FLYING INTO THE FUTURE

A Roadmap For Santa Clara County To Lead In The Multi-Billion Dollar Aviation Industry

ABSTRACT

The multi-billion dollar aviation industry is poised to undergo significant changes in the upcoming years. This paper highlights how Santa Clara County and northern California can leverage their portfolio of capabilities to position themselves as leaders in that transition.

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Supporters

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1 Introduction

In July 2003, Tesla, Inc. was founded with a goal of bringing electric vehicles to the masses. In 2004/2005, the DARPA Grand Challenge was a prize competition for vehicles to autonomously navigate a 142-mile course in the Nevada desert. Although it has taken nearly two decades, the technologies emanating from electrification and automation are poised to fundamentally transform vehicle transportation and the $545 billion dollar a year US automotive market.

Numerous companies and jobs were created by this transition. Many of the necessary technologies were enabled by Silicon Valley innovation. As a result, traditional car companies, new startups, and many semiconductor companies began R&D and manufacturing in our area to address the transition. This transition has begun and is driving and strengthening the economics of local businesses and the region.

Aviation is another existing multi-billion dollar a year market poised to undergo substantial changes in the next decade. Not coincidentally, many of the innovations driven by autonomous and electric vehicles provide the foundation for this change in aviation. Santa Clara County and the surrounding region are well positioned to be centers of innovation and manufacturing for this transition.

The aviation transition is an opportunity to bring multi-billion dollar economic benefits to Santa Clara County and the region.

This white paper is intended to provide a background on the aviation market to help inform policy decisions that Santa Clara County will make regarding its aviation infrastructure. This white paper outlines the economic market opportunity of aviation both nationally and at the state level (Section II), and reviews the drivers and enablers of emerging inflection points in aviation (Section III). More locally, the white paper identifies unique challenges we have in the region and how aviation can address them (Section IV).

This paper goes on to lay out our region's strength in the aviation market (Section V) and the broader economic and regional benefits (Section VI) that we can expect if we invest in aviation as a growth opportunity for the county. Specific measures that the county can pursue from short- to long-range are outlined (Section VII). Given the size of the opportunity, other regions are actively pursuing these markets; Section VIII explores some of the activities within those markets.

Contents

Abbreviations

AAM	Advanced Air Mobility; i.e., NASA program to advance unmanned aircraft operations
AAO	Authorized Areas of Operation; i.e. FAA assigned space for aircraft operation
ATM	Air Traffic Management; i.e., management system for all air traffic
AvGas	Aviation gas
BVLOS	Beyond Visual Line of Sight
eVTOL	Electrical vertical take-off and landing aircraft
FAA	Federal Aviation Administration
FBO	Fixed Base Operator; they provide flight training and aircraft services on an airfield
ICE	Internal combustion engine; i.e., conventional gas powered engine
lUAS	Large Unmanned Aircraft System (more than 55 pounds or 20 kg)
sUAS	Small Unmanned Aircraft System (less than 55 pounds or 20 kg)
UAM	Urban Air Mobility; i.e. air-taxi service
UAS	Unmanned Aircraft System; e.g. drone
UTM	UAS Traffic Management; i.e., management system coordinating unmanned aircraft traffic
VLOS	Visual Line of Sight
VTOL	Vertical take-off and landing aircraft; e.g., often a drone or helicopter

2 Aviation: A Very Large Market

Aviation, both at the national level and within California, is a major driver of jobs and the economy.

2.1 Aviation Nationally

The Federal Aviation Administration (FAA) reported in their 2020 Economic Impact Report that aviation directly contributed $336 billion dollars in 2016 to the United States economy.[1] Beyond this, dollars spent in aviation have secondary impacts on the economy; employees purchase meals, live in homes, and spend their income within the community. The combined primary and secondary output of aviation was estimated to be $847 billion dollars in 2016; the number of jobs employed through aviation was 4.121 million.[2] Not included within these numbers are visitor expenditures, which would more than double these amounts.

Within these broader aviation numbers is a subset that will be explored within this whitepaper. These are areas in which the broader Bay Area could increase participation in the future or is already participating.

National Impact of Aviation (2016) in Current Dollars			
	Primary ($B)	**Primary and Secondary ($B)**	**Jobs (thousands)**
Civilian Aircraft Manufacturing	58.0	144.4	607
Civilian Aircraft Engine and Engine Parts Manufacturing	8.0	18.6	78
Civilian Other Aircraft Parts and Equipment Manufacturing	29.0	71.0	331
Civilian Avionics Manufacturing	10.5	25.7	120
Civilian Research and Development	13.3	40.4	223
General Aviation Operations	21.9	52.3	226
General Aviation Aircraft Manufacturing	11.6	28.8	121
Source: *"The Economic Impact of Civil Aviation on the U.S. Economy", Federal Aviation Administration, January 2020*			

Table 1 National Impact of Aviation (2016) in Current Dollars

General Aviation is any aircraft that is not used for scheduled commercial air service or operated by the military. General aviation includes personal-use aircraft, business aircraft, helicopters, aircraft operated by flight schools, and on-demand passenger or cargo transportation under Federal Aviation Regulation Part 135.

Looking specifically at General Aviation, a Price Waterhouse Coopers study "Contribution of General Aviation to the US Economy in 2018" found the segment employed nationally 31,900 full- and part-time workers in the manufacture of general aviation aircraft. An additional 73,600 were employed as suppliers and vendors, for a combined direct impact of 105,500 jobs. These workers earned $11.0 billion in labor income. [3]

That same study found an additional 168,000 workers were directly involved in the operation and maintenance of general aviation aircraft, including flight training, nonscheduled air transportation, sight-seeing, and support activities for air transportation such as a fixed base operators. [4]

Indirect and induced jobs were an additional 791,300 workers. [5]

National Impact of General Aviation			
	Aircraft and Component Manufacturing	**Operations And Maintenance**	**Indirect and Induced**
Jobs	105,500	168,000	791,300
Labor Income ($B)	$11.0	$14.5	$46.3
Source: *Price Waterhouse Coopers study "Contribution of General Aviation to the US Economy in 2018"*			

Table 2 National Impact of General Aviation

2.2 Aviation in California

The California State Senate has also recognized that general aviation alone contributes $30.2 billion to California economy. California aerospace contributes directly and indirectly to 203,000 and 308,000 jobs, respectively. And **the emergence of unmanned aircraft systems (UAS) – colloquially referred to as drones – technology is expected to drive 18,000 jobs and $14 billion in economic impact in the first decade of drone integration into the airspace.** [6]

The Price Waterhouse Coopers study recognized California as the largest state provider of jobs for General Aviation, with 148,300 people employed. California derived 31,900 jobs directly from aviation; for each aviation job, 3.6 jobs were created elsewhere in the economy either through the supply chain (indirect) or through spending of household income (induced). In the case of California, there were an additional 116,400 indirect and induced jobs from general aviation.[7]

California Impact of General Aviation		
	Directly involved in General Aviation	**Indirect and Induced**
Jobs	31,900	116,400
Labor Income ($B)	$3.756	$7.593
Source: *Price Waterhouse Coopers study "Contribution of General Aviation to the US Economy in 2018"*		

Table 3 California Impact of General Aviation

In February 2019 at the California State Capitol, general aviation industry groups shared the following additional perspectives about the role of aviation within California.[8]

California General Aviation "Fact Sheet"	
US Economic impact	$175.7 billion
US Jobs	1.1 million
Aircraft, engines, parts & avionics manufacturing in California	$31.8 billion
Research and development in California	$3.8 billion
FAA spending in California	$1.6 billion
Jobs created by FAA spending in California	10,473
FAA certified pilots (2018)	59,929 (10.6% of the U.S. total)
Source: *Aviation in California: Fact Sheet (February 2019)*	

Table 4 California General Aviation "Fact Sheet"

3 Aviation at an Inflection Point

Technologies developed for autonomous electric vehicles are now finding their way into aviation. Long-term, they will enable new aviation markets and services. Short term, conventional general aviation is adapting to address market needs.

3.1 Unmanned Aircraft Systems (UAS)

Before diving into the UAS – colloquially referred to as drones – market, it is instructive to briefly examine some of the emerging trends in conventional vehicles as they provide a quasi-blueprint for the aviation industry.

3.1.1 Vehicle Innovations

Electrification of vehicles

Passenger car electrification has seen significant growth and interest driven by various factors and enablers:

- **Reduction of air pollutants**
- **Improvement in battery and electrical powertrain technology.** These improvements have improved customer acceptance of the technology by enabling similar or better performance to internal combustion engine (ICE) vehicles, as well as augmenting ICE vehicles through hybrid solutions. In addition, these developments improve customer confidence that the life of the vehicle will not be compromised by the battery.
- **Simplification of maintenance and operation.** Simpler cars requiring less maintenance. No more oil changes or going to the gas station; no engine maintenance or failures.
- **Improved performance and availability of charging infrastructure**. Faster charging at more places to increase customer acceptance of electric vehicles.
- **Government interest and promotion.** The US and international governments have various motivations to see this technology mature and have consequently looked at ways to accelerate that maturity. The motivations include reduction of air pollutants, but also a mechanism to position their geographies for economic success in this trillion dollar market and in the related services. For this reason, governments – international and domestic – have provided a combination of tax incentives, research dollars, and regulation to promulgate their region's success.

Automation of vehicles

Vehicle autonomy is similarly generating great interest within the transportation market. The driver and enablers are substantially the following.

- **Safety.** Vehicle accidents, especially through human-failure, pose a major economic toll on society. Furthermore, car manufacturers have recognized that "safety sells"; they can often recover investments that they make in safety in the sale price of the vehicle or in market share gains.
- **New business models.** Autonomy eliminates the cost of the driver for many industries, which enables businesses to more easily and cost-effectively scale. In addition, by designing a vehicle for a service rather than for the comfort of the driver, new types of optimized vehicles can be developed that provide greater service and value while reducing costs. These vehicles can then have a substantial impact on numerous industries ranging from agriculture, to delivery, to ride sharing, to mall security.
- **AI and machine learning and sensing.** Emerging and existing compute capabilities, coupled with improved sensing capabilities (camera sensors, LIDAR), are enabling rapid progression of safe autonomy.

Given the substantial R&D and progress that has been made in both the electrification and automation of vehicles, the aviation industry can now begin to leverage and explore these same dynamics for their own market.

3.1.2 UAS: A Confluence of Enablers

Leveraging and adopting numerous developments in vehicle technology, the UAS market is expected to grow significantly over the coming years. On top of this, regulatory and airspace changes will also accelerate the proliferation of UAS businesses and drive UAS manufacturing and adjacent services.

3.1.2.1 Battery Technology and Power Delivery Systems … And a Reduction of Air Pollutants

Aviation must pay critical attention to two forces that are less of an issue with vehicles: drag and lift. Fundamentally, these two forces affect the range of flight and payload of an aircraft. The easiest way to reduce drag is to make the object smaller; similarly, the easiest way to improve lift is to reduce weight.

Lithium-ion battery has energy density by mass of 0.4 to 0.9 MJ/kg and by volume of 1 to 2.6 MJ/L, whereas avgas (100LL) has energy density by mass of 44 MJ/kg and by volume of 32 MJ/L. This means that you need roughly 44x (44/0.9) more weight with batteries to achieve the same amount of energy, or about 12x (32/2.6) more volume.[9]

At first glance, it would appear that traditional aviation fuel would be a more effective solution. However, there are tradeoffs and innovations that are pushing the industry towards batteries:

- **Conversion efficiency.** With improved conversion efficiency, the initial amount of fuel needed to accomplish a mission is reduced.
    - Electric motors are intrinsically more efficient than ICE at converting its stored energy to work. Electric motors generate less wasted heat than an ICE.
    - Emerging silicon carbide (SiC) and gallium nitride (GaN) semiconductor technology improves motor efficiency versus conventional Metal Oxide Silicon Field Effect Transistor (MOSFET) and insulated-gate bipolar transistor (IGBT) technology currently used. These new technologies enable the operation at higher voltages and faster switching speeds, which translates into improved efficiency.[10] The high voltages enabled by these technologies also reduce cabling weight and volume, which improves aircraft performance.
    - Improving motor controller technology allows the motors to operate at higher speeds and with greater efficiency.
- **Battery technology.** Both chemistry and battery management systems are rapidly improving.
- **Serviceability.** Battery motors are simpler to service and maintain.
- **Recharging Infrastructure.** Electricity charging infrastructure is more ubiquitous than Avgas and motor vehicle fuel affording easier recharging opportunities.
- **Code issues.** For larger UAS operating on existing structures and buildings, it will not be possible to bring liquid fuels (refueling) to the tops of these buildings for both safety and practical reasons.
- **Business models.** Ranges are substantially shorter for UAS than aircraft for many business models and markets; these shorter ranges fall within the operating envelope of battery-powered aircraft. A UAS operating at 100 mph can accomplish many types of missions within a 30 minute operating window.

In short, and at the risk of over simplifying, there are business reasons and technology enablers that will allow UAS to have sufficient performance with batteries. This will also have the additional benefit of reducing air pollutants.

Regardless, these are technical issues understood in Silicon Valley; they have been previously solved by Silicon Valley companies for vehicles, and Silicon Valley companies will solve them for future aircraft.

3.1.2.2 Materials and Composites

Advances in material technology – including 3D printing, nano-technology, adhesives, and other specialized materials - are allowing aviation vehicle materials to improve form-factor (reducing drag), strength without compromising weight (improving lift), and aerodynamics (reducing drag and improving lift). Future innovations will allow motors to be lighter, wings and propellers to change shapes based on flight requirements (take-off versus cruise versus landing), surfaces to reduce their drag, and other amazing innovations.

3.1.2.3 Automation, Communication, and Sensing

Aviation autonomy, similar to vehicular autonomy, has the potential to improve aviation economics by removing the pilot and to enable optimized aircraft for specific business models. In many respects, however, autonomy in aviation is easier than in vehicles.

Vehicles operate on a fixed infrastructure: existing roads and bridges on the ground define the path that a vehicle may take. Aviation removes those constraints of a road on the ground, allowing more flexibility in XY (not confined to the width of a physical road) *and* Z (adding altitude) directions; more separation between objects is possible. Where a ground vehicle may follow directly behind another vehicle by less than two seconds on a road and two vehicles on adjacent lanes might be separated by inches, aircraft are not operating as closely and the time to evaluate and execute maneuvers is greater. This proximal and temporal separation and flexibility actually makes aviation autonomy in many respects easier than vehicle autonomy.

Airspace design also enables traffic separation; different size aircraft moving at different speeds and moving in different directions are separated by design. For example, small UAS traffic is currently restricted to below 400 feet above ground level (roughly the height of a 40 story building), whereas general aviation aircraft must generally operate over 1000 feet above ground level and most operate below 15,000 feet. The largest and fastest commercial aircraft generally operate above 18,000 feet. Different size aircraft operating at different speeds are separated; conversely, vehicle traffic often finds trucks, cars, pedestrians, animals, cyclists all sharing the road and in close proximity. This traffic separation by design also makes aviation autonomy in many respects easier than vehicle autonomy.

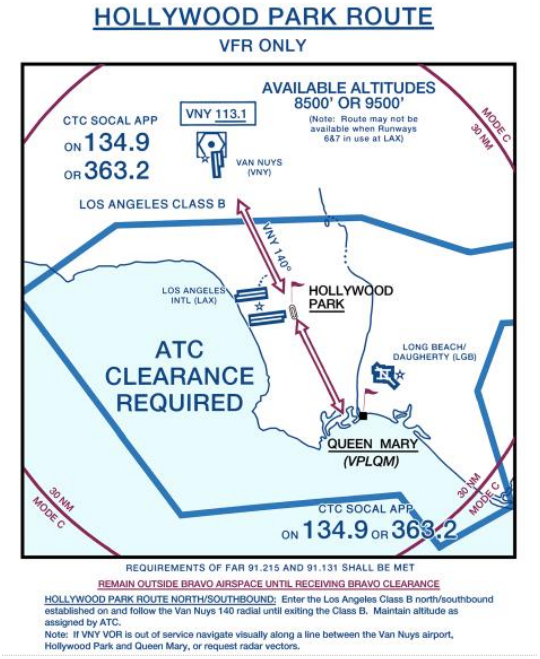

Figure 1 An example of a "VFR corridor" where pilots can transition over the extremely busy LAX airport with minimal communication and interaction provided they stay on a very specific course and altitude.

Extending the concept of traffic separation, it is possible, through GPS, to create virtual "highways in the sky"; dedicated corridors for specific types of aircrafts or operations. An example of this currently in operation is the general aviation corridors that allow smaller airplanes to pass through the busy "Class B" airspaces – similar to that found in the Los Angeles basin and around LAX – without talking to air traffic control. Once again, this traffic separation also makes aviation autonomy in many respects easier than vehicle autonomy.

