Q2 2022

Cities of sustainable flight

Who is investing in the new infrastructure required for eVTOL to take off?

Why are they investing?

What are they investing in?

Leif Capital

The necessity of ‘Air Architecture’

This report profiles just a handful of the investors and companies that are investing in and developing what Ricky Sandhu, founder of Urban-Air Port (UAP), a British infrastructure technology start-up (and, disclosure, a Leif Capital client), calls ‘air architecture’.

This report is inspired by Ricky’s vision of cities accommodating advanced air mobility (AAM) and thereby becoming more sustainable. UAP is our central case study (section 2). We also review a broader ecosystem of venture-backed infra-tech, cyber-tech, data- tech, battery-tech and prop-tech start-ups that enable and advance air mobility (section 3). We start with a review of investors that are seeking to invest more in the infrastructure required by AAM (section 1).

How we architect our cities, physically and digitally, to enable and accommodate sustainable flight is one of the greatest innovation and investment opportunities of our day. I hope you enjoy the report.

Tom Whitehouse, London, May 2022

Tom Whitehouse
CEO
Leif Capital

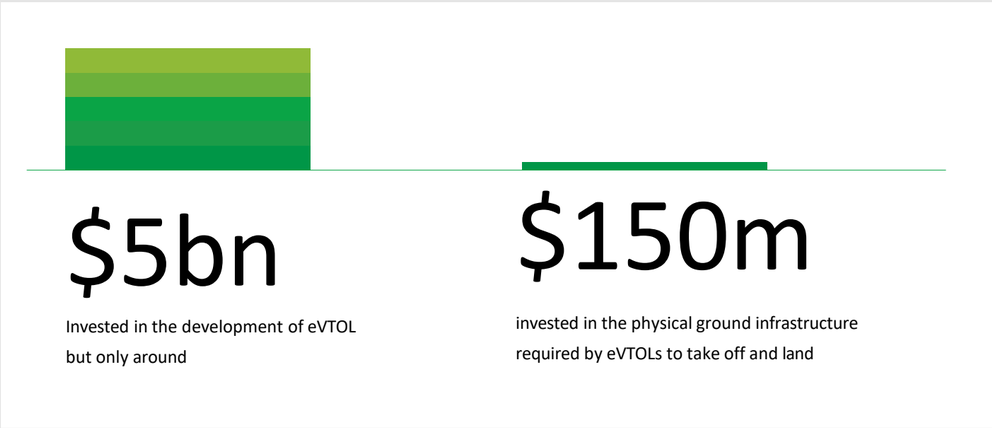
Ricky Sandhu
Founder + Executive Chairman
Urban-Air Port

The discrepancy is the investment opportunity

About $5bn was invested in the development of eVTOL (electric Vertical Take-Off and Landing) vehicles in 2021.[i] But only about $150m was invested in the physical ground infrastructure required by eVTOLs to take off and land. [ii]. Leif Capital sees this discrepancy as an investment opportunity worth exploring, which is what we're doing in this report.

The rapid changes underway in how people and goods are transported and delivered in and around cities need to become more sustainable. Air and sound pollution must be reduced and eliminated. And so must congestion (even of zero emission vehicles) because clogged streets are neither efficient nor safe. They are an urban blight.

The sustainable solution is to transfer more ground transport to the air, to low altitude air to be specific, where zero emission drones and air taxis deliver their cargo and passengers efficiently and safely. But this won't happen without new infrastructure.



[i], [ii] Lufthansa Innovation Hub – TNMT Advanced Air Mobility Investment Dashboard – Figures include investments into 'physical infrastructure' category for 2021.

