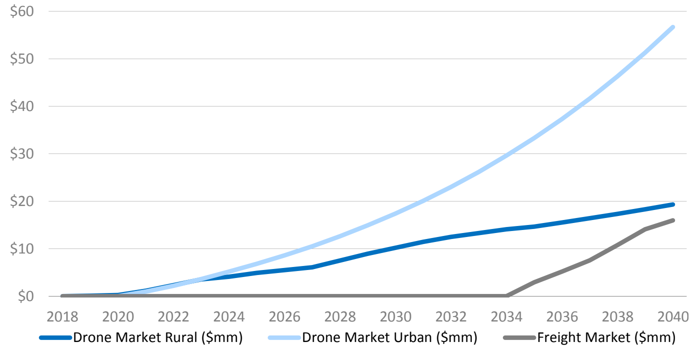
US Drone Share % of Market (Urban / Rural / Freight) – Base Case



Source: Alphawise, Morgan Stanley Research

Exhibit 54:

US Freight Transportation Total Addressable Market (Urban / Rural / Freight – Base Case – $bns)



Source: Alphawise, Morgan Stanley Research

Airlines

We base our airlines US bottom-up Total Addressable Market model on current short haul aircraft seat mile capacity grown through 2040. In our base case we assume a load factor in line with most airlines today (85%), but assume only 65% in our bear case to account for potential logistical issues in starting a newer, more convenient flight service. We calculate average revenue per seat mile based off of a blended average of common short haul flights. The argument could be made that UAM services would be able to charge a premium to this, given the likely convenience factor of the service; however, we assume cost per seat mile in line with airlines today. We apply slow UAM penetration growth through 2040, ultimately reaching 54% UAM penetration in our base case. The primary difference in our bull and bear cases is the UAM penetration rate we apply to "the overall pie" of the short haul airline market, with differences in penetration coming from our views on regulation and technological advance.

Exhibit 55:

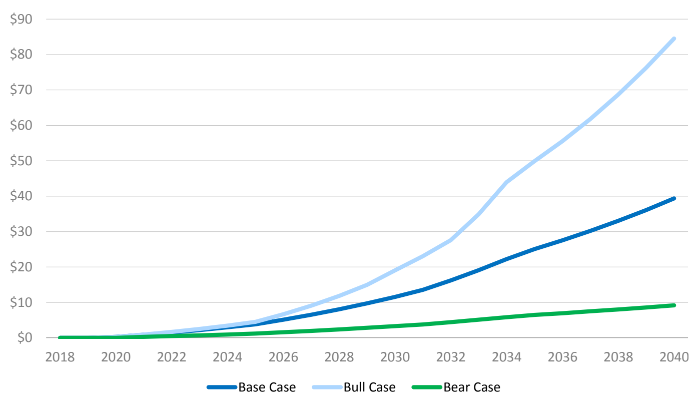
US Airlines UAM TAM Model Summary

Case Summary	2020	2025	2030	2035	2040
Short-Haul Seat Miles (mn)					
	46,893	54,362	63,020	73,058	84,694
Load Factor (%)					
Base	85.0%	85.0%	85.0%	85.0%	85.0%
Bull	85.0%	85.0%	85.0%	85.0%	85.0%
Bear	61.5%	65.3%	69.0%	72.7%	76.5%
UAM Penetration (%)					
Base	1.0%	11.0%	26.0%	44.0%	54.0%
Bull	1.0%	11.0%	32.0%	58.0%	68.0%
Bear	0.0%	5.5%	13.0%	22.0%	27.0%

Source: Morgan Stanley Research

Exhibit 56:

US Airlines Total Addressable Market ($bn)



Source: Morgan Stanley Research

Military & Defense

Although Military and Defense is a very small sliver of our overall Total Addressable Market Model, we see the militaries increased involvement in the space as paramount to both technological and regulatory advance. The total addressable market for Military and Defense is much smaller than the other sectors because we model the market as a function of military spend (i.e. how much will the military spend on advance VTOL vehicles in a given year?). On a relative basis, this is a much smaller revenue pool (~$1bn today) versus the potential for operating a fleet of autonomous aircraft at a cost of $2 mile.

Exhibit 57:

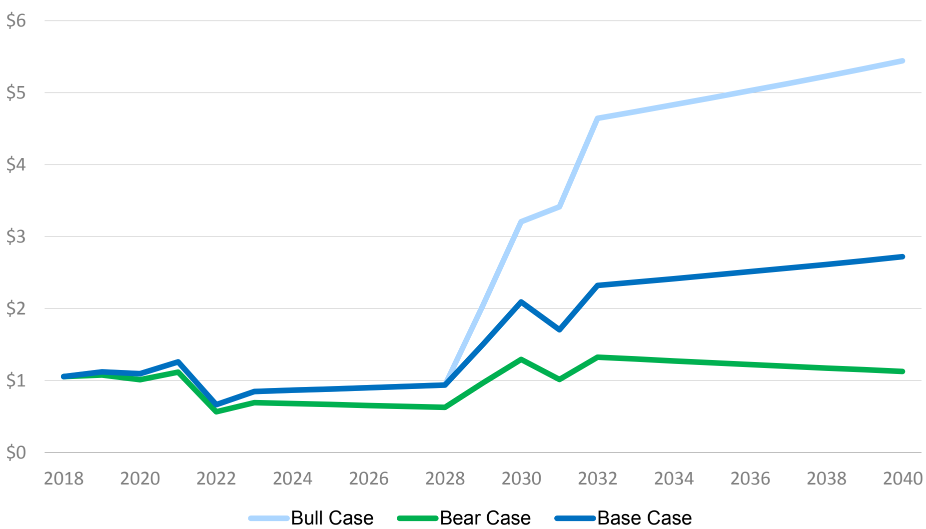
US Military and Defense UAM TAM Model Summary

Key Assumptions	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Units												
Base	20	40	60	80	80	80	80	80	80	80	80	80
Bull	40	80	120	160	160	160	160	160	160	160	160	160
Bear	20	40	60	80	80	80	80	80	80	80	80	80
Revenues ($mm)												
Base	$547	$1,116	$1,708	$2,322	$2,369	$2,416	$2,464	$2,514	$2,564	$2,615	$2,668	$2,721
Bull	$1,094	$2,232	$3,415	$4,645	$4,737	$4,832	$4,929	$5,027	$5,128	$5,231	$5,335	$5,442
Bear	$352	$691	$1,015	$1,326	$1,300	$1,274	$1,248	$1,223	$1,199	$1,175	$1,151	$1,128

Source: Morgan Stanley Research

Exhibit 58:

US Military and Defense Total Addressable Market ($bns)

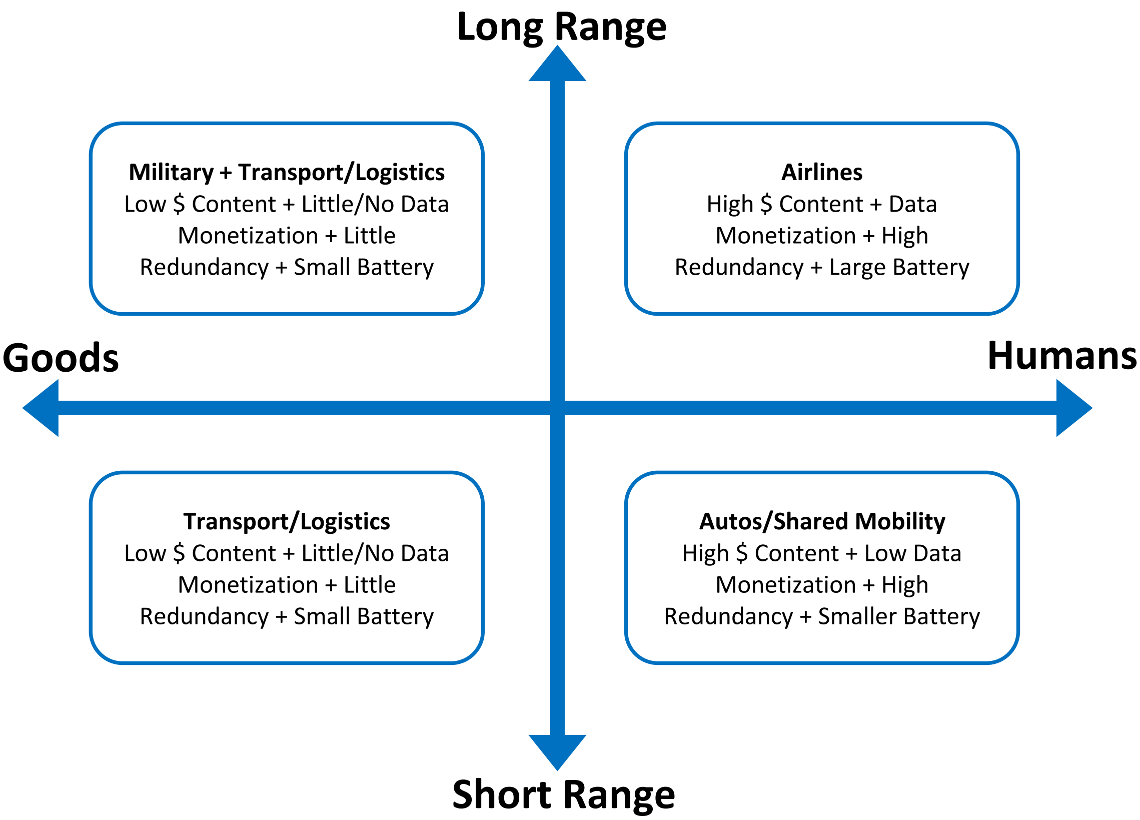


Source: Morgan Stanley Research

Enabling Technology – The Content Opportunity

Exhibit 59:

Assessing the Content Opportunity



Source: Morgan Stanley Research

US Hardware Total Addressable Market

We model hardware by calculating the cost of content per aircraft, using content per autonomous terrestrial vehicle as a proxy for both cost and number of sensors, radars, LiDar, etc. the aircrafts will likely have. To account for the differences in content for a small package drone vs. a long-distance, autonomous eVTOL that would transport humans we broke out content per vehicle based upon estimated unit sales for each sector. We assumed that the "Airlines" portion of our bottom-up TAM model would have the highest level of content due to extra redundancy spend for transporting humans. The only difference we modeled vs. shorter range human aircraft was the battery. We believe that due to regulatory considerations equal levels of redundancy will be needed for each, whether humans be traveling short or long distances, with small changes to the cost of an avionics system.

Exhibit 60:

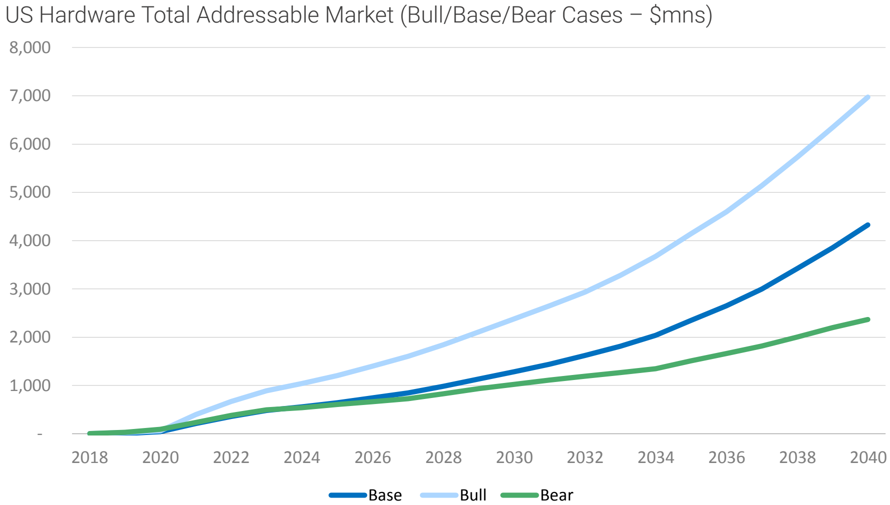
US Hardware Content Opportunity – UAM TAM Model Summary

HARDWARE SUMMARY	2020	2025	2030	2035	2040
Content per Vehicle ($)					
Human - Long Distance	$106,639	$65,888	$57,394	$52,215	$47,271
Human - Short Distance	$86,148	$47,370	$40,366	$36,533	$33,073
Goods - Long Distance	$64,384	$37,674	$32,365	$29,285	$26,514
Goods - Short Distance	$64,384	$37,674	$32,365	$29,285	$26,514
Revenue by Category ($mn) BASE					
Human - Long Distance	$14	$112	$268	$479	$617
Human - Short Distance	$7	$30	$145	$588	$1,826
Goods - Long Distance	$7	$169	$284	$391	$524
Goods - Short Distance	$7	$169	$284	$391	$524
Total Revenue ($mn)	**$36**	**$481**	**$981**	**$1,848**	**$3,491**
Revenue by Category ($mn) BULL					
Human - Long Distance	$21	$169	$495	$947	$1,165
Human - Short Distance	$7	$31	$176	$767	$2,610
Goods - Long Distance	$11	$369	$616	$848	$1,061
Goods - Short Distance	$11	$369	$616	$848	$1,061
Total Revenue ($mn)	**$51**	**$938**	**$1,904**	**$3,410**	**$5,898**
Revenue by Category ($mn) BEAR					
Human - Long Distance	$36	$28	$67	$120	$154
Human - Short Distance	$6	$21	$66	$182	$502
Goods - Long Distance	$11	$166	$259	$324	$380
Goods - Short Distance	$11	$166	$259	$324	$380
Total Revenue ($mn)	**$65**	**$380**	**$650**	**$950**	**$1,417**

Source: Morgan Stanley Research

Exhibit 61:

US Hardware Total Addressable Market (Bull/Base/Bear Cases – $mns)



Source: Morgan Stanley Research

US Software Total Addressable Market

We model the software content opportunity in similar to how we modeled hardware – by breaking down unit sales into categories based on expected relative content per vehicle. We assumed software content per aircraft to be on par with L3-L5 autonomous vehicle content per vehicle. We assume 5% YoY decrease in pricing through 2040, which yields a $23bn Total Addressable Market by 2040. Note that this is content per vehicle, we do not model the total software opportunity for other adjacencies such as air traffic management and data storage, simply the content of the vehicle.

Exhibit 62:

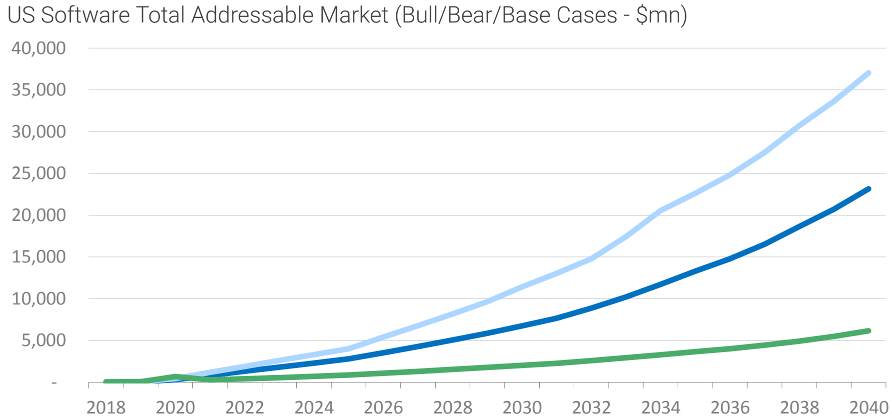
US Software Content Opportunity – UAM TAM Model Summary

SOFTWARE SUMMARY	2020	2025	2030	2035	2040
Content per Vehicle ($)					
Human - Long Distance	$1,470	$1,137	$880	$681	$527
Human - Short Distance	$735	$569	$440	$341	$263
Goods - Long Distance	$368	$284	$220	$170	$132
Goods - Short Distance	$184	$142	$110	$85	$66
Revenue by Category ($mn) BASE					
Human - Long Distance	$197	$1,941	$4,116	$6,248	$6,878
Human - Short Distance	$59	$361	$1,579	$5,478	$14,550
Goods - Long Distance	$25	$243	$514	$781	$860
Goods - Short Distance	$33	$248	$523	$788	$865
Total Revenue ($mn)	**$314**	**$2,793**	**$6,732**	**$13,294**	**$23,153**
Revenue by Category ($mn) BULL					
Human - Long Distance	$295	$2,912	$7,598	$12,354	$12,992
Human - Short Distance	$59	$374	$1,916	$7,149	$20,795
Goods - Long Distance	$37	$364	$950	$1,544	$1,624
Goods - Short Distance	$46	$369	$962	$1,558	$1,635
Total Revenue ($mn)	**$436**	**$4,019**	**$11,426**	**$22,605**	**$37,046**
Revenue by Category ($mn) BEAR					
Human - Long Distance	$492	$485	$1,029	$1,562	$1,720
Human - Short Distance	$55	$250	$718	$1,695	$4,002
Goods - Long Distance	$61	$61	$129	$195	$215
Goods - Short Distance	$70	$66	$137	$202	$220
Total Revenue ($mn)	**$679**	**$862**	**$2,012**	**$3,654**	**$6,156**

Source: Morgan Stanley Research

Exhibit 63:

US Software Total Addressable Market (Bull/Bear/Base Cases - $mn)



Source: Morgan Stanley Research

US Telecom Total Addressable Market

As the number of UAM aircraft increases through 2040 there will be a large content opportunity for internet connectivity of both package drones and human UAM aircraft. In order to value the content opportunity we assume an ARPA (average revenue per aircraft) at the midway point between the ARPU of a car and the ARPU of a private aircraft today. For perspective, AV data could increase global wireless traffic 40x over current levels, delivering a boost for Telcos comparable to the iPhone in 2007. The data opportunity for UAM is not as large ($14bn in our US base case by 2040) but still significant if UAM aircraft is able to monetize by $ per mile.

Exhibit 64:

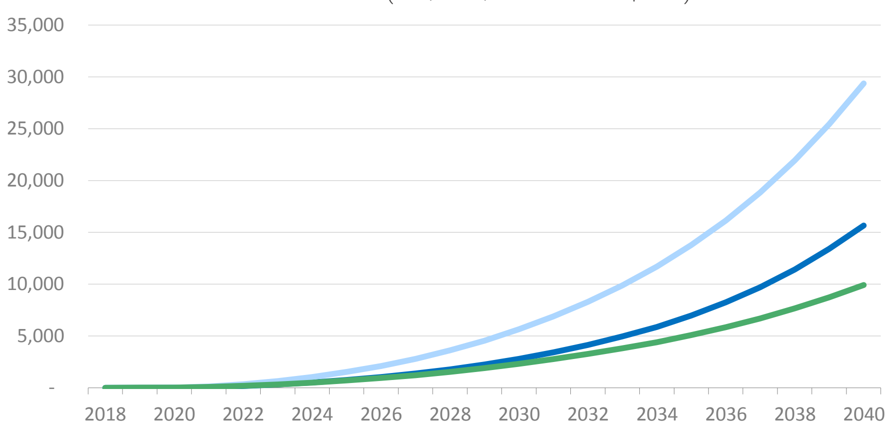
US Telecom Content Opportunity – UAM TAM Model Summary

TELECOM SUMMARY	2020	2025	2030	2035	2040
ARPA ($)					
Base/Bull/Bear	$1,423	$1,458	$1,495	$1,533	$1,572
Revenue by Case ($mn)					
Base	$14	$636	$2,393	$6,099	$14,044
Bull	$18	$1,261	$4,776	$11,871	$25,905
Bear	$20	$580	$1,923	$4,260	$8,071

Source: Morgan Stanley Research

Exhibit 65:

US Telecom Total Addressable Market (Bull/Bear/Base Cases - $mns)



Source: Morgan Stanley Research

US Batteries Total Addressable Market

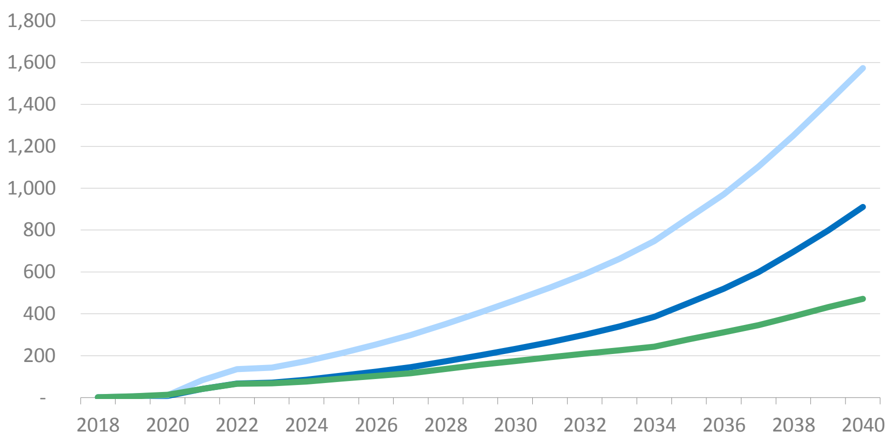
As we mention throughout this report – batteries will likely be a major technological impediment for UAM adoption. This, however, makes batteries a difficult content opportunity to model, given $/kWh could fluctuate heavily based upon required battery specifications. We assume $/kWh eventually falling to $60, which is what most battery/car companies target by 2025. We assume kWh of an electric aircraft to be roughly double what an electric vehicle is today. While this might be on the lower end, we believe that advanced propulsion systems such as DEP will lower the requirements for electric aircraft, although we do note this value may vary significantly based on the long-term aircraft design (i.e. whether it is vectored thrust or wingless).

Exhibit 66:
US Battery Demand Opportunity – UAM TAM Model Summary

BATTERIES	2020	2025	2030	2035	2040
Battery Cost ($/kWh)					
Base/Bull/Bear	$100	$60	$60	$60	$60
Revenue by Case ($mn)					
Base	$7	$89	$202	$406	$841
Bull	$10	$178	$399	$758	$1,434
Bear	$12	$76	$147	$230	$368

Source: Morgan Stanley Research

Exhibit 67:
US Batteries Total Addressable Market (Bull/Bear/Base Cases - $mns)



Source: Morgan Stanley Research

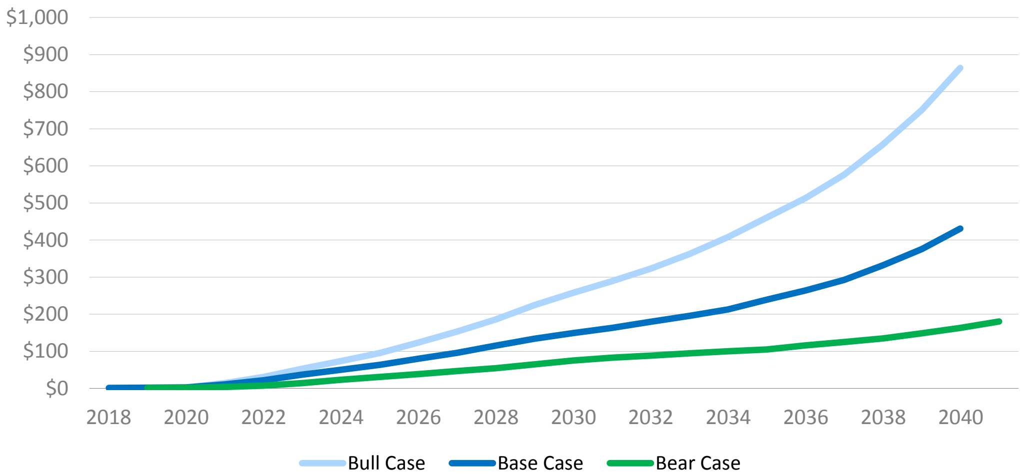
UAM Global Total Addressable Market Extrapolations

See Appendix for our full Global TAM Extrapolation, which includes our assumptions for China, Europe and ROW.

While we do not perform a bottom-up analysis for China, Europe, and ROW, we believe our model extrapolation accurately accounts for differences across regions such as autonomous, electric, and shared mile penetration. Although using terrestrial penetration forecasts for those vectors is not completely apples to apples, they will likely be relatively good proxies to adjust our bottom-up Total Addressable Market estimates across regions. While we acknowledge the regulatory, societal, and national security vectors get significantly more difficult to address as you extrapolate globally, especially for a topic like UAM.

Exhibit 68:

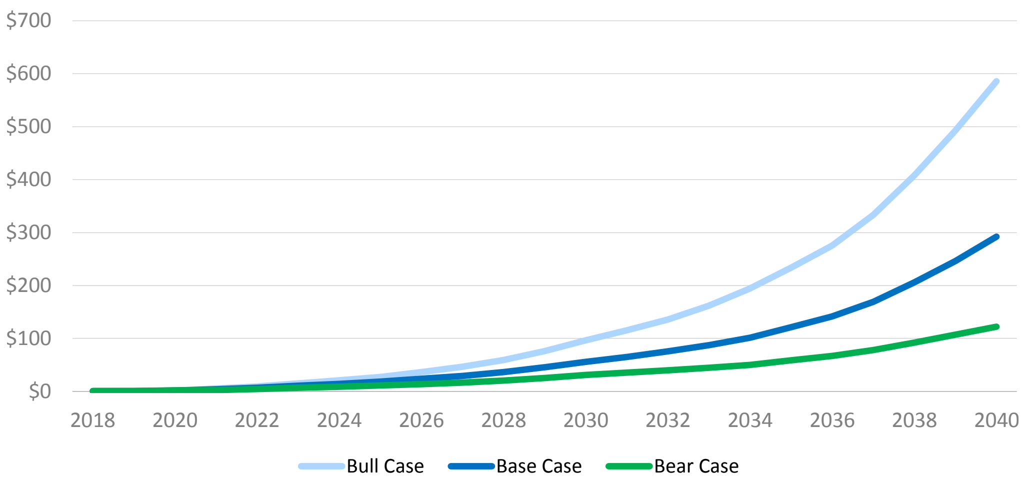
China Total Addressable Market ($bn)



Source: Morgan Stanley Research

Exhibit 69:

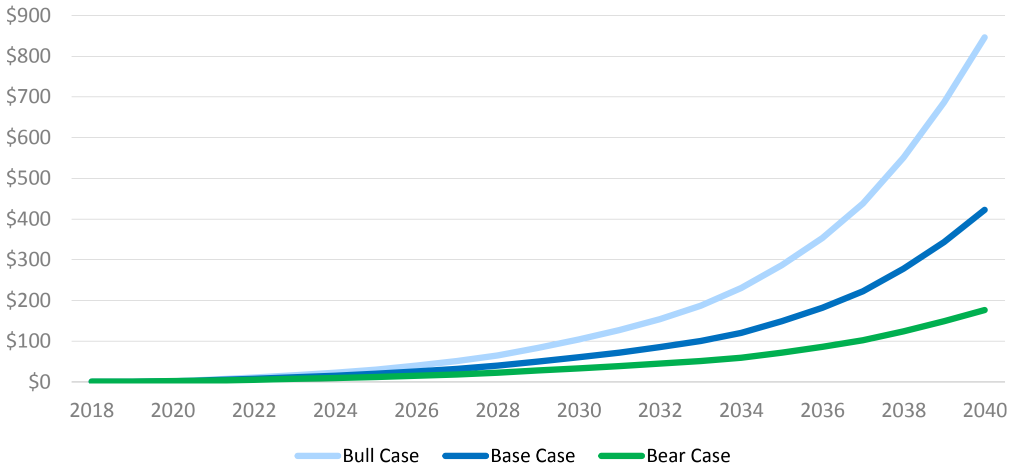
Europe Total Addressable Market ($bn)



Source: Morgan Stanley Research

Exhibit 70:

ROW Total Addressable Market ($bn)



Source: Morgan Stanley Research

Case Assumptions

Exhibit 71:

TAM Analysis Case Assumptions

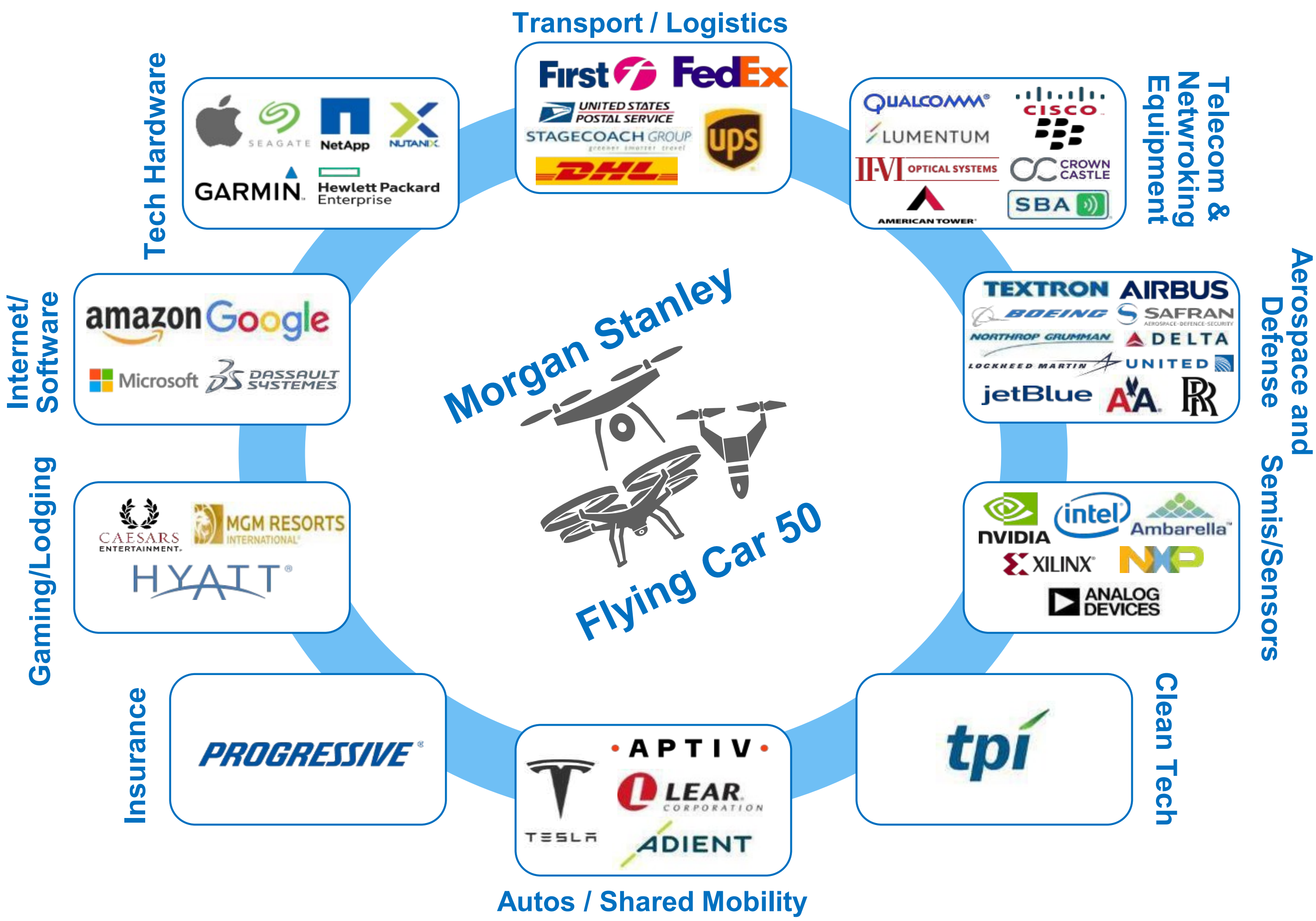
CASE	TECHNOLOGY	REGULATION	OUTCOMES
BASE			
	Payload/Range: 150lbs, 20 miles **Speed:** 100mph **Noise:** slightly more annoying than car traffic **Software:** autonomous, deep learning, AI **Sense & Compute:** lidar, camera, radar, edge-compute **Telecom:** 4G/5G, LEO, V2V, V2X mesh network **Battery:** gen 1 solid state, energy density 0.5KwH/Kg **Unit Cost:** $5k to $250k **Cost per Mile:** approx $3	**Local Government:** bespoke regulatory posture, mixed **FAA Certification:** few national stds, limits broad deployment **Telecom Infrastructure:** somewhat enabling **EV Infrastructure:** density optimized for city/MSA **Public Acceptance:** mixed, depending on application/region	**Narrative: Is it a Bird… a Plane? Oh… It´s My Toothpaste.** Tech advances much faster than regulations. Network gets large enough for low cost operation. Jury still out on consumer safety/envonmental impact. **Market Size:** $250bn, 1.5% of US GDP **Use Cases:** front door package and food delivery, final mile logistics, military. Very limited human traffic. **Reality Check:** Sub 5% level of miles traveled. Advancements in terrestrial Avs the focus of goverments.
BULL			
	Payload/Range: 1 ton, 200 miles **Speed:** 250mph **Noise:** less than car traffic **Software:** fully autonomous, deep learning, AI **Sense & Compute:** lidar, camera, radar, supercompute **Telecom:** 5G, LEO, DSRC, mesh network **Battery:** advanced solid state, energy density 1KwH/Kg **Unit Cost:** $5k to $250k **Cost per Mile:** less than $1	**Local Government:** bends to economic/Fed rulemaking **FAA Certification:** extremely enabling national stds **Telecom Infrastructure:** AV infrastructure well developed **EV Infrastructure:** density optimized for region/nation **Public Acceptance:** high, visible benefits	**Narrative: Meet George Jetson** Major advancements in tech accelerates regulatory posture. Solving noise and range issues were key. Cheaper than today´s cars. Proven safety track record. **Market Size:** $700bn, 4% of US GDP **Use Cases:** final mile logistics, regional shipping, supply chain, advanced military, human payload, tourism **Reality Check:** Still minority of miles traveled (10 to 20%). Requires another decade or two to displace 2D transport.
BEAR			
	Payload/Range: 5lbs, 1 mile **Speed:** 50mph **Noise:** loud, buzzing, highly annoying, much worse than cars **Software:** semi-autonomous, central control **Sense & Compute:** camera, radar sensor-fusion **Telecom:** 4G, wifi **Battery:** Tesla-era EV tech, energy density 0.2KwH/Kg **Unit Cost:** $5k to $250k **Cost per Mile:** approx $5 to $10	**Local Government:** more power than Fed rules **FAA Certification:** high impediments, bottlenecks **Telecom Infrastructure:** limited to short-range operation **EV Infrastructure:** patchwork/responsibility of private firms **Public Acceptance:** low, environmental/privacy pushback	**Narrative: From Hobbyists to Commercial Novelty** Tech/regulation evolve too slowly for major disruption. Network size too small to achieve economies of scale. Many communities ban on noise and privacy concerns. **Market Size:** $50bn, 0.3% of US GDP **Use Cases:** surveilance, entertainment, emergency svcs, line-of-sight delivery. Almost no human traffic. **Reality Check:** Sub 1% level of miles traveled. Moral, legal, ethical and infrastructure impediments.

Source: Morgan Stanley Research

Sector Implications: Introducing the Morgan Stanley Flying Car 50

Exhibit 72:

Morgan Stanley Flying Car 50



Source: Shutterstock, Morgan Stanley Research

List of Stocks Most Exposed to the Adoption of Urban Air Mobility

As part of our collaboration across Morgan Stanley, we have constructed a diversified list of stocks that, in our collective view, are most exposed to the adoption of Urban Air Mobility. The list is populated irrespective of specific 12-month recommendations, and, so, includes some Underweight-rated names, in addition to Equal-weight- and Overweight-rated names.

Autos & Shared Mobility

Tesla (TSLA, EW, covered by Adam Jonas): Tesla has expertise in batteries, AI software, complete vehicle engineering, charging infrastructure and material science that we believe may have transferability to the autonomous aircraft domain. Tesla CEO Elon Musk is regularly asked about flying cars. While he is sometimes cautious about the near-term commercialization of the product due to noise and wind force, he has been outspoken about his desire to design a vertical-take-off-and-landing supersonic electric jet. Tesla's increasingly close relationship with SpaceX may also prove useful in this adjacent area of development.

Aptiv (APTV, UW, covered by Armintas Sinkevicius): Aptiv is a leader in software, sense-and-compute, electronic architecture and hardware integration for autonomous and electric cars. Given the skills overlap between AVs and flying cars discussed throughout this report, we see Aptiv as potentially well positioned in flying cars in a magnitude that we believe exceeds the risk of potential cannibalization. The company has conducted 5,000+ automated rides in Las Vegas, with a 4.96 / 5.00 rating on the Lyft app, and expects to have 75 vehicles in Las Vegas by the end of 2018. For a more in-depth analysis on the auto suppliers, please refer to the report, ***Autos & Shared Mobility: Suppliers: Transfer of Coverage: Auto 1.0 Still Has Gas in the Tank, Fading the Auto 2.0 Hype (22 Mar 2018)***.

Lear (LEA, OW, covered by Armintas Sinkevicius) and **Adient (ADNT, UW, covered by Armintas Sinkevicius)**. Seating/interior companies have expertise in the mass production of seats (including seat structures and mechanism/recliners) that are tested to a high level of longevity and crash safety in a rigorous automotive environment. In our view, while the absolute unit volume of passenger – carrying flying cars may be quite low for the next 10 to 15 years, the $ value per unit may be substantially higher than for light vehicles - perhaps a significant multiple of content value. Adient has been emphasizing the aerospace opportunity broadly for their seating and interior products. Earlier in 2018, Adient and Boeing launched a new company to design and build airplane seats with the aim to sell a portfolio of products directly to airlines and leasing companies. Lear's seating portfolio is also well positioned on the theme, in our opinion. For more information on LEA and ADNT, please refer to the report ***Autos & Shared Mobility: Seating: Uprgrading LEA to OW on Strong Execution vs. Downgrading ADNT to UW on Operational Challenges (31 Jul 2018)***

Airlines / Aerospace & Defense

Textron (TXT, EW, covered by Rajeev Lalwani) Textron has exposure to the aviation industry through both its Textron Aviation and Bell business segments. Textron Aviation is a manufacturer of turboprop and business jet aircraft, including Beechcraft and Cessna brands, while Bell is a manufacturer of helicopter and tiltrotor aircraft for both military and commercial use. In recent months, Bell has overtly expressed interest in Urban Air Mobility through its unveiling of the Bell Air Taxi cabin experience at CES 2018 and collaboration with Uber to accelerate the large-scale deployment of eVTOL.

Boeing (BA, EW, covered by Rajeev Lalwani) Boeing has made a number of moves over the past year to position the company as leader in the emerging UAM market. During the 2018 Farnborough Airshow, the company announced the formation of Boeing NeXt, a business unit tasked with "building the ecosystem that will define the future of urban, regional and global mobility." This "ecosystem" includes next-generation airspace management and global airspace integration, to ensure autonomous and piloted air vehicles can safely coexist. In addition, speaking at the Morgan Stanley Laguna Conference, Boeing CEO Dennis Muilenburg noted that the company was making investments currently working on prototype vehicles.

Northrop Grumman (NOC, EW, covered by Rajeev Lalwani) Northrop Grumman is a leader in unmanned aircraft for military applications, including VTOL and conventional flight systems. The company's Autonomous Systems business segment within its Aerospace Systems sector has been producing aircraft of this type for decades, including Global Hawk and Fire Scout amongst others. In addition, the company has invested in cognitive systems, a fundamental component of autonomous aircraft given the need to navigate congested airspace.

Lockheed Martin (LMT, OW, covered by Rajeev Lalwani) Lockheed Martin, through its Aeronautics and Sikorsky businesses, has commercial and military exposure to the VTOL market. It has built a number of unmanned aircraft for military use and in conjunction with DARPA is currently developing ARES (Aerial Reconfigurable Embedded System) a modular VTOL aircraft that can transport 3,000 pounds of payload load at a range of 250 nautical miles on a single tank of fuel. In addition, the company has demonstrated its MATRIX Technology which enables military and commercial helicopters VTOL aircraft, to safely, reliably, and affordably operate as autonomously or optionally piloted aircraft.

JetBlue Airways (JBLU, EW, covered by Rajeev Lalwani): JetBlue is a domestic US airline that we view as a potential beneficiary of flying cars given its early moves to defensively position itself. The company has acknowledged the emergence of Urban Air Mobility, going so far as to invest in the space through its corporate venture fund, as a backer of Joby Aviation. "We believe the regional transportation ecosystem is ripe for disruption and startups like Joby Aviation will revolutionize how people move across urban areas," said Bonny Simi, President, JetBlue Technology Ventures.

Additionally, we highlight: American / Delta / United (AAL/DAL/UAL, EW/OW/EW, covered by Rajeev Lalwani): The "Legacy" US domestic carries in American, Delta, and United utilize regional feeds that are fundamental to overall network/business flow and represent 10-20% of revenues. The emergence of eVTOL could pose a risk as it targets short-haul routes and begins to penetrate traditional airline markets. That said, we see these networks as somewhat difficult to penetrate, with any impact occurring over a lengthy period of time.

In Europe we highlight Airbus (AIR, OW), Safran SA (SAF, EW), and Rolls-Royce Holdings PLC (RR, EW) all of which are increasing investment in electric propulsion technologies and UAM aircraft concepts. (All are covered by Andrew Humphrey.)

Risk and opportunity exists for aircraft manufacturers and airlines. Given the disruptive nature of eVTOL aircraft to the overall aviation and transportation complex, it is not unreasonable to suggest that legacy players in these spaces will face both risk and opportunity. Aircraft OEMs have begun to respond and therefore appear most willing to evolve as technology, policy and other aspect of the market advance. Some portion of traditional aircraft demand may very well contract, though we see potential for the resultant eVTOL demand to more than displace this. On the airlines side, short haul carriers bear the most risk with ~$25B of annual spend overlapping with eVTOL routes.

Freight Transportation

United Parcel Service (UPS, UW, covered by Ravi Shanker): UPS has experimented with drone delivery and even has a stake in WKHS, an early developer of van-based drones. However, we believe UPS's highly unionized labor force and intricate ground network could be barriers to mass VTOL adoption. Earlier this year, the Teamsters labor union sought to prohibit the use of drones and driverless vehicles in UPS's operations as part of labor deal negotiations. UPS also relies heavily on an integrated ground delivery network which may need to be re-tooled to integrate drone delivery. Further, in the event that retailers themselves vertically integrate into last-mile omnichannel delivery via drone/VTOL, we believe the legacy parcel carriers could be most exposed to disintermediation risk. We count Amazon both as a UPS customer (we estimate ~10% of revenues and ~20% of volume) and as a rapidly emerging competitor, as Amazon has been one of the most vocal proponents of drone/VTOL technology. UPS derives ~40% of revenues from the US Domestic Ground business and roughly 50% of Domestic volumes from B2C/eCommerce. However, we are encouraged by UPS's early investments in the space and do not rule out their ability to adapt to a VTOL future.

FedEx Corporation (FDX, EW, covered by Ravi Shanker): We believe FDX is exposed to many of the same secular/structural risks as UPS, but FDX's lower reliance on eCommerce, more adaptable Ground network and DSP model (no unions) makes their network more flexible. FDX also appears more receptive to new technologies like autonomous trucks and VTOLs. Fedex's non-unionized labor force makes it easier to integrate new technology and their use of third party networks makes it relatively easier to scale operations up or down to accommodate VTOLs. Also, FDX's foundation as an Express airline and their large air network could act as a complement in the initial stages of VTOL adoption. We see FDX as a potentially faster adopter of VTOL technology vs. UPS.

United States Postal Service (USPS): We believe the USPS could be the biggest winner from mass adoption of VTOLs. The USPS has by far the largest and densest delivery network in the country today, largely resulting from the Universal Service Obligation for first class mail. The USPS has also struggled with the long-term secular shift away from first class mail though its eCommerce growth has helped stem that headwind. As the USPS looks to be reformed and reinvented with sustainability a going concern (largely through acts of Congress like H.R. 756/S.2629), we believe VTOLs can present an effective mail/parcel delivery solution to maintain the Universal Service Obligation (which is in danger of being downgraded as a cost savings measure) as well as a lower-cost alternative to mail carriers driving long-distances in rural areas. If the USPS is able to make the transition and adopt VTOLs to become a more nimble and profitable entity, while still preserving its network advantage, it could become even more of a formidable competitor to UPS/FDX.

Deutsche Post AG (DPW, OW, covered by Penelope Butcher) has been an active investor and manufacturer of electric vehicles (Streetscooter) to utilize in its urban delivery network in Germany, but has recently scaled its operations to now manufacture these vehicles for third party customers. DPDHL and other players in ground parcel logistics such as LaPoste (not listed) in France have piloted successful drone deliveries (DHL's Parcelcopter) in urban, regional, and rural markets. According to McKinsey, assuming these technologies can be commercialized and regulated appropriately, the 10-15% of parcel deliveries today that go to low density rural areas in Europe could be transferred to these lower cost options resulting in margin gain for the post and parcel players.

We also highlight National Express (NEX, not covered by Morgan Stanley Research), Stagecoach Group (SGC, not covered by Morgan Stanley Research), and FirstGroup (FGP, not covered by Morgan Stanley Research) as a listed UK universe of bus & rail companies that could potentially be disrupted by commercialization of short-range urban aircraft technology.

Insurance

Progressive Corp. (PGR, OW, covered by Kai Pan): The Urban Air Mobility ecosystem will represent a brand new market for insurers, although it may cannibalize some of the demand for onground transportation. PGR is a market leader in auto insurance (both personal and commercial) and they are the most technology driven insurer with heavy usage of data analytics, telematics, predictive modelling, etc.

Clean Tech

TPI Composites Inc. (TPI, OW, covered by Ethan Ellison): TPI Composites currently makes composite wind turbine blades and has started making composite bus bodies in partnership with Proterra, It now has five development programs in this strategic space (its clean transportation initiative), including EVs in the automotive area, trucks with Navistar, and other products along these lines - a couple have been mentioned by name, including General Motors and Navistar, and there are a few others that remain confidential at this point. On its recent 3Q call, it announced that it is investing ~$12m in '19 to develop an automated pilot manufacturing line for the EV market, which it will use to establish processing IP and showcase manufacturing capabilities at automotive volume rates. It has said it is targeting $500m revenue contribution in 2023 from its clean transportation initiatives (EVs/buses), which would represent ~20% of topline. If it is able to establish a presence in the broad EV space now, it might have an early mover advantage with next generation flying cars.

Internet

Amazon (AMZN, OW, covered by Brian Nowak): Amazon Prime Air (not to be confused with their planes) is developing autonomous drone prototypes. Shipping is Amazon's second largest cost ($28bn in '18e and $38bn in '19e), and UAM aircrafts could cut delivery expense in rural and congested urban areas. Google is also developing autonomous drone prototypes and architecture in its Project Wing.

Alphabet Inc. (GOOGL, OW, covered by Brian Nowak): UAM represents a TAM expansion opportunity as an evolution of Google's self-driving car initiative, Waymo. A push into flying cars would partly mirror Uber's Elevate, which hopes to fly people in urban environments to avoid lengthy commutes.

Software

Microsoft (MSFT, OW, covered by Keith Weiss): We believe that Microsoft will be a likely platform for building applications in the space given its Cloud to Edge capabilities.

Dassault Systemes SA (DSY, OW, covered by Adam Wood): UAM represents a large opportunity for advanced design and material systems, utilizing 3D printing. Dassault is a market leader in 3D design and digital mock-up software.

Semiconductors

NVIDIA (NVDA, OW, covered by Joseph Moore): NVIDIA's Graphics chips are better for video data streams given the higher degree of parallelism they offer vs. traditional microprocessors. And NVIDIA has the advantage that most neural networks are trained on its devices, where it has nearly 100% share outside Google's TPU use cases. Compared to custom chips, graphics chips are also more programmable and NVIDIA has advanced the state of the art software substantially with its investments in Tensor RT, making GPUs more friending towards Inference applications. Having said that power consumption is an area where graphics chips still lag FPGAs and dedicated silicon/ASIC solutions.

Intel Corp. (INTC, EW, covered by Joseph Moore): Intel's exposure to this theme is through several of its product families – 1) Movidius in drones/surveillance (current leader), 2) Mobileye in Autonomous vision; 3) Nervana's ASIC solutions for enabling machine learning training, and 4) Xeon CPUs for driving Machine learning inference applications.

Ambarella Inc. (AMBA, OW, covered by Joseph Moore): Ambarella's computer vision chips, launched late last year, are likely to be used to delivering "perception offload" for some of the cameras, while the NVDA solution addresses the heavier computational lifting.

Xilinx (XLNX, OW, covered by Joseph Moore): Xilinx has significant opportunities to benefit from machine learning inference. Xilinx's key products – customizable logic blocks called field programmable gate arrays, or FPGAs, and 7nm ACAP SoCs are uniquely well suited to machine vision tasks, given their high degree of inherent parallelism, lower latency, and better power consumption compared to graphics. Ease of use has been a challenge in cloud traditionally, which is improving over time as Xilinx and ecosystem partners invest in platforms/compiler software, but closer to the edge we see Xilinx's FPGA solutions having a strong role.

NXP Semiconductor (NXPI, EW, covered by Craig Hettenbach) / Analog Devices (ADI, OW, covered by Craig Hettenbach): Sensor providers (Radar/Lidar/Vision) are the key beneficiaries of increasing penetration of flying Cars. In the near term, DJI's, who is pursuing ASIC designs for their devices, dominance in the consumer drone space can limit the opportunities for US semiconductor companies. We see benefits for increased adoption of NXP and ADI's radar solutions.

Telecom Services

American Tower/Crown Castle/SBA Communications (AMT/CCI/SBAC, all OW, covered by Simon Flannery): We expect connected UAM aircraft to layer additional capacity needs onto wireless networks and view Towers as the best way to play this theme from a telecom perspective as providers of passive network infrastructure. The three public US Tower companies are leading owners of macro tower cell sites with assets leased to various telecom network operators and connectivity providers. They own a combined ~86k domestic towers (~65% of the market). Both AMT and SBAC also have significant international portfolios (largest markets are India and Brazil), while CCI also owns a significant amount of dense metro fiber and small cell assets in the US. As passive asset owners, the companies should benefit from any network deployments to serve this nascent industry whether operated by traditional wireless carriers or emerging companies.

Gaming & Lodging

Caesar's Entertainment (CZR, OW, covered by Thomas Allen) / MGM Resorts Intl. (MGM, OW, covered by Thomas Allen): Flying cars should be a positive for Vegas casinos. , they would improve gaming and nightlife customers' ability to visit Las Vegas, which currently suffers from infrastructure headwinds, like no direct train service and hours of traffic from LA during busy weekends. Vegas does not have a large population base outside of the immediate locals market, so the ability to cut a 4+ hour drive down to minutes would be a game changer.

On the other hand, we note: , greater ability to travel long distances would likely hurt hotels across the country. "Road warriors" and other corporate travelers, who make up 70% of US hotel room nights, would likely choose to stay in their own homes (or their companies would choose this for them) when practical rather than spending the money to stay elsewhere. This would hurt the more corporate focused hotel stocks, such as**, Hyatt (H, EW, covered by Thomas Allen)**

Telecom & Networking Equipment

Qualcomm (QCOM, UW, covered by James Faucette) / Cisco Systems (CSCO, OW, covered by James Faucette) / Blackberry (BB, ++, covered by James Faucette): These are the Comms names with the largest auto / networking exposure, which would help give them a first mover advantage for UAM aircraft connectivity. Cisco's recent acquisition of Jasper allows Ford, GM, and others to connect to a wireless network. Qualcomm makes modem chips for cars as well as networking technology. Blackberry provides a more secure "kernel" for many auto operating systems, which becomes even more imperative if the OS is for a smaller car-like connected aircraft. (Note: Re Blackbeerry, the data for this company have been removed from consideration because under Morgan Stanley policy and/or applicable regulations, Morgan Stanley may be precluded from issuing such information with respect to this company at this time.)

Lumentum (LITE, EW, covered by Meta Marshall) / II-VI Incorporated (IIVI, EW, covered by Meta Marshall): We highlight these companies as important developers of LiDAR technology - responsible for light generation and filtering technology for 3D sensing.

IT Hardware

Seagate Technology (STX, OW, covered by Katy Huberty) / Hewlett Packard Enterprise (HPE, OW, covered by Katy Huberty) / NetApp Inc. (NTAP, EW, covered by Katy Huberty) / Nutanix (NTNX, EW, covered by Katy Huberty): We highlight these names as potential beneficiaries of increased TAM in light increased edge compute and storage in order to operate flying vehicles. This group would generally benefit as part of the broader "data era" thesis. We also highlight **Apple Inc. (APPL, OW, covered by Katy Huberty)** as beneficiaries of automated maintenance of technology. Imagine your iPhone screen breaks but you're busy and you don't have two hours to get to an Apple store and wait for someone to fix your device. Instead, it can be picked up and dropped off at your home or office in the same amount of time and without taking time away from other commitments. The same can be applied to other computers and machinery whereby sensors and remote diagnostics communicate that a part needs to be replaced and it's delivered immediately with no human intervention. APPL is likely the largest beneficiary from customer support business model disruption.

Garmin Ltd. (GRMN, EW, covered by Yuuji Anderson): Garmin recently partnered with Bell/Textron to develop Air Taxis (first to be tested in Dallas). Garmin would provide the avionics and vehicle management. They already have strong share in the US for very light general aircraft (light business jets and smaller), and they recently finished building this a large manufacturing facility in Kansas City. Air taxis are likely part of their 10 year plan.

Urban Air Mobility Potential Disruptors – the Future of Transportation

While public investors may find it difficult to invest in or play the urban air mobility theme in public market, we have identified what we believe to be some of the public/private companies and organizations on the forefront of potential disruption in the Urban Air Mobility space. This list is not exhaustive and we do not have access to all information on these companies, due to their secretive, long-term business plans and highly sensitive IP; however, we do feel this list provides a solid foundation to begin looking at and identifying important themes urban air mobility investment evolves and crystalizes.

We have broken out our private Urban Air Mobility Disruptors into three subsections that we believe have increased relevance with what we discuss in this report.

1. **Passenger**
2. **Freight Transportation**
3. **Technology/Infrastructure**

Afterwards, we have included *all* the companies NASA has identified as playing a pivotal roll in moving forward the urban Air Mobility ecosystem.

Exhibit 73:

Passenger Companies

Passenger					
Company	**Location**	**Value of last funding round**	**Investors/Parent Organization**	**Description**	**Current Model**
Joby Aviation	**Santa Cruz, CA**	**$100mm (Feb 1, 2018)**	AME Cloud Ventures, EDBI, Intel Captial, JetBlue Technology Ventures	Intends to build a four passenger aircraft that can travel ~150-200 miles on a single change, nearly silent. Plans to operate in a ride hailing model, utilizing autonomous technology.	Joby Aviation S4
Karem Aircraft	**Lake Forest, CA**		Developed Company - has completed multiple debt financings	Historically has developed fixed wing an rotary aircraft, but has partnered with Uber to use aerospace experience to construct a cheap and silent eVTOL aircraft	Karem Butterfly
Aurora Flight Sciences	**Manassas, VA**		Acquired by Boeing on October 5th, 2017	Working closely with Uber for Urban On-Demand Mobility, not only with flight design, but also infrastructure buildout	AFS Lightning Strike (defunct)
Bell	**Fort Worth, TX**		Sub-Organization of Textron	One of the largest manufacturer of commercial military vertical takeoff vehicles in the US. Working closely with Uber to help deisgn a vehicle for their On-Demand Air Mobility plans.	Bell X280 Valor (Bell Air Taxi)
Embraer	**Sao Paulo, Brazil**			Working closely with Uber for Urban On-Demand Mobility - likely to launch around 2024 according to Embraer's CEO	Embraer DreamMaker
Kitty Hawk/Cora (part of Zee Aero)	**San Francisco, CA**	**$3mm (Corporate Round)**	Travellers Insurance, Bonfire Ventures ($5mm), The Flying Object, Boeing HorizonX Ventures, **Larry Page**	Designing the KittyHawk Flyer that is meant for everyday purchase and commercial use and not part of a taxi service; Cora arm is meant to build an everday air taxi	KittyHawk Flyer, Cora/Zee Aero Z-P2
Volocopter (by e-volo)	**Germany**	**€30mm**	Intel, btov Partners	Building manned, fully elctric VTOL - uses a rotor design, instead of fixed-wing	Volocopter VC200
Zunum Aero	**Kirkland, Washington**		HorizonX Ventures, JetBlue Technology Ventures	Working on an electric airliner and general improvement of electric propulsion technology	Zunum ZA10
VerdeGo Aero	**Daytona Beach, FL**		Undisclosed	Designing "flying car" for short-range travel	PAT 2000
Lilium Aviation	**Germany**	**$90mm**	Tencent Holdings, Atomico	Building an all electric VTOL; 300 km/hour; noise level is "less than a motorbike"; Payload: up to 5 people	Lilium Jet
AeroMobil	**Slovakia**	**€3mm**	InfraPartners Management, Patrick Hessel	Truly building a "Flying Car" - looks like a combination of a car and an airplane	AeroMobil 5.0
Cartivator Project	**Japan**	**$370k (2017)**	Toyota, Japanese government	VTOL project backed by Japanese government that is being led by Masafumi Miwa, a drone expert and founder of a Japanese online video game developer	
Airbus - A3	**France**			Developing an electric, self-piloted electric vehicle	Vahana
Airis Aerospace	**Bermuda**		*Founded May 1st, 2018*	Design and manufacturing of electric VTOL aircraft for air taxi service providers	AirisOne
AirSpaceX	**Detroit, MI**			Looking to begin production of electric, fully autonomous VTOL by 2020 with full capabilities by 2025	MOBi
Bartini Aero	**Russia**		Blockchain.aero	Developing a "flying car" with a 2 and 4 seater version that travels approximately 300 km/h - unmanned 50% prototype expected to fly at some point in 2018	
DeLorean Aerospace				Developing 2-seater electric VTOL - with targeted range longer than projects like Airbus Vahana	DR-7
DigiRobotics	**Dubai**			Goal is to build entirely smart cities	
Dufour aEro2					aEro 2
EVA	**Singapore**			Building autonomous eVTOL with target capacity of 2 people with 70 dB of noise on the ground	X01
HopFlyt Venturi	**Lusby, MD**		TEDCO - seed round	Building an eVTOL that can hold 4 passengers with speeds of up to 200mph and distance of 200 miles	Venturi
Jetoptera	**Edmunds, WA**			Building eVTOL aircraft with various models anywhere from 1-4 seats and 5000lbs of thrust upon takeoff	Jetoptera 2000
Opener	**Palo Alto, CA**			Single seat eVTOL with less energy consumption than an electric car, with less noise	Blackfly

Source: Crunchbase, Company Websites, Morgan Stanley Research

Exhibit 74:

Freight Transportation Companies

Shipping/Freight					
Company		Location	Value of last funding round	Investors/Parent Organization	Description
3DR	3D Robotics	Berkeley, CA	$53mm ($178mm total)	Atlantic Bridge, Qualcomm Ventures, West Summit Capital, True Ventures	Makes enterprise drone software for constructuion, engineering, and mining firms, along with government agencies - building drone data platform called "Site Scan"
Aeryon Labs Inc.	Aeryon Labs	Waterloo, Canada	$60mm	MaRS Investment Accelerator Fund (Seed Round)	Builds high performance drones for military, public, safety and industrial operators
amazon Prime Air	Amazon Prime Air	Seattle, WA		Funded by Amazon	Service provided through Amazon that will deliver packages up to five pounds in 30 minutes or less using small drones
Ascending Technologies / intel	Ascending Technologies - Intel			Funded by Intel	Leading UAS drone technology developer & manufacturer of technology for professional, civil, and research UAV drones
CAPE	CAPE	San Francisco, CA	$10mm	Gradient Ventures, Telstra Ventures, Commercial Drone Fund, Madrona Venture group	Cape Aerial Telepresence provides the ability to effectively control a flying camera anywhere in the world in real-time - platform that allows drones to be remotely operated
Flirtey	Flirtey	Reno, NV	$16mm	Menlo Ventures, Qualcomm Ventures, Bessemer Venture Partners	Drone delivery company
Wing	Google X - Project Wing	Mountain View, CA		Google X is a subsidiary of Google	Building autonomous drones to rapidly deliver packages. Announced on August 28th, 2014, but was secretly in development for 2 years before that.
CyPhy	CyPhy Works	Danvers, MA	$22mm	Bessemer Venture Partners, UPS Strategic Enterprise Fund, Lux Capital	Robotics company that develops UAV/drones for commercial, civil and defense applications - has contracts with the DoD
SONY ZMP	Aerosense	Asia-Pacific		Joint venture between Sony and SMP	Uses drones to develop a range of image and data-centric services that improves business processes for enterprise customers
	Matternet	Menlo Park, CA	$16mm	Boeing HorizonX Ventures, Andreessen Horowitz	Developer of technology platform for on-demand aerial delivery in urban environments - provides platform as aservice to healthcare, e-commerce, and logistics organizations

Source: Crunchbase, Company Websites, Morgan Stanley Research

Exhibit 75:

Technology/Services Companies

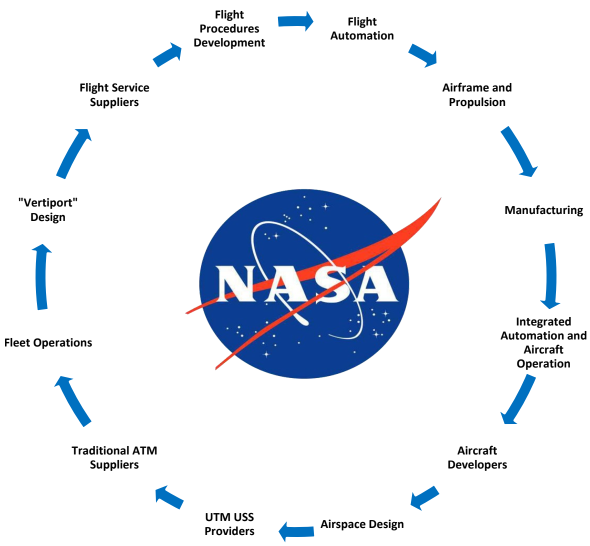
Technology/Services					
Company		Location	Value of last funding round	Investors/Parent Organization	Description
	Caspian Robotics	Berlin, Germany		Hardware.co accelerator	Develops technological platforms targeted at the Commercial & Civil UAV market
	Drone Box	Singapore	SGD50k (seed round)		Drone safety solutions provider integrating open source flight data records, online fleet management, and insurance.
Iris	Iris Automation	San Francisco, CA	$8mm	Bessemer Venture Partners, Bee Partners	Builds collision avoidance systems for industrial drones
PRECISIONHAWK	Precision Hawk	Raleigh, NC	$75mm ($104mm total)	Third Point Ventures, Verizon Ventures, Millenium Technology Value Partners	Fully autonomous UAV performing low altitude data collection management and analysis
Qelzal Be Safe. Roam Free.™	Qelzal	La Jolla, CA			Builds collision avoidance systems for industrial drones
skyfront	Skyfront	Menlo Park, CA	$270k (Venture/Seed Round)	Drone.VC	Builds hybrid electric technology for long distance drones. Technology entends flight times by as much as 10-12x
SKYSENSE	Skysense	Berlin, Germany		Qualcomm Ventures, Techstars	Building an automated charging infrastructure for drones
Skyward	Skyward	Portland, OR	$2.4mm	Verizon Venture, Voyager Capital, Draper Associates, Techstars	Operations management solutions for commercial drone businesses

Source: Crunchbase, Company Websites, Morgan Stanley Research

NASA's UAM Ecosystem Companies

Exhibit 76:

NASA Industry Day: The UAM Ecosystem



Source: NASA, Morgan Stanley Research

Exhibit 77:

Aircraft Developers

AIRCRAFT DEVELOPERS			
AeroVironment	Google X	Textron	Daprato Machine
AirspaceX/Mobi	Hap Car	The Spaceship Co	eHang
Alakia Technology	Hi-Lite Aircraft	TLG Aerospace	Embraer
Ampaire	Intel Ventures	Trimble	Leap
Apex Unmanned	Jetoptera	Trumbull Unmanned	Lilium
ASX	Joby Aviation	Valkyrie Systems Aero	Pipistrel
Bell	KarmenAero	VerdeGo Aero	Rolls-Royce
Boeing/Aurora	Kittyhawk	Volta Volare	Terafugia
Carter Aviation	Piasecki	Workhorse/Surefly	VARCO
Elroy Air	Opener	AXTI Aircraft	Varon
EsaAero	Robodub	Zipline	Vimana
FanFlyer	Sikorsky	Airbus/A3	Volocopter/Intel
General Atomics	Synergy Aircraft	Aeromobile	

Source: NASA, Morgan Stanley Research

Exhibit 78:

Flight Automation

SUBSYSTEMS: FLIGHT AUTOMATION
Aspen Avionics
Avidyne Corporation
Dynon Avionics
Echodyne
Garmin
GE Aviation Systems
Genesys Aerosystems
Honeywell/Bendix King
Iris Automation
Near Earth Autonomy
Rockwell Collins
Sandel Avionics
TruTrak Flight Systems
UTRC
BAE Systems

Source: NASA, Morgan Stanley Research

Exhibit 79:

Airframe and Propulsion

SUBSYSTEMS: Airframe & Propulsion
ES Aero
GE Aviation
LaunchPoint
MAGicALL
S-RAM Dynamics
Thin Gap
United Technologies
Emrax
Rolls Royce
Siemens
Safran

Source: NASA, Morgan Stanley Research

Exhibit 80:

Integrated Automation and Aircraft Operations

INTEGRATED AUTOMATION AND AIRCRAFT OPERATIONS	
Autonodyne	Sikorsky
Bell	Uber
Boeing/Aurora/Jeppeson	Verizon/Skyward
Cavan Solutions	Xwing
Evo-Luz	Zaphod
Garmin	Airbus/A3
Joby Aviation	Drone Employee
Kittyhawk	Skyy Network
Nodelin Robotics	Terafugia
Plank Aerosystems	Third Space Auto

Source: NASA, Morgan Stanley Research

Exhibit 81:

Airspace Design

AIRSPACE DESIGN	
A6I	Skyward
Airmap	XAirSky
ANRA	Airbus/A3
Crown	
GE/AiROXS	
Harris	
Lockheed Martin	
M2C Aerospace	
Metron	
MITRE	
Mosaic ATM	

Source: NASA, Morgan Stanley Research

Exhibit 82:

Traditional ATM Suppliers

TRADITIONAL ATM SUPPLIERS	
ATAC Corporation	Raytheon
GE AiROXS	Rockwell
General Dynamics	Thales
Harris	
Jet Blue Tech Vent	
Lockheed Martin	
M2C Aerospace	
Microsoft	
NeXt (Boeing)	
SparkCognition	
PASSUR Aerospace	

Source: NASA, Morgan Stanley Research

Exhibit 83:

UTM USS Providers

UTM USS Providers
Airmap
AGI (OneSky)
ANRA Technologies
GE/AiRXOS
Skyward/Verizon
Simulyze
Uber Elevate
UTRC
UAS Sidekick
WSI
Unifly
ATECH S/A

Source: NASA, Morgan Stanley Research

Exhibit 84:
Fleet Operations

FLEET OPERATIONS	
AGI	Exchange
Amazon Prime Air	Skyward/Verizon
Blade Helicopter	Sustain Avia Found
Boeing / Horizon X	Uber Elevate
Boeing / Jeppesen	A3
Drop Drone	EmbraerX
FedEx	Sumitomo Corp
IBM	
Kittyhawk	
Kugelair Flight Svc	
Personal Airline	

Source: NASA, Morgan Stanley Research

Exhibit 85:
Flight Procedures Development

FLIGHT PROCEDURES DEVELOPMENT
Boeing/Jeppeson
Hughes Aerospace
Leidos
Wolf UAS
Global Airspace Solutions

Source: NASA, Morgan Stanley Research

Exhibit 86:
"Vertiport" Design

"VERTIPORT" DESIGN
Burns and McDonnell
Gannette Fleming
HeliExperts
Uber Elevate
WSP

Source: NASA, Morgan Stanley Research

Exhibit 87:
Flight Service Suppliers

FLIGHT SERVICE SUPPLIERS
Climacell
Sabre
Stellar Labs
TruWeather
XM WX

Source: NASA, Morgan Stanley Research

Appendix

US Bottom-Up Total Addressable Market Model (Case Summary)

Exhibit 88:

US Base / Bull / Bear for Total Addressable Market ($bn)

Case Summary	2020	2025	2030	2035	2040
Revenue ($bn)					
Base	$2	$17	$45	$108	$284
Bull	$2	$25	$78	$211	$583
Bear	$2	$10	$26	$53	$118
Units					
Base	553	13,343	29,774	57,983	116,769
Bull	768	27,158	59,635	110,139	201,791
Bear	897	11,626	22,411	35,659	60,491
Parc					
Base	733	43,084	155,470	378,832	830,625
Bull	1,188	86,858	314,595	748,399	1,557,092
Bear	1,317	40,314	128,565	275,976	525,746

Source: Morgan Stanley Research

Base Case

Exhibit 89:

US Freight Transportation Total Addressable Market Model (Base Case)

TRANSPORT/LOGISTICS																							
PHASE I: RURAL PARCEL MARKET																							
Core Market Total (mm)	**$ 21,766.02**	**$22,370**	**$22,730**	**$23,051**	**$23,388**	**$23,751**	**$24,141**	**$24,551**	**$24,977**	**$25,417**	**$25,869**	**$26,331**	**$26,802**	**$27,282**	**$27,772**	**$28,272**	**$28,784**	**$29,309**	**$29,848**	**$30,403**	**$30,973**	**$31,559**	**$32,163**
Growth estimate (GDP)		2.8%	1.6%	1.4%	1.5%	1.6%	1.6%	1.7%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.9%	1.9%	1.9%	1.9%
Drone Share	**0%**	**0.5%**	**1%**	**5%**	**10%**	**15%**	**17%**	**20%**	**22%**	**24%**	**29%**	**34%**	**38%**	**42%**	**45%**	**47%**	**49%**	**50%**	**52%**	**54%**	**56%**	**58%**	**60%**
Drone Market Total ($bn)	**$0**	**$0**	**$0**	**$1**	**$2**	**$4**	**$4**	**$5**	**$5**	**$6**	**$8**	**$9**	**$10**	**$11**	**$12**	**$13**	**$14**	**$15**	**$16**	**$16**	**$17**	**$18**	**$19**
PHASE II: URBAN PARCEL MARKET																							
Core Market Total (mm)	**$ 68,925.73**	**$78,217**	**$87,899**	**$98,447**	**$109,277**	**$120,204**	**$129,821**	**$136,312**	**$143,127**	**$150,283**	**$157,798**	**$165,688**	**$173,972**	**$182,670**	**$191,804**	**$201,394**	**$211,464**	**$222,037**	**$233,139**	**$244,796**	**$257,036**	**$269,888**	**$283,382**
Growth estimate (e-comm)		13.5%	12.4%	12.0%	11.0%	10.0%	8.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Drone Share	**0.0%**	**0.0%**	**0.0%**	**1.0%**	**2.0%**	**3.0%**	**4.0%**	**5.0%**	**6.0%**	**7.0%**	**8.0%**	**9.0%**	**10.0%**	**11.0%**	**12.0%**	**13.0%**	**14.0%**	**15.0%**	**16.0%**	**17.0%**	**18.0%**	**19.0%**	**20.0%**
Drone Market Total ($bn)	**$0**	**$0**	**$0**	**$1**	**$2**	**$4**	**$5**	**$7**	**$9**	**$11**	**$13**	**$15**	**$17**	**$20**	**$23**	**$26**	**$30**	**$33**	**$37**	**$42**	**$46**	**$51**	**$57**
Phase III: FREIGHT MARKET																							
Core Market Total (mm)	**$ 54,000.00**	**$55,499**	**$56,392**	**$57,188**	**$58,024**	**$58,926**	**$59,892**	**$60,908**	**$61,966**	**$63,057**	**$64,178**	**$65,324**	**$66,493**	**$67,684**	**$68,899**	**$70,141**	**$71,412**	**$72,715**	**$74,052**	**$75,427**	**$76,841**	**$78,296**	**$79,793**
Growth estimate (GDP)		***2.8%***	***1.6%***	***1.4%***	***1.5%***	***1.6%***	***1.6%***	***1.7%***	***1.7%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.9%***	***1.9%***	***1.9%***	***1.9%***
Drone Share	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**4.0%**	**7.0%**	**10.0%**	**14.0%**	**18.0%**	**20.0%**
Drone Market Total ($bn)	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$3**	**$5**	**$8**	**$11**	**$14**	**$16**
TOTAL PARCEL & FREIGHT MARKET																							
Total VTOL Freight Market Revenue ($bn)	**$0**	**$0**	**$0**	**$2**	**$5**	**$7**	**$9**	**$12**	**$14**	**$17**	**$20**	**$24**	**$28**	**$32**	**$36**	**$39**	**$44**	**$51**	**$58**	**$66**	**$74**	**$84**	**$92**
Growth estimate			103.2%	840.2%	111.7%	58.5%	29.7%	26.1%	20.1%	18.0%	21.1%	18.6%	15.6%	14.4%	12.6%	11.1%	10.7%	16.4%	14.0%	13.0%	13.4%	12.5%	9.9%
Aircraft Share	0.0%	0.1%	0.1%	1.2%	2.4%	3.5%	4.3%	5.3%	6.1%	7.0%	8.1%	9.3%	10.3%	11.4%	12.3%	13.2%	14.0%	15.7%	17.2%	18.7%	20.4%	22.0%	23.3%
# of Aircraft in Logistics Operation		-	291	2,559	5,064	7,519	9,165	10,966	12,700	14,448	16,859	19,257	21,436	23,611	25,583	27,364	29,158	32,644	35,800	38,913	42,421	45,869	48,418

Source: Alphawise, Morgan Stanley Research

Exhibit 90:

US Autos & Shared Mobility Total Addressable Market Model (Base Case)

AUTOS & SHARED MOBILITY																							
US Vehicle Miles Traveled (bn)	3,363	3,406	3,450	3,535	3,591	3,650	3,711	3,852	3,988	4,119	4,242	4,318	4,382	4,469	4,560	4,642	4,724	4,876	4,994	5,103	5,311	5,491	5,656
VTOL Share (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.2%	0.3%	0.4%	0.5%	0.7%	1.0%	1.3%
VTOL Production	30	50	80	124	192	292	438	635	921	1,336	1,870	2,618	3,587	4,843	6,538	8,826	11,915	16,086	20,911	27,185	35,340	44,175	55,219
Production Growth (%)		67%	60.0%	55.0%	55.0%	52.0%	50.0%	45.0%	45.0%	45.0%	40.0%	40.0%	37.0%	35.0%	35.0%	35.0%	35.0%	35.0%	30.0%	30.0%	30.0%	25.0%	25.0%
Implied Useful Life (miles)		1,686,000	1,736,580	1,788,677	1,842,338	1,897,608	1,954,536	2,013,172	2,073,567	2,156,510	2,242,770	2,332,481	2,425,780	2,547,070	2,674,423	2,808,144	2,948,551	3,125,464	3,312,992	3,511,772	3,722,478	3,945,827	4,182,576
Scrappage Rate (%)	0.0%	2.0%	2.2%	2.6%	3.1%	3.6%	4.1%	4.7%	5.2%	5.6%	6.0%	6.5%	7.1%	7.5%	7.9%	8.3%	8.7%	9.1%	9.3%	9.5%	9.7%	9.9%	10.1%
Scrappage	0	2	4	8	14	26	46	80	128	202	312	477	718	1,045	1,507	2,139	3,023	4,223	5,718	7,680	10,258	13,489	17,549
VTOLs in Operation	**50**	**98**	**174**	**290**	**468**	**734**	**1,126**	**1,682**	**2,475**	**3,609**	**5,167**	**7,308**	**10,177**	**13,975**	**19,006**	**25,693**	**34,585**	**46,448**	**61,641**	**81,146**	**106,228**	**136,915**	**174,585**
Hours of Operation/Day	2	2	2	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7	7	8
Speed (mph)	40	42	44	49	53	59	65	71	76	81	87	93	100	106	112	118	123	130	133	137	142	146	150
Annual Miles per VTOL	29,200	33,726	38,954	47,134	57,032	67,754	80,492	95,624	107,434	120,702	135,608	152,356	171,172	190,514	212,042	233,777	257,739	284,157	307,316	332,362	359,450	388,745	420,427
VTOL Miles Traveled (bn)	0	0	0	0	0	0	0	0	0	0	1	1	2	3	4	6	9	13	19	27	38	53	73
Occupancy (people/VTOL)	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.4	2.5	2.6	2.7	2.9	3.0	3.2	3.3
Revenue per Seat Mile ($)	2.00	1.92	1.85	1.78	1.71	1.64	1.58	1.52	1.45	1.38	1.31	1.24	1.17	1.10	1.04	0.98	0.92	0.87	0.81	0.76	0.71	0.66	0.62
Vehicle Revenue per Mile ($)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.48	2.45	2.43	2.40	2.38	2.35	2.33	2.31	2.28	2.26	2.22	2.17	2.13	2.09	2.04
Total Revenue ($bn)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**3**	**4**	**6**	**9**	**14**	**20**	**30**	**42**	**59**	**81**	**111**	**150**

Source: Morgan Stanley Research

Exhibit 91:

US Airlines Total Addressable Market Model (Base Case)

AIRLINES												
US Air Seat Miles (mn)	44,201.29	45,527	46,893	48,300	49,749	51,241	52,779	54,362	55,993	57,673	59,403	61,185
Load Factor (%)	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
US Revenue Passenger Miles	37,571	38,698	39,859	41,055	42,287	43,555	44,862	46,208	47,594	49,022	50,492	52,007
Passenger Revenue per ASM	0.65	0.67	0.68	0.70	0.71	0.72	0.74	0.75	0.77	0.78	0.80	0.81
Revenue ($mn)	**24,608**	**25,853**	**27,161**	**28,535**	**29,979**	**31,496**	**33,090**	**34,764**	**36,523**	**38,371**	**40,313**	**42,353**
UAM Penetration (%)	**0%**	**0%**	**1%**	**3.00%**	**5.00%**	**7.00%**	**9.00%**	**11.00%**	**14.00%**	**17.00%**	**20.0%**	**23.00%**
UAM Revenue ($bn)	**0.0**	**0.0**	**0.3**	**0.9**	**1.5**	**2.2**	**3.0**	**3.8**	**5.1**	**6.5**	**8.1**	**9.7**
Aircraft in Operation	**12,615**	**12,993**	**13,383**	**13,784**	**14,198**	**14,624**	**15,062**	**15,514**	**15,980**	**16,459**	**16,953**	**17,461**
UAM Penetration (%)	**0%**	**0%**	**1%**	**3.00%**	**5.00%**	**7.00%**	**9.00%**	**11.00%**	**14.00%**	**17.00%**	**20.0%**	**23.00%**
UAM Aircraft in Operation	0	0	134	414	710	1,024	1,356	1,707	2,237	2,798	3,391	4,016

AIRLINES											
US Air Seat Miles (mn)	63,020	64,911	66,858	68,864	70,930	73,058	75,250	77,507	79,832	82,227	84,694
Load Factor (%)	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
US Revenue Passenger Miles	53,567	55,174	56,830	58,535	60,291	62,099	63,962	65,881	67,858	69,893	71,990
Passenger Revenue per ASM	0.83	0.85	0.86	0.88	0.90	0.92	0.94	0.95	0.97	0.99	1.01
Revenue ($mn)	**44,496**	**46,747**	**49,113**	**51,598**	**54,209**	**56,952**	**59,833**	**62,861**	**66,042**	**69,383**	**72,894**
UAM Penetration (%)	**26.00%**	**29.00%**	**33.0%**	**37.00%**	**41.00%**	**44.00%**	**46.00%**	**48.00%**	**50.00%**	**52.00%**	**54.00%**
UAM Revenue ($bn)	**11.6**	**13.6**	**16.2**	**19.1**	**22.2**	**25.1**	**27.5**	**30.2**	**33.0**	**36.1**	**39.4**
Aircraft in Operation	**17,985**	**18,525**	**19,081**	**19,653**	**20,243**	**20,850**	**21,475**	**22,120**	**22,783**	**23,467**	**24,171**
UAM Penetration (%)	**26.00%**	**29.00%**	**33.0%**	**37.00%**	**41.00%**	**44.00%**	**46.00%**	**48.00%**	**50.00%**	**52.00%**	**54.00%**
UAM Aircraft in Operation	4,676	5,372	6,297	7,272	8,299	9,174	9,879	10,617	11,392	12,203	13,052

Source: Morgan Stanley Research

Exhibit 92:

US Airlines Total Addressable Market Model Assumptions (Base Case)

Short-haul Capacity	
American	11,599,049,732
Allegiant	107,670,688
Alaska	2,356,421,351
Delta	9,732,949,825
Hawaiian	1,216,600,704
JetBlue	1,127,949,942
Southwest	10,923,454,782
Spirit	396,915,283
United	6,740,273,889
Total	**44,201,286,196**

Assumptions	
Long-term US GDP Growth	2.0%
Annual Fare Growth	2.0%
RASM	$0.65
Demand Factor (on GDP)	1.5x
Aircraft Capacity	10
Aircraft Speed (MPH)	100
Daily Permitted Flying Hours	12
Utilization	80%
Average Stage Length (Miles)	200

PRASM Analysis	
BOS-LGA	
Flight Distance	190
Ticket Price	$160
RASM	0.84
LAX-LAS	
Flight Distance	240
Ticket Price	$113
RASM	0.47
RDU-DCA	
Flight Distance	225
Ticket Price	$156
RASM	0.69
Average	
Flight Distance	655
Ticket Price	$429
RASM	0.65

Source: Morgan Stanley Research

Exhibit 93:

US Military and Defense Total Addressable Market Model (Base Case)

MILITARY AND DEFENSE																							
Fleet (BoP)	873	921	971	1,019	1,073	1,101	1,136	1,171	1,206	1,241	1,276	1,311	1,366	1,441	1,501	1,502	1,502	1,503	1,504	1,504	1,505	1,505	1,506
Retirements	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-79	-79	-79	-79	-79	-79	-79	-79	-79
Acquisitions (Blackhawk)	48	50	48	54	28	35	35	35	35	35	35	35	35	0	0	0	0	0	0	0	0	0	0
Acquisitions (Future Vertical Lift)	0	0	0	0	0	0	0	0	0	0	0	20	40	60	80	80	80	80	80	80	80	80	80
Fleet (EoP)	921	971	1,019	1,073	1,101	1,136	1,171	1,206	1,241	1,276	1,311	1,366	1,441	1,501	1,502	1,502	1,503	1,504	1,504	1,505	1,505	1,506	1,507
Net Change in Fleet	48	50	48	54	28	35	35	35	35	35	35	55	75	60	1	1	1	1	1	1	1	1	1
Growth Rates		5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	4%	5%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Unit Price ($M)	$ 22.0	$ 22.4	$ 22.9	$ 23.3	$ 23.8	$ 24.3	$ 24.8	$ 25.3	$ 25.8	$ 26.3	$ 26.8	$ 27.4	$ 27.9	$ 28.5	$ 29.0	$ 29.6	$ 30.2	$ 30.8	$ 31.4	$ 32.0	$ 32.7	$ 33.3	$ 34.0
Blackhawk Procurement ($M)	$1,056.00	$1,122.00	$1,098.66	$1,260.72	$666.78	$850.14	$867.15	$884.49	$902.18	$920.22	$938.63	$957.40	$976.55	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Future Vertical Lift Procurement ($M)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$547.08	$1,116.05	$1,707.56	$2,322.28	$2,368.73	$2,416.10	$2,464.42	$2,513.71	$2,563.99	$2,615.27	$2,667.57	$2,720.92
Total VTOL Troop Transport ($bn)	**1.06**	**1.12**	**1.10**	**1.26**	**0.67**	**0.85**	**0.87**	**0.88**	**0.90**	**0.92**	**0.94**	**1.50**	**2.09**	**1.71**	**2.32**	**2.37**	**2.42**	**2.46**	**2.51**	**2.56**	**2.62**	**2.67**	**2.72**

Assumptions	
Inventory	873
FRP Rate	79
IOC Year	2007
Service Life (Years)	25
Minimum Economic Order	10
Base Year Price ($M)	$22
Inflation	2%

Prior	2017	2018	2019	2020	2021	2022	2023	Total
873	61	48	50	48	54	28	35	1,375

FY19 FYDP Presidents Request

Source: Morgan Stanley Research

Exhibit 94:

US Hardware Total Addressable Market Model (Base Case)