Finally, aviation traffic is less dense than ground traffic, and there are fewer players to coordinate movement with. This also eases the challenges of aviation autonomy.

While automation is easier, complexity elsewhere in the system is introduced. Accurate GPS position reporting is needed in XY *and* Z dimensions at rates enabling high travel speeds while overcoming and accommodating signal issues, reflections, urban canyons, and atmospheric pressure issues. The ability to detect birds while enroute (UAS will often be quieter so potentially birds may have less ability to respond) and to avoid trees and power lines and random animals when landing; it may be necessary, for example, for an individual on the ground to assist in identifying a safe area to land. Identifying obstacles may be more difficult, since there is no surface upon which to focus a search, and objects below an aircraft may not be readily visible against ground clutter. Finally, aviation will likely require the development of communication networks that can handle a substantial increase in the number of aircraft and the amount of data that will be needed to safely remotely operate.

Once again, these are technical issues understood in Silicon Valley. Items like automation, sensing, and communication are topics and areas of ongoing innovation for Silicon Valley companies. And, in some cases, some of the technology may be more quickly introduced in aviation than on city streets.

3.1.2.4 Government Interest and Promotion

Initial federal regulations placed UAS within the scope of remote controlled model airplanes in December 2015; Part 107 commercial drone operations went into the Federal Register in April 2016, but were still largely based on requirements for remote controlled model airplanes. As such, FAA waivers were needed for operations such as night, over people, beyond visual line of sight (BVLOS), certain altitudes, and over a moving vehicle. [11]

These limitations on operations severely curtailed potential business models emerging for UAS operation; at the same time, these limitations did not exist in other countries. A concern emerged that the US would fall behind in developing this valuable industry.

On February 13, 2019, the FAA issued a notice of proposed rulemaking (NPRM) titled Operation of Small Unmanned Aircraft Systems over People, which proposed to modify these regulations to permit routine operations of small unmanned aircraft over people, at night, and over vehicles, all under certain conditions. On December 28, 2020, the FAA published the final rules for Part 107 making these changes; these rules are expected to become active in January 2021.[12]

These rules and others being proposed to the FAA are intended to enable the US to lead the drone industry world-wide.

3.1.2.5 UAS Flight Planning - FAA

In addition to the broader operational changes being made to license UAS pilots and the aircraft, significant changes are being considered by the FAA to integrate UAS Traffic Management (UTM) with the National Airspace System (NAS). Under current rules, UAS are basically prohibited from operating in controlled airspaces; this limits many potential UAS applications and commercial services that would benefit from operating within controlled air spaces, such as in and out of an airport area or above 800 feet.

In March 2020, the FAA released their NextGEN UTM Concept of Operations (ConOps) v2.0 which outlines scenarios and goals for integrating UAS into controlled airspace. At a high level, "V2.0 updates and expands the set of operational scenarios, describing more complex operations in denser airspace, including beyond visual line of sight (BVLOS) operations in controlled airspace."[13]

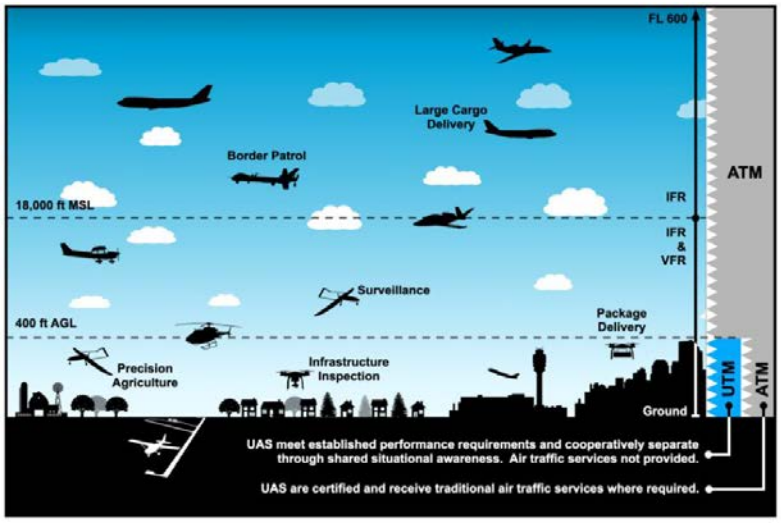

Figure 2 Showing interaction of UAS in the national airspace air traffic management environment

It is envisioned that UAS will operate in areas that require interaction with air traffic management (ATM) and managed airspaces for many applications. To make that happen, considerable development will be required.

There are a couple items worth highlighting.

First, considerable industry development and innovation will be required: vehicle to vehicle and vehicle to ground communication, security infrastructure, real time tracking and monitoring, integration with supplemental service providers (weather, terrain, obstacle), data bases, aircraft systems, and highly reliable software and networking. These technologies are the life-blood of Silicon Valley, and many participating companies will benefit in having a local area in which to test and develop their technologies.[1]

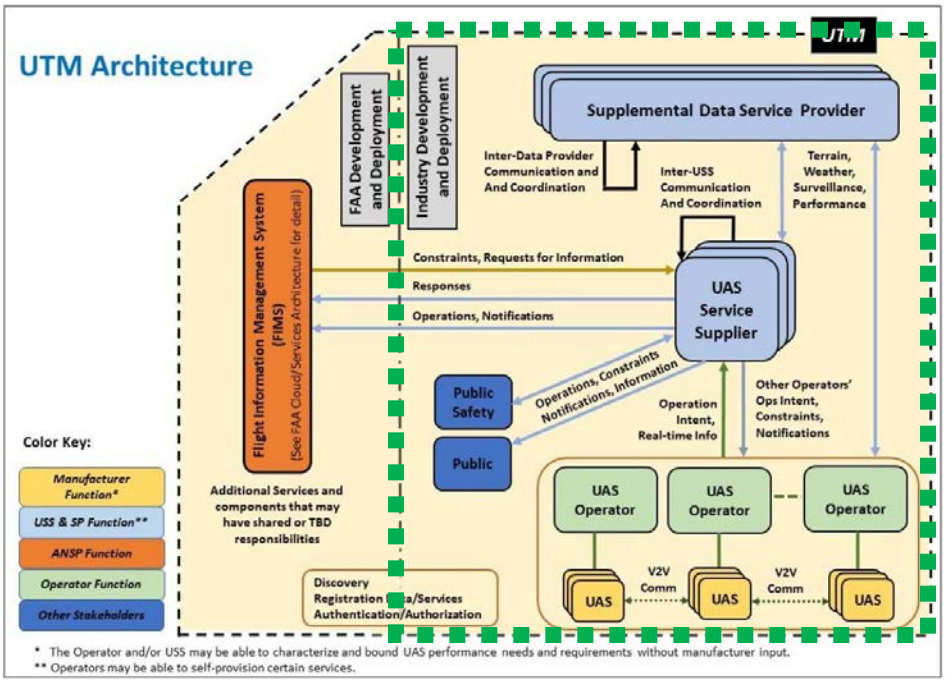

Figure 3 The communication and interaction between the many services required for UTM. (Credit: NASA)

A second anecdotal item worth highlighting is an example use case that the FAA uses. At a high level, it highlights some of the many UAS activities that might be active within a community.

[1] The FAA refers to these areas as Authorized Areas of Operation (AAO).

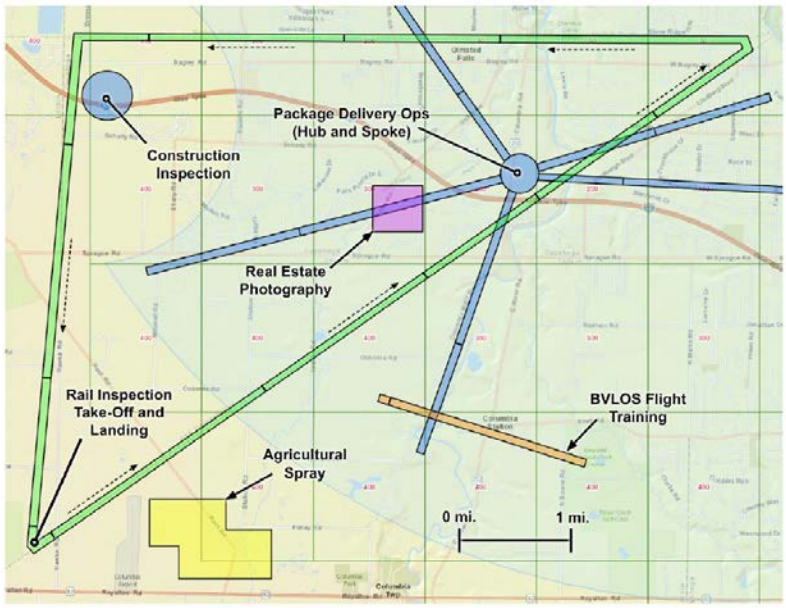

Figure 4 Example of the various airspaces for UAS activities operating under and within the national airspace. (Credit: NASA)

Their example highlights the various applications (that will require different types of UAS developments); the complexity of interaction (that will require both extensive software and communication); the operational ranges (that will require innovation in batteries and battery management systems); security, safety and reliability (that will drive software and silicon development); and the potential impact on roads and congestion by taking traffic "vertically".

These are all developments and business models that will emerge in coming years. These are all areas of expertise of Santa Clara County companies.

3.1.2.6 NASA Advance Air Mobility: Bringing It All Together

NASA is bringing the disparate pieces together with their Advanced Air Mobility (AAM) effort. Their vision "is to help emerging aviation markets to safely develop an air transportation system that moves people and cargo between places previously not served or underserved by aviation – local, regional, intraregional, urban – using revolutionary new aircraft that are only just now becoming possible."[14]

They recognize that multiple businesses and activities need to come together to enable these new markets and are providing the organizational framework to enable that interaction.[15] These five "pillars" frame the effort required to enable UAS businesses including, but not limited to, air transportation of people and freight.

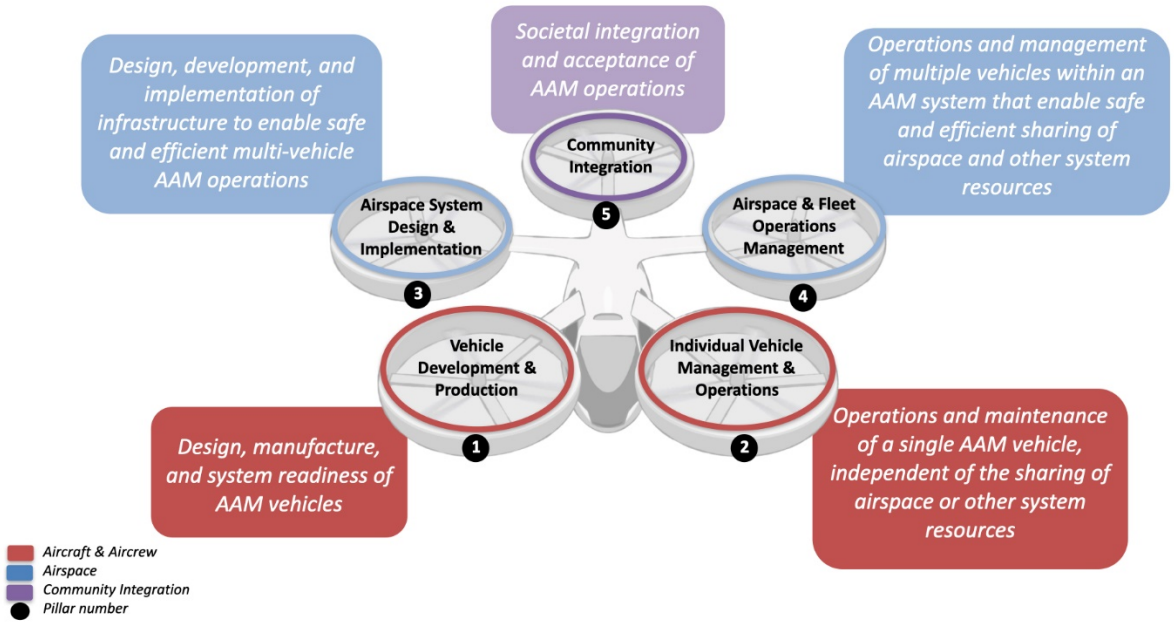

Figure 5 NASA five pillars of Advanced Air Mobility (Credit: NASA)

Below is a slide that they provided to lay out the various companies and organizations involved in the limited (though very complex) effort of enabling aerial passenger transport; this slide does not capture other UAS markets.[16] This slide provides an example of the number of companies and jobs that will be created to service this market.

Community Landscape - Passenger Carrying Focus

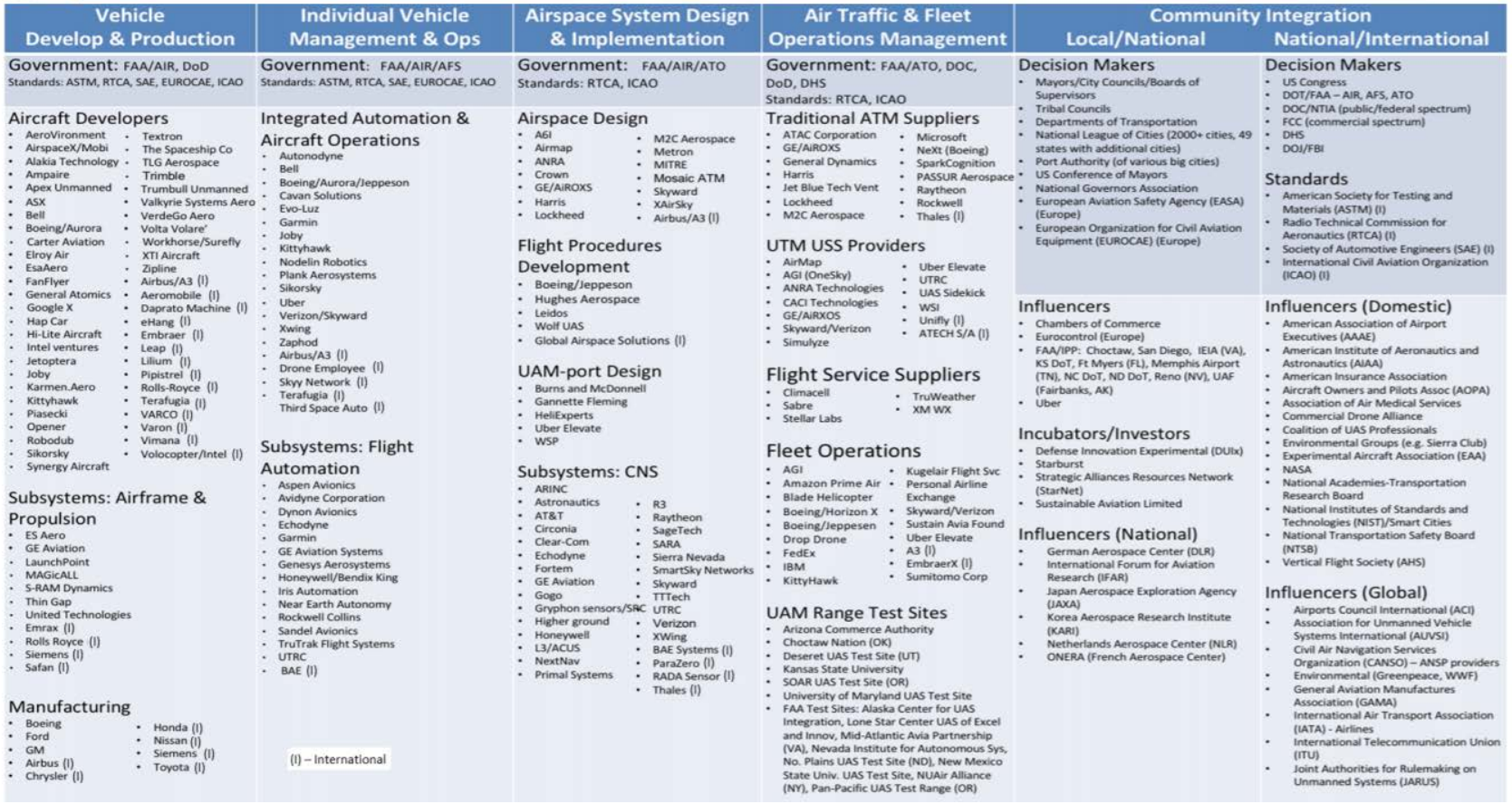

Figure 6 An example of the numerous companies involved in developing technology for airborne carrying of passengers. (Credit: NASA)

3.1.3 New Business Models and Emerging Uses

The confluence of technology innovation and government support at both the national and state level is enabling companies to explore a variety of new and emerging applications for UAS.

Below is just a brief sampling; each of the items below has multiple sub-applications within it.