eVTOL requires new infrastructure – physical and digital

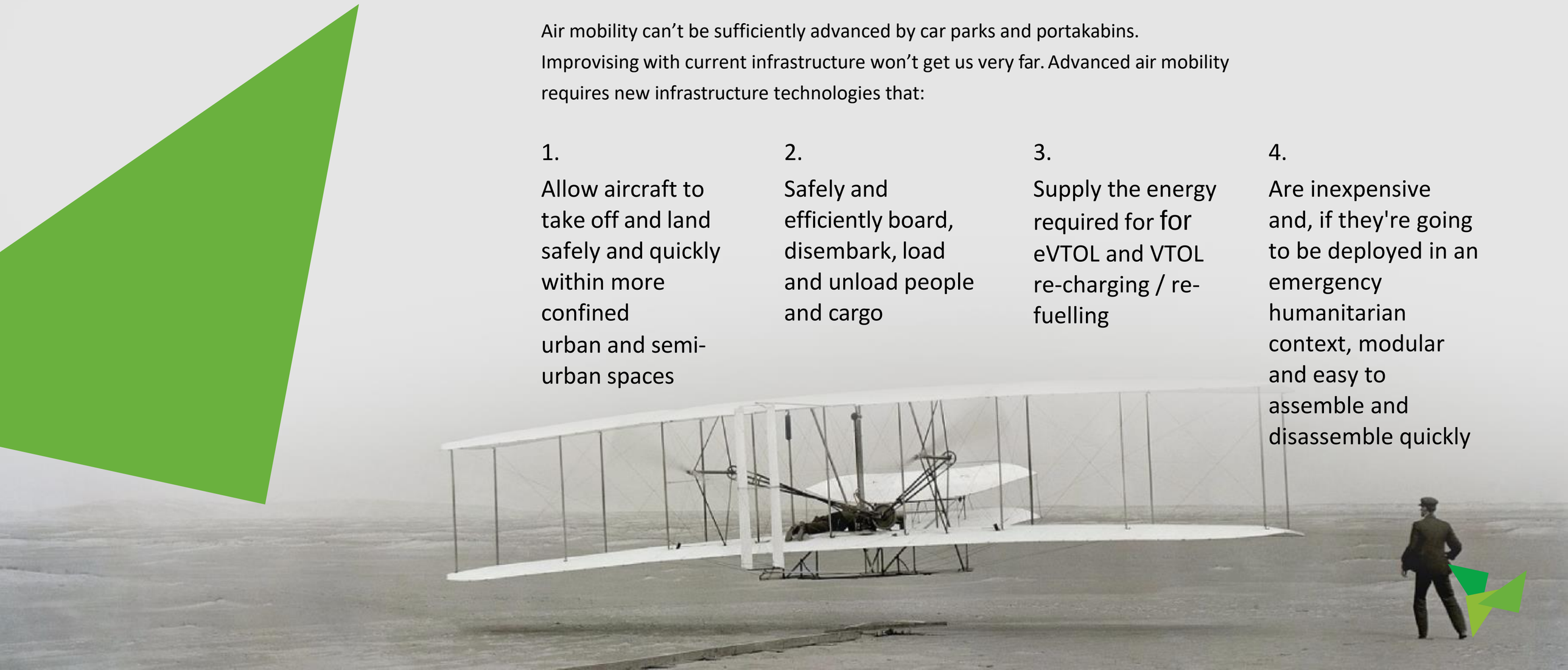
Air mobility can’t be sufficiently advanced by car parks and portakabins. Improvising with current infrastructure won’t get us very far. Advanced air mobility requires new infrastructure technologies that:

1. Allow aircraft to take off and land safely and quickly within more confined urban and semi-urban spaces

2. Safely and efficiently board, disembark, load and unload people and cargo

3. Supply the energy required for for eVTOL and VTOL re-charging / re-fuelling

4. Are inexpensive and, if they're going to be deployed in an emergency humanitarian context, modular and easy to assemble and disassemble quickly



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Who is investing and why?

Who is investing and why?

The three corporate investors cited below - Hyundai, Lockheed Martin, and Brussels Airport Company - aim to disrupt rather than be disrupted. They are hoping to get on the right side of the forces of creative destruction confronting their core industries.

The financial VCs - Levitate Capital, Green Eight Capital, AEI HorizonX and UP.Partners – underline the hoped-for exit potential of early investments in what is poised to be high growth industry. (The UAM market is forecast to grow by 9% annually, reaching US$12.7 billion by 2027 and up to US$1 trillion in the next 20 years).