HARDWARE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
CORE MARKETS (unit Sales)																							
Transport/Logistics	2	-	291	2,559	5,064	7,519	9,165	10,966	12,700	14,448	16,859	19,257	21,436	23,611	25,583	27,364	29,158	32,644	35,800	38,913	42,421	45,869	48,418
Auto/Shared Mobility	30	50	80	124	192	292	438	635	921	1,336	1,870	2,618	3,587	4,843	6,538	8,826	11,915	16,086	20,911	27,185	35,340	44,175	55,219
Military/Government	48	50	48	54	28	35	35	35	35	35	35	55	75	60	80	80	80	80	80	80	80	80	80
Airlines	0	0	134	414	710	1,024	1,356	1,707	2,237	2,798	3,391	4,016	4,676	5,372	6,297	7,272	8,299	9,174	9,879	10,617	11,392	12,203	13,052
Core Market Total	**80**	**100**	**553**	**3,151**	**5,994**	**8,870**	**10,994**	**13,343**	**15,894**	**18,617**	**22,155**	**25,947**	**29,774**	**33,886**	**38,497**	**43,542**	**49,453**	**57,983**	**66,670**	**76,795**	**89,232**	**102,327**	**116,769**
Cost per Sensor ($)																							
Camera	$125	$125	$106	$91	$79	$70	$62	$56	$51	$47	$44	$41	$39	$37	$36	$36	$35	$35	$34	$34	$34	$33	$33
Radar	$100	$100	$85	$73	$64	$56	$50	$45	$41	$38	$35	$33	$31	$30	$29	$28	$28	$28	$28	$27	$27	$27	$27
Ultrasonic	$15	$15	$15	$15	$15	$14	$14	$14	$14	$14	$14	$14	$13	$13	$13	$13	$13	$13	$13	$13	$12	$12	$12
LiDAR	$20,000	$20,000	$12,542	$7,865	$4,932	$3,093	$1,940	$1,216	$763	$478	$300	$297	$294	$291	$288	$285	$282	$280	$277	$274	$271	$269	$266
Note: Content Level ($) Highest to Lowest																							
Human/Long Distance (Airlines)																							
Camera	$750	$250	$213	$183	$159	$140	$125	$112	$102	$94	$87	$82	$78	$75	$73	$71	$70	$70	$69	$68	$68	$67	$66
# per vehicle	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Radar	$500	$100	$170	$146	$127	$112	$100	$90	$82	$75	$70	$66	$62	$60	$58	$57	$56	$56	$55	$55	$54	$54	$53
# per vehicle	5	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ultrasonic	$120	$30	$30	$29	$29	$29	$29	$28	$28	$28	$27	$27	$27	$27	$26	$26	$26	$26	$25	$25	$25	$25	$24
# per vehicle	8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
LiDAR	$60,000	$60,000	$37,627	$23,596	$14,797	$9,280	$5,819	$3,649	$2,289	$1,435	$900	$1,188	$1,176	$1,164	$1,153	$1,141	$1,130	$1,398	$1,384	$1,370	$1,357	$1,343	$1,330
# per vehicle	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5
Central Computer/Avionics System	$70,000	$70,000	$68,600	$67,228	$65,883	$64,566	$63,274	$62,009	$60,769	$59,553	$58,362	$57,195	$56,051	$54,930	$53,832	$52,755	$51,700	$50,666	$49,653	$48,659	$47,686	$46,733	$45,798
Total Content per Vehicle	$131,370	$130,380	$106,639	$91,182	$80,996	$74,126	$69,346	$65,888	$63,269	$61,185	$59,447	$58,558	$57,394	$56,256	$55,141	$54,050	$52,982	$52,215	$51,186	$50,178	$49,189	$48,221	$47,271
Revenue $mn	**$0.00**	**$0.00**	**$14.27**	**$37.71**	**$57.50**	**$75.88**	**$94.01**	**$112.44**	**$141.54**	**$171.20**	**$201.56**	**$235.18**	**$268.39**	**$302.22**	**$347.20**	**$393.03**	**$439.72**	**$479.02**	**$505.65**	**$532.76**	**$560.35**	**$588.42**	**$616.99**
Human/Short Distance (Autos/SM)																							
Camera	$750	$250	$213	$183	$159	$140	$125	$112	$102	$94	$87	$82	$78	$75	$73	$71	$70	$70	$69	$68	$68	$67	$66
# per vehicle	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Radar	$500	$100	$170	$146	$127	$112	$100	$90	$82	$75	$70	$66	$62	$60	$58	$57	$56	$56	$55	$55	$54	$54	$53
# per vehicle	5	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ultrasonic	$120	$120	$119	$118	$116	$115	$114	$113	$112	$111	$110	$109	$107	$106	$105	$104	$103	$102	$101	$100	$99	$98	$97
# per vehicle	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$60,000	$60,000	$37,627	$23,596	$14,797	$9,280	$5,819	$3,649	$2,289	$1,435	$900	$891	$882	$873	$865	$856	$847	$839	$830	$822	$814	$806	$798
# per vehicle	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Central Computer/Avionics System	$50,000	$49,000	$48,020	$47,060	$46,118	$45,196	$44,292	$43,406	$42,538	$41,687	$40,854	$40,037	$39,236	$38,451	$37,682	$36,928	$36,190	$35,466	$34,757	$34,062	$33,380	$32,713	$32,059
Total Content per Vehicle	$111,370	$109,470	$86,148	$71,102	$61,318	$54,843	$50,450	$47,370	$45,122	$43,402	$42,020	$41,184	$40,366	$39,565	$38,783	$38,017	$37,267	$36,533	$35,813	$35,107	$34,415	$33,737	$33,073
Revenue $mn	**$3**	**$5**	**$7**	**$9**	**$12**	**$16**	**$22**	**$30**	**$42**	**$58**	**$79**	**$108**	**$145**	**$192**	**$254**	**$336**	**$444**	**$588**	**$749**	**$954**	**$1,216**	**$1,490**	**$1,826**
Goods/Long Distance (Military + Transpo/Logistics)																							
Camera	$500	$500	$425	$366	$318	$280	$249	$224	$204	$188	$175	$164	$156	$150	$145	$142	$141	$139	$138	$137	$135	$134	$133
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Radar	$400	$400	$340	$292	$254	$224	$199	$179	$163	$150	$140	$131	$125	$120	$116	$114	$113	$112	$110	$109	$108	$107	$106
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Ultrasonic	$120	$120	$119	$118	$116	$115	$114	$113	$112	$111	$110	$109	$107	$106	$105	$104	$103	$102	$101	$100	$99	$98	$97
# per vehicle	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$40,000	$40,000	$25,084	$15,731	$9,865	$6,186	$3,880	$2,433	$1,526	$957	$600	$594	$588	$582	$576	$571	$565	$559	$554	$548	$543	$537	$532
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Central Computer/Avionics System	$40,000	$39,200	$38,416	$37,648	$36,895	$36,157	$35,434	$34,725	$34,031	$33,350	$32,683	$32,029	$31,389	$30,761	$30,146	$29,543	$28,952	$28,373	$27,805	$27,249	$26,704	$26,170	$25,647
Total Content per Vehicle	$81,020	$80,220	$64,384	$54,154	$47,448	$42,962	$39,876	$37,674	$36,035	$34,755	$33,707	$33,027	$32,365	$31,719	$31,089	$30,474	$29,873	$29,285	$28,709	$28,143	$27,590	$27,047	$26,514
Revenue $mn	**$0.1**	**$0.0**	**$9.4**	**$69.3**	**$120.1**	**$161.5**	**$182.7**	**$206.6**	**$228.8**	**$251.1**	**$284.1**	**$318.0**	**$346.9**	**$374.5**	**$397.7**	**$416.9**	**$435.5**	**$478.0**	**$513.9**	**$547.6**	**$585.2**	**$620.3**	**$641.9**
Goods/Short Distance (Transportation/Logistics)																							
Camera	$500	$500	$425	$366	$318	$280	$249	$224	$204	$188	$175	$164	$156	$150	$145	$142	$141	$139	$138	$137	$135	$134	$133
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Radar	$400	$400	$340	$292	$254	$224	$199	$179	$163	$150	$140	$131	$125	$120	$116	$114	$113	$112	$110	$109	$108	$107	$106
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Ultrasonic	$120	$120	$119	$118	$116	$115	$114	$113	$112	$111	$110	$109	$107	$106	$105	$104	$103	$102	$101	$100	$99	$98	$97
# per vehicle	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$40,000	$40,000	$25,084	$15,731	$9,865	$6,186	$3,880	$2,433	$1,526	$957	$600	$594	$588	$582	$576	$571	$565	$559	$554	$548	$543	$537	$532
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Central Computer/Avionics System	$40,000	$39,200	$38,416	$37,648	$36,895	$36,157	$35,434	$34,725	$34,031	$33,350	$32,683	$32,029	$31,389	$30,761	$30,146	$29,543	$28,952	$28,373	$27,805	$27,249	$26,704	$26,170	$25,647
Total Content per Vehicle	$81,020	$80,220	$64,384	$54,154	$47,448	$42,962	$39,876	$37,674	$36,035	$34,755	$33,707	$33,027	$32,365	$31,719	$31,089	$30,474	$29,873	$29,285	$28,709	$28,143	$27,590	$27,047	$26,514
Revenue $mn	**$0.1**	**$0.0**	**$9.4**	**$69.3**	**$120.1**	**$161.5**	**$182.7**	**$206.6**	**$228.8**	**$251.1**	**$284.1**	**$318.0**	**$346.9**	**$374.5**	**$397.7**	**$416.9**	**$435.5**	**$478.0**	**$513.9**	**$547.6**	**$585.2**	**$620.3**	**$641.9**
Revenue ($mn) by Category																							
Human/Long Distance (Airlines)	$0	$0	$14	$38	$57	$76	$94	$112	$142	$171	$202	$235	$268	$302	$347	$393	$440	$479	$506	$533	$560	$588	$617
Human/Short Distance (Autos/SM)	$3	$5	$7	$9	$12	$16	$22	$30	$42	$58	$79	$108	$145	$192	$254	$336	$444	$588	$749	$954	$1,216	$1,490	$1,826
Goods/Long Distance (Military + Transpo/Logistics)	$0	$0	$9	$69	$120	$162	$183	$207	$229	$251	$284	$318	$347	$374	$398	$417	$436	$478	$514	$548	$585	$620	$642
Goods/Short Distance (Transportation/Logistics)	$0	$0	$9	$69	$120	$162	$183	$207	$229	$251	$284	$318	$347	$374	$398	$417	$436	$478	$514	$548	$585	$620	$642
Revenue $mn	**$4**	**$5**	**$40**	**$185**	**$310**	**$415**	**$482**	**$556**	**$641**	**$731**	**$848**	**$979**	**$1,107**	**$1,243**	**$1,396**	**$1,562**	**$1,755**	**$2,023**	**$2,282**	**$2,582**	**$2,947**	**$3,319**	**$3,727**
% Y / Y		56%	629%	364%	67%	34%	16%	15%	15%	14%	16%	15%	13%	12%	12%	12%	12%	15%	13%	13%	14%	13%	12%
% CAGR																							
Revenue ($mn) by Category																							
Camera	0.0	0.0	0.2	1.1	1.8	2.3	2.5	2.7	2.9	3.1	3.4	3.7	4.0	4.3	4.7	5.0	5.5	6.3	7.1	7.9	8.9	9.9	11.0
Radar	0.0	0.0	0.2	0.8	1.4	1.8	2.0	2.2	2.3	2.5	2.7	3.0	3.2	3.4	3.7	4.0	4.4	5.1	5.7	6.3	7.1	7.9	8.8
Ultrasonic	0.0	0.0	0.1	0.3	0.6	0.9	1.1	1.4	1.6	1.8	2.1	2.5	2.8	3.2	3.6	4.0	4.5	5.2	6.0	6.9	8.0	9.1	10.4
LiDAR	3.8	5.0	16.6	53.8	63.6	58.9	46.1	35.3	26.7	19.8	14.9	18.6	21.3	24.3	27.7	31.5	36.0	44.6	50.9	58.3	67.3	76.7	87.2
Central Computer/Avionics System	3.5	4.4	26.1	132.0	243.5	352.4	431.2	515.4	608.5	705.3	826.4	953.1	1,078.1	1,209.4	1,358.9	1,520.3	1,706.8	1,963.8	2,215.0	2,505.1	2,857.8	3,217.8	3,611.8
Revenue	**$7**	**$9**	**$43**	**$188**	**$311**	**$416**	**$483**	**$557**	**$642**	**$733**	**$850**	**$981**	**$1,109**	**$1,245**	**$1,399**	**$1,565**	**$1,757**	**$2,025**	**$2,285**	**$2,585**	**$2,949**	**$3,322**	**$3,729**
% Y / Y		28.3%	353.4%	337.2%	65.3%	33.9%	16.0%	15.3%	15.3%	14.1%	16.0%	15.5%	13.1%	12.2%	12.4%	11.9%	12.3%	15.2%	12.8%	13.1%	14.1%	12.6%	12.3%
% CAGR																							
Semiconductor Revenue ($mn)																							
Semiconductor	$0.6	$1	$6	$30	$50	$67	$78	$89	$103	$118	$137	$158	$178	$200	$225	$252	$283	$326	$367	$416	$474	$534	$600
Total Hardware Revenue (+ Semis)	**$4**	**$6**	**$46**	**$215**	**$359**	**$482**	**$559**	**$645**	**$744**	**$849**	**$985**	**$1,137**	**$1,285**	**$1,443**	**$1,621**	**$1,814**	**$2,037**	**$2,348**	**$2,650**	**$2,998**	**$3,421**	**$3,854**	**$4,327**
% Y / Y		56%	629%	364%	67%	34%	16%	15%	15%	14%	16%	15%	13%	12%	12%	12%	12%	15%	13%	13%	14%	13%	12%

Source: Morgan Stanley Research

Exhibit 95:

US Software Total Addressable Market Model (Base Case)

SOFTWARE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Unit Sales by Category																							
Transportation/Logistics	2	0	291	2,559	5,064	7,519	9,165	10,966	12,700	14,448	16,859	19,257	21,436	23,611	25,583	27,364	29,158	32,644	35,800	38,913	42,421	45,869	48,418
Autos and Shared Mobility	30	50	80	124	192	292	438	635	921	1,336	1,870	2,618	3,587	4,843	6,538	8,826	11,915	16,086	20,911	27,185	35,340	44,175	55,219
Military and Government	48	50	48	54	28	35	35	35	35	35	35	55	75	60	80	80	80	80	80	80	80	80	80
Airlines	0	0	134	414	710	1,024	1,356	1,707	2,237	2,798	3,391	4,016	4,676	5,372	6,297	7,272	8,299	9,174	9,879	10,617	11,392	12,203	13,052
Total Unit Sales	**80**	**100**	**553**	**3,151**	**5,994**	**8,870**	**10,994**	**13,343**	**15,894**	**18,617**	**22,155**	**25,947**	**29,774**	**33,886**	**38,497**	**43,542**	**49,453**	**57,983**	**66,670**	**76,795**	**89,232**	**102,327**	**116,769**
$ Content Per Vehicle																							
Human/Long Distance (Airlines)	$1,629	$1,547	$1,470	$1,397	$1,327	$1,260	$1,197	$1,137	$1,081	$1,027	$975	$926	$880	$836	$794	$755	$717	$681	$647	$615	$584	$555	$527
Human/Short Distance (Autos/SM)	$814	$774	$735	$698	$663	$630	$599	$569	$540	$513	$488	$463	$440	$418	$397	$377	$358	$341	$324	$307	$292	$277	$263
Goods/Long Distance (Military + Transpo/Logistics)	$407	$387	$368	$349	$332	$315	$299	$284	$270	$257	$244	$232	$220	$209	$199	$189	$179	$170	$162	$154	$146	$139	$132
Goods/Short Distance (Transportation/Logistics)	$204	$193	$184	$175	$166	$158	$150	$142	$135	$128	$122	$116	$110	$105	$99	$94	$90	$85	$81	$77	$73	$69	$66
$ Content Per Vehicle	**$427,572**	**$483,563**	**$566,888**	**$259,606**	**$218,450**	**$203,203**	**$208,897**	**$209,311**	**$221,750**	**$229,941**	**$227,926**	**$226,248**	**$226,090**	**$225,637**	**$230,060**	**$234,189**	**$236,902**	**$229,278**	**$221,399**	**$215,095**	**$208,875**	**$202,483**	**$198,279**
% Y / Y		13.1%	17.2%	-54.2%	-15.9%	-7.0%	2.8%	0.2%	5.9%	3.7%	-0.9%	-0.7%	-0.1%	-0.2%	2.0%	1.8%	1.2%	-3.2%	-3.4%	-2.8%	-2.9%	-3.1%	-2.1%
% CAGR																							
Revenue ($mn)																							
Human/Long Distance (Airlines)	0	0	197	578	942	1,290	1,623	1,941	2,417	2,872	3,307	3,721	4,116	4,492	5,002	5,487	5,950	6,248	6,392	6,526	6,652	6,769	6,878
Human/Short Distance (Autos/SM)	24	39	59	87	127	184	262	361	498	686	912	1,213	1,579	2,025	2,597	3,330	4,271	5,478	6,765	8,355	10,318	12,252	14,550
Goods/Long Distance (Military + Transpo/Logistics)	0	0	25	72	118	161	203	243	302	359	413	465	514	561	625	686	744	781	799	816	831	846	860
Goods/Short Distance (Transportation/Logistics)	10	10	33	82	122	167	208	248	307	364	418	471	523	568	633	693	751	788	805	822	837	852	865
Revenue ($mn)	**34**	**48**	**314**	**818**	**1,309**	**1,802**	**2,297**	**2,793**	**3,524**	**4,281**	**5,050**	**5,870**	**6,732**	**7,646**	**8,857**	**10,197**	**11,716**	**13,294**	**14,761**	**16,518**	**18,638**	**20,719**	**23,153**
% Y / Y		41.4%	548.4%	160.9%	60.1%	37.6%	27.4%	21.6%	26.2%	21.5%	18.0%	16.3%	14.7%	13.6%	15.8%	15.1%	14.9%	13.5%	11.0%	11.9%	12.8%	11.2%	11.7%

Source: Morgan Stanley Research

Exhibit 96:

US Telecom Total Addressable Market Model (Base Case)

TELECOM SERVICES	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
UAM Aircraft Parc				80	180	733	3,884	9,878	18,747	29,741	43,084	58,978	77,594	99,749	125,696	155,470	189,356	227,854	271,395	320,848	378,832	445,502	522,297	611,529	713,856	830,625
x $ ARPA			$1,401	$1,408	$1,415	$1,423	$1,430	$1,437	$1,444	$1,451	$1,458	$1,466	$1,473	$1,480	$1,488	$1,495	$1,503	$1,510	$1,518	$1,525	$1,533	$1,541	$1,548	$1,556	$1,564	$1,572
Revenue ($mn)		**0**	**0**	**1**	**3**	**13**	**67**	**170**	**325**	**518**	**754**	**1,037**	**1,372**	**1,772**	**2,244**	**2,790**	**3,415**	**4,129**	**4,943**	**5,873**	**6,969**	**8,237**	**9,705**	**11,420**	**13,397**	**15,666**
% Y / Y					126.1%	309.3%	432.4%	155.6%	90.7%	59.4%	45.6%	37.6%	32.2%	29.2%	26.6%	24.3%	22.4%	20.9%	19.7%	18.8%	18.7%	18.2%	17.8%	17.7%	17.3%	16.9%
AIRCRAFT vs. CAR ARPA COMPARISONS																										
Car ARPU		$25	$26	$26	$27	$28	$29	$30	$30	$31	$32	$33	$34	$35	$36	$37	$39	$40	$41	$42	$43	$45	$46	$47	$49	$50
Business Aircraft ARPA	$2,302	$2,548	$2,803	$2,817	$2,831	$2,845	$2,859	$2,874	$2,888	$2,902	$2,917	$2,931	$2,946	$2,961	$2,976	$2,991	$3,006	$3,021	$3,036	$3,051	$3,066	$3,081	$3,097	$3,112	$3,128	$3,143
x Penetration (%)		35%	35%	36%	37%	39%	40%	42%	43%	45%	46%	47%	49%	50%	52%	53%	55%	56%	58%	59%	60%	62%	63%	65%	66%	68%
x % for Satellite		48%	48%	50%	51%	52%	54%	55%	56%	57%	59%	60%	61%	62%	64%	65%	66%	68%	69%	70%	71%	73%	74%	75%	76%	78%
Commercial Aircraft ARPA	$11,263	$11,519	$11,749	$11,984	$12,224	$12,469	$12,718	$12,972	$13,232	$13,496	$13,766	$14,042	$14,323	$14,609	$14,901	$15,199	$15,503	$15,813	$16,130	$16,452	$16,781	$17,117	$17,459	$17,808	$18,164	$18,528
x Penetration (%)		27%	27%	29%	31%	33%	34%	36%	38%	40%	41%	43%	45%	47%	48%	50%	52%	54%	55%	57%	59%	61%	62%	64%	66%	68%
x % for Satellite		63%	63%	64%	64%	65%	65%	66%	66%	67%	67%	68%	68%	69%	69%	70%	70%	71%	71%	72%	72%	73%	73%	74%	74%	75%
UAM Aircraft ARPA			**$1,401**	**$1,408**	**$1,415**	**$1,423**	**$1,430**	**$1,437**	**$1,444**	**$1,451**	**$1,458**	**$1,466**	**$1,473**	**$1,480**	**$1,488**	**$1,495**	**$1,503**	**$1,510**	**$1,518**	**$1,525**	**$1,533**	**$1,541**	**$1,548**	**$1,556**	**$1,564**	**$1,572**

Source: Morgan Stanley Research

Exhibit 97:

US Batteries Total Addressable Market Model (Base Case)

Batteries	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Transport/Logistics	2	-	291	2,559	5,064	7,519	9,165	10,966	12,700	14,448	16,859	19,257
Autos/Shared Mobility	30	50	80	124	192	292	438	635	921	1,336	1,870	2,618
Military/Government	48	50	48	54	28	35	35	35	35	35	35	55
Airlines	-	-	134	414	710	1,024	1,356	1,707	2,237	2,798	3,391	4,016
UAM Aircraft Sales	**80**	**100**	**553**	**3,151**	**5,994**	**8,870**	**10,994**	**13,343**	**15,894**	**18,617**	**22,155**	**25,947**
UAM Aircraft Parc	**80**	**180**	**733**	**3,884**	**9,878**	**18,747**	**29,741**	**43,084**	**58,978**	**77,594**	**99,749**	**125,696**
"Gigafactories"	1	1	1	1	1	1	2	2	2	2	2	2
x Capacity per Gigafactory (GwH)	50	50	50	50	50	50	50	50	50	50	50	50
Total Gigafactory Capacity (000s)	50	50	50	50	50	50	100	100	100	100	100	100
Battery Capacity (KwH/Car)	78	76	75	73	70	67	65	65	65	65	65	65
Total Battery Capacity (GwH)	0	0	0	0	1	1	2	3	4	5	6	8
Annual Aircraft Battery Demand (GwH)	0	0	0	0	0	1	1	1	1	1	1	2
Replacement rate (%)	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Replacement demand (GwH)	0	0	0	0	0	0	0	1	1	1	2	2
Total GwH Demanded	0	0	0	0	1	1	1	2	2	2	3	4
Factory Utilization	0%	0%	0%	1%	1%	2%	1%	2%	2%	2%	3%	4%
Aircraft plant	1	1	1	1	2	2	2	2	3	3	3	3
Capacity per plant/year	50	200	250	300	360	432	518	622	746	896	1,075	1,290
Growth (%)					20%	20%	20%	20%	20%	20%	20%	20%
Total Capacity	50.00	200.00	250.00	300.00	720.00	864.00	1,036.80	1,244.16	2,239.49	2,687.39	3,224.86	3,869.84
Unit cost ($mn)												
Aircraft plants/facilities	200	300	400	500	600	700	1,000	1,000	1,000	1,000	1,000	1,000
Aircraft plant (cost per 100k units)	2.50	3.00	0.72	0.16	0.10	0.08	0.09	0.07	0.06	0.05	0.05	0.04
Battery cost ($/kWh)	$120	$110	$100	$90	$80	$60	$60	$60	$60	$60	$60	$60
kWh per Car	78	76	75	73	70	67	65	65	65	65	65	65
kWh per Aircraft	156	152	150	146	140	134	130	130	130	130	130	130
Battery cost (absolute)	$18,720	$16,720	$15,000	$13,140	$11,200	$8,040	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800
Battery Revenue ($mm)	**1**	**2**	**8**	**41**	**67**	**71**	**86**	**104**	**124**	**145**	**173**	**202**

Batteries	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Transport/Logistics	21,436	23,611	25,583	27,364	29,158	32,644	35,800	38,913	42,421	45,869	48,418
Autos/Shared Mobility	3,587	4,843	6,538	8,826	11,915	16,086	20,911	27,185	35,340	44,175	55,219
Military/Government	75	60	80	80	80	80	80	80	80	80	80
Airlines	4,676	5,372	6,297	7,272	8,299	9,174	9,879	10,617	11,392	12,203	13,052
UAM Aircraft Sales	**29,774**	**33,886**	**38,497**	**43,542**	**49,453**	**57,983**	**66,670**	**76,795**	**89,232**	**102,327**	**116,769**
UAM Aircraft Parc	**155,470**	**189,356**	**227,854**	**271,395**	**320,848**	**378,832**	**445,502**	**522,297**	**611,529**	**713,856**	**830,625**
"Gigafactories"	3	3	3	4	4	4	4	5	5	5	6
x Capacity per Gigafactory (GwH)	50	50	50	50	50	50	50	50	50	50	50
Total Gigafactory Capacity (000s)	150	150	150	200	200	200	200	250	250	250	300
Battery Capacity (KwH/Car)	65	65	65	65	65	65	65	65	65	65	65
Total Battery Capacity (GwH)	10	12	15	18	21	25	29	34	40	46	54
Annual Aircraft Battery Demand (GwH)	2	2	3	3	3	4	4	5	6	7	8
Replacement rate (%)	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Replacement demand (GwH)	3	3	4	4	5	6	7	8	10	12	13
Total GwH Demanded	4	5	6	7	8	10	12	13	16	18	21
Factory Utilization	3%	4%	4%	4%	4%	5%	6%	5%	6%	7%	7%
Aircraft plant	3	3	4	4	4	5	5	5	6	6	6
Capacity per plant/year	1,548	1,858	2,229	2,675	3,210	3,852	4,622	5,547	6,656	7,987	9,584
Growth (%)	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Total Capacity	4,643.80	5,572.56	8,916.10	10,699.32	12,839.18	19,258.78	23,110.53	27,732.64	39,935.00	47,922.00	57,506.40
Unit cost ($mn)											
Aircraft plants/facilities	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Aircraft plant (cost per 100k units)	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Battery cost ($/kWh)	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60
kWh per Car	65	65	65	65	65	65	65	65	65	65	65
kWh per Aircraft	130	130	130	130	130	130	130	130	130	130	130
Battery cost (absolute)	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800
Battery Revenue ($mm)	**232**	**264**	**300**	**340**	**386**	**452**	**520**	**599**	**696**	**798**	**911**

Source: Morgan Stanley Research

Total Addressable Market Model (Bear Case)

Exhibit 98:

US Freight Transportation Total Addressable Market Model (Bear Case)

TRANSPORT/LOGISTICS																							
PHASE I: RURAL PARCEL MARKET																							
Core Market Total (mm)	**$ 21,766.02**	**$22,370**	**$22,730**	**$23,051**	**$23,388**	**$23,751**	**$24,141**	**$24,551**	**$24,977**	**$25,417**	**$25,869**	**$26,331**	**$26,802**	**$27,282**	**$27,772**	**$28,272**	**$28,784**	**$29,309**	**$29,848**	**$30,403**	**$30,973**	**$31,559**	**$32,163**
Growth estimate (GDP)		2.8%	1.6%	1.4%	1.5%	1.6%	1.6%	1.7%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.9%	1.9%	1.9%	1.9%
Drone Share	**0%**	**0.5%**	**1%**	**5%**	**10%**	**15%**	**17%**	**20%**	**22%**	**24%**	**29%**	**34%**	**38%**	**42%**	**45%**	**47%**	**49%**	**50%**	**52%**	**54%**	**56%**	**58%**	**60%**
Drone Market Total ($bn)	**$0**	**$0**	**$0**	**$1**	**$2**	**$4**	**$4**	**$5**	**$5**	**$6**	**$8**	**$9**	**$10**	**$11**	**$12**	**$13**	**$14**	**$15**	**$16**	**$16**	**$17**	**$18**	**$19**
PHASE II: URBAN PARCEL MARKET																							
Core Market Total (mm)	**$ 68,925.73**	**$78,217**	**$87,899**	**$98,447**	**$109,277**	**$120,204**	**$129,821**	**$136,312**	**$143,127**	**$150,283**	**$157,798**	**$165,688**	**$173,972**	**$182,670**	**$191,804**	**$201,394**	**$211,464**	**$222,037**	**$233,139**	**$244,796**	**$257,036**	**$269,888**	**$283,382**
Growth estimate (e-comm)		13.5%	12.4%	12.0%	11.0%	10.0%	8.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Drone Share	**0.0%**	**0.0%**	**0.0%**	**0.5%**	**1.0%**	**1.5%**	**2.0%**	**2.5%**	**3.0%**	**3.5%**	**4.0%**	**4.5%**	**5.0%**	**5.5%**	**6.0%**	**6.5%**	**7.0%**	**7.5%**	**8.0%**	**8.5%**	**9.0%**	**9.5%**	**10.0%**
Drone Market Total ($bn)	**$0**	**$0**	**$0**	**$0**	**$1**	**$2**	**$3**	**$3**	**$4**	**$5**	**$6**	**$7**	**$9**	**$10**	**$12**	**$13**	**$15**	**$17**	**$19**	**$21**	**$23**	**$26**	**$28**
Phase III: Freight Market																							
Core Market Total (mm)	**$ 54,000.00**	**$55,499**	**$56,392**	**$57,188**	**$58,024**	**$58,926**	**$59,892**	**$60,908**	**$61,966**	**$63,057**	**$64,178**	**$65,324**	**$66,493**	**$67,684**	**$68,899**	**$70,141**	**$71,412**	**$72,715**	**$74,052**	**$75,427**	**$76,841**	**$78,296**	**$79,793**
Growth estimate (GDP)		***2.8%***	***1.6%***	***1.4%***	***1.5%***	***1.6%***	***1.6%***	***1.7%***	***1.7%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.8%***	***1.9%***	***1.9%***	***1.9%***	***1.9%***
Drone Share	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**4.0%**	**7.0%**	**10.0%**	**14.0%**	**18.0%**	**20.0%**
Drone Market Total ($bn)	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$3**	**$5**	**$8**	**$11**	**$14**	**$16**
TOTAL PARCEL AND FREIGHT MARKET																							
Total UAM Freight Market	**$0**	**$0**	**$0**	**$2**	**$3**	**$5**	**$7**	**$8**	**$10**	**$11**	**$14**	**$16**	**$19**	**$22**	**$24**	**$26**	**$29**	**$34**	**$39**	**$45**	**$51**	**$58**	**$64**
Growth estimate			103.2%	623.6%	108.6%	56.4%	24.9%	24.1%	17.7%	16.1%	21.6%	18.8%	15.1%	13.9%	11.6%	9.9%	9.6%	18.4%	15.0%	13.8%	14.4%	13.3%	9.6%
Aircraft Share		0.1%	0.2%	1.4%	2.6%	3.7%	4.4%	5.2%	5.8%	6.5%	7.5%	8.5%	9.4%	10.2%	10.9%	11.5%	12.0%	13.6%	15.0%	16.3%	17.8%	19.3%	20.2%
# of Aircraft in Logistics Operation		240	440	2,897	5,521	7,931	9,175	10,725	12,082	13,419	15,615	17,745	19,536	21,281	22,719	23,874	25,015	28,309	31,128	33,845	37,021	40,076	41,961

Source: Alphawise, Morgan Stanley Research

Exhibit 99:

US Autos and Shared Mobility Total Addressable Market Model (Bear Case)