- Public safety (fire, traffic, wild fires, search and rescue, blood delivery)
- Cargo / deliveries (urban and rural package deliveries)
- Infrastructure inspection (pipelines, wind turbines, roads)
- Surveillance (sports events, crowds)
- Weather monitoring
- News gathering (sports, events, traffic)
- Agriculture (harvesting, crop inspection, irrigation management, spraying, seeding)
- Mapping (street view, high def mapping)
- Disaster relief (earthquake, wild fires, tsunami support)
- Entertainment industry (film, TV)
- Construction (inspections, mining)
- Consumer (realty, personal entertainment, photography)
- Air metro (i.e. "aerial bus service" along given routes) / Air taxi (i.e. "aerial taxi service" akin to Uber)

Each of these represents a new business opportunity for some (or multiple) company to pursue.

These new applications will drive the construction of UAS vehicles; they will drive new service industries; they will drive new supply chains; they will drive new innovation; and they will drive supporting activities like housing and shopping.

To provide a narrow example of how UAS will change things, NASA-funded UAM market studies by Booz Allen Hamilton and Crown Consulting found that

- By ~2028 "air metro" could be profitable and by ~2030 result in ~750M annual passenger trips in 15 metro areas[17] or 137,000 passenger trips/day/area.[18]
- By ~2030 "last mile package delivery" could be profitable and result in ~500M deliveries annually[19]
- Price for delivery in 2030 could approach $4.20 for a five pound payload[20]
- Airport Shuttle and Air Taxi markets are viable markets with a significant total available market value of $500B annually at the market entry price points in the best-case unconstrained scenario. After applying operational constraints/barriers, 0.5% of the total available market worth $2.5B can be captured in the near term. For comparison, the report indicates that US domestic airline industry is only ~$150B annually[21] or 8200 passenger trips/day/area. [22]

In short, it is these emerging opportunities that the California Senate had in mind when they said that the emergence of UAS would drive 18,000 jobs and $14 billion in economic impact in the first decade of drone integration into the airspace. [23]

3.1.4 Projected Growth of Market

The FAA divides the UAS market into small (sUAS) and large (lUAS) aircraft, with 55 pounds (25 kg) of aircraft plus payload being the dividing point between the two segments. As the market is nascent, FAA projections are relatively short-term in nature and are focused largely on existing use cases and business models; this contrasts with 20-year projections that the FAA offers on mature markets such as commercial jet aircraft and passenger traffic.

With that limitation in mind, the FAA provided in 2020 the following forecast for sUAS and lUAS. [24]

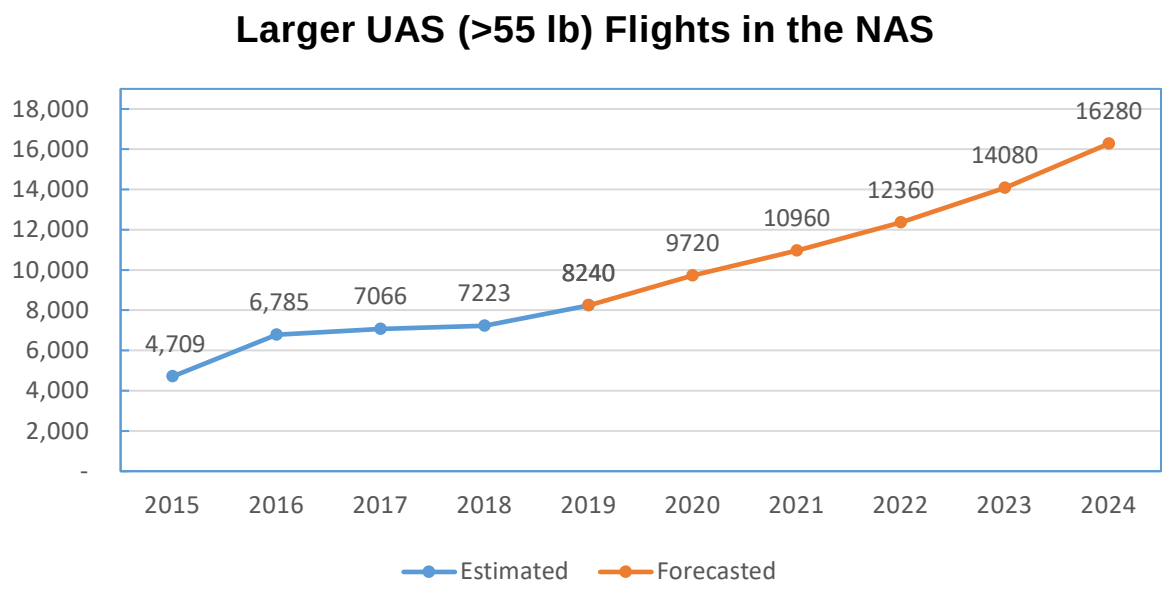

Figure 7 Flight operations of larger UAS (greater than 55 pounds or 20 kilograms) vehicles

The level growth of lUAS these last few years reflects that most of the operation of lUAS is by the military, whereas the emerging growth is projected from commercial applications.[25] The lUAS report also indicates that this number does not reflect many flights that will occur below controlled airspace, such as those serving agricultural and emergency response; these flight will add to what is shown above.[26] In addition, many potential large markets such as package delivery are not expected to have significant growth within the forecasted period (through 2024); achieving the earlier mentioned projection of 500 million packages annually shipped in 2030 would accelerate the growth of these numbers considerably outside of the forecast period.

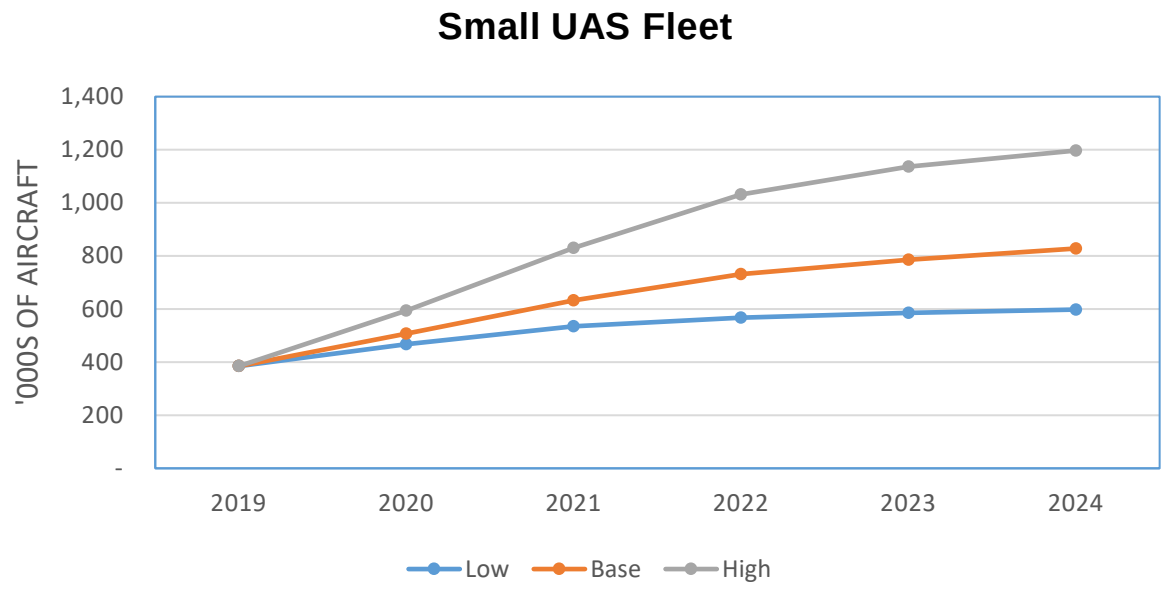

Figure 8 Projections on the number of small UAS vehicles in the North American fleet

For sUAS, the FAA projection reflects a CAGR of 9%, 17%, and 25% for low, base, and high projections, respectively, through 2024. It is worth noting that the FAA feels the market is still in its early stages during this time and that growth may non-linearly accelerate in the future with improvements in technology, regulations, and new business models.[27]

3.2 Industry Changes Driving Increased Need for Pilots

With changes in industry dynamics, it is projected that there will be a significantly increased need for pilots.

3.2.1 UAS

With the aforementioned growth in UAS, the need for remote pilots to operate these UAS vehicles is expected to also proportionately increase. The FAA projects the following needs for remote pilots. [28]

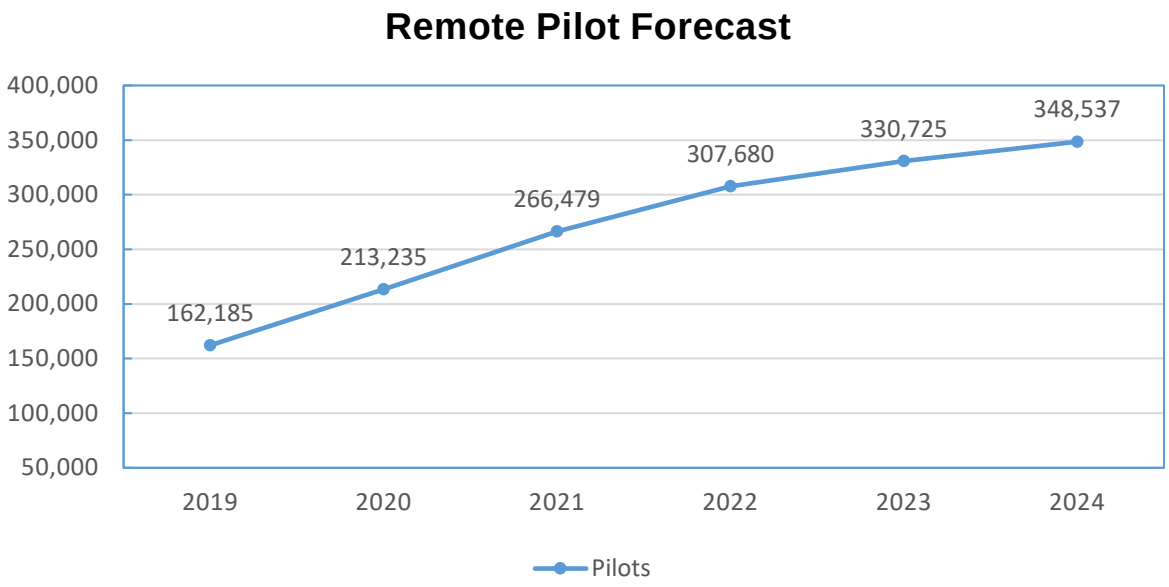

Figure 9 Number of pilots needed to support UAS aircraft in next four years

These jobs go well beyond traditional "joy-stick" operations that recreational pilots historically performed. Pilots will need to be familiar with airspace and flight rules; complex aircraft, their systems, and performance; programming of routes and navigation; meteorology; planning and potentially supervision of multiple autonomous aircraft simultaneously (similar to an air traffic controller); and will have tremendous responsibility in insuring operational safety. UAS pilots will need to become a "Part 107" certificated Remote Pilot and Commercial Operator, requiring passing the necessary FAA knowledge tests and recurrent knowledge tests; and TSA background checks.[29] As such, these are going to be well paying jobs requiring a solid education.

The FAA report goes on to add that the need for remote pilots "may enhance even more if larger UAS are used in commercial activities and urban air mobility become a reality in the near future." [30]

3.2.2 Increasing Need for Commercial Pilots and Aviation Personnel

There are various factors that are driving the need for pilots of conventional jets and aircraft.

- **Average age.** The average age of airline transport pilots – those pilots that fly larger turbine jets – has steadily been increasing since 2002. In 2019, the average age was 50.8. [31] In 2009, Congress made the mandatory retirement age of airline pilots 65; based on the 2019 average age of pilots, roughly 50% of the nation's pilots will retire in the next 13 years.[32]

- **Emergence of low-cost flights and migration to smaller aircraft**. Airlines are recognizing and adapting to market demand for low-cost flights. To do that, they are migrating operations from wide-body aircraft servicing major hubs to narrow-body aircraft that they can consistently operate at a higher load (occupancy) factor. In addition, these narrow-body aircraft are increasing performance, allowing them to fly ever-longer nonstop flights. The trend towards higher efficiency flights enables lower costs, which increases pilot demand; and increases in fleet size and the number of flights required will further increase pilot and maintenance personnel demand. [33]
- **Increased air freight.** With increasing air freight by Amazon, UPS, and others, cargo flights should continue to expand. This will also marginally increase pilot demand.

Based on these trends, and despite the current glut of airline personnel due to COVID's impact on aviation, Boeing forecasts that the North American market will need 569,000 new aviation personnel between now and 2039: 208,000 pilots, 192,000 technicians, and 169,000 cabin crew members. World-wide, 2,086,000 new commercial aviation personnel will be needed, and 319,000 business aviation and civil helicopter aviation personnel will be needed.[34]

These are possible future jobs for the youth in our area and enabled by the flight schools operating here.

3.3 Technology Innovation Eliminating Historic Community Concerns

For many of the proposed business models to succeed and for the general health of the industry, it has been incumbent upon the industry to address long-standing community concerns. Technological advances are enabling that to happen.

3.3.1 Fuel

The existing general aviation fleet is currently the most significant environmental contributor to lead through its use of 100LL, a 100 octane leaded fuel. Lead is recognized as contributing to health and development problems for young kids. Specifically at Reid Hillview, community groups consistently recognize concerns over this issue.

The FAA has approved an unleaded aviation-grade fuel called UL94. This 94 octane unleaded fuel is compatible with a significant portion of the aircraft at Reid Hillview and with the fleets operated by the major flight schools. A Reid Hillview pilot-driven initiative is underway to make that fuel available at Reid Hillview and in California; this fuel is currently produced in the mid-west (Indiana) and has not previously been generally available west of the Mississippi. **Successfully bringing this fuel to Reid Hillview and reducing the leading source of lead in the community will reverberate throughout all of California and the west coast; our success will set a template for numerous general aviation airports and communities on the west coast.**

Beyond this, various companies are working on an unleaded 100+ octane fuel that would be compatible with all general aviation aircraft that currently operate on 100LL. The November 2020 national elections are expected to accelerate a migration to a cleaner aviation fuel source, and enable final ratification of a 100 unleaded solution. With parity in performance between a leaded fuel and unleaded fuel, it is expected that the market will switch "overnight" to this drop-in replacement.

Beyond this, next generation aircraft may well use batteries and electricity. Already, passenger aircraft are available that operate on batteries. For example, Pipistrel offers an electric training aircraft that can fly 400 pounds payload (two passengers) for 60 minutes plus a reserve.[35]

Figure 10 Pipistrel plug in port for electric vehicle (left)

Figure 11 Ampaire Electric EEL hybrid (gas and electric) aircraft (right)

Similar to automotive hybrid vehicle innovation, aircraft designers are developing aircraft that use a hybrid model of fuel and electricity. The Ampaire Electric EEL hybrid-aircraft, is a retrofit of a six-seat Cessna 337 Skymaster and operates on a hybrid engine.

In the realm of "air taxis" and large UAS, companies such as Boeing's Aurora or Joby Aviation, among many others, are developing aircraft that are exclusively battery operated.

3.3.2 Noise

Within the emerging UAS market, considerable focus is being placed upon the reduction of noise to insure community acceptance of emerging lUAS, such as air-taxis. Reduction of noise is being addressed in multiple ways including:

1. **Electric operation.** Emerging UAS are eliminating the sound of a combustion engine. Similar to the quiet operation of an electric vehicle, these new UAS will eliminate a major source of sound.

2. **Smaller and specially designed propellers.** Propellers in conventional general aviation aircraft are often perceived as being loud (including by the pilots who sit directly behind them!). This is due to the prop tips operating near the speed of sound: a 74.75" diameter prop spinning at 2500 rotations per minute is moving at about 9784 inches per second (815 fps) at the propeller tips, or roughly 73% the speed of sound. As the speed of sound is approached, the noise level increases; this is why propellers make most of their sound at the tips.[36]

   

   Emerging UAS are being designed with multiple props that are all smaller. While these provide less lift individually, in aggregate they provide the needed lift. At the same time, the smaller propellers move more slowly at the tips resulting in a smaller noise footprint. Even in aggregate, prototype multi-rotor lUAS are 18 dB(A) quieter than a small helicopter.[37]

   In addition, propeller and propulsion systems are being designed to operate in specific frequencies, and to avoid other frequency ranges where the human ear is more sensitive to sound. One of the ways this is done is by modeling the colliding vortices – the air currents coming off of the blade – to insure that the created harmonics conform to the target audio profiles and frequencies. If not, propeller airfoil changes can be made to meet the design objectives.[38]

3. **Air space design.** In defining emerging UAS routes, extensive acoustic modeling is being done of the proposed landing area, neighborhoods, vertiport design and location, and other aspects to insure that UAS operation will operate within the urban soundscape and be accepted by the community. [39]

Many of the emerging efforts involve the creation of extensive models, such that the noise can be proactively predicted and adjusted, rather than mitigated once it has occurred. This informs the aircraft design. The net result is intended to be an aircraft that is accepted by the neighborhood, rather than conforms to industry limits.