A governmental investor, the UK government's Future Flight Challenge (part of UK Research and Innovation), underlines the importance of governments to the future of AAM, and the UK's determination to maintain its expertise in all matters aeronautical.

supernal

brussels airport

LEVITATE CAPITAL

UP.PARTNERS

LOCKHEED MARTIN

ae HORIZONX

Green Eight Capital

UKRI UK Research and Innovation

01

Who is investing and why?

Supernal (Hyundai Motor Group)

Lesser-known fact: Hyundai made roads before it made cars. Its transport interests started with infrastructure.

This history rhymes with its investment last year in Urban-Air Port Ltd, a British start-up, which, at the time of writing, has just unveiled ‘Air One’, its first operating vertiport in the English city of Coventry.

“At Supernal, we are on a mission to transform how people and society move, connect, and live; therefore, it is essential we not only develop electric air vehicles, but also help shape the broader advanced air mobility market from the ground up.”

Jaiwon Shin,

CEO of Supernal (Hyundai’s UAM subsidiary)

supernal

HYUNDAI MOTOR GROUP

Sample portfolio company:

UAP urban-Air Port ltd

01

Who is investing and why?

Future Flight Challenge (UK Government)

The Future Flight Challenge (FFC) is a £125m UK government ‘match fund’ providing significant non-dilutive grants to British businesses, conditional on them also raising private sector funding.

“Rather than just funding the vehicles, we’re funding all aspects of the system, with the belief that all of these new aviation systems – from air traffic management (ATM) to infrastructure and regulation – are interconnected.”

Gary Cutts

Director
Future Flight Challenge

Grant recipients include:

INDUSTRIAL STRATEGY

UK Research and Innovation

urban-Air Port ltd

ALTITUDE ANGEL

01

Who is investing and why?

Lockheed Martin (LM Ventures)

Aside from its investments in eVTOL OEM innovators Elroy Air, Electra and Skydio (not the subject of this report), the UAM investments made by the corporate venture unit of the US-based defence and aerospace giant have typically focused on detection, recognition, and surveillance. For example, Hidden Level is a New York-based company that designs and develops sensors for low-altitude airspace monitoring.

"Hidden Level underscores our focus on mitigating airspace safety challenges.

We are excited to add Hidden Level to our investment portfolio and look forward to working with their team and gaining access to their distributed sensor network that may offer a solution to address these escalating challenges."

Chris Moran

General Manager
LM Ventures

Sample portfolio company:

LOCKHEED MARTIN

Hidden Level

01

Who is investing and why?

Levitate Capital

The first financial venture capital firm to focus exclusively on AAM, US-based Levitate Capital, which was founded in 2017 by Michael Linse, previously of Kleiner Perkins, has spread its investments among eVTOL OEMs (such as Volocopter and Elroy Air) and companies building digital infrastructure such as Shield AI (unmanned systems without GPS) and Dedrone (drone detection and mitigation).

"The most attractive opportunities in the enterprise drone space center around high-value software. The primary value enterprises derive from drones comes from the data they collect and the software they use to analyze that data; therefore, unless coupled with mission-critical software, drone hardware will become increasingly commoditized."
From the conclusion to Levitate Capital's 2020 white paper 'The Future of the Drone Economy.'

Michael Linse
Managing Director
Levitate Capital

Sample portfolio company:

SHIELD AI

01

Who is investing and why?

Brussels Airport Company

Brussels Airport's skills in logistics have been underlined by its success in transporting nearly a billion Covid vaccine shots through its airport.

Its 2021 acquisition of a 50% stake in SkeyDrone, a provider of UTM (unmanned traffic management) services, from skeyes, Belgium's state-owned air navigation and traffic provider, is expected to be the first of several strategic investments intended to defend and extend their technological edge.

"Brussels Airport's investment in SkeyDrone is strategic and goes beyond investing in drone know-how and technology. It is an investment in co-creating the future of unmanned air traffic… we can fully explore, develop and commercialise drone management systems and drone services that can be used on a daily basis by clients in various industries."

Arnaud Feist

CEO
Brussels Airport Company

Sample portfolio company:

skeydrone
Enabling safe drone operations

01

Who is investing and why?