AUTOS & SHARED MOBILITY																							
US Vehicle Miles Traveled (bn)	3,363	3,406	3,450	3,535	3,591	3,650	3,711	3,852	3,988	4,119	4,242	4,318	4,382	4,469	4,560	4,642	4,724	4,876	4,994	5,103	5,311	5,491	5,656
VTOL Share (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.3%	0.4%
VTOL Production	30	50	75	111	160	229	320	440	594	787	1,023	1,305	1,631	2,038	2,548	3,185	3,981	4,977	6,221	7,776	9,720	12,150	15,187
Production Growth (%)		67%	50.0%	47.5%	45.0%	42.5%	40.0%	37.5%	35.0%	32.5%	30.0%	27.5%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Implied Useful Life (miles)		1,686,000	1,736,580	1,788,677	1,842,338	1,897,608	1,954,536	2,013,172	2,073,567	2,156,510	2,242,770	2,332,481	2,425,780	2,547,070	2,674,423	2,808,144	2,948,551	3,125,464	3,312,992	3,511,772	3,722,478	3,945,827	4,182,576
Scrappage Rate (%)	0.0%	2.0%	2.2%	2.6%	3.1%	3.6%	4.1%	4.7%	5.2%	5.6%	6.0%	6.5%	7.1%	7.5%	7.9%	8.3%	8.7%	9.1%	9.3%	9.5%	9.7%	9.9%	10.1%
Scrappage	0	2	4	7	13	22	37	61	93	137	197	280	390	527	704	928	1,216	1,574	1,998	2,534	3,214	4,075	5,165
VTOLs in Operation	**50**	**98**	**169**	**273**	**420**	**626**	**909**	**1,288**	**1,789**	**2,440**	**3,265**	**4,290**	**5,530**	**7,042**	**8,885**	**11,143**	**13,908**	**17,311**	**21,534**	**26,776**	**33,282**	**41,357**	**51,380**
Hours of Operation/Day	2	2	2	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7	7	8
Speed (mph)	40	42	44	49	53	59	65	71	76	81	87	93	100	106	112	118	123	130	133	137	142	146	150
Annual Miles per VTOL	29,200	33,726	38,954	47,134	57,032	67,754	80,492	95,624	107,434	120,702	135,608	152,356	171,172	190,514	212,042	233,777	257,739	284,157	307,316	332,362	359,450	388,745	420,427
VTOL Miles Traveled (bn)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	3	4	5	7	9	12	16	22
Occupancy (people/VTOL)	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.4	2.5	2.6	2.7	2.9	3.0	3.2	3.3
Revenue per Seat Mile ($)	2.00	1.92	1.85	1.78	1.71	1.64	1.58	1.52	1.45	1.38	1.31	1.24	1.17	1.10	1.04	0.98	0.92	0.87	0.81	0.76	0.71	0.66	0.62
Vehicle Revenue per Mile ($)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.48	2.45	2.43	2.40	2.38	2.35	2.33	2.31	2.28	2.26	2.22	2.17	2.13	2.09	2.04
Total Revenue ($bn)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2**	**3**	**4**	**6**	**8**	**11**	**15**	**19**	**25**	**34**	**44**

Source: Morgan Stanley Research

Exhibit 100:

US Airlines Total Addressable Market Model (Bear Case)

AIRLINES																							
US Air Seat Miles (mn)	44,201	45,527	46,893	48,300	49,749	51,241	52,779	54,362	55,993	57,673	59,403	61,185	63,020	64,911	66,858	68,864	70,930	73,058	75,250	77,507	79,832	82,227	84,694
Load Factor (%)	60%	61%	62%	62%	63%	64%	65%	65%	66%	67%	67%	68%	69%	70%	70%	71%	72%	73%	73%	74%	75%	76%	76%
US Revenue Passenger Miles	26,521	27,658	28,839	30,067	31,342	32,666	34,042	35,471	36,955	38,496	40,097	41,759	43,484	45,275	47,135	49,066	51,070	53,150	55,309	57,549	59,874	62,287	64,791
Passenger Revenue per ASM	0.65	0.65	0.64	0.64	0.63	0.62	0.62	0.61	0.60	0.60	0.59	0.59	0.58	0.57	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.53
Revenue ($mn)	**17,370**	**17,934**	**18,513**	**19,108**	**19,719**	**20,347**	**20,992**	**21,654**	**22,334**	**23,033**	**23,751**	**24,488**	**25,245**	**26,022**	**26,820**	**27,639**	**28,480**	**29,344**	**30,230**	**31,140**	**32,075**	**33,033**	**34,018**
UAM Penetration (%)	**0%**	**0%**	**0%**	**1.50%**	**2.50%**	**3.50%**	**4.50%**	**5.50%**	**7.00%**	**8.50%**	**10.0%**	**11.50%**	**13.00%**	**14.50%**	**16.5%**	**18.50%**	**20.50%**	**22.00%**	**23.00%**	**24.00%**	**25.00%**	**26.00%**	**27.00%**
UAM Revenue ($bn)	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**3**	**4**	**4**	**5**	**6**	**6**	**7**	**7**	**8**	**9**	**9**
Aircraft in Operation	**6,307**	**6,496**	**6,691**	**6,892**	**7,099**	**7,312**	**7,531**	**7,757**	**7,990**	**8,230**	**8,476**	**8,731**	**8,993**	**9,262**	**9,540**	**9,827**	**10,121**	**10,425**	**10,738**	**11,060**	**11,392**	**11,733**	**12,085**
UAM Penetration (%)	**0%**	**0%**	**5%**	**1.50%**	**2.50%**	**3.50%**	**4.50%**	**5.50%**	**7.00%**	**8.50%**	**10.0%**	**11.50%**	**13.00%**	**14.50%**	**16.5%**	**18.50%**	**20.50%**	**22.00%**	**23.00%**	**24.00%**	**25.00%**	**26.00%**	**27.00%**
UAM Aircraft in Operation	0	0	335	103	177	256	339	427	559	700	848	1,004	1,169	1,343	1,574	1,818	2,075	2,293	2,470	2,654	2,848	3,051	3,263

Source: Morgan Stanley Research

Exhibit 102:

US Military and Defense Total Addressable Market Model (Bear Case)

MILITARY AND DEFENSE												
Fleet (BoP)	873	921	971	1,019	1,073	1,101	1,136	1,171	1,206	1,241	1,276	1,311
Retirements	0	0	0	0	0	0	0	0	0	0	0	0
Acquisitions (Blackhawk)	48	50	48	54	28	35	35	35	35	35	35	35
Acquisitions (Future Vertical Lift)	0	0	0	0	0	0	0	0	0	0	0	20
Fleet (EoP)	921	971	1,019	1,073	1,101	1,136	1,171	1,206	1,241	1,276	1,311	1,366
Net Change in Fleet	48	50	48	54	28	35	35	35	35	35	35	55
Growth Rates		5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	4%
Unit Price ($M)	$ 22.0	$ 21.6	$ 21.1	$ 20.7	$ 20.3	$ 19.9	$ 19.5	$ 19.1	$ 18.7	$ 18.3	$ 18.0	$ 17.6
Blackhawk Procurement ($M)	$1,056	$1,078	$1,014	$1,118	$568	$696	$682	$668	$655	$642	$629	$617
Future Vertical Lift Procurement ($M)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$352
Total VTOL Troop Transport ($mm)	**1**	**1.1**	**1.0**	**1.1**	**0.6**	**0.7**	**0.7**	**0.7**	**0.7**	**0.6**	**0.6**	**1.0**

MILITARY AND DEFENSE (cont.)											
Fleet (BoP)	1,366	1,441	1,501	1,502	1,502	1,503	1,504	1,504	1,505	1,505	1,506
Retirements	0	0	-79	-79	-79	-79	-79	-79	-79	-79	-79
Acquisitions (Blackhawk)	35	0	0	0	0	0	0	0	0	0	0
Acquisitions (Future Vertical Lift)	40	60	80	80	80	80	80	80	80	80	80
Fleet (EoP)	1,441	1,501	1,502	1,502	1,503	1,504	1,504	1,505	1,505	1,506	1,507
Net Change in Fleet	75	60	1	1	1	1	1	1	1	1	1
Growth Rates	5%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Unit Price ($M)	$ 17.3	$ 16.9	$ 16.6	$ 16.2	$ 15.9	$ 15.6	$ 15.3	$ 15.0	$ 14.7	$ 14.4	$ 14.1
Blackhawk Procurement ($M)	$604	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Future Vertical Lift Procurement ($M)	$691	$1,015	$1,326	$1,300	$1,274	$1,248	$1,223	$1,199	$1,175	$1,151	$1,128
Total VTOL Troop Transport ($mm)	**1.3**	**1.0**	**1.3**	**1.3**	**1.3**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.1**

Assumptions	
Inventory	873
FRP Rate	79
IOC Year	2007
Service Life (Years)	25
Minimum Economic Order	10
Base Year Price ($M)	$22
Inflation	-2%

Prior	2017	2018	2019	2020	2021	2022	2023	Total
873	61	48	50	48	54	28	35	1,375

FY19 FYDP Presidents Request

Source: Morgan Stanley Research

Exhibit 103:

US Hardware Total Addressable Market Model (Bear Case)

HARDWARE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
CORE MARKETS (unit Sales)																							
Transport/Logistics	2	189	349	2,301	4,397	6,337	7,398	8,790	9,899	10,991	12,786	14,527	15,989	17,413	18,586	19,525	20,454	22,159	23,525	24,859	26,160	27,431	28,673
Auto/Shared Mobility	30	50	75	111	160	229	320	440	594	787	1,023	1,305	1,631	2,038	2,548	3,185	3,981	4,977	6,221	7,776	9,720	12,150	15,187
Military/Government	48	50	48	54	28	35	35	35	35	35	35	55	75	60	80	80	80	80	80	80	80	80	80
Airlines	0	0	335	103	177	256	339	427	559	700	848	1,004	1,169	1,343	1,574	1,818	2,075	2,293	2,470	2,654	2,848	3,051	3,263
Core Market Total	80	289	807	2,569	4,763	6,856	8,092	9,692	11,087	12,513	14,692	16,890	18,864	20,854	22,788	24,608	26,591	29,509	32,296	35,369	38,808	42,711	47,203
Cost per Sensor ($)																							
Camera	$125	$125	$106	$91	$79	$70	$62	$56	$51	$47	$44	$41	$39	$37	$36	$36	$35	$35	$34	$34	$34	$33	$33
Radar	$100	$100	$85	$73	$64	$56	$50	$45	$41	$38	$35	$33	$31	$30	$29	$28	$28	$28	$28	$27	$27	$27	$27
Ultrasonic	$15	$15	$15	$15	$15	$14	$14	$14	$14	$14	$14	$14	$13	$13	$13	$13	$13	$13	$13	$13	$12	$12	$12
LiDAR	$20,000	$20,000	$12,542	$7,865	$4,932	$3,093	$1,940	$1,216	$763	$478	$300	$297	$294	$291	$288	$285	$282	$280	$277	$274	$271	$269	$266
Note: Content Level ($) Highest to Lowest																							
Human/Long Distance (Airlines)																							
Camera	$750	$250	$213	$183	$159	$140	$125	$112	$102	$94	$87	$82	$78	$75	$73	$71	$70	$70	$69	$68	$68	$67	$66
# per vehicle	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Radar	$500	$100	$170	$146	$127	$112	$100	$90	$82	$75	$70	$66	$62	$60	$58	$57	$56	$56	$55	$55	$54	$54	$53
# per vehicle	5	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ultrasonic	$120	$30	$30	$29	$29	$29	$29	$28	$28	$28	$27	$27	$27	$27	$26	$26	$26	$26	$25	$25	$25	$25	$24
# per vehicle	8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
LiDAR	$60,000	$60,000	$37,627	$23,596	$14,797	$9,280	$5,819	$3,649	$2,289	$1,435	$900	$1,188	$1,176	$1,164	$1,153	$1,141	$1,130	$1,398	$1,384	$1,370	$1,357	$1,343	$1,330
# per vehicle	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5
Central Computer/Avionics System	$70,000	$70,000	$68,600	$67,228	$65,883	$64,566	$63,274	$62,009	$60,769	$59,553	$58,362	$57,195	$56,051	$54,930	$53,832	$52,755	$51,700	$50,666	$49,653	$48,659	$47,686	$46,733	$45,798
Total Content per Vehicle	$131,370	$130,380	$106,639	$91,182	$80,996	$74,126	$69,346	$65,888	$63,269	$61,185	$59,447	$58,558	$57,394	$56,256	$55,141	$54,050	$52,982	$52,215	$51,186	$50,178	$49,189	$48,221	$47,271
Revenue $mn	$0	$0	$36	$9	$14	$19	$24	$28	$35	$43	$50	$59	$67	$76	$87	$98	$110	$120	$126	$133	$140	$147	$154
Human/Short Distance (Autos/SM)																							
Camera	$750	$250	$213	$183	$159	$140	$125	$112	$102	$94	$87	$82	$78	$75	$73	$71	$70	$70	$69	$68	$68	$67	$66
# per vehicle	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Radar	$500	$100	$170	$146	$127	$112	$100	$90	$82	$75	$70	$66	$62	$60	$58	$57	$56	$56	$55	$55	$54	$54	$53
# per vehicle	5	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ultrasonic	$120	$120	$119	$118	$116	$115	$114	$113	$112	$111	$110	$109	$107	$106	$105	$104	$103	$102	$101	$100	$99	$98	$97
# per vehicle	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$60,000	$60,000	$37,627	$23,596	$14,797	$9,280	$5,819	$3,649	$2,289	$1,435	$900	$891	$882	$873	$865	$856	$847	$839	$830	$822	$814	$806	$798
# per vehicle	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Central Computer/Avionics System	$50,000	$49,000	$48,020	$47,060	$46,118	$45,196	$44,292	$43,406	$42,538	$41,687	$40,854	$40,037	$39,236	$38,451	$37,682	$36,928	$36,190	$35,466	$34,757	$34,062	$33,380	$32,713	$32,059
Total Content per Vehicle	$111,370	$109,470	$86,148	$71,102	$61,318	$54,843	$50,450	$47,370	$45,122	$43,402	$42,020	$41,184	$40,366	$39,565	$38,783	$38,017	$37,267	$36,533	$35,813	$35,107	$34,415	$33,737	$33,073
Revenue $mn	$3	$5	$6	$8	$10	$13	$16	$21	$27	$34	$43	$54	$66	$81	$99	$121	$148	$182	$223	$273	$335	$410	$502
Goods/Long Distance (Military + Transpo/Logistics)																							
Camera	$500	$500	$425	$366	$318	$280	$249	$224	$204	$188	$175	$164	$156	$150	$145	$142	$141	$139	$138	$137	$135	$134	$133
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Radar	$400	$400	$340	$292	$254	$224	$199	$179	$163	$150	$140	$131	$125	$120	$116	$114	$113	$112	$110	$109	$108	$107	$106
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Ultrasonic	$120	$120	$119	$118	$116	$115	$114	$113	$112	$111	$110	$109	$107	$106	$105	$104	$103	$102	$101	$100	$99	$98	$97
# per vehicle	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$40,000	$40,000	$25,084	$15,731	$9,865	$6,186	$3,880	$2,433	$1,526	$957	$600	$594	$588	$582	$576	$571	$565	$559	$554	$548	$543	$537	$532
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Central Computer/Avionics System	$40,000	$39,200	$38,416	$37,648	$36,895	$36,157	$35,434	$34,725	$34,031	$33,350	$32,683	$32,029	$31,389	$30,761	$30,146	$29,543	$28,952	$28,373	$27,805	$27,249	$26,704	$26,170	$25,647
Total Content per Vehicle	$81,020	$80,220	$64,384	$54,154	$47,448	$42,962	$39,876	$37,674	$36,035	$34,755	$33,707	$33,027	$32,365	$31,719	$31,089	$30,474	$29,873	$29,285	$28,709	$28,143	$27,590	$27,047	$26,514
Revenue $mn	$0	$8	$11	$62	$104	$136	$148	$166	$178	$191	$215	$240	$259	$276	$289	$298	$306	$324	$338	$350	$361	$371	$380
Goods/Short Distance (Transportation/Logistics)																							
Camera	$500	$500	$425	$366	$318	$280	$249	$224	$204	$188	$175	$164	$156	$150	$145	$142	$141	$139	$138	$137	$135	$134	$133
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Radar	$400	$400	$340	$292	$254	$224	$199	$179	$163	$150	$140	$131	$125	$120	$116	$114	$113	$112	$110	$109	$108	$107	$106
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Ultrasonic	$120	$120	$119	$118	$116	$115	$114	$113	$112	$111	$110	$109	$107	$106	$105	$104	$103	$102	$101	$100	$99	$98	$97
# per vehicle	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$40,000	$40,000	$25,084	$15,731	$9,865	$6,186	$3,880	$2,433	$1,526	$957	$600	$594	$588	$582	$576	$571	$565	$559	$554	$548	$543	$537	$532
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Central Computer/Avionics System	$40,000	$39,200	$38,416	$37,648	$36,895	$36,157	$35,434	$34,725	$34,031	$33,350	$32,683	$32,029	$31,389	$30,761	$30,146	$29,543	$28,952	$28,373	$27,805	$27,249	$26,704	$26,170	$25,647
Total Content per Vehicle	$81,020	$80,220	$64,384	$54,154	$47,448	$42,962	$39,876	$37,674	$36,035	$34,755	$33,707	$33,027	$32,365	$31,719	$31,089	$30,474	$29,873	$29,285	$28,709	$28,143	$27,590	$27,047	$26,514
Revenue $mn	$0	$8	$11	$62	$104	$136	$148	$166	$178	$191	$215	$240	$259	$276	$289	$298	$306	$324	$338	$350	$361	$371	$380
Revenue ($mn) by Category																							
Human/Long Distance (Airlines)	$0	$0	$36	$9	$14	$19	$24	$28	$35	$43	$50	$59	$67	$76	$87	$98	$110	$120	$126	$133	$140	$147	$154
Human/Short Distance (Autos/SM)	$3	$5	$6	$8	$10	$13	$16	$21	$27	$34	$43	$54	$66	$81	$99	$121	$148	$182	$223	$273	$335	$410	$502
Goods/Long Distance (Military + Transpo/Logistics)	$0	$8	$11	$62	$104	$136	$148	$166	$178	$191	$215	$240	$259	$276	$289	$298	$306	$324	$338	$350	$361	$371	$380
Goods/Short Distance (Transportation/Logistics)	$0	$8	$11	$62	$104	$136	$148	$166	$178	$191	$215	$240	$259	$276	$289	$298	$306	$324	$338	$350	$361	$371	$380
Revenue $mn	$4	$21	$65	$142	$233	$304	$335	$380	$419	$459	$524	$592	$650	$709	$763	$814	$869	$950	$1,025	$1,106	$1,196	$1,299	$1,417
% Y / Y		489%	213%	120%	64%	30%	10%	14%	10%	10%	14%	13%	10%	9%	8%	7%	7%	9%	8%	8%	8%	9%	9%
% CAGR																							
Revenue ($mn) by Category																							
Camera	0.0	0.1	0.3	0.9	1.5	1.9	1.9	2.1	2.1	2.2	2.4	2.6	2.7	2.9	3.0	3.1	3.3	3.6	3.9	4.1	4.4	4.7	5.0
Radar	0.0	0.1	0.2	0.7	1.2	1.5	1.5	1.7	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.7	2.9	3.1	3.3	3.5	3.8	4.0
Ultrasonic	0.0	0.0	0.1	0.3	0.5	0.8	0.9	1.1	1.2	1.3	1.5	1.8	1.9	2.1	2.3	2.4	2.6	2.8	3.1	3.3	3.6	4.0	4.3
LiDAR	3.8	12.6	25.4	42.1	48.7	43.9	32.7	24.6	17.8	12.7	9.4	11.0	12.3	13.5	14.8	16.0	17.3	19.8	21.7	23.7	26.0	28.7	31.7
Central Computer/Avionics System	3.5	11.8	41.8	100.8	182.4	257.2	299.0	352.0	397.3	442.2	510.3	576.7	633.7	689.6	743.4	792.7	845.9	923.7	995.2	1,073.6	1,161.0	1,260.0	1,373.7
Revenue	$7	$25	$68	$145	$234	$305	$336	$381	$420	$460	$526	$594	$653	$710	$766	$817	$872	$953	$1,027	$1,108	$1,199	$1,301	$1,419
% Y / Y		233.4%	174.7%	113.9%	61.7%	30.3%	10.1%	13.5%	10.2%	9.5%	14.2%	13.0%	9.9%	8.8%	7.8%	6.6%	6.7%	9.3%	7.8%	7.9%	8.2%	8.6%	9.1%
% CAGR																							
Semiconductor Revenue ($mn)																							
Semiconductor	$1.5	$9	$27	$60	$99	$129	$142	$161	$177	$194	$222	$251	$275	$300	$323	$345	$368	$403	$434	$468	$507	$550	$600
Total Hardware Revenue (+ Semis)	$5	$29	$92	$202	$331	$432	$476	$541	$596	$653	$746	$843	$926	$1,009	$1,087	$1,159	$1,238	$1,353	$1,458	$1,574	$1,703	$1,849	$2,017
% Y / Y		489%	213%	120%	64%	30%	10%	14%	10%	10%	14%	13%	10%	9%	8%	7%	7%	9%	8%	8%	8%	9%	9%

Source: Morgan Stanley Research

Exhibit 104:

US Software Total Addressable Market Model (Bear Case)

SOFTWARE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Unit Sales by Category																							
Transportation/Logistics	2	189	349	2,301	4,397	6,337	7,398	8,790	9,899	10,991	12,786	14,527	15,989	17,413	18,586	19,525	20,454	22,159	23,525	24,859	26,160	27,431	28,673
Autos and Shared Mobility	30	50	75	111	160	229	320	440	594	787	1,023	1,305	1,631	2,038	2,548	3,185	3,981	4,977	6,221	7,776	9,720	12,150	15,187
Military and Government	48	50	48	54	28	35	35	35	35	35	35	55	75	60	80	80	80	80	80	80	80	80	80
Airlines	0	0	335	103	177	256	339	427	559	700	848	1,004	1,169	1,343	1,574	1,818	2,075	2,293	2,470	2,654	2,848	3,051	3,263
Total Unit Sales	**80**	**289**	**807**	**2,569**	**4,763**	**6,856**	**8,092**	**9,692**	**11,087**	**12,513**	**14,692**	**16,890**	**18,864**	**20,854**	**22,788**	**24,608**	**26,591**	**29,509**	**32,296**	**35,369**	**38,808**	**42,711**	**47,203**
$ Content Per Vehicle																							
Human/Long Distance (Airlines)	$1,629	$1,547	$1,470	$1,397	$1,327	$1,260	$1,197	$1,137	$1,081	$1,027	$975	$926	$880	$836	$794	$755	$717	$681	$647	$615	$584	$555	$527
Human/Short Distance (Autos/SM)	$814	$774	$735	$698	$663	$630	$599	$569	$540	$513	$488	$463	$440	$418	$397	$377	$358	$341	$324	$307	$292	$277	$263
Goods/Long Distance (Military + Transpo/Logistics)	$407	$387	$368	$349	$332	$315	$299	$284	$270	$257	$244	$232	$220	$209	$199	$189	$179	$170	$162	$154	$146	$139	$132
Goods/Short Distance (Transportation/Logistics)	$204	$193	$184	$175	$166	$158	$150	$142	$135	$128	$122	$116	$110	$105	$99	$94	$90	$85	$81	$77	$73	$69	$66
$ Content Per Vehicle	**$428**	**$167**	**$841**	**$104**	**$85**	**$81**	**$87**	**$89**	**$98**	**$104**	**$105**	**$105**	**$107**	**$108**	**$113**	**$119**	**$124**	**$124**	**$124**	**$125**	**$127**	**$129**	**$130**
% Y / Y		-60.9%	402.8%	-87.6%	-18.1%	-5.3%	7.9%	2.2%	9.7%	7.0%	0.2%	0.4%	1.6%	1.7%	4.5%	4.8%	4.2%	0.0%	0.4%	0.8%	1.1%	1.4%	1.5%
% CAGR																							
Revenue ($mn)																							
Human/Long Distance (Airlines)	0	0	492	144	235	323	406	485	604	718	827	930	1,029	1,123	1,250	1,372	1,487	1,562	1,598	1,632	1,663	1,692	1,720
Human/Short Distance (Autos/SM)	24	39	55	77	106	144	192	250	321	404	499	604	718	852	1,012	1,202	1,427	1,695	2,012	2,390	2,838	3,370	4,002
Goods/Long Distance (Military + Transpo/Logistics)	0	0	61	18	29	40	51	61	76	90	103	116	129	140	156	171	186	195	200	204	208	212	215
Goods/Short Distance (Transportation/Logistics)	10	10	70	27	34	46	56	66	80	94	108	123	137	147	164	179	193	202	206	210	214	217	220
Revenue	**34**	**48**	**679**	**267**	**405**	**553**	**704**	**862**	**1,081**	**1,306**	**1,537**	**1,773**	**2,012**	**2,262**	**2,583**	**2,924**	**3,294**	**3,654**	**4,016**	**4,435**	**4,922**	**5,491**	**6,156**
% Y / Y		41.4%	1303.6%	-60.6%	51.7%	36.4%	27.4%	22.4%	25.4%	20.8%	17.6%	15.4%	13.5%	12.4%	14.2%	13.2%	12.6%	10.9%	9.9%	10.4%	11.0%	11.5%	12.1%
% CAGR																							

Source: Morgan Stanley Research

Exhibit 105:

US Telecom Total Addressable Market Model (Bear Case)

TELECOM SERVICES	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
UAM Aircraft Parc				80	369	1,176	3,745	8,508	15,365	23,457	33,149	44,236	56,749	71,441	88,331	107,195	128,050	150,837	175,446	202,036	231,545	263,841	299,210	338,017	380,729	427,932
x $ ARPA			$1,401	$1,408	$1,415	$1,423	$1,430	$1,437	$1,444	$1,451	$1,458	$1,466	$1,473	$1,480	$1,488	$1,495	$1,503	$1,510	$1,518	$1,525	$1,533	$1,541	$1,548	$1,556	$1,564	$1,572
Revenue ($mn)		**0**	**0**	**1**	**6**	**20**	**64**	**147**	**266**	**408**	**580**	**778**	**1,003**	**1,269**	**1,577**	**1,923**	**2,309**	**2,734**	**3,196**	**3,698**	**4,260**	**4,878**	**5,560**	**6,312**	**7,145**	**8,071**
% Y / Y					363.6%	220.2%	220.1%	128.3%	81.5%	53.4%	42.0%	34.1%	28.9%	26.5%	24.3%	22.0%	20.1%	18.4%	16.9%	15.7%	15.2%	14.5%	14.0%	13.5%	13.2%	13.0%
AIRCRAFT vs. CAR ARPA COMPARISONS																										
Car ARPU		$25	$26	$26	$27	$28	$29	$30	$30	$31	$32	$33	$34	$35	$36	$37	$39	$40	$41	$42	$43	$45	$46	$47	$49	$50
Business Aircraft ARPA	$2,302	$2,548	$2,803	$2,817	$2,831	$2,845	$2,859	$2,874	$2,888	$2,902	$2,917	$2,931	$2,946	$2,961	$2,976	$2,991	$3,006	$3,021	$3,036	$3,051	$3,066	$3,081	$3,097	$3,112	$3,128	$3,143
x Penetration (%)		35%	35%	36%	37%	39%	40%	42%	43%	45%	46%	47%	49%	50%	52%	53%	55%	56%	58%	59%	60%	62%	63%	65%	66%	68%
x % for Satellite		48%	48%	50%	51%	52%	54%	55%	56%	57%	59%	60%	61%	62%	64%	65%	66%	68%	69%	70%	71%	73%	74%	75%	76%	78%
Commercial Aircraft ARPA	$11,263	$11,519	$11,749	$11,984	$12,224	$12,469	$12,718	$12,972	$13,232	$13,496	$13,766	$14,042	$14,323	$14,609	$14,901	$15,199	$15,503	$15,813	$16,130	$16,452	$16,781	$17,117	$17,459	$17,808	$18,164	$18,528
x Penetration (%)		27%	27%	29%	31%	33%	34%	36%	38%	40%	41%	43%	45%	47%	48%	50%	52%	54%	55%	57%	59%	61%	62%	64%	66%	68%
x % for Satellite		63%	63%	64%	64%	65%	65%	66%	66%	67%	67%	68%	68%	69%	69%	70%	70%	71%	71%	72%	72%	73%	73%	74%	74%	75%
UAM Aircraft ARPA			**$1,401**	**$1,408**	**$1,415**	**$1,423**	**$1,430**	**$1,437**	**$1,444**	**$1,451**	**$1,458**	**$1,466**	**$1,473**	**$1,480**	**$1,488**	**$1,495**	**$1,503**	**$1,510**	**$1,518**	**$1,525**	**$1,533**	**$1,541**	**$1,548**	**$1,556**	**$1,564**	**$1,572**

Source: Morgan Stanley Research

Exhibit 106:

US Batteries Total Addressable Market Model (Bear Case)