3.3.3 Safety

Again, community acceptance is a major driver within the development of emerging UAS market. Considerable focus is placed upon insuring that proposed aircraft can be operated safely. This is being done in a number of ways including:

1. **Multiple motors and propellers.** Within the scope of electric vertical take-off and landing (eVTOL) aircraft such as proposed air-taxis, many of the proposed aircraft have multiple motors and propellers, meaning that the failure of any one of them will only cause a fractional reduction in performance. While the aircraft may still be forced to land, it may often still retain the ability to provide significant lift using the remaining operational motors and propellers.

   This architecture also differs from conventional aircraft and helicopter, where a single point of failure exists in the architecture. With a multi-propeller and muti-motor design, the single point of failure is eliminated.[40]

2. **Simplicity of design.** Electric motors are simple designs relative to an internal combustion engine. They require less cooling and are lower weight. They are less prone to mechanical failures, require less maintenance (i.e. oil changes, spark plugs, gaskets and valves), and usually omit a transmission. There is no liquid fuel system that requires "hardening" against corrosive materials. With a simpler design, fewer thing can go wrong, which increases safety.

3. **Parachutes.** Many of the proposed lUAS incorporate a parachute that can be deployed in the event of an emergency[41]. While the aircraft will still hit the ground in this worst-case scenario, the descent speed may prevent injuries on the ground.

By providing these multi-layered approaches to safety, business developers in this space hope to earn the support of the community.

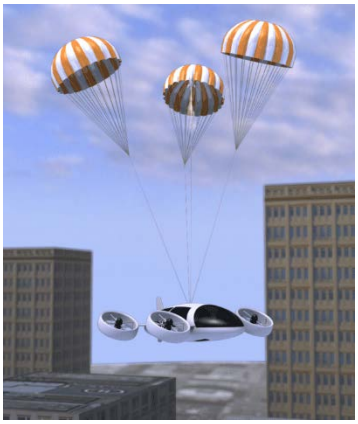

Figure 12 Depiction of deployed parachute on UAS

4 Unique Market Challenge and Opportunity

Santa Clara County and, uniquely, Reid Hill have the ability to address a safety need and two specific substantial market opportunities; those opportunities are discussed here. The region's and airport's credentials and "bona fides" are addressed in the next section.

4.1 "Prime" Air – Rural

Rural communities face many disparities relative to urban environments. The lack of density means that it is often economically difficult for companies to put in place the same infrastructure and services that can be found in urban areas. Among many challenges, poor access to resources and the ability to receive goods in a timely and cost-effective manner poses a challenge to those living in non-urban setting.

The economics of serving those communities with the same level of performance as metro areas usually do not exist. Companies are not able to achieve the economies of scale, so often cut back on services until it makes economic sense; deliveries happen less often and some services are not offered. Alternatively, they provide the service and pass the surcharge and higher prices on to the consumers in the rural areas. However, rural areas are often areas of poverty, unemployment, homelessness and other economic challenges; they are ill-suited and often unwilling or unable to pay such surcharges. [42]

Figure 13 US Postal Service often used by Amazon for rural delivery

Amazon is a major supplier of goods in the US, however much of their rural business is addressed through the US Postal Service (USPS).[43] The USPS is obligated by law to provide universal service; to deliver mail to "as nearly as practicable the entire population of the United States."[44] As such, Amazon is able to leverage them to provide rural services, but they may be able to reduce expenses in doing so; the Washington Post in September 2020 revealed that Amazon generated for USPS $1.6B in profit and $3.9B in revenue delivering 1.54 billion Amazon packages.[45] To potentially better and more economically address rural markets, Amazon is rumored to be evaluating a "wagon wheel" architecture where a fleet of Amazon aircraft and vehicles, rather than USPS, service rural communities from a central hub location.[46, 47]

Separately, FedEx already provides rural service through a fleet of over 300 "feeder aircraft".[48] In 2017, FedEx indicated that fleet included 239 Cessna Caravans; in November 2017, FedEx announced they would take delivery of an additional 50 Cessna SkyCourier 408 aircraft beginning in mid-2020.[49, 50] The FedEx Express Feeder network is a strategic component of the overall global linehaul network, serving markets too small for direct FedEx Express air linehaul service and markets where FedEx Express does not have operating rights.[51]

Figure 14 FedEx using aircraft to service rural market

In replacing ground transportation with UAS to service a rural community, a current 440-mile day-long round trip (55 mph * 8hr working day) is potentially significantly reduced with UAS and direct routes; automated flight and delivery significantly reduces labor costs; direct routing saves fuel costs; and increased speeds enable greater flexibility in servicing customers.

In replacing air transportation with UAS to service rural communities, the primary savings may be through a decline of labor (pilot) costs leveraging automated UAS, or a single pilot may be able to fly multiple UAS safely. In addition, new pilot-less aircraft designs can potentially enable new business models.

Given the potential savings and opportunities, both startups and large companies are actively exploring UAS to address the rural opportunity.

A brief technical note on this market. To address the requirements of extended range (as is often required in rural applications) and likely heavier loads, fixed wing aircraft – or, in the future, fixed-wing UAS – are often employed for better power efficiency (longer range), more economical service, and faster flight speeds; this is why FedEx, for example, services their rural customers with traditional airplanes and not helicopters. Fixed wing aircraft usually benefit from a runway for take-off and landing. Finally, the dual requirement of extended range and support for heavier load also lends itself to lUAS.

Airports form an aerial network connecting California rural and urban communities, and indeed, most communities in America. The FAA recognizes 492 California airports and the League of California Cities recognizes a nearly identical number of cities, 482. [52, 53] Nationally, the Bureau of Transportation Statistics recognizes 19,636 airports in the US; in 2018, there were nearly an identical number of incorporated cities, towns and villages in the United States: 19,495.[54, 55] Of the 19,636 airports in the US, 522 are Part 139 certificated airports, meaning they have scheduled air-carrier operations (San Jose, Oakland, and San Francisco are all Part 139 airports) and are typically larger; the remaining 19,117 airports are general aviation airports.[56] This aerial network of interconnected small and large airports is critical in the event of a natural disaster; they also have the potential to enable rural deliveries.

These rural airports are part of the transportation network of CA, but are also potential ports for companies like Amazon, UPS, FedEx and new startups to bring in product.

lUAS operating out of Reid Hillview could potentially address some of this market; it is, in fact, uniquely positioned to address this market. This will be discussed in Section 5.

4.2 "Prime" Air – Urban

Figure 15 Amazon UAS prototype package-delivery aircraft

In 2013, Amazon CEO Jeff Bezos announced on "60 Minutes" their prototype Octocopter and the vision to enable 30-minute delivery times of small packages in urban areas.[57] By replacing labor costs associated with delivery with capital costs of automated UAS, various benefits are possible: among other things, product differentiation through faster service, long-term reduction in delivery costs, increased hours of delivery enabling increased number of deliveries, and greater automation reducing the possibility of delivery mistakes.[58]

Various economic studies and cost analysis show that in an urban setting, the delivery cost of a package weighing less than five pounds in under thirty minutes using a sUAS could be lower than one-third of a conventional road vehicle delivery; for example, one study showed delivery costs would reduce from $1.20/package average to somewhere between $0.20 and $0.41 per package depending upon the number of packages delivered and hours of operation.[59] Another study estimated that the $1.20/package delivery cost could approach $0.05 to $0.07/package.[60] Less optimistically, another estimate is that price for sUAS delivery in 2030 could approach $4.20 for delivery of package; while higher

than other estimates, it is nonetheless impressive for rapid-delivery capability. [61] It is these economics that enable the prediction of 500 million packages annually shipped through UAS vehicles.

A significant requirement for these economics is operating in an urban setting, similar to that found in Santa Clara County and Silicon Valley. sUAS operating out of Reid Hillview could potentially address some of this market; it is, in fact, uniquely positioned to address this market. This will be discussed in Section 5.

Figure 16 Amazon Prime Air vehicle "MK27" shown at Amazon re:MARS 2019 event

4.3 Fire Suppression

2020 was a record-setting year of wildfires in California.[62] The fires burned nearly 4.4 million acres, destroyed 10,000 structures, resulted in over $12 billion in damages, and had $2 billion in fire suppression costs. [63, 64, 65]

It was also not unexpected. A 2016 report "Santa Clara County Community Wildfire Protection Plan" done for the county started off their report saying "in the last few years, most western states have experienced the largest wildfires in their histories." [66]

Within that report, they highlighted areas of Santa Clara County that were at "very high" risk of fire. [67]

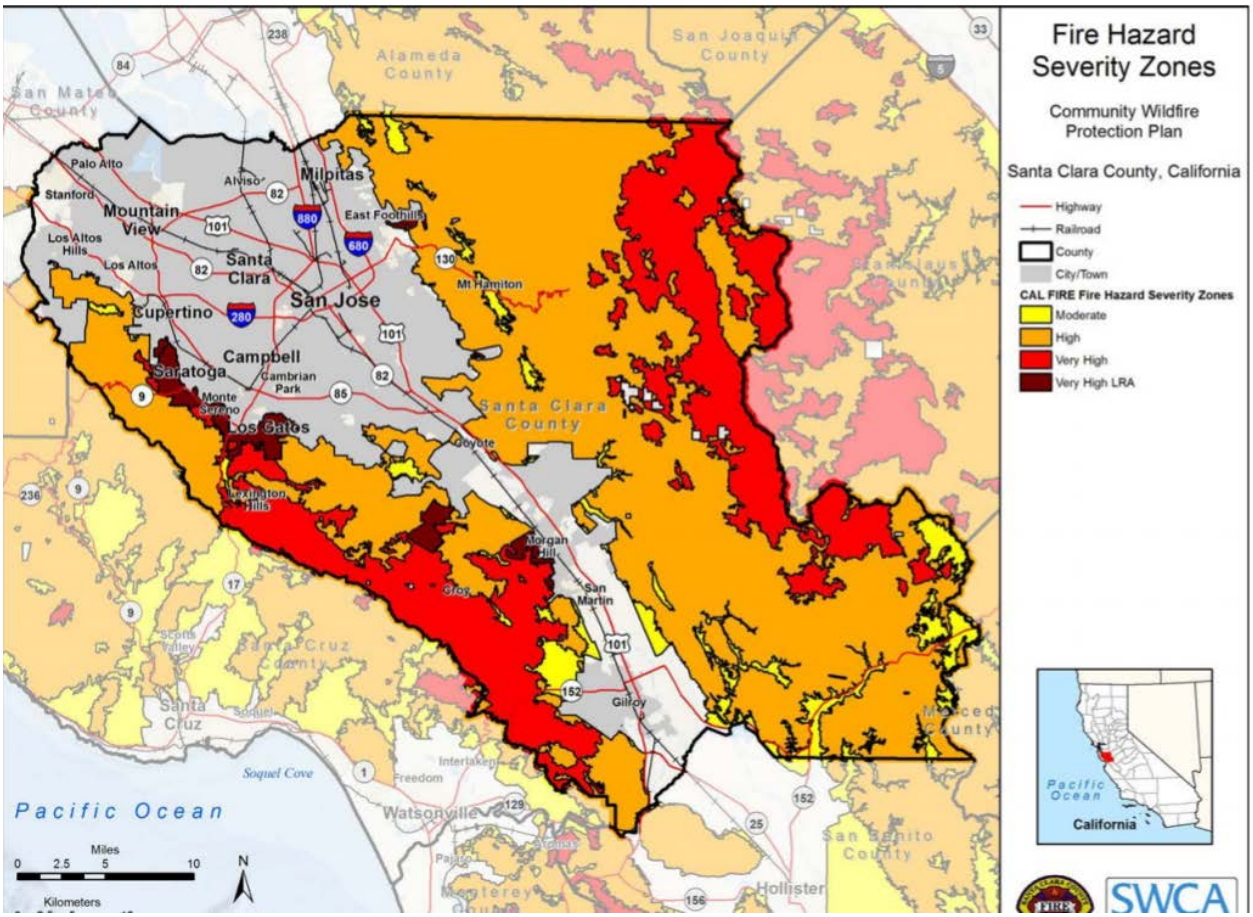

Figure 17 Fire hazard severity zones (Credit: Santa Clara County Community Wildfire Protection Plan)

The report went on to identify areas within Santa Clara County where fire could spread at rates approaching 40 feet per minute.

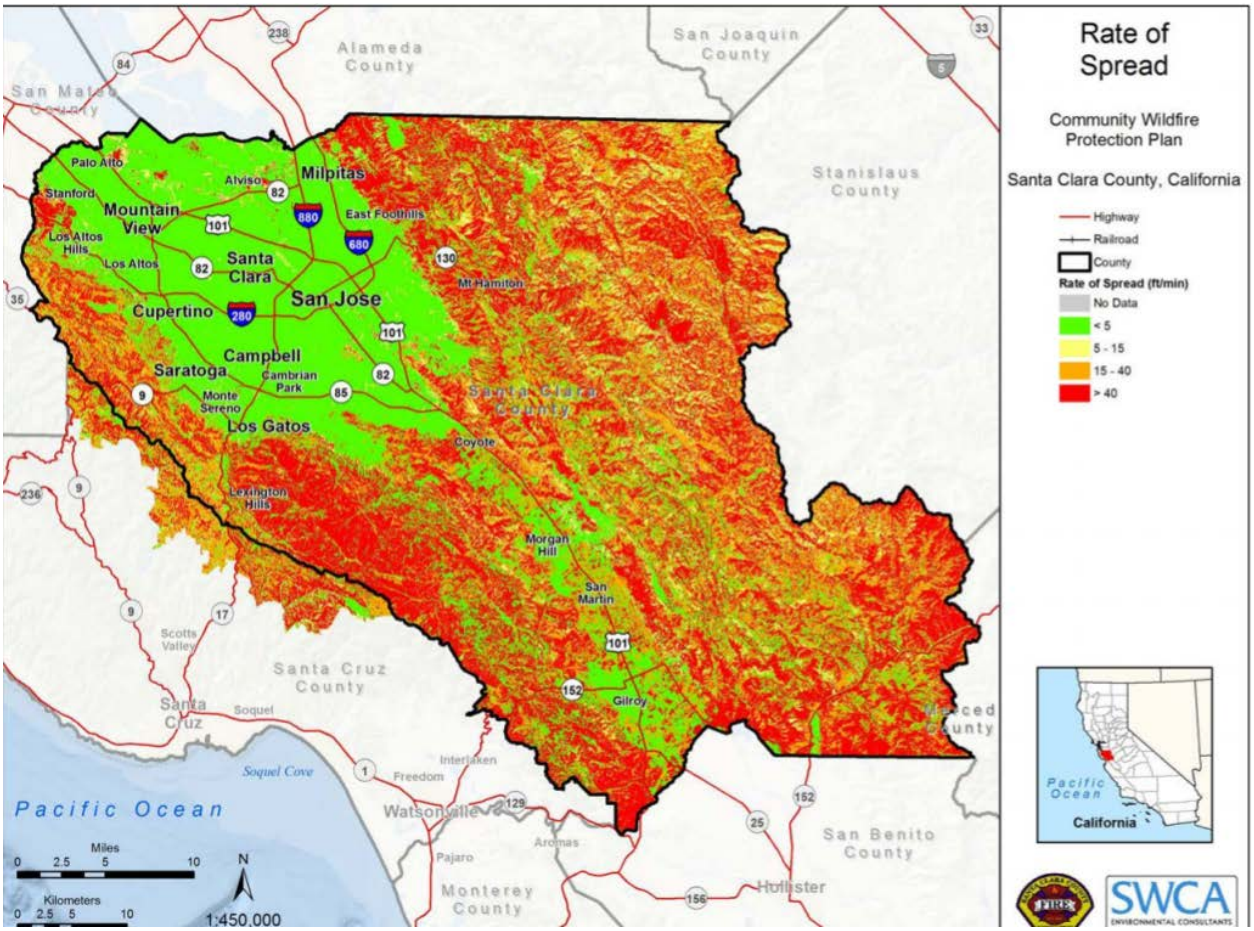

Figure 18 Rate of fire spread (Credit: Santa Clara County Community Wildfire Protection Plan)

This 2020 fire should not have been unexpected, nor is the threat of future fires expected to be greatly reduced.