Green Eight Capital, UP.Partners, AEI HorizonX

Green Eight is a Switzerland-based investment company established by Philipp Maurer as a spin-out of Deutsche Bank. In addition to AAM, Green Eight also seeks investments in logistics infrastructure, satellites and cybersecurity. Its first investments are expected this year.

UP.Partners is a US-based $230m venture fund focused on 'Transforming the Moving World' by investing in technologies that help move people and goods cleaner, faster, safer and at lower cost - on the ground, in the air, on the sea and in space.
Its backers include Woven Capital (Toyota) and Alaska Air Group.

Last year Boeing year entered a strategic partnership with the private equity firm AE Industrial Partners (AEI). Together they established AEI HorizonX to manage and expand its Boeing's venture capital arm which had a portfolio of more than 40 start-ups.

Green Eight Capital

UP.PARTNERS

ae HORIZONX

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Case Study:
Urban-Air Port Ltd

The first eVTOL investment in new infrastructure

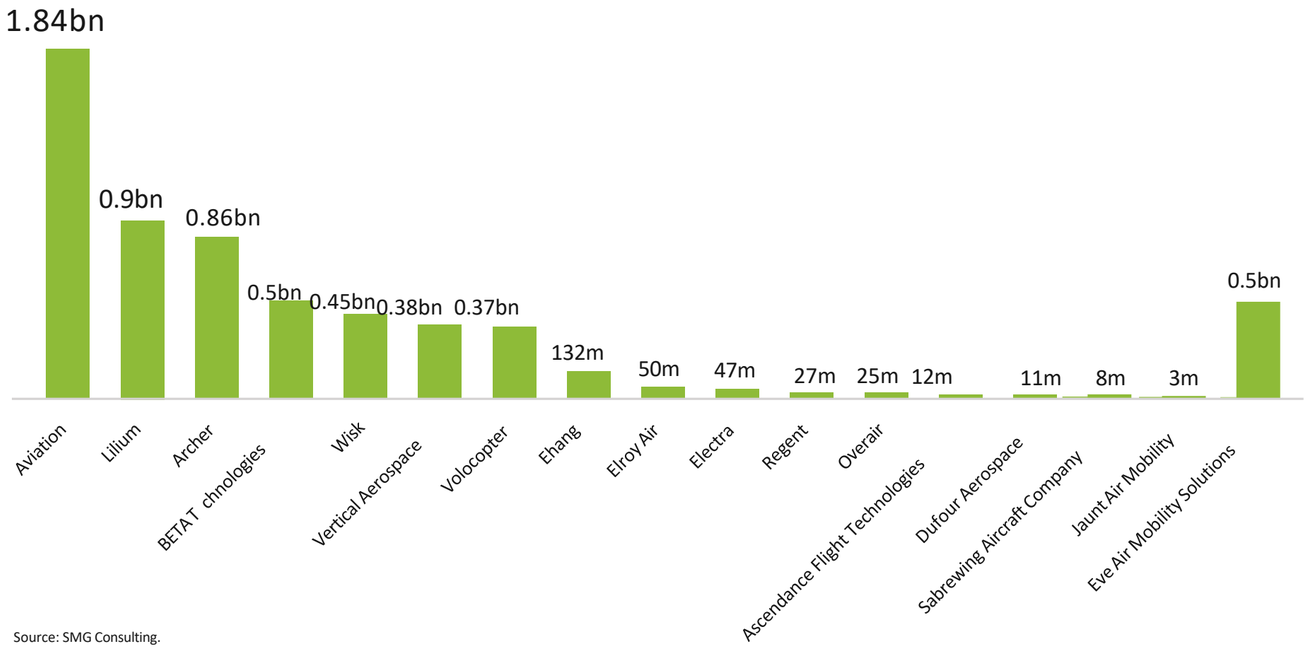
Hyundai Motor Group became the first automotive OEM to invest in new eVTOL infrastructure when it invested in Urban-Air Port earlier this year and joined its board.