Batteries	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Transport/Logistics	2	189	349	2,301	4,397	6,337	7,398	8,790	9,899	10,991	12,786	14,527	15,989	17,413	18,586	19,525	20,454	22,159	23,525	24,859	26,160	27,431	28,673
Autos/Shared Mobility	30	50	75	111	160	229	320	440	594	787	1,023	1,305	1,631	2,038	2,548	3,185	3,981	4,977	6,221	7,776	9,720	12,150	15,187
Military/Government	48	50	48	54	28	35	35	35	35	35	35	55	75	60	80	80	80	80	80	80	80	80	80
Airlines	-	-	335	103	177	256	339	427	559	700	848	1,004	1,169	1,343	1,574	1,818	2,075	2,293	2,470	2,654	2,848	3,051	3,263
UAM Aircraft Sales	**80**	**289**	**807**	**2,569**	**4,763**	**6,856**	**8,092**	**9,692**	**11,087**	**12,513**	**14,692**	**16,890**	**18,864**	**20,854**	**22,788**	**24,608**	**26,591**	**29,509**	**32,296**	**35,369**	**38,808**	**42,711**	**47,203**
UAM Aircraft Parc	**80**	**369**	**1,176**	**3,745**	**8,508**	**15,365**	**23,457**	**33,149**	**44,236**	**56,749**	**71,441**	**88,331**	**107,195**	**128,050**	**150,837**	**175,446**	**202,036**	**231,545**	**263,841**	**299,210**	**338,017**	**380,729**	**427,932**
"Gigafactories"	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	4	4	4	4	5	5	5	6
x Capactity per Gigafactory (GwH)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Total Gigafactory Capacity (000s)	50	50	50	50	50	50	100	100	100	100	100	100	150	150	150	200	200	200	200	250	250	250	300
Battery Capacity (KwH/Car)	78	76	75	73	70	67	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
Total Battery Capacity (GwH)	0	0	0	0	1	1	2	2	3	4	5	6	7	8	10	11	13	15	17	19	22	25	28
Annual Aircraft Battery Demand (GwH)	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3
Replacement rate (%)	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Replacement demand (GwH)	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	3	3	4	4	5	5	6	7
Total GwH Demanded	0	0	0	0	0	1	1	1	1	2	2	3	3	3	4	4	5	6	6	7	8	9	10
Factory Utilization	0%	0%	0%	1%	1%	1%	1%	1%	1%	2%	2%	3%	2%	2%	3%	2%	3%	3%	3%	3%	3%	4%	3%
Aircraft plant	1	1	1	1	2	2	2	2	3	3	3	3	3	3	4	4	4	5	5	5	6	6	6
Capacity per plant/year	50	200	250	300	360	432	518	622	746	896	1,075	1,290	1,548	1,858	2,229	2,675	3,210	3,852	4,622	5,547	6,656	7,987	9,584
Growth (%)					20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Total Capacity	50.00	200.00	250.00	300.00	720.00	864.00	1,036.80	1,244.16	2,239.49	2,687.39	3,224.86	3,869.84	4,643.80	5,572.56	8,916.10	10,699.32	12,839.18	19,258.78	23,110.53	27,732.64	39,935.00	47,922.00	57,506.40
Unit cost ($mn)																							
Aircraft plants/facilities	200	300	400	500	600	700	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Aircraft plant (cost per 100k units)	2.50	1.04	0.50	0.19	0.13	0.10	0.12	0.10	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02
Battery cost ($/kWh)	$120.00	$110.00	$100.00	$90.00	$80.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00
kWh per Car	78	76	75	73	70	67	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
kWh per Aircraft	156	152	150	146	140	134	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
Battery cost (absolute)	$18,720.00	$16,720.00	$15,000.00	$13,140.00	$11,200.00	$8,040.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00	$7,800.00
Battery Revenue ($mm)	**1**	**5**	**12**	**34**	**53**	**55**	**63**	**76**	**86**	**98**	**115**	**132**	**147**	**163**	**178**	**192**	**207**	**230**	**252**	**276**	**303**	**333**	**368**

Source: Morgan Stanley Research

Total Addressable Market Model (Bull Case)

Exhibit 107:

US Freight Transportation Total Addressable Market Model (Bull Case)

TRANSPORT/LOGISTICS																							
PHASE I: RURAL PARCEL MARKET																							
Core Market Total (mm)	$ 21,766	$ 22,370	$ 22,730	$ 23,051	$ 23,388	$ 23,751	$ 24,141	$ 24,551	$ 24,977	$ 25,417	$ 25,869	$ 26,331	$ 26,802	$ 27,282	$ 27,772	$ 28,272	$ 28,784	$ 29,309	$ 29,848	$ 30,403	$ 30,973	$ 31,559	$ 32,163
Growth estimate (GDP)		2.8%	1.6%	1.4%	1.5%	1.6%	1.6%	1.7%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.9%	1.9%	1.9%	1.9%
Drone Share	0%	0.5%	1%	5%	10%	15%	17%	20%	22%	24%	29%	34%	38%	42%	45%	47%	49%	50%	52%	54%	56%	58%	60%
Drone Market Total ($bn)	$0	$0	$0	$1	$2	$4	$4	$5	$5	$6	$8	$9	$10	$11	$12	$13	$14	$15	$16	$16	$17	$18	$19
PHASE II: URBAN PARCEL MARKET																							
Core Market Total (mm)	$ 68,926	$ 78,217	$ 87,899	$ 98,447	$ 109,277	$ 120,204	$ 129,821	$ 136,312	$ 143,127	$ 150,283	$ 157,798	$ 165,688	$ 173,972	$ 182,670	$ 191,804	$ 201,394	$ 211,464	$ 222,037	$ 233,139	$ 244,796	$ 257,036	$ 269,888	$ 283,382
Growth estimate (e-comm)		13.5%	12.4%	12.0%	11.0%	10.0%	8.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Drone Share	0.0%	0.0%	0.0%	2.0%	4.0%	6.0%	8.0%	10.0%	12.0%	14.0%	16.0%	18.0%	20.0%	22.0%	24.0%	26.0%	28.0%	30.0%	32.0%	34.0%	36.0%	38.0%	40.0%
Drone Market Total ($mm)	$0	$0	$0	$2	$4	$7	$10	$14	$17	$21	$25	$30	$35	$40	$46	$52	$59	$67	$75	$83	$93	$103	$113
Phase III: Freight Market																							
Core Market Total (mm)	$ 54,000.00	$55,499	$56,392	$57,188	$58,024	$58,926	$59,892	$60,908	$61,966	$63,057	$64,178	$65,324	$66,493	$67,684	$68,899	$70,141	$71,412	$72,715	$74,052	$75,427	$76,841	$78,296	$79,793
Growth estimate (GDP)		*2.8%*	*1.6%*	*1.4%*	*1.5%*	*1.6%*	*1.6%*	*1.7%*	*1.7%*	*1.8%*	*1.8%*	*1.8%*	*1.8%*	*1.8%*	*1.8%*	*1.8%*	*1.8%*	*1.8%*	*1.8%*	*1.9%*	*1.9%*	*1.9%*	*1.9%*
Drone Share	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.0%	9.0%	13.0%	15.0%	20.0%	20.0%
Drone Market Total (mm)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$4	$7	$10	$12	$16	$16
PHASE III: TOTAL PARCEL AND FREIGHT MARKET																							
Total VTOL Freight Market	$0	$0	$0	$3	$7	$11	$14	$19	$23	$27	$33	$39	$45	$52	$59	$66	$73	$86	$97	$109	$121	$137	$149
Growth estimate			103.2%	1273.3%	115.0%	60.6%	34.5%	28.0%	22.3%	19.7%	20.7%	18.4%	16.0%	14.8%	13.3%	12.2%	11.7%	16.8%	13.0%	13.1%	10.9%	12.5%	8.9%
Aircraft Share		0.1%	0.2%	2.6%	5.1%	7.5%	9.4%	11.5%	13.5%	15.4%	17.8%	20.2%	22.4%	24.6%	26.7%	28.6%	30.5%	34.1%	36.8%	39.8%	42.2%	45.3%	47.1%
# of Aircraft in Logistics Operation	2	189	349	4,368	8,598	12,724	15,999	19,595	22,926	26,259	30,313	34,330	38,085	41,818	45,315	48,595	51,877	57,915	62,566	67,611	71,657	76,987	80,059

Source: Alphawise, Morgan Stanley Research

Exhibit 108:

US Autos and Shared Mobility Total Addressable Market Model (Bull Case)

AUTOS & SHARED MOBILITY																							
US Vehicle Miles Traveled (bn)	3,363	3,406	3,450	3,535	3,591	3,650	3,711	3,852	3,988	4,119	4,242	4,318	4,382	4,469	4,560	4,642	4,724	4,876	4,994	5,103	5,311	5,491	5,656
VTOL Share (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.2%	0.3%	0.4%	0.6%	0.9%	1.2%	1.6%	2.2%
VTOL Production	30	50	80	124	192	292	438	657	986	1,479	2,145	3,110	4,353	6,095	8,533	11,519	15,551	20,993	28,341	37,977	50,510	63,137	78,921
Production Growth (%)		67%	60.0%	55.0%	55.0%	52.0%	50.0%	50.0%	50.0%	50.0%	45.0%	45.0%	40.0%	40.0%	40.0%	35.0%	35.0%	35.0%	35.0%	34.0%	33.0%	25.0%	25.0%
Implied Useful Life (miles)		1,686,000	1,736,580	1,788,677	1,842,338	1,897,608	1,954,536	2,013,172	2,073,567	2,156,510	2,242,770	2,332,481	2,425,780	2,547,070	2,674,423	2,808,144	2,948,551	3,125,464	3,312,992	3,511,772	3,722,478	3,945,827	4,182,576
Scrappage Rate (%)	0.0%	2.0%	2.2%	2.6%	3.1%	3.6%	4.1%	4.7%	5.2%	5.6%	6.0%	8.7%	9.4%	10.0%	10.6%	11.1%	11.7%	12.2%	12.4%	12.7%	12.9%	13.2%	13.5%
Scrappage	0	2	4	8	14	26	46	81	132	214	340	702	1,069	1,584	2,337	3,362	4,789	6,718	9,227	12,625	17,187	22,847	29,904
VTOLs in Operation	50	98	174	290	468	734	1,126	1,702	2,556	3,821	5,625	8,033	11,318	15,828	22,024	30,181	40,942	55,218	74,332	99,684	133,006	173,296	222,313
Hours of Operation/Day	2	2	2	3	3	3	3	4	4	4	4	6	6	7	7	7	8	8	8	9	9	10	10
Speed (mph)	40	42	44	49	53	59	65	71	76	81	87	93	100	106	112	118	123	130	133	137	142	146	150
Annual Miles per VTOL	29,200	33,726	38,954	47,134	57,032	67,754	80,492	95,624	107,434	120,702	135,608	203,883	229,063	254,947	283,756	312,841	344,907	380,260	411,251	444,768	481,017	520,219	562,617
VTOL Miles Traveled (bn)	0	0	0	0	0	0	0	0	0	0	1	2	3	4	6	9	14	21	31	44	64	90	125
Occupancy (people/VTOL)	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.4	2.5	2.6	2.7	2.9	3.0	3.2	3.3
Revenue per Seat Mile ($)	1.60	1.54	1.48	1.42	3.42	3.21	3.00	2.81	2.63	2.46	2.30	2.12	1.96	1.81	1.67	1.54	1.41	1.30	1.19	1.09	1.00	0.91	0.83
Vehicle Revenue per Mile ($)	2.00	2.00	2.00	2.00	5.00	4.88	4.75	4.63	4.50	4.38	4.25	4.13	4.00	3.88	3.75	3.63	3.50	3.38	3.25	3.13	3.00	2.88	2.75
Total Revenue ($bn)	$0	$0	$0	$0	$0	$0	$0	$1	$1	$2	$3	$7	$10	$16	$23	$34	$49	$71	$99	$139	$192	$259	$344

Source: Morgan Stanley Research

Exhibit 109:

US Airlines Total Addressable Market Model (Bull Case)

AIRLINES												
US Air Seat Miles (mn)	44,201	45,748	47,350	49,007	50,722	52,497	54,335	56,236	58,205	60,242	62,350	64,533
Load Factor (%)	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
US Revenue Passenger Miles	37,571	38,886	40,247	41,656	43,114	44,623	46,184	47,801	49,474	51,206	52,998	54,853
Passenger Revenue per ASM	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.90	0.93	0.97	1.01
Revenue ($mn)	**24,608**	**26,488**	**28,511**	**30,690**	**33,034**	**35,558**	**38,275**	**41,199**	**44,346**	**47,735**	**51,381**	**55,307**
UAM Penetration (%)	**0%**	**0%**	**1%**	**3.00%**	**5.00%**	**7.00%**	**9.00%**	**11.00%**	**15.00%**	**19.00%**	**23.00%**	**27.00%**
UAM Revenue ($bn)	**0**	**0**	**0**	**1**	**2**	**2**	**3**	**5**	**7**	**9**	**12**	**15**
Aircraft in Operation	**18,922**	**19,489**	**20,074**	**20,676**	**21,297**	**21,936**	**22,594**	**23,271**	**23,970**	**24,689**	**25,429**	**26,192**
UAM Penetration (%)	**0%**	**0%**	**1%**	**3.00%**	**5.00%**	**7.00%**	**9.00%**	**11.00%**	**15.00%**	**19.00%**	**23.00%**	**27.00%**
UAM Aircraft in Operation	0	0	201	620	1,065	1,535	2,033	2,560	3,595	4,691	5,849	7,072

AIRLINES											
US Air Seat Miles (mn)	66,791	69,129	71,548	74,053	76,644	79,327	82,103	84,977	87,951	91,030	94,216
Load Factor (%)	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
US Revenue Passenger Miles	56,773	58,760	60,816	62,945	65,148	67,428	69,788	72,230	74,759	77,375	80,083
Passenger Revenue per ASM	1.05	1.09	1.13	1.18	1.23	1.28	1.33	1.38	1.44	1.49	1.55
Revenue ($mn)	**59,532**	**64,081**	**68,977**	**74,246**	**79,919**	**86,025**	**92,597**	**99,671**	**107,286**	**115,483**	**124,306**
UAM Penetration (%)	**32.00%**	**36.00%**	**40.0%**	**47.00%**	**55.00%**	**58.00%**	**60.00%**	**62.00%**	**64.00%**	**66.00%**	**68.00%**
UAM Revenue ($bn)	**19**	**23**	**28**	**35**	**44**	**50**	**56**	**62**	**69**	**76**	**85**
Aircraft in Operation	**26,978**	**27,787**	**28,621**	**29,480**	**30,364**	**31,275**	**32,213**	**33,179**	**34,175**	**35,200**	**36,256**
UAM Penetration (%)	**32.00%**	**36.00%**	**40.0%**	**47.00%**	**55.00%**	**58.00%**	**60.00%**	**62.00%**	**64.00%**	**66.00%**	**68.00%**
UAM Aircraft in Operation	8,633	10,003	11,448	13,855	16,700	18,139	19,328	20,571	21,872	23,232	24,654

Source: Morgan Stanley Research

Exhibit 110:

US Airlines Total Addressable Market Model Assumptions (Bull Case)

Short-haul Capacity	
American	11,599,049,732
Allegiant	107,670,688
Alaska	2,356,421,351
Delta	9,732,949,825
Hawaiian	1,216,600,704
JetBlue	1,127,949,942
Southwest	10,923,454,782
Spirit	396,915,283
United	6,740,273,889
Total	**44,201,286,196**

Assumptions	
Long-term US GDP Growth	2.0%
Annual Fare Growth	4.0%
RASM	$0.65
Demand Factor (on GDP)	1.8x
Aircraft Capacity	10
Aircraft Speed (MPH)	150
Daily Permitted Flying Hours	12
Utilization	80%
Average Stage Length (Miles)	200

PRASM Analysis	
BOS-LGA	
Flight Distance	190
Ticket Price	$160
RASM	0.84
LAX-LAS	
Flight Distance	240
Ticket Price	$113
RASM	0.47
RDU-DCA	
Flight Distance	225
Ticket Price	$156
RASM	0.69
Average	
Flight Distance	655
Ticket Price	$429
RASM	0.65

Source: Morgan Stanley Research

Exhibit 111:

US Military and Defense Total Addressable Market Model (Bull Case)

MILITARY AND DEFENSE												
Fleet (BoP)	873	921	971	1,019	1,073	1,101	1,136	1,171	1,206	1,241	1,276	1,311
Retirements	0	0	0	0	0	0	0	0	0	0	0	0
Acquisitions (Blackhawk)	48	50	48	54	28	35	35	35	35	35	35	35
Acquisitions (Future Vertical Lift)	0	0	0	0	0	0	0	0	0	0	0	40
Fleet (EoP)	921	971	1,019	1,073	1,101	1,136	1,171	1,206	1,241	1,276	1,311	1,386
Net Change in Fleet	48	50	48	54	28	35	35	35	35	35	35	75
Growth Rates		5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	6%
Unit Price ($M)	$ 22.0	$ 22.4	$ 22.9	$ 23.3	$ 23.8	$ 24.3	$ 24.8	$ 25.3	$ 25.8	$ 26.3	$ 26.8	$ 27.4
Blackhawk Procurement ($M)	$1,056	$1,122	$1,099	$1,261	$667	$850	$867	$884	$902	$920	$939	$957
Future Vertical Lift Procurement ($M)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,094
Total VTOL Troop Transport ($bn)	**1.06**	**1.12**	**1.10**	**1.26**	**0.67**	**0.85**	**0.87**	**0.88**	**0.90**	**0.92**	**0.94**	**2.05**

MILITARY AND DEFENSE (cont.)											
Fleet (BoP)	1,386	1,501	1,621	1,702	1,782	1,863	1,944	2,024	2,105	2,185	2,266
Retirements	0	0	-79	-79	-79	-79	-79	-79	-79	-79	-79
Acquisitions (Blackhawk)	35	0	0	0	0	0	0	0	0	0	0
Acquisitions (Future Vertical Lift)	80	120	160	160	160	160	160	160	160	160	160
Fleet (EoP)	1,501	1,621	1,702	1,782	1,863	1,944	2,024	2,105	2,185	2,266	2,347
Net Change in Fleet	115	120	81	81	81	81	81	81	81	81	81
Growth Rates	8%	8%	5%	5%	5%	4%	4%	4%	4%	4%	4%
Unit Price ($M)	$ 27.9	$ 28.5	$ 29.0	$ 29.6	$ 30.2	$ 30.8	$ 31.4	$ 32.0	$ 32.7	$ 33.3	$ 34.0
Blackhawk Procurement ($M)	$977	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Future Vertical Lift Procurement ($M)	$2,232	$3,415	$4,645	$4,737	$4,832	$4,929	$5,027	$5,128	$5,231	$5,335	$5,442
Total VTOL Troop Transport ($bn)	**3.21**	**3.42**	**4.64**	**4.74**	**4.83**	**4.93**	**5.03**	**5.13**	**5.23**	**5.34**	**5.44**

Assumptions	
Inventory	873
FRP Rate	79
IOC Year	2007
Service Life (Years)	25
Minimum Economic Order	10
Base Year Price ($M)	$22
Inflation	2%

Prior	2017	2018	2019	2020	2021	2022	2023	Total
873	61	48	50	48	54	28	35	1,375

FY19 FYDP Presidents Request

Source: Morgan Stanley Research

Exhibit 112:

US Hardware Total Addressable Market Model (Bull Case)

HARDWARE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
CORE MARKETS (unit Sales)											
Transport/Logistics	2	189	349	4,368	8,598	12,724	15,999	19,595	22,926	26,259	30,313
Auto/Shared Mobility	30	50	80	124	192	292	438	657	986	1,479	2,145
Military/Government	48	50	48	54	28	35	35	35	35	35	35
Airlines	0	0	201	620	1,065	1,535	2,033	2,560	3,595	4,691	5,849
Core Market Total	80	289	678	5,166	9,883	14,587	18,506	22,847	27,542	32,464	38,341
Cost per Sensor ($)											
Camera	$125	$125	$106	$91	$79	$70	$62	$56	$51	$47	$44
Radar	$100	$100	$85	$73	$64	$56	$50	$45	$41	$38	$35
Ultrasonic	$15	$15	$15	$15	$15	$14	$14	$14	$14	$14	$14
LiDAR	$20,000	$20,000	$12,542	$7,865	$4,932	$3,093	$1,940	$1,216	$763	$478	$300
Note: Content Level ($) Highest to Lowest											
Human/Long Distance (Airlines)											
Camera	$750	$250	$213	$183	$159	$140	$125	$112	$102	$94	$87
# per vehicle	6	2	2	2	2	2	2	2	2	2	2
Radar	$500	$100	$170	$146	$127	$112	$100	$90	$82	$75	$70
# per vehicle	5	1	2	2	2	2	2	2	2	2	2
Ultrasonic	$120	$30	$30	$29	$29	$29	$29	$28	$28	$28	$27
# per vehicle	8	2	2	2	2	2	2	2	2	2	2
LiDAR	$60,000	$60,000	$37,627	$23,596	$14,797	$9,280	$5,819	$3,649	$2,289	$1,435	$900
# per vehicle	3	3	3	3	3	3	3	3	3	3	3
Central Computer/Avionics System	$70,000	$70,000	$68,600	$67,228	$65,883	$64,566	$63,274	$62,009	$60,769	$59,553	$58,362
Total Content per Vehicle	$131,370	$130,380	$106,639	$91,182	$80,996	$74,126	$69,346	$65,888	$63,269	$61,185	$59,447
Revenue $mn	$0.00	$0.00	$21.41	$56.56	$86.25	$113.82	$141.01	$168.66	$227.48	$287.01	$347.69
Human/Short Distance (Autos/SM)											
Camera	$750	$250	$213	$183	$159	$140	$125	$112	$102	$94	$87
# per vehicle	6	2	2	2	2	2	2	2	2	2	2
Radar	$500	$100	$170	$146	$127	$112	$100	$90	$82	$75	$70
# per vehicle	5	1	2	2	2	2	2	2	2	2	2
Ultrasonic	$120	$120	$119	$118	$116	$115	$114	$113	$112	$111	$110
# per vehicle	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$60,000	$60,000	$37,627	$23,596	$14,797	$9,280	$5,819	$3,649	$2,289	$1,435	$900
# per vehicle	3	3	3	3	3	3	3	3	3	3	3
Central Computer/Avionics System	$50,000	$49,000	$48,020	$47,060	$46,118	$45,196	$44,292	$43,406	$42,538	$41,687	$40,854
Total Content per Vehicle	$111,370	$109,470	$86,148	$71,102	$61,318	$54,843	$50,450	$47,370	$45,122	$43,402	$42,020
Revenue $mn	$3	$5	$7	$9	$12	$16	$22	$31	$44	$64	$90
Goods/Long Distance (Military + Transpo/Logistics)											
Camera	$500	$500	$425	$366	$318	$280	$249	$224	$204	$188	$175
# per vehicle	4	4	4	4	4	4	4	4	4	4	4
Radar	$400	$400	$340	$292	$254	$224	$199	$179	$163	$150	$140
# per vehicle	4	4	4	4	4	4	4	4	4	4	4
Ultrasonic	$120	$120	$119	$118	$116	$115	$114	$113	$112	$111	$110
# per vehicle	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$40,000	$40,000	$25,084	$15,731	$9,865	$6,186	$3,880	$2,433	$1,526	$957	$600
# per vehicle	2	2	2	2	2	2	2	2	2	2	2
Central Computer/Avionics System	$40,000	$39,200	$38,416	$37,648	$36,895	$36,157	$35,434	$34,725	$34,031	$33,350	$32,683
Total Content per Vehicle	$81,020	$80,220	$64,384	$54,154	$47,448	$42,962	$39,876	$37,674	$36,035	$34,755	$33,707
Revenue $mn	$0.1	$7.6	$11.2	$118.3	$204.0	$273.3	$319.0	$369.1	$413.1	$456.3	$510.9
Goods/Short Distance (Transportation/Logistics)											
Camera	$500	$500	$425	$366	$318	$280	$249	$224	$204	$188	$175
# per vehicle	4	4	4	4	4	4	4	4	4	4	4
Radar	$400	$400	$340	$292	$254	$224	$199	$179	$163	$150	$140
# per vehicle	4	4	4	4	4	4	4	4	4	4	4
Ultrasonic	$120	$120	$119	$118	$116	$115	$114	$113	$112	$111	$110
# per vehicle	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$40,000	$40,000	$25,084	$15,731	$9,865	$6,186	$3,880	$2,433	$1,526	$957	$600
# per vehicle	2	2	2	2	2	2	2	2	2	2	2
Central Computer/Avionics System	$40,000	$39,200	$38,416	$37,648	$36,895	$36,157	$35,434	$34,725	$34,031	$33,350	$32,683
Total Content per Vehicle	$81,020	$80,220	$64,384	$54,154	$47,448	$42,962	$39,876	$37,674	$36,035	$34,755	$33,707
Revenue $mn	$0	$8	$11	$118	$204	$273	$319	$369	$413	$456	$511
Revenue ($mn) by Category											
Human/Long Distance (Airlines)	$0	$0	$21	$57	$86	$114	$141	$169	$227	$287	$348
Human/Short Distance (Autos/SM)	$3	$5	$7	$9	$12	$16	$22	$31	$44	$64	$90
Goods/Long Distance (Military + Transpo/Logistics)	$0	$8	$11	$118	$204	$273	$319	$369	$413	$456	$511
Goods/Short Distance (Transportation/Logistics)	$0	$8	$11	$118	$204	$273	$319	$369	$413	$456	$511
Revenue $mn	$4	$21	$51	$302	$506	$677	$801	$938	$1,098	$1,264	$1,460
% Y/Y		489%	146%	494%	68%	34%	18%	17%	17%	15%	15%
% CAGR											
Revenue ($mn) by Category											
Camera	0.0	0.1	0.2	1.8	2.9	3.8	4.3	4.8	5.2	5.5	6.0
Radar	0.0	0.1	0.2	1.4	2.4	3.1	3.4	3.8	4.1	4.4	4.8
Ultrasonic	0.0	0.0	0.1	0.6	1.1	1.5	1.9	2.4	2.8	3.2	3.7
LiDAR	3.8	12.6	20.5	87.1	103.7	95.9	76.6	59.5	45.5	34.0	25.4
Central Computer/Avionics System	3.5	11.8	32.9	214.0	397.3	573.7	716.2	868.9	1,041.8	1,217.9	1,420.8
Revenue	$7	$25	$54	$305	$507	$678	$802	$939	$1,099	$1,265	$1,461
% Y/Y		233.4%	118.6%	465.8%	66.4%	33.6%	18.4%	17.1%	17.0%	15.1%	15.5%
% CAGR											
Semiconductor Revenue ($mn)											
Semiconductor	$0.4	$2	$5	$31	$51	$69	$81	$95	$112	$129	$148
Total Hardware Revenue (+ Semis)	$4	$23	$56	$333	$557	$745	$883	$1,033	$1,210	$1,392	$1,608
% Y/Y		489%	146%	494%	68%	34%	18%	17%	17%	15%	15%

HARDWARE	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
CORE MARKETS (unit Sales)												
Transport/Logistics	34,330	38,085	41,818	45,315	48,595	51,877	57,915	62,566	67,611	71,657	76,987	80,059
Auto/Shared Mobility	3,110	4,353	6,095	8,533	11,519	15,551	20,993	28,341	37,977	50,510	63,137	78,921
Military/Government	75	115	120	160	160	160	160	160	160	160	160	160
Airlines	7,072	8,633	10,003	11,448	13,855	16,700	18,139	19,328	20,571	21,872	23,232	24,654
Core Market Total	44,586	51,186	58,036	65,456	74,129	84,288	97,207	110,394	126,319	144,198	163,516	183,795
Cost per Sensor ($)												
Camera	$41	$39	$37	$36	$36	$35	$35	$34	$34	$34	$33	$33
Radar	$33	$31	$30	$29	$28	$28	$28	$28	$27	$27	$27	$27
Ultrasonic	$14	$13	$13	$13	$13	$13	$13	$13	$13	$12	$12	$12
LiDAR	$297	$294	$291	$288	$285	$282	$280	$277	$274	$271	$269	$266
Note: Content Level ($) Highest to Lowest												
Human/Long Distance (Airlines)												
Camera	$82	$78	$75	$73	$71	$70	$70	$69	$68	$68	$67	$66
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2
Radar	$66	$62	$60	$58	$57	$56	$56	$55	$55	$54	$54	$53
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2
Ultrasonic	$27	$27	$27	$26	$26	$26	$26	$25	$25	$25	$25	$24
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2
LiDAR	$1,188	$1,176	$1,164	$1,153	$1,141	$1,130	$1,398	$1,384	$1,370	$1,357	$1,343	$1,330
# per vehicle	4	4	4	4	4	4	5	5	5	5	5	5
Central Computer/Avionics System	$57,195	$56,051	$54,930	$53,832	$52,755	$51,700	$50,666	$49,653	$48,659	$47,686	$46,733	$45,798
Total Content per Vehicle	$58,558	$57,394	$56,256	$55,141	$54,050	$52,982	$52,215	$51,186	$50,178	$49,189	$48,221	$47,271
Revenue $mn	$414.11	$495.48	$562.75	$631.28	$748.89	$884.81	$947.15	$989.32	$1,032.22	$1,075.86	$1,120.26	$1,165.43
Human/Short Distance (Autos/SM)												
Camera	$82	$78	$75	$73	$71	$70	$70	$69	$68	$68	$67	$66
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2
Radar	$66	$62	$60	$58	$57	$56	$56	$55	$55	$54	$54	$53
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2
Ultrasonic	$109	$107	$106	$105	$104	$103	$102	$101	$100	$99	$98	$97
# per vehicle	8	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$891	$882	$873	$865	$856	$847	$839	$830	$822	$814	$806	$798
# per vehicle	3	3	3	3	3	3	3	3	3	3	3	3
Central Computer/Avionics System	$40,037	$39,236	$38,451	$37,682	$36,928	$36,190	$35,466	$34,757	$34,062	$33,380	$32,713	$32,059
Total Content per Vehicle	$41,184	$40,366	$39,565	$38,783	$38,017	$37,267	$36,533	$35,813	$35,107	$34,415	$33,737	$33,073
Revenue $mn	$128	$176	$241	$331	$438	$580	$767	$1,015	$1,333	$1,738	$2,130	$2,610
Goods/Long Distance (Military + Transpo/Logistics)												
Camera	$164	$156	$150	$145	$142	$141	$139	$138	$137	$135	$134	$133
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4
Radar	$131	$125	$120	$116	$114	$113	$112	$110	$109	$108	$107	$106
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4
Ultrasonic	$109	$107	$106	$105	$104	$103	$102	$101	$100	$99	$98	$97
# per vehicle	8	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$594	$588	$582	$576	$571	$565	$559	$554	$548	$543	$537	$532
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2
Central Computer/Avionics System	$32,029	$31,389	$30,761	$30,146	$29,543	$28,952	$28,373	$27,805	$27,249	$26,704	$26,170	$25,647
Total Content per Vehicle	$33,027	$32,365	$31,719	$31,089	$30,474	$29,873	$29,285	$28,709	$28,143	$27,590	$27,047	$26,514
Revenue $mn	$566.9	$616.3	$663.2	$704.4	$740.4	$774.9	$848.0	$898.1	$951.4	$988.5	$1,041.1	$1,061.4
Goods/Short Distance (Transportation/Logistics)												
Camera	$164	$156	$150	$145	$142	$141	$139	$138	$137	$135	$134	$133
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4
Radar	$131	$125	$120	$116	$114	$113	$112	$110	$109	$108	$107	$106
# per vehicle	4	4	4	4	4	4	4	4	4	4	4	4
Ultrasonic	$109	$107	$106	$105	$104	$103	$102	$101	$100	$99	$98	$97
# per vehicle	8	8	8	8	8	8	8	8	8	8	8	8
LiDAR	$594	$588	$582	$576	$571	$565	$559	$554	$548	$543	$537	$532
# per vehicle	2	2	2	2	2	2	2	2	2	2	2	2
Central Computer/Avionics System	$32,029	$31,389	$30,761	$30,146	$29,543	$28,952	$28,373	$27,805	$27,249	$26,704	$26,170	$25,647
Total Content per Vehicle	$33,027	$32,365	$31,719	$31,089	$30,474	$29,873	$29,285	$28,709	$28,143	$27,590	$27,047	$26,514
Revenue $mn	$567	$616	$663	$704	$740	$775	$848	$898	$951	$988	$1,041	$1,061
Revenue ($mn) by Category												
Human/Long Distance (Airlines)	$414	$495	$563	$631	$749	$885	$947	$989	$1,032	$1,076	$1,120	$1,165
Human/Short Distance (Autos/SM)	$128	$176	$241	$331	$438	$580	$767	$1,015	$1,333	$1,738	$2,130	$2,610
Goods/Long Distance (Military + Transpo/Logistics)	$567	$616	$663	$704	$740	$775	$848	$898	$951	$988	$1,041	$1,061
Goods/Short Distance (Transportation/Logistics)	$567	$616	$663	$704	$740	$775	$848	$898	$951	$988	$1,041	$1,061
Revenue $mn	$1,676	$1,904	$2,130	$2,371	$2,668	$3,014	$3,410	$3,800	$4,268	$4,791	$5,333	$5,898
% Y/Y	15%	14%	12%	11%	13%	13%	13%	11%	12%	12%	11%	11%
% CAGR												
Revenue ($mn) by Category												
Camera	6.5	7.0	7.5	8.0	8.7	9.6	10.8	11.9	13.3	14.6	16.1	17.5
Radar	5.2	5.6	6.0	6.4	7.0	7.7	8.7	9.6	10.6	11.7	12.9	14.0
Ultrasonic	4.3	4.8	5.4	6.0	6.6	7.4	8.5	9.7	11.1	12.7	14.3	16.1
LiDAR	31.6	36.5	41.4	46.8	53.5	61.4	75.4	85.0	96.6	109.8	123.5	138.4
Central Computer/Avionics System	1,630.9	1,853.7	2,073.9	2,308.7	2,596.7	2,932.7	3,311.3	3,688.8	4,141.3	4,646.8	5,170.0	5,716.6
Revenue	$1,678	$1,908	$2,134	$2,376	$2,673	$3,019	$3,415	$3,805	$4,273	$4,796	$5,337	$5,903
% Y/Y	14.9%	13.6%	11.9%	11.3%	12.5%	13.0%	13.1%	11.4%	12.3%	12.2%	11.3%	10.6%
% CAGR												
Semiconductor Revenue ($mn)												
Semiconductor	$170	$194	$217	$241	$271	$307	$347	$387	$434	$487	$542	$600
Total Hardware Revenue (+ Semis)	$1,846	$2,097	$2,347	$2,612	$2,939	$3,321	$3,757	$4,187	$4,702	$5,279	$5,875	$6,498
% Y/Y	15%	14%	12%	11%	13%	13%	13%	11%	12%	12%	11%	11%