Lick Observatory

It is worth briefly recognizing Lick Observatory in the 2020 fires. This irreplaceable asset and landmark within Santa Clara County was nearly lost due to wildfires.[68] This 132-year old observatory continues to conduct cutting-edge research, and is credited with identifying the first planet to orbit a sun-like star, the first multi-planet system, and the first five-planet system; in addition to these firsts, it has contributed to space research in a variety of other ways. [69]

The report identified various measures that could benefit the community in reducing the risk of fire. Two of those related to aviation are identified below:

FC7	**Obtain additional helicopters/ air resource for suppression**	Provides back-up to on-the-ground resources. Improves suppression capabilities in inaccessible areas where use of ground resources would threaten firefighter safety. Improves response time to aid in protection of life and property.

FC10	**Investigate potential for use of drones to assess and monitor wildfire**	Drones could be a useful tool for the monitoring of wildfire in areas with limited access but future research is needed to fully assess their utility and application. The fire departments could launch a pilot study to determine effectiveness of the tool.

Table 5 Aerial firefighting recommendations outlined in "Santa Clara County Community Wildfire Protection Plan"

Various UAS companies are, in fact, developing drones to support firefighting operations. These include high-lift UAS that are capable of lifting heavy equipment (e.g., chain saws, rescue gear, lights, rope) to firefighters and of dropping flame retardants on the fires. Other smaller UAS are capable of providing scene monitoring, long-term observation and surveillance capabilities to provide early-warning capabilities to firefighters, assisting in the optimum placement of firefighting resources, illumination, search-and-rescue, guidance in evacuation, and the identification of potentially at-risk individuals.[70]

Complementing this, NASA's Ames Research Center in Santa Clara County is developing a Scalable Traffic Management for Emergency Response Operations project, or STEReO, to enable emergency UAS to be rapidly deployed in an emergency, provide operational resiliency to dynamic conditions, scale operations, and to operate within an airspace with firefighting or other piloted emergency aircraft.[71]

Figure 19 Example UAS firefighting aircraft in development

5 Santa Clara County and Northern California: Well Positioned for UAS

Santa Clara County is well positioned to lead in developing the next generation of aircraft and pilots. As the opportunity is expected to drive some 18,000 jobs and $14B in economic impact, Santa Clara County would be well served leading the effort with other northern California counties to maximize the number of jobs coming to the region.

5.1 Pedigree

Within our populous state of California, we have 493 airports. Of those 493 airports, Santa Clara County has three airports in the top 12 relative to airport operations (take offs and landings); even our smallest airport, San Martin, is among the top 20% most active airports in the state. With 641,788 operations, our four airports represent approximately 5.5% of all airport operations occurring in the state. Santa Clara County is the busiest county in the Bay Area, even exceeding San Mateo County which contains San Francisco International.

In this most-busy of aviation regions, the county's busiest airport is … Reid Hillview.

From the FAA, below is a listing of the 21 recognized public airports within the northern California Bay Area and their respective ranking, in terms of airport operations, within California; the Santa Clara County airports are highlighted. Not shown are government and military airfields (e.g. Moffett Naval Air Station).

Ranking	County	City	Facility Name	Total Operations
2	SAN MATEO	SAN FRANCISCO	SAN FRANCISCO INTL	470164
6	ALAMEDA	OAKLAND	METROPOLITAN OAKLAND INTL	237821
10	**SANTA CLARA**	**SAN JOSE**	**REID-HILLVIEW OF SANTA CLARA COUNTY**	**209314**
11	**SANTA CLARA**	**SAN JOSE**	**NORMAN Y MINETA SAN JOSE INTL**	**207611**
12	**SANTA CLARA**	**PALO ALTO**	**PALO ALTO**	**191697**
16	ALAMEDA	LIVERMORE	LIVERMORE MUNI	154940
21	ALAMEDA	HAYWARD	HAYWARD EXECUTIVE	116753
23	SAN MATEO	SAN CARLOS	SAN CARLOS	115980
30	SOLANO	VACAVILLE	NUT TREE	101500
38	CONTRA COSTA	CONCORD	BUCHANAN FIELD	90686
42	MARIN	NOVATO	GNOSS FIELD	85500
44	CONTRA COSTA	BYRON	BYRON	83075
54	MONTEREY	SALINAS	SALINAS MUNI	70110
62	SANTA CRUZ	WATSONVILLE	WATSONVILLE MUNI	60000
67	SAN BENITO	HOLLISTER	HOLLISTER MUNI	57489
68	MONTEREY	MONTEREY	MONTEREY RGNL	56617
72	SAN MATEO	HALF MOON BAY	HALF MOON BAY	50150
74	NAPA	NAPA	NAPA COUNTY	49968
84	MONTEREY	MARINA	MARINA MUNI	42000
94	SOLANO	RIO VISTA	RIO VISTA MUNI	35000
98	**SANTA CLARA**	**SAN MARTIN**	**SAN MARTIN**	**33166**

Table 6 Ranking of Northern California airports in terms of landing and takeoff operations. Source: https://www.faa.gov/airports/airport_safety/airportdata_5010/

Aviation and pilots are a vibrant and active portion of our community. Our "ideal" weather lends itself to learning to fly, while our frequently cloudy coastal weather enables pilots to learn more advanced flying techniques. The high density of airports and air traffic results in extremely rigorous training of air space and communication; this applies not only to pilots, but to air traffic controllers who manage the airspace. Supporting the high density of aircraft operations are numerous aircraft maintenance personnel. To enable this ecosystem are a number of flight schools, instructors, and maintenance training programs.

5.2 Transportation High Technology Mecca

Santa Clara County and the Bay Area already claim international bragging rights to significant technology innovation. More specifically, the area leads in innovation in autonomous and battery-powered vehicles. These bragging rights are easily transferable to aviation.

From humble roots beginning with the DARPA Grand Challenge kicked off in 2002, this area has arguably matured into the center of autonomous vehicle development. (Winner: Stanford University, located in Santa Clara County) Quite likely there are over 40 different companies, if not many more, working on autonomous vehicle technology with some portion of the development here in the Bay Area. From this has spawned a number of other autonomous vehicle developments, ranging from autonomous grocery delivery systems to autonomous security robots.

Figure 20 Stanford entry for DARPA Grand Challenge

Figure 21 Tesla electric vehicle

Pushing electric vehicle transportation, Tesla, founded in 2002 and headquartered in Santa Clara County, now boasts a market cap of over $800 billion and is worth more than the combined market cap of the nine largest car companies globally.[72, 73] Tesla is now one of the largest manufacturing employers in California, stimulated $5.5 billion in sales activity and generated $4.1 billion in direct spending in the state in Fiscal Year 2017 alone. In 2017, Tesla created 51,000 jobs in California, including employees and jobs in their supply chain. [74]

Simply put, virtually every car company and car supplier in the world has an office or development location in Silicon Valley.

As a result, virtually all of the technologies outlined in UAS: A Confluence of Enablers, Section 3.1.2 are also developed (and frequently invented) in the area:

- Connectivity
- Communication
- Autonomy
- Materials
- User interfaces

- Big data
- Battery Management
- Multi-modal transportation
- Security
- LIDAR

- Navigation and GPS
- Image sensors
- Electric propulsion
- Software
- Charging systems

and much more!

Through our expertise enabling vehicle autonomy and electric vehicles, Santa Clara County is well positioned to develop technology needed for next-generation aircraft.

Beyond developing the technology, the Bay Area has demonstrated its ability to do high volume manufacturing of complex vehicles. In the adjacent county of Alameda, Fremont is home to more than 10,000 employees manufacturing electric vehicles.[75]

5.3 NASA Ames and Moffett

Figure 22 NASA Ames Research Center in Santa Clara County

NASA aeronautics has contributed to virtually every commercial aircraft and air traffic system in the United States.[76] Within Santa Clara County, NASA Ames Research Center and its 2,500 employees and contractors conduct a variety of cutting-edge aviation related activities including the following[77]:

Next generation air transportation	Air traffic management (ATM) research and development of the Next Generation Air Transportation System. This includes the development of the next generation airspace, facilities, equipment, services, workforce, procedures, etc.
Airborne science	Examining our world from the sky
Autonomy and robotics	Complementing humans in flight
Human factors	Advancing human-technology interaction
Wind tunnels	Testing aircraft on the ground before taking flight
Supercomputing	Enabling advanced flight modeling and simulation

Table 7 General NASA Aviation research efforts

Beyond these general areas are specific projects and efforts focused on UAS:

Revolutionary Vertical Lift Technology (RVLT) Project	The RVLT project develops and validates tools, technologies, and concepts to overcome key barriers to the expanded use of vertical lift configurations in the nation's airspace. RVLT research advances technologies that increase speed, range, payload, and safety and decrease noise, weight, emissions, and fuel burn. The research uses advanced computer-based multi-fidelity prediction methods, use of unique NASA facilities, and state-of-the art experimental techniques. RVLT considers current and future vertical lift vehicles of all classes and sizes, ranging from very small configurations to configurations that are viable commercial transports in the National Airspace System.[78]
UAS Traffic Management (UTM) and Advanced Air Mobility (AAM)	Transforms traditional, human-centric air traffic management into a modern, machine-centric, federated approach; integrates into existing airspace safely and accessiblely; integrates additional services including low-altitude weather information, congestion management, terrain avoidance, route planning, re-rerouting, separation management, and contingency management; interconnects services and enables communicating via well-defined interfaces and protocols.[79]

Design Environment for Novel Vertical Lift Vehicles (DELIVER)	DELIVER demonstrates the applicability of current design and sizing tools to novel vehicle configurations and sizes; and the addition of key transformational technologies of noise, autonomy, and hybrid-electric and all-electric propulsion into the vehicle conceptual design process. [80]
Scalable Traffic Management for Emergency Response Operations project (STEReO)	Enable emergency UAS to be rapidly deployed in an emergency, provide operational resiliency to dynamic conditions, scale operations, and to operate within an airspace with firefighting or other piloted emergency aircraft[81]

Table 8 NASA projects on aviation

Large portions of these projects are conducted at and/or led by NASA Ames in Santa Clara County.

While NASA Ames includes a substantial airport, the ability to develop, roll out, and verify projects such as Urban Air Mobility and aerial package delivery within other areas of Santa Clara County is likely to be well received. This is because many envisioned business and aircraft operations may not be easily possible at a secure government facility.

5.4 Lockheed Martin

Lockheed Martin, with approximately 110,000 employees worldwide, is a global aerospace company with a solid footprint and history in Sunnyvale and Palo Alto; Lockheed's Advanced Technology Center, for example, is headquartered in Palo Alto.[82]

While much of their business focuses on the military and there is considerable work done in offices outside of the county, the company's capabilities nonetheless translate well into the next generation of aviation programs discussed in this white paper. Sikorsky, a Lockheed Martin company, is a leading manufacturer of helicopters; these skills align with developing eVTOL aircraft. Aligning further with the next generation of aircraft, Sikorsky Autonomy Research Aircraft (SARA) integrates mission-critical fly-by-wire and autonomous mission software and hardware that will be critical to the safe operation of future aircraft.[83] Initially, until such time as these aircraft are fully autonomous, new flight management systems will help pilots safely monitor and manage the workload of multi-rotor and electric aircraft; this is developed through efforts like Lockheed's Aircrew Labor In-Cockpit Automation System (ALIAS).[84] Finally, created in Sunnyvale, the AEHF (Advanced Extreme High Frequency) satellites provide secure communication; secure communication will be necessary to insure the integrity of information coming and going to autonomous aircraft.[85]

It should be noted that Lockheed Martin has historically developed advanced aircraft in Palmdale, California; this group is traditionally and informally referred to as Skunkworks.[86]

5.5 Universities

Santa Clara County is the home to numerous world-class universities that are working on cutting-edge research and projects related directly to aviation and to adjacent fields that contribute to aviation.

5.5.1 San Jose State University

The San Jose State University aviation program is one of the most mature in the nation; it originated approximately 85 years ago with the founding of Reid's Hillview airport. The aviation program has between 275 to 500 students enrolled and has graduated over 5000 professional pilots.[87] They offer multiple aviation degrees and a wide variety of aviation career roadmaps for their students.[88] A portion of the aviation program campus is based at Reid-Hillview airport.

Aviation Degree Options
• Aviation Management • Aviation Maintenance Management • Aviation Operations • Professional Flight

Aviation career options (example)
• Flight operations • Air traffic and airspace management • Transportation management • Aviation maintenance

	• Management of aviation maintenance • Airport planning • Airport security systems • Pilot

Table 9 San Jose State University aviation programs and career opportunity examples.

San Jose State University has a Hybrid & Electric Vehicle Technology Laboratory where they develop technologies around batteries, charging stations, on-board electronics and navigation, motor and power electronics, and the overall vehicle drive train performance.[89] These are all applicable to next generation aircraft.

San Jose State University aviation program goes beyond student education. They have an extensive effort in promoting "Women In Engineering", collaboration with aviation industry, and their STEM community outreach programs have educated hundreds of high school kids on aviation. For example, the San Jose State University aviation was awarded $73 million to enhance air management safety together with NASA; this program is closely aligned with efforts at NASA Ames.[90]

Jason Dahl
Reflecting a quintessential nobility, San Jose State University aeronautics graduate Jason Dahl was United Airlines Flight 93 captain on September 11, 2001. In his heroic death, he is credited with struggling with hijackers and likely saving the US Capitol in the process.[91]

5.5.2 Stanford

Stanford's Aeronautics and Astronautics department addresses a broad range of technologies to develop systems, design, and analysis methods to further our nation's aerospace enterprise and improve society.[92]

Aviation Research Areas
• Autonomous Systems and Controls • Cyber Safety for Transportation • Distributed Space Systems • Future Aircraft Design • Multidisciplinary Computational Aerosciences • Multifunctional Materials and Intelligent Structures

Table 10 Stanford University aviation research areas

Within the area of future aircraft, they specifically call out areas of research and development in silent and efficient flight, airborne delivery of goods and people, reducing global emissions, electric propulsion, autonomous vehicles, and computational-based design of vehicles and structures.[93]

Stanford has a variety of research laboratories focused on next-generation aviation. Highlighting just a few of them directly contributing to UAS[94]:

Example Aviation Lab	Example of research activities
Aerospace Computing Lab	Understanding and computing airflows
Aerospace Design Laboratory	Understanding industrial design issues of aircraft
Aerospace Robotics Laboratory	Optimizing human-robot interaction in aerial applications
Aircraft Aerodynamics and Design Group	Studies of unusual aircraft configurations and novel flight-control concepts
Farhat Research Group	Computational modeling of complex systems
GPS Laboratory	Centimeter-level accuracy for aircraft positioning

KACST-Stanford Center of Excellence for Aeronautics and Astronautics	Alternative aviation fuels, micro UAS, safety systems for aircraft
Navigation and Autonomous Vehicles Lab	Navigation safety, cyber security, resilient systems using advanced signal processing, sensor fusion and machine learning methods
Stanford Intelligent Systems Laboratory	Systems for air traffic control and unmanned aircraft
Structures And Composites Lab	Lithium-ion batteries, microfabrication, composite manufacturing
The Boeing Flight & Autonomy Lab	Research and testing of autonomous aerial vehicles

Table 11 Sampling of research labs at Stanford University

Stanford has a number of alliances and programs with aviation industry heavy-weights including NASA, DARPA, DoE, AFRL, AFOSR, Boeing, Raytheon Aircraft and the U.S. Navy, among others.[95]

5.5.3 Santa Clara University

Santa Clara University Department of Mechanical Engineering offers undergraduate and graduate aerospace engineering programs to understand aerospace vehicles and their subsystems. Their focus covers both atmospheric flight (airplanes, UAS, helicopters, etc.) as well as space flight. Among many other topics, this program covers aerodynamics, aerospace structures, propulsion systems, and flight dynamics and control.[96]

In Fall 2019, Santa Clara University expanded their aviation efforts with a new master's degree in Aerospace Engineering (MSAE).[97]

Beyond aerospace, Santa Clara University has a rich legacy in electrical engineering, computer science, and technical innovation. These are critical to a wide variety of next generation aviation issues, including autonomy and electrification of propulsion systems.

5.6 Weather

In an average year: 257 sunny days a year and 17 inches of rain (US average is 38).[98] Simply put, Santa Clara County has great weather!

Surprisingly, we also have considerable inclement weather nearby as well. Adjacent to Santa Clara County, Half Moon Bay is cloudy approximately 7 months a year and wet over 5 months a year. [99]

The geographic weather separation – where certain areas are usually sunny and other parts are often wet and cloudy on the same day – afforded the area provides a rich environment in which to do real-life flight training, aircraft development, and airspace management under any desired weather scenario.

5.7 Reid Hillview Airport

Reid Hillview airport, in east San Jose, is the state's tenth-busiest airport.