02

Case Study: Urban-Air Port Ltd

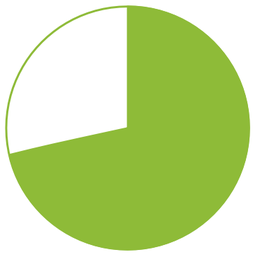
The Problem: So many aircraft with nowhere to take-off or land

Advanced Air Mobility (AAM) Aircraft Investment as of Feb ‘22



Source: SMG Consulting.

A 2019 NASA/Booz Allen study found that a near-term US market size of $500bn is achievable



$355bn

of that value comes from removing the infrastructure constraint.

“

If leaders want to scale the Urban Air Mobility market… they must establish many more ports, as well as more routes among them”

To take off, flying vehicles first need places to land – McKinsey & Company

02

Case Study:
Urban-Air Port Ltd

The Solution: Urban-Air Port®

Enabling Advanced Air Mobility through Innovative Infrastructure

We provide innovative ground infrastructure-as-a-service for future air mobility. An ultra-compact, rapidly deployable, multi-functional operations hub for manned and unmanned vehicles providing aircraft command and control, charging/refueling, cargo and passenger loading and other mission specific facilities.

Air One

Water

Rooftop

City Box

City Box XXS

Passengers

Logistics – autonomous drone deliveries

Disaster emergency management

Mobile defence operations

02

Case Study:
Urban-Air Port Ltd

Unique Selling Points:

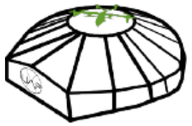
Air One | Marine One | Resilience One

Enabling Zero Emission Flight

Using renewables in off-grid locations

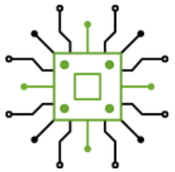
Scalable

Multiple sizes for customers to match to their market



Solution to AAM lack of Infrastructure

First demonstrator in April 2022



Technology driven

With patented 3Dimensional airfield

Cost Efficient

CapEx and OpEx far lower than airports with comparable throughput

Rapidly deployable

Portable and quick to install. Designed for transport in shipping containers

Compact footprint

60% the land take of a comparable heliport, reducing cost in urban locations

Modular

Integrated pax and cargo operations increase flights and reduce operational costs

02

Case Study: Urban-Air Port Ltd

Global Total Addressable Market

Revenue Model		2022	2023	2024	2025	2026	2027	2028	2029	2030
Logistics			2022 Logistics drones begin commercial operations in last mile solutions	2024 Larger drones enter middle mile logistics market	GTAM by 2025: $2bn			Drones are cemented as component in all parts of logistics chain		GTAM by 2040: $413bn*
Humanitarian			COVAX plan to distribute billions of vaccines – huge demand in developing countries	Larger aircraft allow broader mission profile including emergency response, search and rescue	GTAM by 2025: $1bn		Climate change increases the need for disaster relief, particularly in coastal regions. Drone solutions form major part of Governments disaster response			GTAM by 2040: No current estimate
Passenger			Early Adopters/ Demo Projects/ Tourism	2024 Passenger Air Taxi operations in US	GTAM by 2025: $3bn			Global rollout of passenger Air Taxi services. Vertiport installation boom		GTAM by 2040: $851bn*
Security			Drones widely used – Need specialist operations hubs	Autonomous coastal security systems -	GTAM by 2025: $2bn		Unmanned operations continue to define security plans and spending			GTAM by 2040: $12bn*

Source: * Morgan Stanley "Flying Cars: Investment Implications of Autonomous Urban Air Mobility" – 'Medium Forecast'

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03

Venture- backed case studies in AAM infrastructure

Developer of an aviation technology designed to manage autonomous drones.

ALTITUDE ANGEL

Airspace Management Solution

GuardianUTM Enterprise provides comprehensive oversight of airspace and managing aerial access for Unmanned Aerial Vehicles (UAVs) around critical infrastructure, land and managed properties.

Enabling national aviation authorities and air navigation service providers to establish new services to support growth in drone industry.

API & Services

Provides drone manufacturers and software developers with tools and data to access accurate, up-to-date and relevant operational data.

Interface directly with UTM systems on national level.

Receive dynamic alerts for potential mid-air collisions.