Source: Morgan Stanley Research

Exhibit 113:

US Software Total Addressable Market Model (Bull Case)

SOFTWARE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Unit Sales by Category																							
Transportation/Logistics	2	189	349	4,368	8,598	12,724	15,999	19,595	22,926	26,259	30,313	34,330	38,085	41,818	45,315	48,595	51,877	57,915	62,566	67,611	71,657	76,987	80,059
Autos and Shared Mobility	30	50	80	124	192	292	438	657	986	1,479	2,145	3,110	4,353	6,095	8,533	11,519	15,551	20,993	28,341	37,977	50,510	63,137	78,921
Military and Government	48	50	48	54	28	35	35	35	35	35	35	75	115	120	160	160	160	160	160	160	160	160	160
Airlines	0	0	201	620	1,065	1,535	2,033	2,560	3,595	4,691	5,849	7,072	8,633	10,003	11,448	13,855	16,700	18,139	19,328	20,571	21,872	23,232	24,654
Total Unit Sales	**80**	**289**	**678**	**5,166**	**9,883**	**14,587**	**18,506**	**22,847**	**27,542**	**32,464**	**38,341**	**44,586**	**51,186**	**58,036**	**65,456**	**74,129**	**84,288**	**97,207**	**110,394**	**126,319**	**144,198**	**163,516**	**183,795**
$ Content Per Vehicle																							
Human/Long Distance (Airlines)	$1,629	$1,547	$1,470	$1,397	$1,327	$1,260	$1,197	$1,137	$1,081	$1,027	$975	$926	$880	$836	$794	$755	$717	$681	$647	$615	$584	$555	$527
Human/Short Distance (Autos/SM)	$814	$774	$735	$698	$663	$630	$599	$569	$540	$513	$488	$463	$440	$418	$397	$377	$358	$341	$324	$307	$292	$277	$263
Goods/Long Distance (Military + Transpo/Logistics)	$407	$387	$368	$349	$332	$315	$299	$284	$270	$257	$244	$232	$220	$209	$199	$189	$179	$170	$162	$154	$146	$139	$132
Goods/Short Distance (Transportation/Logistics)	$204	$193	$184	$175	$166	$158	$150	$142	$135	$128	$122	$116	$110	$105	$99	$94	$90	$85	$81	$77	$73	$69	$66
$ Content Per Vehicle	**$428**	**$167**	**$644**	**$228**	**$192**	**$179**	**$179**	**$176**	**$196**	**$209**	**$213**	**$216**	**$223**	**$224**	**$226**	**$235**	**$244**	**$233**	**$225**	**$218**	**$213**	**$206**	**$202**
% Y / Y		-60.9%	284.8%	-64.6%	-15.8%	-6.9%	0.0%	-1.7%	11.3%	6.7%	2.1%	1.3%	3.3%	0.5%	0.6%	4.2%	3.7%	-4.6%	-3.3%	-3.2%	-2.1%	-3.5%	-2.0%
% CAGR																							
Revenue ($b)																							
Human/Long Distance (Airlines)	0	0	295	866	1,413	1,935	2,435	2,912	3,885	4,816	5,704	6,552	7,598	8,364	9,094	10,456	11,972	12,354	12,505	12,644	12,771	12,887	12,992
Human/Short Distance (Autos/SM)	24	39	59	87	127	184	262	374	533	759	1,046	1,440	1,916	2,548	3,389	4,346	5,574	7,149	9,168	11,671	14,747	17,512	20,795
Goods/Long Distance (Military + Transpo/Logistics)	0	0	37	108	177	242	304	364	486	602	713	819	950	1,046	1,137	1,307	1,497	1,544	1,563	1,581	1,596	1,611	1,624
Goods/Short Distance (Transportation/Logistics)	10	10	46	118	181	247	310	369	490	606	717	828	962	1,058	1,153	1,322	1,511	1,558	1,576	1,593	1,608	1,622	1,635
Revenue	**34**	**48**	**436**	**1,179**	**1,898**	**2,609**	**3,311**	**4,019**	**5,394**	**6,783**	**8,180**	**9,639**	**11,426**	**13,016**	**14,772**	**17,431**	**20,554**	**22,605**	**24,813**	**27,489**	**30,723**	**33,632**	**37,046**
% Y / Y		41.4%	802.7%	170.1%	61.0%	37.4%	26.9%	21.4%	34.2%	25.8%	20.6%	17.8%	18.5%	13.9%	13.5%	18.0%	17.9%	10.0%	9.8%	10.8%	11.8%	9.5%	10.2%
% CAGR																							

Source: Morgan Stanley Research

Exhibit 114:

US Telecom Total Addressable Market Model (Bull Case)

TELECOM SERVICES	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
UAM Aircraft Parc	80	369	1,047	6,213	16,096	30,683	49,189	72,036	99,578	132,042	170,383	214,969	266,155	324,191	389,648	463,777	548,065	645,272	755,667	881,986	1,026,184	1,189,700	1,373,495
x $ ARPA	$1,408	$1,415	$1,423	$1,430	$1,437	$1,444	$1,451	$1,458	$1,466	$1,473	$1,480	$1,488	$1,495	$1,503	$1,510	$1,518	$1,525	$1,533	$1,541	$1,548	$1,556	$1,564	$1,572
Revenue ($mn)	**1**	**6**	**18**	**107**	**278**	**532**	**857**	**1,261**	**1,751**	**2,334**	**3,027**	**3,838**	**4,776**	**5,846**	**7,062**	**8,447**	**10,032**	**11,871**	**13,971**	**16,388**	**19,163**	**22,327**	**25,905**
% Y / Y		363.6%	185.1%	496.3%	160.4%	91.6%	61.1%	47.2%	38.9%	33.3%	29.7%	26.8%	24.4%	22.4%	20.8%	19.6%	18.8%	18.3%	17.7%	17.3%	16.9%	16.5%	16.0%
AIRCRAFT vs. CAR ARPA COMPARISONS																							
Car ARPU	$26	$27	$28	$29	$30	$30	$31	$32	$33	$34	$35	$36	$37	$39	$40	$41	$42	$43	$45	$46	$47	$49	$50
Business Aircraft ARPA	$2,817	$2,831	$2,845	$2,859	$2,874	$2,888	$2,902	$2,917	$2,931	$2,946	$2,961	$2,976	$2,991	$3,006	$3,021	$3,036	$3,051	$3,066	$3,081	$3,097	$3,112	$3,128	$3,143
x Penetration (%)	36%	37%	39%	40%	42%	43%	45%	46%	47%	49%	50%	52%	53%	55%	56%	58%	59%	60%	62%	63%	65%	66%	68%
x % for Satellite	50%	51%	52%	54%	55%	56%	57%	59%	60%	61%	62%	64%	65%	66%	68%	69%	70%	71%	73%	74%	75%	76%	78%
Commercial Aircraft ARPA	$11,984	$12,224	$12,469	$12,718	$12,972	$13,232	$13,496	$13,766	$14,042	$14,323	$14,609	$14,901	$15,199	$15,503	$15,813	$16,130	$16,452	$16,781	$17,117	$17,459	$17,808	$18,164	$18,528
x Penetration (%)	29%	31%	33%	34%	36%	38%	40%	41%	43%	45%	47%	48%	50%	52%	54%	55%	57%	59%	61%	62%	64%	66%	68%
x % for Satellite	64%	64%	65%	65%	66%	66%	67%	67%	68%	68%	69%	69%	70%	70%	71%	71%	72%	72%	73%	73%	74%	74%	75%
UAM Aircraft ARPA	**$1,408**	**$1,415**	**$1,423**	**$1,430**	**$1,437**	**$1,444**	**$1,451**	**$1,458**	**$1,466**	**$1,473**	**$1,480**	**$1,488**	**$1,495**	**$1,503**	**$1,510**	**$1,518**	**$1,525**	**$1,533**	**$1,541**	**$1,548**	**$1,556**	**$1,564**	**$1,572**

Source: Morgan Stanley Research

Exhibit 115:

US Batteries Total Addressable Market Model (Bull Case)

Batteries	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Transport/Logistics	2	240	440	5,497	10,795	15,927	19,840	23,906	27,981	32,060	37,019	41,936
Autos/Shared Mobility	30	50	80	124	192	292	438	657	986	1,479	2,145	3,110
Military/Government	48	50	48	54	28	35	35	35	35	35	35	75
Airlines	-	-	201	620	1,065	1,535	2,033	2,560	3,595	4,691	5,849	7,072
UAM Aircraft Sales	**80**	**340**	**768**	**6,295**	**12,080**	**17,790**	**22,347**	**27,158**	**32,597**	**38,265**	**45,047**	**52,192**
UAM Aircraft Parc	**80**	**420**	**1,188**	**7,484**	**19,564**	**37,354**	**59,700**	**86,858**	**119,456**	**157,720**	**202,768**	**254,960**
"Gigafactories"	1	1	1	1	1	1	2	2	2	2	2	2
x Capacity per Gigafactory (GwH)	50	50	50	50	50	50	50	50	50	50	50	50
Total Gigafactory Capacity (000s)	50	50	50	50	50	50	100	100	100	100	100	100
Battery Capacity (KwH/Car)	78	76	75	73	70	67	65	65	65	65	65	65
Total Battery Capacity (GwH)	0	0	0	1	1	3	4	6	8	10	13	17
Annual Aircraft Battery Demand (GwH)	0	0	0	0	1	1	1	2	2	2	3	3
Replacement rate (%)	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Replacement demand (GwH)	0	0	0	0	0	1	1	1	2	3	3	4
Total GwH Demanded	0	0	0	1	1	2	2	3	4	5	6	8
Factory Utilization	0%	0%	0%	1%	2%	4%	2%	3%	4%	5%	6%	8%
Aircraft plant	1	1	1	1	2	2	2	2	3	3	3	3
Capacity per plant/year	50	200	250	300	360	432	518	622	746	896	1,075	1,290
Growth (%)					20%	20%	20%	20%	20%	20%	20%	20%
Total Capacity	50	200	250	300	720	864	1,037	1,244	2,239	2,687	3,225	3,870
Unit cost ($mn)												
Aircraft plants/facilities	200	300	400	500	600	700	1,000	1,000	1,000	1,000	1,000	1,000
Aircraft plant (cost per 100k units)	2.50	0.88	0.52	0.08	0.05	0.04	0.04	0.04	0.03	0.03	0.02	0.02
Battery cost ($/kWh)	$120.00	$110.00	$100.00	$90.00	$80.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00
kWh per Car	78	76	75	73	70	67	65	65	65	65	65	65
kWh per Aircraft	156	152	150	146	140	134	130	130	130	130	130	130
Battery cost (absolute)	$18,720	$16,720	$15,000	$13,140	$11,200	$8,040	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800
Battery Revenue ($mm)	**1**	**6**	**12**	**83**	**135**	**143**	**174**	**212**	**254**	**298**	**351**	**407**

Batteries	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Transport/Logistics	46,534	51,107	55,393	59,416	63,445	70,846	76,554	82,749	87,722	94,270	98,055
Autos/Shared Mobility	4,353	6,095	8,533	11,519	15,551	20,993	28,341	37,977	50,510	63,137	78,921
Military/Government	115	120	160	160	160	160	160	160	160	160	160
Airlines	8,633	10,003	11,448	13,855	16,700	18,139	19,328	20,571	21,872	23,232	24,654
UAM Aircraft Sales	**59,635**	**67,325**	**75,534**	**84,950**	**95,856**	**110,139**	**124,383**	**141,457**	**160,264**	**180,799**	**201,791**
UAM Aircraft Parc	**314,595**	**381,920**	**457,454**	**542,404**	**638,260**	**748,399**	**872,782**	**1,014,239**	**1,174,503**	**1,355,302**	**1,557,092**
"Gigafactories"	3	3	3	4	4	4	4	5	5	5	6
x Capacity per Gigafactory (GwH)	50	50	50	50	50	50	50	50	50	50	50
Total Gigafactory Capacity (000s)	150	150	150	200	200	200	200	250	250	250	300
Battery Capacity (KwH/Car)	65	65	65	65	65	65	65	65	65	65	65
Total Battery Capacity (GwH)	20	25	30	35	41	49	57	66	76	88	101
Annual Aircraft Battery Demand (GwH)	4	4	5	6	6	7	8	9	10	12	13
Replacement rate (%)	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Replacement demand (GwH)	5	6	7	9	10	12	14	16	19	22	25
Total GwH Demanded	9	11	12	14	17	19	22	26	30	34	38
Factory Utilization	6%	7%	8%	7%	8%	10%	11%	10%	12%	14%	13%
Aircraft plant	3	3	4	4	4	5	5	5	6	6	6
Capacity per plant/year	1,548	1,858	2,229	2,675	3,210	3,852	4,622	5,547	6,656	7,987	9,584
Growth (%)	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Total Capacity	4,644	5,573	8,916	10,699	12,839	19,259	23,111	27,733	39,935	47,922	57,506
Unit cost ($mn)											
Aircraft plants/facilities	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Aircraft plant (cost per 100k units)	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Battery cost ($/kWh)	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00
kWh per Car	65	65	65	65	65	65	65	65	65	65	65
kWh per Aircraft	130	130	130	130	130	130	130	130	130	130	130
Battery cost (absolute)	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800	$7,800
Battery Revenue ($mm)	**465**	**525**	**589**	**663**	**748**	**859**	**970**	**1,103**	**1,250**	**1,410**	**1,574**

Source: Morgan Stanley Research

Global Total Addressable Market Model Extrapolation

Exhibit 116:

Global TAM Model (Extrapolation of US bottom-up model)

US TOTAL TAM $bn																							
Base	1	1	2	5	9	13	17	21	26	32	39	47	56	66	78	92	109	131	156	187	225	272	328
Bull	1	1	2	7	12	19	25	32	41	51	63	79	98	117	141	171	208	253	303	368	447	544	658
Bear	1	1	3	4	6	8	10	13	15	18	22	27	31	36	41	47	53	64	74	86	101	118	137
Global TAM Extrapolation																							
US GDP ($bn)	**19,953**	**20,422**	**20,813**	**21,042**	**21,274**	**21,508**	**21,744**	**21,983**	**22,225**	**22,470**	**22,717**	**22,967**	**23,219**	**23,475**	**23,733**	**23,994**	**24,258**	**24,525**	**24,795**	**25,067**	**25,343**	**25,622**	**25,904**
Growth (%)	2.90%	2.35%	1.92%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%	1.10%
VTOL TAM (% of US GDP)																							
Base Total	**0.0055%**	**0.0064%**	**0.0096%**	**0.0258%**	**0.0407%**	**0.0606%**	**0.0774%**	**0.0961%**	**0.1178%**	**0.1414%**	**0.1708%**	**0.2057%**	**0.2430%**	**0.2805%**	**0.3301%**	**0.3838%**	**0.4482%**	**0.5354%**	**0.6299%**	**0.7448%**	**0.8895%**	**1.0623%**	**1.2666%**
Transport/Logistics	0.0000%	0.0005%	0.0011%	0.0102%	0.0213%	0.0333%	0.0428%	0.0533%	0.0634%	0.0740%	0.0886%	0.1039%	0.1188%	0.1344%	0.1496%	0.1645%	0.1802%	0.2074%	0.2340%	0.2616%	0.2934%	0.3266%	0.3549%
Autos/Shared Mobility	0.0000%	0.0000%	0.0001%	0.0002%	0.0003%	0.0006%	0.0010%	0.0018%	0.0030%	0.0047%	0.0075%	0.0116%	0.0178%	0.0267%	0.0396%	0.0577%	0.0839%	0.1217%	0.1693%	0.2336%	0.3206%	0.4332%	0.5791%
Military/Government	0.0053%	0.0055%	0.0053%	0.0060%	0.0031%	0.0040%	0.0040%	0.0040%	0.0041%	0.0041%	0.0041%	0.0066%	0.0090%	0.0073%	0.0098%	0.0099%	0.0100%	0.0100%	0.0101%	0.0102%	0.0103%	0.0104%	0.0105%
Airlines	0.0000%	0.0000%	0.0013%	0.0041%	0.0070%	0.0103%	0.0137%	0.0174%	0.0230%	0.0290%	0.0355%	0.0424%	0.0498%	0.0578%	0.0683%	0.0796%	0.0916%	0.1022%	0.1110%	0.1204%	0.1303%	0.1408%	0.1520%
Enabling Tech	0.0002%	0.0003%	0.0018%	0.0054%	0.0090%	0.0125%	0.0159%	0.0195%	0.0244%	0.0296%	0.0351%	0.0412%	0.0475%	0.0544%	0.0628%	0.0721%	0.0825%	0.0940%	0.1055%	0.1190%	0.1349%	0.1513%	0.1701%
Bull Total	**0.0055%**	**0.0065%**	**0.0104%**	**0.0338%**	**0.0573%**	**0.0867%**	**0.1141%**	**0.1440%**	**0.1827%**	**0.2253%**	**0.2761%**	**0.3449%**	**0.4200%**	**0.4978%**	**0.5932%**	**0.7117%**	**0.8582%**	**1.0304%**	**1.2230%**	**1.4661%**	**1.7633%**	**2.1235%**	**2.5383%**
Transport/Logistics	0.0000%	0.0005%	0.0011%	0.0148%	0.0315%	0.0501%	0.0666%	0.0843%	0.1020%	0.1208%	0.1442%	0.1688%	0.1937%	0.2200%	0.2466%	0.2736%	0.3022%	0.3492%	0.3904%	0.4366%	0.4790%	0.5328%	0.5737%
Autos/Shared Mobility	0.0000%	0.0000%	0.0001%	0.0001%	0.0006%	0.0011%	0.0020%	0.0034%	0.0056%	0.0090%	0.0143%	0.0294%	0.0447%	0.0666%	0.0987%	0.1426%	0.2037%	0.2890%	0.4007%	0.5527%	0.7573%	1.0116%	1.3279%
Military/Government	0.0053%	0.0055%	0.0053%	0.0060%	0.0031%	0.0040%	0.0040%	0.0040%	0.0041%	0.0041%	0.0041%	0.0089%	0.0138%	0.0145%	0.0196%	0.0197%	0.0199%	0.0201%	0.0203%	0.0205%	0.0206%	0.0208%	0.0210%
Airlines	0.0000%	0.0000%	0.0014%	0.0044%	0.0078%	0.0116%	0.0158%	0.0206%	0.0299%	0.0404%	0.0520%	0.0650%	0.0820%	0.0983%	0.1163%	0.1454%	0.1812%	0.2034%	0.2241%	0.2465%	0.2709%	0.2975%	0.3263%
Enabling Tech	0.0002%	0.0004%	0.0025%	0.0085%	0.0143%	0.0199%	0.0256%	0.0316%	0.0412%	0.0511%	0.0615%	0.0727%	0.0858%	0.0983%	0.1120%	0.1303%	0.1511%	0.1687%	0.1876%	0.2097%	0.2353%	0.2608%	0.2894%
Bear Total	**0.0055%**	**0.0063%**	**0.0144%**	**0.0176%**	**0.0263%**	**0.0387%**	**0.0475%**	**0.0580%**	**0.0687%**	**0.0803%**	**0.0965%**	**0.1155%**	**0.1345%**	**0.1524%**	**0.1744%**	**0.1960%**	**0.2205%**	**0.2592%**	**0.2986%**	**0.3433%**	**0.3980%**	**0.4612%**	**0.5288%**
Transport/Logistics	0.0000%	0.0005%	0.0011%	0.0078%	0.0161%	0.0249%	0.0308%	0.0378%	0.0440%	0.0506%	0.0608%	0.0714%	0.0813%	0.0916%	0.1011%	0.1099%	0.1192%	0.1395%	0.1587%	0.1786%	0.2022%	0.2265%	0.2455%
Autos/Shared Mobility	0.0000%	0.0000%	0.0001%	0.0002%	0.0003%	0.0005%	0.0008%	0.0014%	0.0021%	0.0032%	0.0047%	0.0068%	0.0097%	0.0135%	0.0185%	0.0250%	0.0337%	0.0453%	0.0591%	0.0771%	0.1005%	0.1309%	0.1704%
Military/Government	0.0053%	0.0053%	0.0049%	0.0053%	0.0027%	0.0032%	0.0031%	0.0030%	0.0029%	0.0029%	0.0028%	0.0042%	0.0056%	0.0043%	0.0056%	0.0054%	0.0053%	0.0051%	0.0049%	0.0048%	0.0046%	0.0045%	0.0044%
Airlines	0.0000%	0.0000%	0.0044%	0.0014%	0.0023%	0.0033%	0.0043%	0.0054%	0.0070%	0.0087%	0.0105%	0.0123%	0.0141%	0.0161%	0.0186%	0.0213%	0.0241%	0.0263%	0.0280%	0.0298%	0.0316%	0.0335%	0.0355%
Enabling Tech	0.0002%	0.0005%	0.0039%	0.0029%	0.0049%	0.0067%	0.0084%	0.0103%	0.0126%	0.0150%	0.0177%	0.0207%	0.0238%	0.0270%	0.0306%	0.0343%	0.0383%	0.0429%	0.0477%	0.0530%	0.0591%	0.0658%	0.0730%
Global GDPs ($bn)																							
China	13,048	13,874	14,723	15,532	16,387	17,288	18,204	19,151	20,108	21,073	22,043	23,013	23,979	24,938	25,886	26,818	27,730	28,617	29,476	30,301	31,089	31,835	32,535
Growth (%)	6.60%	6.33%	6.12%	5.50%	5.50%	5.50%	5.30%	5.20%	5.00%	4.80%	4.60%	4.40%	4.20%	4.00%	3.80%	3.60%	3.40%	3.20%	3.00%	2.80%	2.60%	2.40%	2.20%
Europe	19,162	19,478	19,770	20,067	20,368	20,673	20,984	21,298	21,618	21,942	22,271	22,606	22,945	23,289	23,638	23,993	24,353	24,718	25,089	25,465	25,847	26,235	26,629
Growth (%)	1.92%	1.65%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
ROW	25,184	25,813	26,459	27,120	27,798	28,493	29,205	29,935	30,684	31,451	32,237	33,043	33,869	34,716	35,584	36,473	37,385	38,320	39,278	40,260	41,266	42,298	43,355
Growth (%)	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Shared Miles Penetration (Autos %)																							
United States	**9.19%**	**10.44%**	**11.89%**	**14.68%**	**17.45%**	**20.17%**	**22.82%**	**27.69%**	**32.25%**	**36.51%**	**40.51%**	**43.35%**	**46.11%**	**49.53%**	**52.72%**	**55.55%**	**58.13%**	**61.64%**	**64.89%**	**67.90%**	**71.65%**	**75.04%**	**78.15%**
China	8.72%	10.07%	11.39%	14.54%	17.54%	20.40%	23.14%	25.76%	28.26%	30.66%	32.97%	35.17%	37.29%	38.69%	40.06%	41.40%	42.70%	43.97%	45.21%	46.41%	47.59%	48.74%	49.99%
vs. US	95%	96.46%	95.81%	99.05%	100.46%	101.14%	101.41%	93.02%	87.64%	83.99%	81.38%	81.13%	80.87%	78.12%	75.99%	74.53%	73.45%	71.33%	69.66%	68.35%	66.42%	64.95%	63.97%
Europe	4.62%	4.99%	5.49%	6.05%	6.32%	6.87%	7.95%	8.76%	11.11%	12.39%	14.86%	16.07%	18.88%	21.79%	23.31%	26.03%	29.03%	30.78%	32.81%	36.36%	38.89%	41.30%	42.86%
vs. US	50%	47.80%	46.18%	41.20%	36.22%	34.06%	34.86%	31.63%	34.45%	33.92%	36.70%	37.07%	40.95%	44.00%	44.22%	46.87%	49.95%	49.94%	50.56%	53.55%	54.28%	55.04%	54.84%
ROW	2.73%	2.99%	3.00%	3.24%	3.48%	3.72%	4.64%	5.81%	8.10%	10.37%	12.72%	15.29%	16.39%	19.79%	22.14%	23.48%	25.83%	28.15%	30.66%	33.16%	35.65%	38.11%	40.79%
vs. US	29.76%	28.70%	25.26%	22.10%	19.95%	18.45%	20.34%	21.00%	25.13%	28.41%	31.40%	35.26%	35.55%	39.96%	41.99%	42.28%	44.43%	45.67%	47.25%	48.84%	49.76%	50.79%	52.20%
Autonomous Miles Penetration (Autos % - L4 / L5)																							
United States	**0.00%**	**0.02%**	**0.03%**	**0.06%**	**0.11%**	**0.18%**	**0.30%**	**0.46%**	**0.74%**	**1.19%**	**1.83%**	**2.81%**	**4.18%**	**5.88%**	**8.13%**	**11.06%**	**14.62%**	**19.00%**	**24.23%**	**30.33%**	**36.40%**	**43.35%**	**49.53%**
China	0.00%	0.00%	0.00%	0.18%	0.51%	1.00%	1.64%	2.41%	3.74%	5.59%	7.83%	10.44%	12.66%	15.25%	18.15%	21.14%	24.23%	27.34%	30.43%	33.46%	36.42%	39.45%	42.68%
vs. US	0.00%	0.00%	0.00%	292.50%	470.36%	550.72%	552.82%	525.98%	504.23%	471.47%	428.39%	372.25%	303.11%	259.23%	223.29%	191.11%	165.79%	143.86%	125.61%	110.32%	100.07%	91.00%	86.17%
Europe	0.00%	0.01%	0.02%	0.04%	0.07%	0.12%	0.20%	0.31%	0.50%	0.79%	1.22%	1.86%	2.68%	3.69%	5.04%	6.80%	8.99%	11.76%	15.03%	19.42%	24.17%	29.03%	32.54%
vs. US	72.99%	71.60%	74.37%	70.68%	68.88%	67.43%	66.08%	66.66%	66.78%	66.76%	66.87%	66.44%	64.08%	62.69%	62.03%	61.46%	61.50%	61.89%	62.03%	64.03%	66.41%	66.96%	65.71%
ROW	0.00%	0.01%	0.02%	0.05%	0.09%	0.15%	0.25%	0.39%	0.63%	0.99%	1.51%	2.27%	3.34%	4.72%	6.60%	9.04%	12.33%	16.81%	22.39%	29.02%	36.66%	45.03%	52.16%
vs. US	78.63%	71.51%	74.42%	79.15%	83.22%	84.67%	84.45%	85.40%	84.83%	83.76%	82.72%	80.85%	79.98%	80.28%	81.13%	81.73%	84.34%	88.43%	92.41%	95.67%	100.72%	103.87%	105.32%
Electric Vehicle Miles Penetration (Autos %)																							
United States	**0.19%**	**0.27%**	**0.39%**	**0.53%**	**0.70%**	**0.93%**	**1.23%**	**1.57%**	**1.97%**	**2.45%**	**2.99%**	**3.66%**	**4.45%**	**5.50%**	**6.91%**	**8.59%**	**10.70%**	**12.98%**	**15.80%**	**19.10%**	**22.60%**	**26.69%**	**31.10%**
China	0.71%	1.06%	1.61%	2.22%	2.89%	3.77%	5.05%	6.57%	8.26%	10.09%	12.17%	14.50%	17.13%	19.86%	22.87%	26.13%	29.45%	32.91%	36.59%	40.16%	43.73%	47.29%	50.93%
vs. US	373.05%	391.63%	411.66%	420.18%	413.34%	404.84%	411.02%	418.47%	418.95%	412.35%	406.22%	396.44%	385.01%	360.92%	330.84%	304.14%	275.26%	253.46%	231.55%	210.29%	193.52%	177.18%	163.75%
Europe	0.14%	0.25%	0.43%	0.67%	0.98%	1.42%	1.98%	2.68%	3.50%	4.47%	5.56%	6.97%	8.73%	10.56%	12.75%	15.17%	17.90%	21.19%	24.72%	28.73%	33.45%	38.25%	43.40%
vs. US	74.53%	92.55%	108.95%	126.32%	140.55%	152.57%	160.62%	170.57%	177.63%	182.68%	185.59%	190.51%	196.27%	191.97%	184.51%	176.60%	167.33%	163.23%	156.42%	150.45%	148.02%	143.32%	139.53%
ROW	0.11%	0.19%	0.32%	0.49%	0.68%	0.92%	1.23%	1.63%	2.08%	2.57%	3.14%	3.81%	4.64%	5.55%	6.64%	7.89%	9.28%	10.87%	12.83%	14.95%	17.32%	19.96%	22.76%
vs. US	56.08%	69.23%	81.86%	92.24%	97.66%	99.17%	100.30%	103.97%	105.39%	105.04%	104.99%	104.19%	104.33%	100.82%	96.04%	91.86%	86.71%	83.73%	81.17%	78.28%	76.66%	74.78%	73.19%
Adjustment Factor																							
China	**1.6x**	**1.6x**	**1.7x**	**2.7x**	**3.3x**	**3.5x**	**3.6x**	**3.5x**	**3.4x**	**3.2x**	**3.1x**	**2.8x**	**2.6x**	**2.3x**	**2.1x**	**1.9x**	**1.7x**	**1.6x**	**1.4x**	**1.3x**	**1.2x**	**1.1x**	**1.0x**
Europe	**0.7x**	**0.7x**	**0.8x**	**0.8x**	**0.8x**	**0.8x**	**0.9x**	**0.9x**	**0.9x**	**0.9x**	**1.0x**	**1.0x**	**1.0x**	**1.0x**	**1.0x**	**0.9x**	**0.9x**	**0.9x**	**0.9x**	**0.9x**	**0.9x**	**0.9x**	**0.9x**
ROW	**0.5x**	**0.6x**	**0.6x**	**0.6x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.7x**	**0.8x**	**0.8x**	**0.8x**