Reliever Airport

Reid Hillview is a reliever airport for San Jose Mineta International, allowing slower speed aircraft to operate away from faster, larger aircraft[100, 101]. Reliever airports also have the additional benefit of spreading out air traffic, improving air flow, reducing air traffic for the entire community, and improving the utilization of the larger commercial airports.[102]

Flight Training

Reid Hillview does extensive flight training. Four flight schools with over one hundred instructors in aggregate teach nearly one thousand people to fly annually. It is a major training facility for international pilots; these visiting pilots contribute to the economy by staying in local hotels and apartments and purchasing from local stores and restaurants while they are doing their training. Reid Hillview is a campus for aviation students at San Jose State University. It is a training facility for UAS operations. Through all of these efforts, Reid Hillview generates an extensive number of pilots to address the nation's pilot-shortage (see 3.2 Industry Changes Driving Increased Need for Pilots).

Figure 23 CalFire helicopter supports water dropping and crew insertion

Fire Support

Reid Hillview's proximity to the adjacent flammable mountain region has recently proven valuable in firefighting activities; numerous firefighting operations were conducted out of Reid Hillview during the 2020 Bay Area wildfires. The proximity of Reid Hillview to the spreading fires was instrumental in reducing the spread in known high-risk regions where fire was forecast to spread at 40 feet per minute (see Figure 14 and Figure 15). Reid Hillview is well positioned as a UAS base for firefighting operations and would conform to the recommendations of the Santa Clara County Community Wildfire Protection Plan (see 4.3 Fire Suppression)

Law Enforcement and Emergency Services

Figure 24 Santa Clara County Star 1 Helicopter

An unnamed county official has said emergency helicopter operations out of Reid Hillview would allow them to better service the county. For example, many Santa Clara County sheriff helicopter operations depart from Moffett air field on the far northwest corner of Santa Clara County in an urban area where their services are infrequently needed; this places them over fifty miles from the southern and eastern borders of the county where more rural and mountainous regions have critical needs for their service. Santa Clara County sheriff's N621LS helicopter is a 2002 Eurocopter EC120 with a cruise speed of 120-140 mph, meaning they are roughly 25-30 minutes away (including a five minute scramble time) from the southern and eastern reaches of the county that need them.[103, 104] Placement at Reid Hillview airport allows better servicing of rural portions of the county – where helicopter services are crucial – and is more central to the entire county; they would be able to reach the entire county in roughly 15 – 18 minutes (including a five minute scramble time) maximum. Placement at San Jose airport is possible, but this could negatively impact both commercial and emergency flight operations; emergency air operations out of a reliever airport eliminates that contention. The Los Angeles Sheriff helicopter fleet, the largest of any sheriff's department in the US, takes such a strategy.[105]

Reid Hillview also serves as a potential staging area for land-based response efforts. As such, it could support the broader east San Jose community in the event of a natural disaster and do it in an immediate and expeditious way.

CalDART

Reid Hillview Airport supports the emergency operations of CalDART, the California Disaster Airlift Response Teams. In the face of earthquakes, floods, mudslides, fires and other disasters, CalDART provides emergency aviation services to rapidly transport supplies and personnel to affected regions.[106] These disasters can impede highway and road infrastructure, making it difficult to quickly and easily reach the impacted areas. As virtually every incorporated community has a nearby airport, a powerful aerial network bypasses ground-level disasters; however, many of these airports are small and unable to handle large aircraft, making the general aviation community critical to the safety of these remote communities. Reid Hillview, with an extensive fleet of small aircraft and a large pilot community, is a critical supplier into this aerial network.

It is worth noting that Santa Clara pilots founded CalDART and remain critical in its operation. This organization has received recognitions from FEMA, and serves as a model for DART operations in other states.[107]

Cost Effective Alternative

The development of aviation programs at Reid Hillview are likely to be less expensive than those at San Jose Mineta International or at Palo Alto.

5.8 Eastridge Mall and Reid Hillview: 1.4 Million Square Feet Next To an Airport

The juxtaposition of the Eastridge Mall and its 1.4 million square feet of retail space and roughly 121 acres of land next to Reid Hillview airport presents a unique opportunity to address rural and urban package delivery (see "Prime" Air – Rural and "Prime" Air – Urban).[108]

Once considered a catalyst for economic growth and a means to drive sales tax revenue to offset property taxes, malls were rapidly constructed in the 60s and 70s and had the additional benefit of driving housing expansion and regional growth.[109] These malls were often built near major thoroughfares, to allow people to easily get to them from the different communities. Now, however, malls are rapidly "turning into ghost towns – first losing shoppers and then stores" as Smithsonian Magazine described in a 2014 article.[110] Nationally, the vacancy rate for regional malls was 9.3% in Q1 2019.[111] The COVID crisis has likely made the number considerably worse.

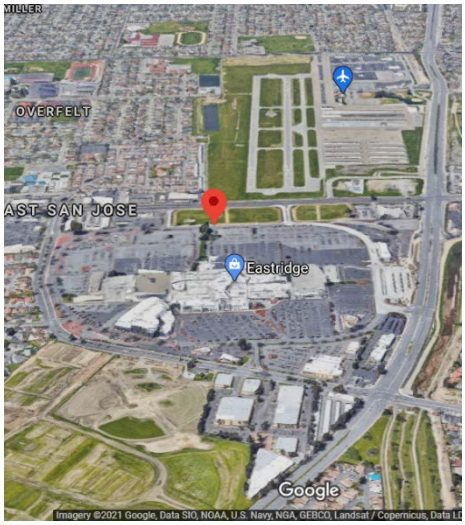

Figure 25 Eastridge Mall, directly southeast of Reid Hillview airport

Opened in May 1971, Eastridge Mall is 50 years old this year.[112] Only two of four anchor tenants remain; tenants such as Barnes & Noble and Sears have exited, as part of nationwide pressures that those companies are facing.[113] Recent bankruptcy filings by JCPenny, an anchor tenant at Eastridge, further complicates the situation there. Anchor stores are now listed as Macy's, JCPenny, Round 1 Bowling and Red Robin burgers; not the stellar lineup that existed when it opened as the largest mall in the western US.[114, 115]

As an example of the challenges faced by local mall owners, URW – parent company of Westfield which owns sixteen malls in California – announced that it will sell off Westfield assets to compensate for roughly $9.2 billion in losses in 2020.[116] The challenges malls faced have been complicated further with the onslaught of the pandemic; malls were closed for large portions of the year, and eviction moratoriums and suspended rent collection decimated revenue. Westfield has multiple properties in Santa Clara County.

Malls are facing great pressure from online retailers, namely Amazon and its "Prime" delivery service to a person's front door. Adding insult to injury (or, from another perspective, perhaps saving them), Amazon is now acquiring some of these same malls and making them into distribution and fulfillment centers; FedEx and DHL have made similar moves.[117] A mall's access to communities and major thoroughfares is attractive to the Amazon's of the world who wish to provide easy access for trucks to reach their distribution centers, and then turn around and offer rapid delivery to customers.

These same companies that are leasing malls and running distribution centers – Amazon, FedEx, UPS, and DHL – are also exploring rural and urban UAS delivery. FedEx, for example, is working with Walgreens and Alphabet's (Google) Wing UAS service to test out medication delivery during the pandemic.[118, 119] Similarly, UPS - through their aerial subsidiary UPS Flight Forward and working with CVS - is experimenting with medical sample and prescription delivery with UAS aircraft.[120, 121] Walmart is working with UAS and Half Moon Bay company Zipline to trial product delivery.[122]

Figure 26 UPS carrying prescription from CVS store

Having some or all of the 1.4 million square feet for a distribution facility adjacent to an airport could enable development of both rural and/or urban "Prime Air" UAS programs. Reid Hillview's runways could enable lUAS to take off and carry heavier loads longer distances and address more rural communities. Urban "Prime Air" programs would benefit from the central location of Reid Hillview and Eastridge to many communities.

Other benefits that companies might see operating out of Reid Hillview and Eastridge Mall.

- **Controlled airport.** Reid Hillview controllers are guiding and assisting in the separation of traffic; they are de-conflicting the environment and ensuring traffic is where it is supposed to be. This human oversight can assist in the integration of autonomous aircraft inside of an airport environment. While traffic patterns would have to be developed to separate (or safely integrate) general aviation traffic from UAS, these are issues that NASA and the FAA are already working on.
- **Conveniently located inside of a major city.** San Jose is a major city that has sufficient volume to justify many business models around UAS deployment, including package delivery. Within a five mile radius of this area are roughly 551,854 people and 158,739 households, offering a dense service area in which to enable a new service.[123] The bordering communities of the mall and airport are East San Jose and Evergreen, the first and third most populous neighborhoods in San Jose.[124] East San Jose and its nearby neighbor, Alum Rock – East Foothills, are the second and fifth most densely populated neighborhoods in San Jose.[125, 2]
- **Convenient to technology developers.** The proximity of the airport to R&D centers could accelerate the development and deployment of innovative technology, as well as reduce the cost of development.
- **Airport infrastructure.** Reid Hillview is a modern airport. It has runways/taxiways, hangers, terminal building, drainage, and facilities that UAS developers could leverage for onsite research and development.

[2] Original source data for demographics comes from the US Census Bureau, specifically from the 2010 census, and from the 2012-2016 American Community Survey. As such, this data is four to ten years old and does not reflect the impact of COVID upon the communities.

- **Convenient to thoroughfares.** It has excellent access to Capitol Expressway and is only a few minutes away from Highway 101 and Interstate 680. This enables easy access to facilitate transportation of goods to the distribution center.
- **Integration with public transportation.** Eastridge Mall already is one of the busiest transit centers in Silicon Valley with approximately 5,070 passengers per day (2017).[126] The future BART regional connector from Alum Rock light rail station to the Eastridge Transit Center will further improve public transportation to the area.[127] This will enable a number of workers to leverage public transportation.
- **Working-age demographics.** In East San Jose, roughly 64% of the population is working age (18-64), with roughly 32% "younger adult" and college age (18-39).[128] In Evergreen, roughly 62% of the population is working age (18-64), with roughly 25% "younger adult" and college age (18-39).[129]
- **Cost-effective hiring.** The median income of East San Jose is approximately $74.0k, which is 18.1% below the median income of San Jose.[130]
- **Good work-force.** The broader Santa Clara County and more specifically the East San Jose neighborhood offers an abundant and qualified workforce from entry-level, to aviation experts, to advanced R&D.
- **Good air routes.** Reid Hillview approach routes and runways lie parallel to San Jose approach routes and runways and are separated by roughly three miles; as such, aircraft departing and flying into Reid Hillview remain clear of San Jose airport's commercial traffic. Areas to the north of Reid Hillview clockwise through the southeast avoid any airport approaches; rural communities to the northeast extending clockwise through the south – areas that would benefit most from "Prime Air" Rural – could be easily addressed. Reid Hillview also lies outside of the Class B "Mode C veil" surrounding SFO airport which might make it easier to roll out a UAS program. While "Prime Air" Urban traffic that would have to go west could not go directly there (at least initially) due to San Jose airport, travelling only approximately eight to ten miles south of Reid Hillview would enable sUAS to turn west bound and pass under San Jose airport's approach to get to the west side of San Jose.
- **Secure facility.** Ensuring the separation of people from aircraft provides safety to those on the ground.
- **Potential expansion of runway.** The adjacency of Reid Hillview to Eastridge Mall could also enable the Reid Hillview runways to be further lengthened; note that this is not a requirement, only an option. It would likely not increase the landing length of the runway due to clearance requirements over the mall, but could extend the takeoff length of the runway enabling heavier loaded aircraft to take off. This strategy would require that surface traffic be rerouted, which could be potentially done by utilizing Quimby Road.

The UAS freight business model – rural or urban – likely will benefit from warehouse space adjacent to an airport. Many other major airports have freight centers close by or adjacent to the airport, but the combination of Reid Hillview and Eastridge Mall would enable a company to expeditiously test this combination and in an area where there is an immediate need and market opportunity. Once proven successful, the model of adjacent airfield and floor space could be rolled out to other airports.

6 Economic Impacts on the Area

Reid Hillview airport coupled with Eastridge Mall has an opportunity to combine UAS flight with a freight distribution center. Such a combination could benefit both the community and the companies, providing a win for all parties.

6.1 Jobs

This report envisages aviation growth in three stages – immediate, mid-term, and long-term – for the county. The economic benefits of these three stages is outline below.

6.1.1 Short term: Aviation Education and R&D

Economic Impact: **100s of jobs**

Approach:

(1) Keep existing jobs
(2) Grow existing instructor and maintenance programs
(3) Create new pilots
(4) Develop R&D programs

Immediately, there is an opportunity for Santa Clara County to save and create hundreds of jobs; this can be done in multiple parallel ways.

First, Santa Clara County's unclear position on Reid Hillview airport is causing existing flight schools and flight operation companies – known in the industry as fixed-base operators or FBOs – to limit investment in their business and to explore moving their operations to other airports. Their departure would result in the relocation and/or loss of over 100 aviation jobs from the area.

Second, if Santa Clara County could provide clarity on the future of Reid Hillview, this would allow FBOs to confidently continue in the investment and growth of their business. As discussed earlier, there is need both for commercial aircraft pilots, UAS pilots, and aviation maintenance technicians. By enabling and encouraging these FBOs to build their business, they can provide the needed job training to address this shortage. Reid Hillview, with over 100 aviation instructors and maintenance personnel, has a strong foundation upon which to expand and grow its existing training business to address this market need.

Third, over the next 18 years, 569,000 aviation personnel (pilots, mechanics, and aviation experts) are needed, or just over 30,000 per year (see 3.2.2 Increasing Need for Commercial Pilots and Aviation Personnel). Trained at Reid Hillview and with three major commercial airports in the region, it is not unreasonable to expect that many of the emerging commercial pilots trained at Reid Hillview will remain in the area.

Fourth, numerous companies are developing technology to enable the next generation of UAS. Enabling one of these companies to develop technology at Reid Hillview could bring some R&D jobs to the area. These efforts could be around specific verticals that align with Reid Hillview, such as wildfire UAS or "Prime Air" programs; or it could be around specific technologies, such as UAS traffic management. Clarity around Santa Clara County's commitment to Reid Hillview and aviation – coupled with the specific advantages that Reid Hillview could bring to a development – could bring over one hundred R&D-type jobs.

To provide a sense of the number of jobs and the economic impact created by a UAS company, Joby is a UAS startup operating in Santa Cruz and San Mateo counties; publicly they indicate that they have "over 500 employees" and have raised $820 million.[131] Wisk, headquartered in Santa Clara County's city of Mountain View, is estimated to have over 200 employees.[132] These are just two examples; there are many others.

Finally, it should be remembered that each aviation job created contributes to an additional 3.6 jobs elsewhere in the economy.[133] Conversely, every aviation job lost will have a similar impact on the economy.

6.1.2 Mid-term: UAS "Prime Air" Services

Economic Impact: **1000s of jobs**

Approach:

(1) Development of mall as a distribution facility

(2) Development of airport as UAS "Prime Air" facility

"Prime Air" services revolve around (1) the development of all or portions of Eastridge Mall as a distribution center; and (2) the development of the aviation portion of "Prime Air". It goes without saying that there are numerous complexities to achieving this ambitious and bold goal; nonetheless, the juxtaposition of the mall and the airport properties is a unique and valuable combination (see 5.7 Eastridge Mall and Reid Hillview: 1.4 Million Square Feet Next To an Airport) and the number of jobs that could be created would be in the thousands.

The development of a distribution center could be done on the order of months; it is the development of UAS technology around "Prime Air" urban and rural services that still require considerable innovation and likely will take a few years.[134]

Based on other distribution centers, one at Eastridge Mall could support at least 1000 jobs, and possibly 2000-3000 jobs depending upon the number of square feet needed. As benchmark, Amazon has "1000 full time jobs" in their 640,000 square foot South Dakota facility, "2000 people" in their 650,000 Nampa, ID location, and will add 3000 employees to their 855,000 square foot Phoenix fulfillment center.[135, 136, 137] A distribution facility focused on aviation will likely be biased towards a high number of smaller goods, rather than on larger bulky items; this will increase the number of transactions, which drives higher employment needs.[138]

Beyond the employees employed at a fulfillment center, many additional jobs would be created in the community.

The development of UAS "Prime Air" businesses are still not possible with existing technology; this applies to both the UAS aircraft (and the technologies within), as well as the integration of UAS into the national air space. Both of these will take some time to develop.

Once ready, a UAS distribution business for the Bay Area could support over 1000 jobs. As a benchmark, Half Moon Bay UAS distribution company Zipline is estimated to have over 409 employees.[139] Zipline enables distribution of blood and medical supplies using UAS; their aircraft are already servicing a 50 mile service radius and fly over 25,000 miles daily and do hundreds of deliveries daily.[140] They currently provide medical delivery services in remote areas such as Rwanda and Ghana and are doing pilot delivery programs in Arkansas and Missouri.[141] With potentially thousands of daily commercial deliveries happening in the Bay Area, the number of jobs could be substantial.

Figure 27 Walmart using drones from Zipline to run pilot delivery program.

As before, every direct job in aviation is expected to create 3.6 jobs elsewhere in the economy.

6.1.3 Long-term: UAS Manufacturing

Economic Impact: **10,000+ jobs**

Approach:

(1) Manufacturing of UAS aircraft

As R&D transitions to volume manufacturing, the estimated requirements of UAS aircraft manufacturing – and the number of new jobs that will be created – is breathtaking.

Figure 28 Bell Helicopter final assembly location in Mirabel Canada; 1300 employees. Source: https://www.bellflight.com/company/canada

The Uber Elevate UAS program (now part of Joby) is targeting a need of 5,000 large UAS "air taxi" vehicles per year.[142] To put that in perspective, the total number of general aviation aircraft sold *in the world* in 2019 was 2,658; this is half of what Uber Elevate says they will need annually![143] The FAA estimates the total number of employees in the US working on general aviation aircraft manufacturing in 2016 was 121 thousand. [144] When the volume of aircrafts manufactured doubles as Uber projects, it is not unreasonable to think that tens of thousands of new jobs will be created.

And that is just for "air taxi" UAS services.

Looking at air delivery services, Paul Misener, Amazon Vice President of Global Public Policy, told the FAA that "one day, seeing Amazon Prime Air will be as normal as seeing a mail truck on the road today."[145] One study projected that Amazon would need 384 drones to service the broader Chattanooga Tennessee area, which is the site of Amazon's initial Prime Air rollout.[146] As a reference point, Chattanooga with 184 thousand people is only the 144th largest city in the US[147]; to service the entire US could take well over a hundred thousand of these UAS aircraft.

Note that these UAS are not the toy drones we see flying around parks. They are complex, state-of-the-art multi-thousand to multi-hundred-thousand dollar aircraft weighing from 50 pounds (for small package delivery) to as much as 4000 pounds (for air taxi aircraft). These aircraft are loaded with electronics, batteries, and multiple motors to support longer range autonomous flight. The air taxi UAS have a size and complexity that exceeds any current production car.

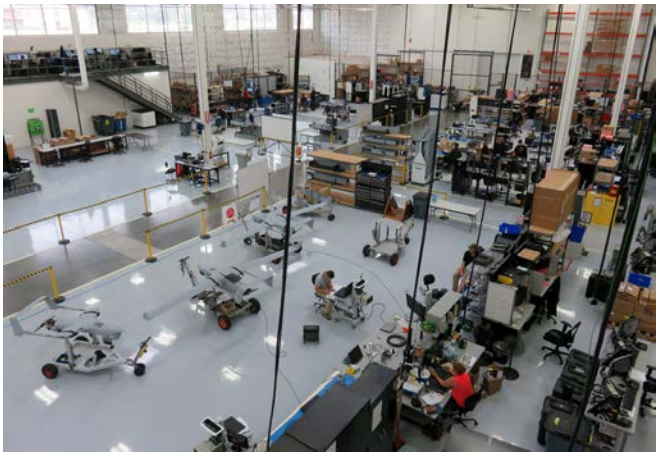

Figure 29 Washington state drone company Insitu was making 20-25 50-pound drones per month at the time of this picture

Beyond the manufacturing of aircraft, adjacent and related businesses would see substantial growth. Maintenance of aircraft, battery recharging services, trucking, UAS launchers, and supply chains to feed manufacturing would all grow, as would adjacent businesses such as restaurants, housing, stores, and gas stations.

As an example, Insitu, a subsidiary of Boeing making UAS military aircraft, set up a manufacturing facility in 2014 on the Washington-Oregon border where the primary industry had been aluminum smelters, timber mills, and agriculture. By 2017, it was estimated that

1,700 people and 17 companies had become involved in UAS within the region; median household income had risen in the region nearly 30% since Insitu had set up shop.[148] Insitu had drawn to the area Orbital UAV, an Australian drone motor company; a radio communication company Sagetech; a catapult launch company Hood Tech; and Zepher, a UAV recovery company.[149] It is worth noting that Insitu only made 20-25 UAS per month at this facility; the volumes needed by Amazon could be over 100,000.[150]

Given the size, complexity, volume, and precedent, large scale manufacturing of UAS aircraft could create well over 10,000 jobs within Santa Clara County and the surrounding region. Fortunately, this region has already demonstrated through Tesla its ability to provide high volume manufacturing of advanced transportation vehicles.[151]

6.2 Blue Ocean

The opportunities outlined within this white paper are by and large "blue ocean" opportunities; they focus on enabling new businesses and markets that don't currently exist and focus on creating new customer values, rather than competing simply on cost. These values include such things such as improved rural delivery service, improved safety services, and providing customers with new levels of customer delivery; they augment existing solutions to provide a better end product.

While the ideas leverage technologies already in development in this region, they reinvigorate an aeronautics industry (e.g. Lockheed Martin) that is arguably in decline within the region.[152] Rather than having to focus on driving costs down to remain competitive (a difficult proposition in Silicon Valley), it can create value – and jobs – through development of new technology.

And while some jobs could be affected – namely, at Eastridge Mall – these jobs are already under attack. What is offered here, however, is an option to redefine how the facility is used so that it does not face the broader cultural attack coming from online sellers. In so doing, it provides an opportunity for growth rather than the threat of decline.

Finally, this is a new market. There are no established players or cities that can reasonably claim an insurmountable advantage. It is still early in the game, and no one has scored.

6.3 Job Opportunities at All Skill Levels

The opportunities outlined within this white paper discuss leveraging cutting-edge innovation to create industries that will require massive manufacturing capability, assuming the long-term vision is achieved.

This creates a wide spectrum of jobs, but perhaps more importantly, the plan outlined creates a considerable number of jobs at the lower-end of the economic spectrum. Many of these jobs will not require specialized skills, beyond that which an employee would get with on-the-job training.

In particular, the warehouse fulfillment and manufacturing positions have the opportunity to be living-wage, non-seasonal, and low-turnover jobs. The positions may involve working with robotic and automated systems or other advanced technologies, but many of the roles likely would not require college degrees and could also include those who have left the criminal justice system. Furthermore, many veterans, especially those with logistics experience, have teamwork and leadership skills that align well with managing and driving the teams necessary for large-scale operations.

In creating this new industry, all economic classes have the opportunity to benefit. Everyone can find a job that can bring them dignity, income, inclusion and freedom.

6.4 Inspiring Education and STEM through Aviation

Ask a group of children what they want to be, and pilot or astronaut will likely be somewhere on their list.[153]

Aviation inspires kids and kids of all ages. This inspiration can be leveraged and integrated into school curriculums to develop STEM skills. Ronald Reagan recognized this benefit when he named a teacher as NASA's first non-astronaut to go to space.[154]

Within the East Bay Regional Community – Evergreen, Mt. Pleasant, Eastside Union, and Alum Rock ESD – are roughly 50 schools that likely would experience educational improvements with the development of an aviation industry.[155]

To do that, the aviation community could develop some of the following programs:

- Training, internships, and mentorships in aviation at local FBOs
- Ground school classes offered at high schools
- Discounted flight training for youth; promotion of free introductory flight
- Shadow programs with pilots and aircraft maintenance personnel
- Curricula oriented around aviation
- Cooperative high school and university programs. For example, San Jose State University already has a high school community outreach program.
- Leveraging Civil Air Patrol cadet programs
- Development of aviation programs targeting at-risk youth; an example of this is the Bob Hoover Academy operating in Salinas, CA
- Promotion and development of Experimental Aircraft Association (EAA) Young Eagles program
- Boys and Girls Club aviation programs
- Youth "flight assistants" to accompany pilots when they fly their humanitarian missions

Figure 30 Aviation inspires the youth.

Figure 31 (Image credit: EAA and General Aviation News) Student member being taught how to assemble wing rib.

As one example of how this might works, an EAA chapter in Florida teaches teenage youth every Saturday how to build and repair their own homebuilt aircraft.[156] Work is done under the supervision and tutelage of certified airframe and power mechanics. "Graduating students" are then well positioned for aviation maintenance positions and/or continuing education in aviation.

6.5 Enhances and Leverages Transportation Infrastructure

Reid Hillview and Eastridge Mall have excellent access to transportation infrastructure. Developing the airport area can leverage and improve the economics of this infrastructure.

Bi-directional usage of light rail. The proposed Eastridge light rail extension to BART can achieve increased utilization through the development of an aviation industry around Reid Hillview. While the extension provides a valuable service to enable the community to go elsewhere for work, the extension also has the potential to bring a significant number of employees to the airport and Eastridge Mall. This would increase ridership on the line, as well as improve sales revenue in the area.

Road infrastructure. The airport and mall region are proximate to multiple highways, which is ideal for the development of a regional fulfillment center. Their proximity to major thoroughfares allows the envisioned fulfillment center to be easily and quickly restocked.

Route	Distance
Bay Shore Freeway (Highway 101) to East Ridge Mall via Tully	0.8 miles
Bay Shore Freeway (Highway 101) to Reid Hillview Airport via Tully	1.2 miles
Interstate 680 to Reid Hillview Airport	1.7 miles
Interstate 680 to East Ridge Mall	2.3 miles
Bay Shore Freeway (Highway 101) to East Ridge Mall via Capitol Expressway	1.9 miles
Bay Shore Freeway (Highway 101) to Reid Hillview Airport via Capitol Expressway	2.7 miles

San Jose Mineta (SJC) Airport. UAS traffic can be reduced at San Jose Mineta airport by encouraging it at Reid Hillview. In the early stages of UAS development, it is not unreasonable to think that separation of high passenger-count aircraft from UAS aircraft may be desired. Therefore, aggressively developing a UAS program based out of San Jose Mineta may slow down commercial flights into the area and airport, slow down UAS developments, and constrict the long-term growth opportunity of these emerging businesses.

Similarly, development of Reid Hillview that services small aircraft, including UAS, is exactly what is in mind of a "reliever airport." San Jose Mineta commercial air traffic would not be impacted with the development of a UAS program.

San Martin (E16) Airport. San Martin has both positive and negative characteristics in the development of UAS activity.

On the positive side, operational issues for UAS aircraft are likely eased by operating in less congested airspace and there is very little commercial traffic that would be affected at the airport. In addition, the land footprint around the airport can be cost-effectively increased versus around other county airports. Finally, the south county area would be ideal for cost-effective manufacturing within the county; in that case, San Martin might be an ideal location for the development of UAS aircraft and/or as a port from which newly manufactured aircraft could depart.

On the negative side, its distance from urban areas makes it less ideal for "Prime Air Urban"; operation out of San Martin would increase the distance that a UAS would travel to reach dense populations where the economic advantages can more quickly be recognized.

6.6 Creating Regional Prosperity

As seen in Klickitat County in Washington, home of UAS drone manufacturer Insitu mentioned earlier, UAS manufacturing has the opportunity to create regional prosperity. This community had high unemployment in the 1990s and officials were struggling to find a lifeline for their citizens. Fundamentally because of the UAS manufacturing industry that came to the area, median income rose 30% between 2010 and 2017 (date of the article) and the number of households in the county earning between $100,000 and $149,999 more than doubled to over 10%. Small businesses in the area also thrived with the increased buying power of its citizens.[157]

The development of an aviation and fulfillment industry centered in East San Jose, coupled with manufacturing towards South County, can similarly drive economic growth and prosperity in these more economically challenged and marginalized communities.

The proposed aviation, manufacturing, and fulfillment industries do not require the advanced degrees and expertise required of many other Silicon Valley jobs and industries. In East San Jose, this is particularly relevant as most individuals do not have advanced degrees; only 23% of the population has a post high school degree, which is

less than one-half the rate found in the broader San Jose community.[158] In addition, many of the proposed jobs can leverage the skills and qualities found in veterans, refugees, and those who have exited the justice system.

By aligning the skills found in the community with the employers' needs, gentrification issues are minimized; it is less likely that area residents will be displaced by higher income individuals.

Many fulfillment and manufacturing jobs offer benefits such as health care, medical coverage and prescription programs that can be extended to family members.[159, 160, 161] Having such healthcare services would be of particular benefit in East San Jose and South County regions. In San Jose East Valley, 23% of adults are uninsured according to a 2016 county profile, which is more than 50% higher than the broader Santa Clara County (14%); in areas around Gilroy, 26% of adults have no health insurance. [162, 163] By providing jobs in the region that provide healthcare benefits, this has derivative benefits in the form of reduced hospital admissions, emergency room visits, and premature deaths.[164]

With economic growth in the region, quality of living and education should also improve, the number of individuals living in a household should decrease, and unemployment should be reduced.

By developing the proposed critical, high-growth economic engine in East San Jose and South County, these areas have the opportunity to address socio-economic issues that have long plagued these communities. This pays dividends not only for these communities, but also for the broader region.

7 Short / Medium / Long Term Goals

Within this section, various potential goals and projects are identified for consideration. These goals are grouped into short-term projects that can be – and should be! – developed relatively quickly with minimal effort and change to infrastructure; they are focused on forming the relationships, establishing the direction, and initial research and development. Medium-term goals mark the transition from research and development to commercialization. Long-term goals are provided as an aspirational direction for the county and are primarily tied to future local manufacturing.

7.1 Short-Term Goals

7.1.1 Pilot Training

- **Provide commitment to Reid Hillview FBOs through long-term lease agreements.** This will enable these flight schools to confidently invest in and promote their aviation programs.

- **Publicize goals of making San Jose a destination for both pilot and UAS training**. (See 3.2.2 Increasing Need for Commercial Pilots and Aviation Personnel and 5.6 Reid Hillview Airport) For example, this can be encouraged by beginning to orient some city messaging around aviation.

7.1.2 Unleaded Fuel

- **Encourage transition from leaded fuel to unleaded fuel.** (See 3.3.1 Fuel) Santa Clara County has an opportunity to lead an adoption of unleaded aviation gas ("avgas") in California. Pilots at Reid Hillview are aggressively pursuing the adoption of the unleaded avgas UL94 – an unleaded 94 octane aviation fuel – at the airport. This FAA certificated fuel must be brought in from Indiana where it is currently refined, which places it at a competitive disadvantage versus locally refined fuels; local refiners have expressed no interest in offering this fuel.

  Policy considerations might assist in leveling the playing field with the existing leaded fuel option. A separate detailed presentation is available on this topic.

7.1.3 Scholastic Outreach and Collaboration

- **Encourage development of aviation curriculum and policy development.** Local universities have a rich portfolio of relevant aviation and aviation-related capabilities (see 5.4 Universities). Supporting, developing, and involving them in aviation programs can have a rich symbiotic relationship both for the universities as well as providing a pipeline of talent for the emerging companies.

- **High school and youth programs.** (See 3.2 Increasing Need for Commercial Pilots and Aviation Personnel and 6.4 Inspiring Education and STEM through Aviation). Develop programs where youth have the opportunity to develop skills around aviation and aviation maintenance and using the airports as a classroom.

7.1.4 Reid Hillview Airport for Emergency Services

- **Promote UAS development at Reid Hillview for fire management operations.** (See 4.3 Fire Suppression) Encourage UAS developers focused on fire management operations to operate at Reid Hillview. This is consistent with the 2016 "Santa Clara County Community Wildfire Protection Plan" report.

- **Evaluate Reid Hillview as a base for the Santa Clara County Sheriff helicopters.** (See 5.6 Reid Hillview Airport) Procurement notice SHO-SINGLE-09/16/20 indicated that Santa Clara County Sheriff was exploring a site for a new base. Reid Hillview should be evaluated as potential relocation site, especially if the decision has not already been made.

- **Re-evaluate Reid Hillview as a base for CalFire.** (See 4.3 Fire Suppression and 5.6 Reid Hillview Airport) This is consistent with the 2016 "Santa Clara County Community Wildfire Protection Plan" report. While a report was recently submitted to the Board of Supervisors regarding the response to the 2020 wildfires, it did not appear to fully consider the recommendations and concerns outlined in the 2016 report with respect to aerial response to fires.

7.1.5 Research and Development

- **Identify and encourage research and development opportunities at Reid Hillview.** (See 4 Unique Market Challenge and Opportunity and 3.1.2 UAS: A Confluence of Enablers for example technologies) Various properties and facilities at Reid Hillview could be leveraged to entice UAS developers. By way of example, these developments might be focused on development of the UAS aircraft, infrastructure such as airspace management integration, or adjacent technologies, such as communication, materials, or robotics development.

- **Identify and encourage research and development elsewhere.** (See 4 Unique Market Challenge and Opportunity and 3.1.2 UAS: A Confluence of Enablers for example technologies) Additionally, programs should be explored at other airports, county facilities, university campuses, etc. as a mechanism to more fully integrate aviation into our county and community.

7.1.6 Policy

- **Formalize a county-focused policy around aviation; redevelop the Aviation Master Plan.** Identify aviation as a strategic initiative for the county and map out the activities that the county will pursue to address this emerging market. This demonstrates a level of commitment that potential aviation developers will appreciate; and state and local officials can leverage to appropriately direct governmental resources.