Source: Morgan Stanley Research

Exhibit 117:

China Base / Bull / Bear for Total Addressable Market ($bn)

China TAM ($bn)																							
China Base TAM ($bn)	**1**	**1**	**2**	**11**	**22**	**37**	**50**	**64**	**80**	**96**	**115**	**134**	**149**	**163**	**179**	**195**	**213**	**239**	**264**	**293**	**332**	**376**	**431**
Transport/Logistics	0	0	0	4	11	20	28	35	43	50	60	68	73	78	81	84	86	93	98	103	109	115	121
Autos/Shared Mobility	0	0	0	0	0	0	1	1	2	3	5	8	11	15	22	29	40	54	71	92	120	153	197
Military/Government	1	1	1	3	2	2	3	3	3	3	3	4	6	4	5	5	5	4	4	4	4	4	4
Airlines	0	0	0	2	4	6	9	12	16	20	24	28	31	34	37	41	44	46	47	47	49	50	52
Enabling Tech	0	0	0	2	5	8	10	13	17	20	24	27	29	32	34	37	39	42	44	47	50	53	58
% of China GDP	0%	0%	0.02%	0.07%	0.13%	0.21%	0.27%	0.33%	0.40%	0.46%	0.52%	0.58%	0.62%	0.65%	0.69%	0.73%	0.77%	0.84%	0.90%	0.97%	1.07%	1.18%	1.33%
China Bull TAM ($bn)	**1**	**1**	**3**	**14**	**31**	**53**	**74**	**95**	**124**	**153**	**186**	**225**	**258**	**289**	**323**	**362**	**408**	**461**	**513**	**576**	**658**	**751**	**864**
Transport/Logistics	0	0	0	6	17	31	43	56	69	82	97	110	119	128	134	139	144	156	164	172	179	188	195
Autos/Shared Mobility	0	0	0	0	0	1	1	2	4	6	10	19	27	39	54	73	97	129	168	217	283	358	452
Military/Government	1	1	1	3	2	2	3	3	3	3	3	6	8	8	11	10	9	9	9	8	8	7	7
Airlines	0	-	0	2	4	7	10	14	20	27	35	42	50	57	63	74	86	91	94	97	101	105	111
Enabling Tech	0	0	1	4	8	12	17	21	28	35	41	47	53	57	61	66	72	75	79	82	88	92	99
% of China GDP	0.01%	0.01%	0.02%	0.09%	0.19%	0.31%	0.41%	0.50%	0.62%	0.73%	0.84%	0.98%	1.08%	1.16%	1.25%	1.35%	1.47%	1.61%	1.74%	1.90%	2.12%	2.36%	2.66%
China Bear TAM ($bn)	**1**	**1**	**4**	**7**	**14**	**24**	**31**	**38**	**47**	**55**	**65**	**75**	**83**	**88**	**95**	**100**	**105**	**116**	**125**	**135**	**148**	**163**	**180**
Transport/Logistics	0	0	0	3	9	15	20	25	30	34	41	47	50	53	55	56	57	62	67	70	75	80	84
Autos/Shared Mobility	0	0	0	0	0	0	1	1	1	2	3	4	6	8	10	13	16	20	25	30	37	46	58
Military/Government	1	1	1	2	1	2	2	2	2	2	2	3	3	3	3	3	2	2	2	2	2	2	1
Airlines	0	-	1	1	1	2	3	4	5	6	7	8	9	9	10	11	11	12	12	12	12	12	12
Enabling Tech	0	0	1	1	3	4	5	7	9	10	12	14	15	16	17	17	18	19	20	21	22	23	25
% of China GDP	0.01%	0.01%	0.02%	0.05%	0.09%	0.14%	0.17%	0.20%	0.23%	0.26%	0.29%	0.33%	0.34%	0.35%	0.37%	0.37%	0.38%	0.40%	0.42%	0.45%	0.48%	0.51%	0.55%

Source: Morgan Stanley Research

Exhibit 118:

Europe Base / Bull / Bear for Total Addressable Market ($bn)

Europe TAM ($bn)																							
Europe Base TAM ($bn)	**1**	**1**	**1**	**4**	**7**	**11**	**14**	**18**	**24**	**29**	**37**	**46**	**56**	**65**	**76**	**87**	**101**	**121**	**142**	**169**	**206**	**246**	**292**
Transport/Logistics	-	0	0	2	4	6	8	10	13	15	19	23	27	31	34	37	41	47	53	60	68	76	82
Autos/Shared Mobility	0	0	0	0	0	0	0	0	1	1	2	3	4	6	9	13	19	28	38	53	74	101	134
Military/Government	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
Airlines	-	-	0	1	1	2	3	3	5	6	8	9	11	13	16	18	21	23	25	27	30	33	35
Enabling Tech	0	0	0	1	1	2	3	4	5	6	8	9	11	13	14	16	19	21	24	27	31	35	39
% of Europe GDP	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.07%	0.09%	0.11%	0.13%	0.16%	0.20%	0.24%	0.28%	0.32%	0.36%	0.42%	0.49%	0.56%	0.67%	0.80%	0.94%	1.10%
Europe Bull TAM ($bn)	**1**	**1**	**2**	**5**	**10**	**15**	**21**	**27**	**37**	**47**	**59**	**76**	**97**	**115**	**136**	**162**	**194**	**234**	**275**	**334**	**408**	**493**	**586**
Transport/Logistics	-	0	0	2	5	9	12	16	20	25	31	37	45	51	56	62	68	79	88	99	111	124	132
Autos/Shared Mobility	0	0	0	0	0	0	0	1	1	2	3	7	10	15	23	33	46	65	90	126	175	235	307
Military/Government	1	1	1	1	1	1	1	1	1	1	1	2	3	3	4	4	5	5	5	5	5	5	5
Airlines	-	-	0	1	1	2	3	4	6	8	11	14	19	23	27	33	41	46	50	56	63	69	75
Enabling Tech	0	0	0	1	2	3	5	6	8	11	13	16	20	23	26	30	34	38	42	48	54	61	67
% of Europe GDP	0.00%	0.00%	0.01%	0.03%	0.05%	0.07%	0.10%	0.13%	0.17%	0.21%	0.27%	0.34%	0.42%	0.50%	0.57%	0.68%	0.80%	0.94%	1.10%	1.31%	1.58%	1.88%	2.20%
Europe Bear TAM ($bn)	**1**	**1**	**2**	**3**	**4**	**7**	**9**	**11**	**14**	**17**	**21**	**26**	**31**	**35**	**40**	**45**	**50**	**59**	**67**	**78**	**92**	**107**	**122**
Transport/Logistics	-	0	0	1	3	4	6	7	9	10	13	16	19	21	23	25	27	32	36	41	47	53	57
Autos/Shared Mobility	0	0	0	0	0	0	0	0	0	1	1	2	2	3	4	6	8	10	13	18	23	30	39
Military/Government	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Airlines	-	-	1	0	0	1	1	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
Enabling Tech	0	0	1	0	1	1	2	2	3	3	4	5	5	6	7	8	9	10	11	12	14	15	17
% of Europe GDP	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.05%	0.06%	0.08%	0.09%	0.11%	0.14%	0.15%	0.17%	0.19%	0.20%	0.24%	0.27%	0.31%	0.36%	0.41%	0.46%

Source: Morgan Stanley Research

Exhibit 119:

ROW Base / Bull / Bear for Total Addressable Market ($bn)

ROW TAM ($bn)																							
ROW Base TAM ($bn)	**1**	**1**	**2**	**5**	**8**	**12**	**15**	**20**	**26**	**32**	**40**	**50**	**60**	**72**	**86**	**101**	**120**	**149**	**182**	**223**	**278**	**344**	**422**
Transport/Logistics	-	0	0	2	4	6	9	11	14	17	21	25	29	34	39	43	48	58	68	78	92	106	118
Autos/Shared Mobility	0	0	0	0	0	0	0	0	1	1	2	3	4	7	10	15	23	34	49	70	100	140	193
Military/Government	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	3	3	3	3	3	3	4
Airlines	-	-	0	1	1	2	3	4	5	7	8	10	12	15	18	21	25	28	32	36	41	46	51
Enabling Tech	0	0	0	1	2	2	3	4	5	7	8	10	12	14	16	19	22	26	31	36	42	49	57
% of ROW GDP	0.00%	0.00%	0.01%	0.02%	0.03%	0.04%	0.05%	0.07%	0.08%	0.10%	0.12%	0.15%	0.18%	0.21%	0.24%	0.28%	0.32%	0.39%	0.46%	0.55%	0.67%	0.81%	0.97%
ROW Bull TAM ($bn)	**1**	**1**	**2**	**6**	**11**	**17**	**23**	**30**	**40**	**51**	**65**	**84**	**104**	**127**	**154**	**187**	**230**	**287**	**354**	**438**	**551**	**687**	**846**
Transport/Logistics	-	0	0	3	6	10	13	18	22	28	34	41	48	56	64	72	81	97	113	131	150	172	191
Autos/Shared Mobility	0	0	0	0	0	0	0	1	1	2	3	7	11	17	26	37	55	80	116	165	237	327	443
Military/Government	1	1	1	1	1	1	1	1	1	1	1	2	3	4	5	5	5	6	6	6	6	7	7
Airlines	-	-	0	1	1	2	3	4	7	9	12	16	20	25	30	38	49	57	65	74	85	96	109
Enabling Tech	0	0	0	1	3	4	5	7	9	12	14	18	21	25	29	34	41	47	54	63	74	84	96
% of ROW GDP	0.00%	0.00%	0.01%	0.02%	0.04%	0.06%	0.08%	0.10%	0.13%	0.16%	0.20%	0.25%	0.31%	0.37%	0.43%	0.51%	0.62%	0.75%	0.90%	1.09%	1.34%	1.62%	1.95%
ROW Bear TAM ($bn)	**1**	**1**	**2**	**3**	**5**	**7**	**9**	**12**	**15**	**18**	**23**	**28**	**33**	**39**	**45**	**51**	**59**	**72**	**86**	**103**	**124**	**149**	**176**
Transport/Logistics	-	0	0	1	3	5	6	8	10	12	14	17	20	23	26	29	32	39	46	53	63	73	82
Autos/Shared Mobility	0	0	0	0	0	0	0	0	0	1	1	2	2	3	5	7	9	13	17	23	31	42	57
Military/Government	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Airlines	-	-	1	0	0	1	1	1	2	2	2	3	4	4	5	6	6	7	8	9	10	11	12
Enabling Tech	0	0	1	1	1	1	2	2	3	3	4	5	6	7	8	9	10	12	14	16	18	21	24
% of ROW GDP	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.03%	0.04%	0.05%	0.06%	0.07%	0.08%	0.10%	0.11%	0.13%	0.14%	0.16%	0.19%	0.22%	0.25%	0.30%	0.35%	0.41%

Source: Morgan Stanley Research

Exhibit 120:

Global Total Addressable Market by Sector ($bn)

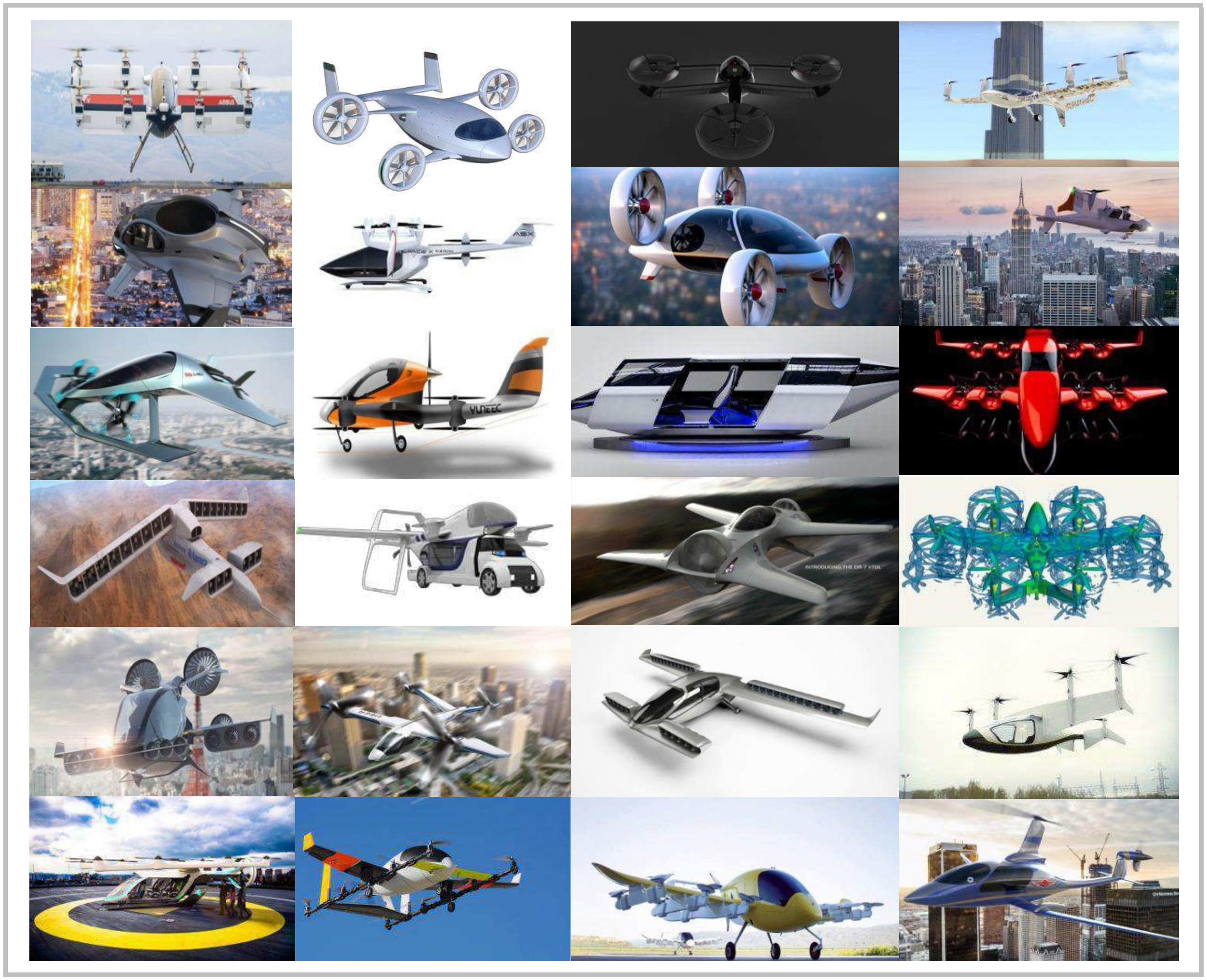
Total TAM by Sector ($bn)																							
Global TAM Base ($bn)	**4**	**5**	**7**	**25**	**45**	**72**	**96**	**123**	**156**	**189**	**231**	**277**	**322**	**365**	**419**	**476**	**544**	**641**	**744**	**871**	**1,041**	**1,238**	**1,474**
Transport/Logistics	-	0	1	10	23	40	53	68	84	99	120	140	157	175	190	204	219	248	276	306	343	381	413
Autos/Shared Mobility	0	0	0	0	0	1	1	2	4	6	10	16	24	35	50	72	102	146	200	273	375	505	674
Military/Government	4	4	4	6	3	5	5	5	5	5	6	9	12	9	12	12	12	12	12	12	12	12	12
Airlines	-	-	1	4	8	12	17	22	30	39	48	57	66	75	87	99	111	122	131	141	153	164	177
Enabling Tech	0	0	1	5	10	15	20	25	32	40	47	55	63	71	80	89	100	113	125	139	158	176	198
Global TAM Bull ($bn)	**4**	**5**	**8**	**33**	**63**	**103**	**142**	**185**	**241**	**302**	**373**	**464**	**557**	**649**	**753**	**882**	**1,041**	**1,234**	**1,445**	**1,715**	**2,064**	**2,474**	**2,954**
Transport/Logistics	-	0	1	14	35	60	83	108	135	162	195	227	257	287	313	339	367	418	461	511	561	621	668
Autos/Shared Mobility	0	0	0	0	1	1	2	4	7	12	19	40	59	87	125	177	247	346	473	647	886	1,179	1,545
Military/Government	4	4	4	6	3	5	5	5	5	5	6	12	18	19	25	24	24	24	24	24	24	24	24
Airlines	-	-	1	4	9	14	20	26	40	54	70	88	109	128	148	180	220	244	265	288	317	347	380
Enabling Tech	0	0	2	8	16	24	32	41	54	68	83	98	114	128	142	161	183	202	222	245	275	304	337
Global TAM Bear ($bn)	**4**	**5**	**11**	**17**	**29**	**46**	**59**	**74**	**91**	**108**	**130**	**155**	**178**	**199**	**222**	**243**	**267**	**310**	**353**	**402**	**466**	**537**	**615**
Transport/Logistics	-	0	1	8	18	30	38	49	58	68	82	96	108	119	128	136	145	167	188	209	237	264	286
Autos/Shared Mobility	0	0	0	0	0	1	1	2	3	4	6	9	13	18	23	31	41	54	70	90	118	152	198
Military/Government	4	4	4	5	3	4	4	4	4	4	4	6	7	6	7	7	6	6	6	6	5	5	5
Airlines	-	-	3	1	3	4	5	7	9	12	14	17	19	21	24	26	29	32	33	35	37	39	41
Enabling Tech	0	0	3	3	5	8	10	13	17	20	24	28	32	35	39	43	46	51	56	62	69	77	85

Source: Morgan Stanley Research

Miscellaneous

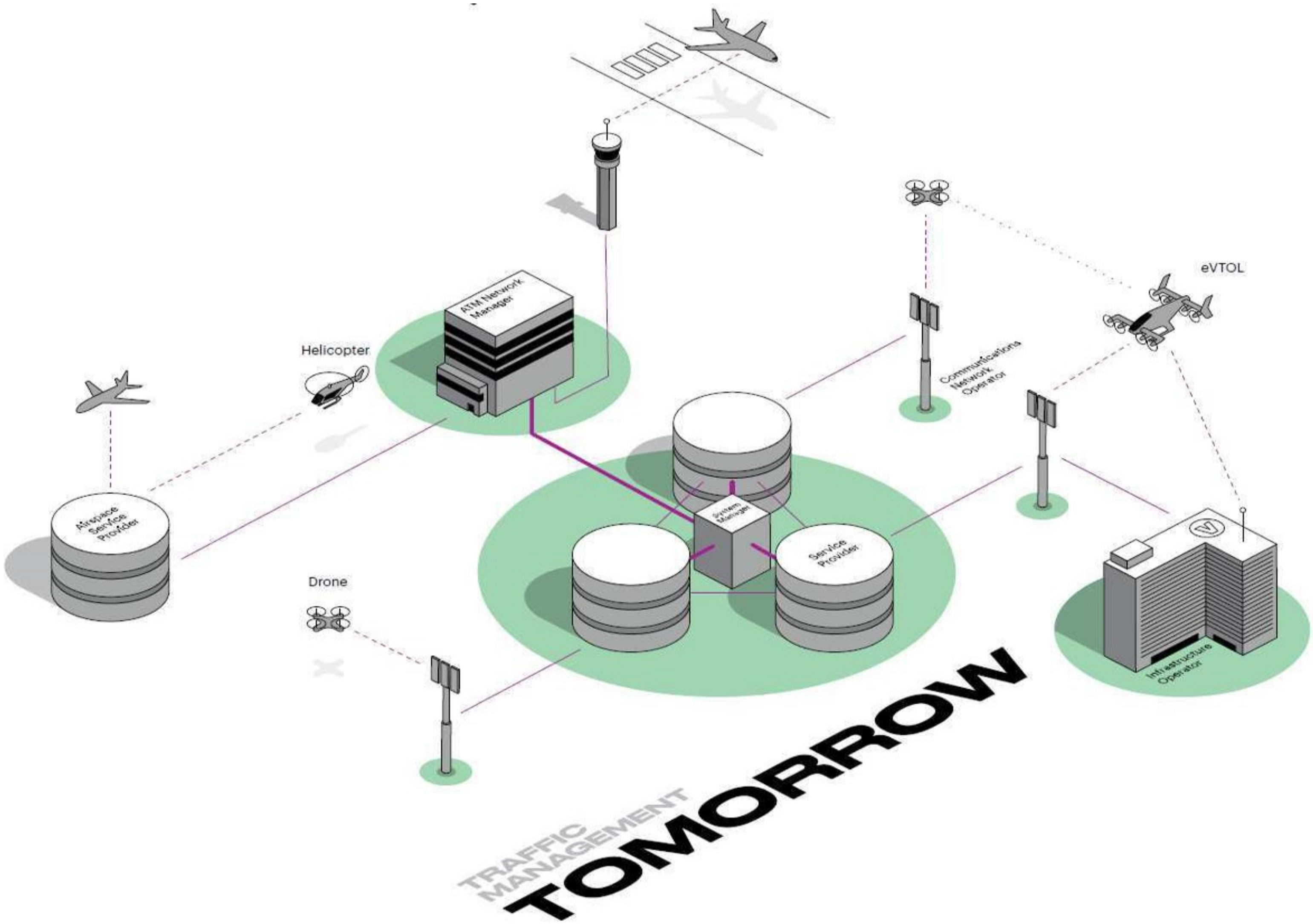
Exhibit 121:

eVTOL Concept Designs for Urban Air Mobility (Non-Exhaustive)



Source: eVTOL News, Company websites, Morgan Stanley Research

Exhibit 122:
Airbus Sample Air Traffic Management Infrastructure



Source: Airbus, Morgan Stanley Research

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(as of October 31, 2018)

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	Coverage Universe		Investment Banking Clients (IBC)			Other Material Investment Services Clients (MISC)	
Stock Rating Category	Count	% of Total	Count	% of Total IBC	% of Rating Category	Count	% of Total Other MISC
Overweight/Buy	1157	37%	305	42%	26%	544	39%
Equal-weight/Hold	1380	44%	335	46%	24%	632	45%
Not-Rated/Hold	47	1%	7	1%	15%	7	0%
Underweight/Sell	553	18%	82	11%	15%	220	16%
Total	3,137		729			1403	

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Equal-weight (E or Equal) - The stock's total return is expected to be in line with the total return of the relevant country MSCI Index or the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis over the next 12-18 months.

Not-Rated (NR) - Currently the analyst does not have adequate conviction about the stock's total return relative to the relevant country MSCI Index or the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Underweight (U or Under) - The stock's total return is expected to be below the total return of the relevant country MSCI Index or the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Unless otherwise specified, the time frame for price targets included in Morgan Stanley Research is 12 to 18 months.

Analyst Industry Views

Attractive (A): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be attractive vs. the relevant broad market benchmark, as indicated below.

In-Line (I): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be in line with the relevant broad market benchmark, as indicated below.

Cautious (C): The analyst views the performance of his or her industry coverage universe over the next 12-18 months with caution vs. the relevant broad market benchmark, as indicated below.

Benchmarks for each region are as follows: North America - S&P 500; Latin America - relevant MSCI country index or MSCI Latin America Index; Europe - MSCI Europe; Japan - TOPIX; Asia - relevant MSCI country index or MSCI sub-regional index or MSCI AC Asia Pacific ex Japan Index.

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INDUSTRY COVERAGE: Autos & Shared Mobility

COMPANY (TICKER)	RATING (AS OF)	PRICE* (11/29/2018)
Adam Jonas, CFA		
Avis Budget Group Inc (CAR.O)	U (06/26/2018)	$29.08
Ferrari NV (RACE.N)	E (08/02/2018)	$109.21
Fiat Chrysler Automobiles NV (FCHA.MI)	O (02/24/2016)	€14.82
Fiat Chrysler Automobiles NV (FCAU.N)	O (02/24/2016)	$16.87
Ford Motor Company (F.N)	E (10/19/2018)	$9.37
General Motors Company (GM.N)	O (04/09/2018)	$36.76
Harley-Davidson Inc (HOG.N)	O (05/06/2013)	$42.49
Hertz Global Holdings Inc (HTZ.N)	U (09/14/2017)	$18.65
Tesla Inc (TSLA.O)	E (05/15/2017)	$341.17
Armintas Sinkevicius, CFA, CPA		
Adient PLC (ADNT.N)	U (07/31/2018)	$23.53
American Axle & Manufacturing Holdings Inc (AXL.N)	O (03/22/2018)	$12.19
Aptiv Plc (APTV.N)	U (12/05/2017)	$71.50
Asbury Automotive Group Inc (ABG.N)	E (07/10/2018)	$69.07
AutoNation Inc. (AN.N)	U (07/10/2018)	$37.15
BorgWarner Inc. (BWA.N)	O (03/22/2018)	$39.37
Carmax Inc (KMX.N)	O (07/10/2018)	$66.09
Delphi Technologies PLC (DLPH.N)	E (10/15/2018)	$16.84
Goodyear Tire & Rubber Company (GT.O)	E (08/13/2018)	$23.07
Group 1 Automotive, Inc (GPI.N)	E (11/14/2018)	$55.97
Lear Corporation (LEA.N)	O (07/31/2018)	$134.87
Lithia Motors Inc. (LAD.N)	O (07/10/2018)	$83.25
Magna International Inc. (MGA.N)	U (03/22/2018)	$49.51
Penske Automotive Group, Inc (PAG.N)	O (07/10/2018)	$43.38
Sonic Automotive Inc (SAH.N)	U (07/10/2018)	$15.76
Tenneco Inc. (TEN.N)	U (11/14/2018)	$33.34
Visteon Corporation (VC.O)	U (03/22/2018)	$73.76

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* Historical prices are not split adjusted.

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