- **Hold workshops and forums to engage industry and show support.** The Uber Elevate events held in Dallas and Los Angeles are examples of such engagements. Similarly, NASA Ames is often engaged in such industry-wide events.

- **Outreach to neighboring counties.** Coordinate a broader message with neighboring counties (see 5.1 Pedigree) to promote and develop aviation in the region.

- **Outreach to fulfillment companies.** Identify to fulfillment companies (see 4.1"Prime" Air – Rural and 4.2 "Prime" Air – Urban) the opportunity that exists regarding airborne fulfillment in Santa Clara County and more specifically at Reid Hillview. (see 5.7 Eastridge Mall and Reid Hillview: 1.4 Million Square Feet Next To an Airport).

- **Outreach to Eastridge Mall.** (see 5.7 Eastridge Mall and Reid Hillview: 1.4 Million Square Feet Next To an Airport).Similarly and just as importantly, open up discussions with Eastridge Mall owners about their interest in using some or all of the mall for an airborne fulfillment program.

- **Outreach to NASA Ames and FAA.** (see 5.3 NASA Ames and Moffett). Engage NASA Ames about how Santa Clara County and its airspace and airports may be leveraged to test and further UAS airspace integration.

- **Engage Community.** Communicate to community how Santa Clara County is making the existing air space safer and how the growth of aviation will improve quality of life and economic opportunity to its citizens (see 6 Economic Impacts on the Area and 3.3 Technology Innovation Eliminating Historic Community Concerns). For long-term success in aviation, it would be helpful to have the county communicate the benefits of the emerging aviation market rather than its threats.

7.2 Medium-Term Goals

- **Prototype airspace integration.** Working together with NASA and the FAA, begin prototype air space development and integration (see 3.1.2.5 UAS Flight Planning - FAA). This will almost certainly be in a series of gradual steps to insure safety: gradually move from rural to urban environments, gradually distances will increase, gradually flights beyond visual line-of-site will occur, and gradually they will transition into more active air spaces. Protocols will need to be developed to insure safety of the broader public and the aviation environment, as well as to receive the acceptance of the community.

- **Prototype "Prime Air – Urban" and "Prime Air – Rural".** Support and facilitate where possible prototype roll-outs of airborne delivery of goods (see 4.1 "Prime" Air – Rural and 4.2 "Prime" Air – Urban). Examples of activities might include improving movement of goods between the mall and airport facilities; the education of community members on what is happening; development of noise studies for proposed flight paths; supporting communication equipment installation; enhancing power delivery to the region to recharge aircraft; documentation of obstacles; or any number of activities that benefit from a private/public cooperation.

  In addition, Santa Clara County endorsement of rural airborne deliveries to regional counties and airports could provide a win for all parties.

- **Maintenance, repair, recharging, and support of UAS.** Develop a center for aircraft services. While there are some UAS activities that will benefit from operating out of an airport environment, there are some that will not; nonetheless, a regional airport such as Reid Hillview can still participate in these programs. Large scale overnight charging operations, avionics and communication work, airframe repairs, painting, upholstery, and any number of aircraft service activities can be performed and might benefit from working in proximity to each other.

7.3 Long-Term Goals

These are not required in order to move aviation policy forward, but serve only to provide a directional signpost for areas of future exploration.

- **UAS Manufacturing.** Develop public policy to encourage volume UAS manufacturing in South County. Secure space around San Martin airport for future airport expansion. Provide electrical infrastructure for large-scale battery charging or aircraft manufacturing.

- **Integration of Eastridge Mall and Reid Hillview airport.** To the extent that the existing mall and airport are successful in developing the proposed rural and urban airborne services, there is potentially an opportunity for operational improvements through the unification of these properties. If that is the case, ideas such as shifting traffic from Tully over to Quimby can be explored, which would simplify movement of materials between the properties. In addition, if the properties are directly adjacent, there may be an opportunity to lengthen and/or strengthen runways to handle more cargo.

8 Examples in Competing Regions

Given the billions of dollars of incremental revenue and thousands of jobs that the next generation of aviation will bring, on top of the billions of dollars of revenue and employment aviation already provides, other communities – and states! – are aggressively positioning themselves in the pursuit of this market. In light of this competition, it is important that Santa Clara County and our companies begin actively pursuing this space as well.

This section offers a brief look at some of the other regions also likely interested in this market.

8.1 Florida and Orlando

The state of Florida in 2019 estimated that aviation contributed $175 billion dollars (2017) to the state's economy.[165] While the large amount is expected given the number of tourists arriving on commercial flights, there is still heavy aviation development and training that occurs in Florida. $9.8 Billion dollars and over 108,000 jobs in Florida come from military aviation projects. Another $4 billion dollars in economic activity is attributed to general aviation.

Their report provides case studies of how smaller airports and communities have embraced aviation to grow their economies, providing a win for both the company and the community.

Airport	Jobs or jobs created	Company
Pensacola Airport	400 new jobs	ST Engineering
Melbourne Airport	850 jobs	Embraer
Lake City Airport	400 new jobs	HAECO airframes

They talk about how communities work with the companies, giving the example of how the Columbia County School District worked with HAECO to train the needed workforce.

They highlight the alignment of higher education with aviation, and how that contributes to creating a skilled workforce. Specifically, they say that over 800 faculty teach 7200 aviation students at four higher education schools (Embry-Riddle Aeronautical University, the College of Aeronautics at the Florida Institute of Technology, the School of Aviation at Jacksonville University, and Lynn University's Burton D. Morgan College of Aeronautics) in over 100 aviation fields.[166] Elsewhere, they say flight schools employing over 2000 people across 83 airports create thousands of pilots a year to address the pilot and aviation personnel shortage.[167, 168]

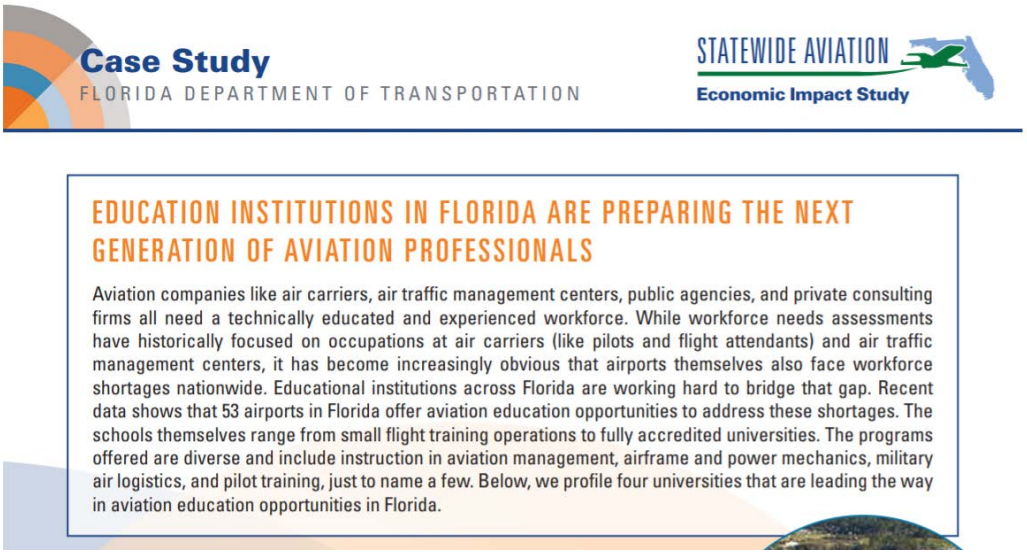

Figure 32 Florida Educational Institution Case Study (Source: https://www.fdot.gov/aviation/economicimpact.shtm)

In November 2020, the city of Orlando announced that they would work with a German eVTOL company Lilium to develop a port in Orlando. This will create 143 jobs at 150% of the median wage in Orange County.[169] Lilium highlighted in their decision the city's development of a white paper (https://business.orlando.org/wp-content/uploads/sites/3/2020/08/UrbanAirMobility_WhitePaper.pdf) on urban air mobility as a reason for their decision. Orlando highlighted the strengths they presented to Lilium, including weather, existing aviation industry, heavily populated but spread out community, strength in aerospace and aviation, and their commitment as a testing ground for autonomous vehicles.[170] These are many of the same attributes and factors highlighted within this white paper.

A short video produced by the City of Orlando on their cooperation with Lilium can be found here: https://news.orlando.org/wp-content/uploads/2020/11/Tavistock-Lilium_Presser_Nov-11-2020.mp4

8.2 Chattanooga, TN

Amazon set up a fulfillment center in Chattanooga, Tennessee that employed between 2000 and 2500 full-time employees in 2017.[171] Amazon is also using this facility to evaluate their Prime Air distribution system; aspects that Amazon will likely evaluate include FAA interaction, drone design, logistics, economics of airborne delivery, and related factors to operate the drone system.[172]

8.3 Los Angeles and Southern California

A 2014 economic impact study on the California aerospace industry – including both space and the aircraft industry – found that the state was generating roughly $16.6B in direct revenue from the aircraft market, and another $22.3B in indirect and induced revenue.

Sector	$B
Aircraft	$2.4
Engine and parts	$1.1
SDNGN (Search, detection, navigation, and nautical instruments)	$7.1
Other parts	$3.2
Maintenance, repair, and overhaul	$2.8

Much of this revenue comes from the development of military aircraft in southern California. In 2013, approximately 4-9% of US military aircraft came from California; of 16 major military aircraft developments, California contractors played a significant role in five of them. With the exception of a small project done by Lockheed, all of the aircraft contractors were in southern California. [173]

Los Angeles and southern California have a long legacy in space and aircraft industry. Home of Vandenburg AFB, Skunkworks (located in Palmdale), Space-X (Hawthorne), major portions of Boeing (Long Beach), Northrop Grumman (Redondo Beach), General Atomics Aeronautics (originally General Dynamics; located in Poway), this area is an aviation and aerospace powerhouse.

Already, this area is working on large UAS developments. [174]

	Project	"Program Acquisition Cost"	Company
	**Predator / Reaper**	$1.91B	General Atomics Poway, CA
	**Global Hawk**	$1.25B	Northrop Redondo Beach, CA
	**Shadow / Raven**	$0.23B	AeroVironment Simi Valley, CA

Table 12 Source: California Aerospace Industry Economic Impact Study (2014)

More recently, in November 2017, Uber Elevate (now part of Joby Aviation) announced that Los Angeles would be one of the first locations for an air taxi service – along with Dallas, Texas and Melbourne, Australia – in 2023.[175, 176] This program is similar to the Orlando Lilium relationship, where Los Angeles will work with Joby Aviation to help enable this new transportation business model. As one recent example of that collaboration, Los Angeles hosted the second Uber Elevate conference, which brought in over 800 developers of aerial ridesharing technology.[177]

8.4 Washington State

Employing 68,900 people (2017), Boeing is the largest private employer in Washington State. [178, 179] This engine of employment has created roughly 84,000 aerospace jobs (including those at Boeing) in Washington State, and has spawned 44.6 thousand jobs elsewhere in the state's economy.[180] Aeronautics has contributed $11.6 billion

dollars to the state's economy outside of aeronautics; that is to say, it has contributed to everything from grocery stores to home building.[181]

Hundreds of companies beyond Boeing exist to support aerospace, and hundreds of companies outside of aerospace exist to support aerospace.

Aviation has become intrinsic to Washington State. Numerous counties derive hundreds to thousands of jobs due to aerospace and its related industries; the impact extends to far beyond Boeing's main assembly site.

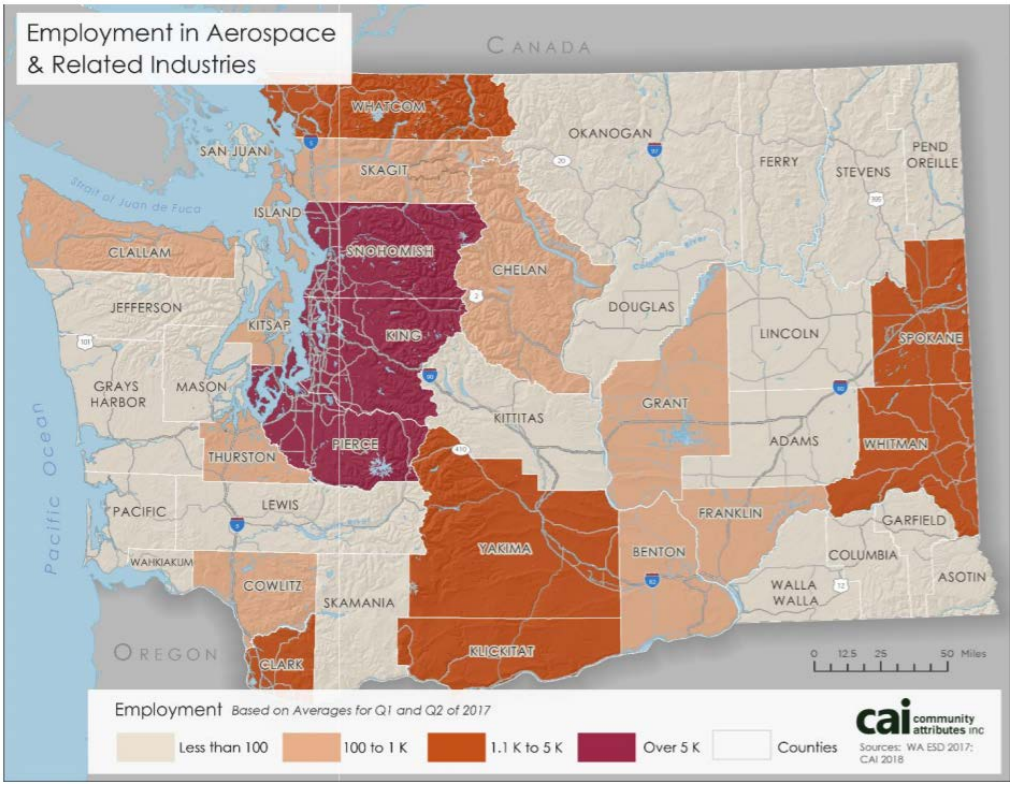

Figure 33 Employment in aerospace and related industries for Washington State (2017)

The aviation industry is recognized as driving good wages within the state, both to those directly in it, and those that are in related industries. The average annual aerospace wage was $109.4 thousand dollars (2017), while those supporting the industry had an average annual wage of $76.0 thousand dollars (2017), or roughly $38 dollars per hour.[182]

Aviation is embraced by the Washington state communities. It is part of their DNA. It will motivate their future.

9 Opportunity

This white paper discusses an emerging market and emerging technologies. That leadership around technology and innovation is what defines companies, people, and universities in this area … and in Santa Clara County in particular. Leveraging the aviation pedigree and capabilities of the community, Santa Clara County is well positioned to take on the mantle of leadership for the next generation of aviation.

This is a critical time when the county should embrace aviation and expand its aviation resources and activities; it is certainly not a time when we should talk of shutting portions of it down.

We have witnessed how electric vehicles, automation, and next-day delivery have changed our world and how we live; we have had a front-row seat, because these businesses were developed here. We now have an opportunity to combine all of those technologies in an amazing way, using valuable precious resources already in place. Through serendipity, we have a mall and an airport adjacent to each other; together, they are a valuable resource that provides the community a unique opportunity to build an amazing next-generation capability.

This is an opportunity to grow the economy. In particular, it is an opportunity to develop areas of the county that have been historically underserved. An opportunity to improve the health of that community in multiple ways. An opportunity to improve the educational level of the youth in the area, and an opportunity for our youth to develop skills to intercept this high-growth market. An opportunity to help the homeless and marginalized. An opportunity to set an example for the rest of the state and the nation.

Aviation is at an inflection point. This white paper outlines how the county can position themselves for a segment that will add 18,000 jobs and $14 billion in economic impact. This can be the next growth engine for the county. It can be a win for the community, for business, and for the people of Santa Clara County and the surrounding area.

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[9] https://en.wikipedia.org/wiki/Energy_density
[10] Power is voltage times current. By increasing the operating voltage, less current is needed to achieve the same power. Lowering the current reduces wiring size which is a substantial contributor to vehicle weight. By reducing the vehicle weight, greater efficiency is achieved.
[11] "FAA Aerospace Forecast; Fiscal Years 2020-2040", Federal Aviation Administration, p. 41 – 63.
[12] https://www.faa.gov/uas/commercial_operators/operations_over_people/
[13] https://www.faa.gov/uas/research_development/traffic_management/media/UTM_ConOps_v2.pdf, p. xi.
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[29] https://www.faa.gov/uas/commercial_operators/
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[31] "2019 Active Civil Airmen Statistics", https://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/, Federal Aviation Administration, Table 13.
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