03

Venture- backed case studies in AAM infrastructure

infiniDome's products protect against attacks of GPS-based systems critical for autonomous vehicles, drones, connected fleets and critical infrastructure

infiniDome
THE GPS SECURITY COMPANY

Backed by

BOUNDARY HOLDING

NEXTGEAR VENTURES

Honeywell

Industry problem: GPS attacks

GPS jamming has become the #1 threat to defence and commercial drones.

GPS attacks are the easiest way to take a drone down.

The Solution: GPSdome

infiniDome offers the industry's only non-military GPS anti-jamming protection solution.

Wireless end-to-end protection solution detecting and protecting from jamming and spoofing of GPS, V2X, cellular and other wireless sensor signals

Shields the received GSP signals from being overpowered by the jammer and alerts operator when attack is detected.

03

Venture- backed case studies in AAM infrastructure

Creating an electric transportation ecosystem that’s safe, reliable and sustainable

Backed by

Extensive Charging Infrastructure

Continuous Power

350 kVA

Battery Charge Range

Up to 950 Vdc

Continuous Charge Current

350 Amps

Boost Charge Current

500 Amps

Recharge Pad

Battery energy storage

Generator

Elevated landing deck

Pilot Lounge

Sleeping Accommodations

Maintenance & repair workshop

ALIA-250(C)

Range: 250 NM (nautical miles)

Recharge Time: 50 minutes MTOW: 6000lbs

ALIA 250 and ALIA 250c are Beta technologies passenger and cargo eVTOL state-of-the-art aircrafts

ALIA’s fixed-pitch propellers and centrally located batteries make it an inherently stable aircraft that is safe to fly and easy to manoeuvre.

03

Venture- backed case studies in AAM infrastructure

Developing hydrogen fuel cell system, providing an avenue for eVTOL to achieve performance and range targets difficult to achieve with convention Li-ion batteries

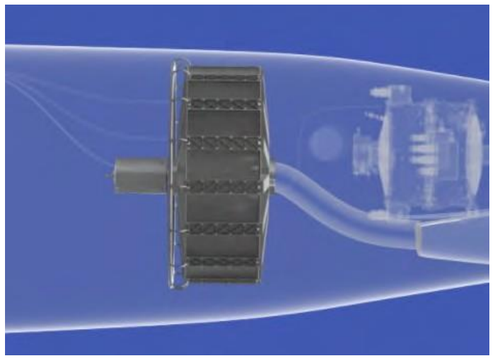
hypoint

Backed by

808 ventures

ASYMMETRY VENTURES

ALCHEMIST ACCELERATOR

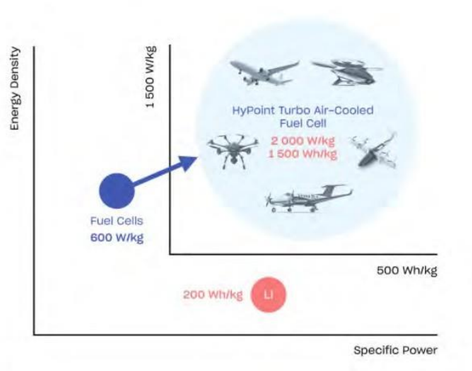


Turbo-Air Cooled HTPEM Hydrogen Fuel Cell System

Utilizes compressed air for both cooling and oxygen supply.

Reduces overall weight compared with traditional liquid cooling.

Increases cooling efficiency by at least 300%.



Hydrogen vs Li-ion

Zero-emission aviation vehicles are limited by the energy density limitation of Li-ion batteries and specific power limitations of hydrogen fuel cells.

HyPoint have built next generation fuel cells with both high specific power and high energy density.

Use cases

For a variety of aviation and air mobility uses including logistics drones, air taxis, eVTOLs, and fixed-wing airplanes.

Easy to integrate from 50kM drones to 10MW aircrafts.

03

Venture- backed case studies in AAM infrastructure

BLADE is a technology-powered, global urban air mobility platform committed to reducing travel friction by enabling cost-effective air transportation alternatives

BLADE

Backed by

AIRBUS GROUP

RAINE

COLONY NORTHSTAR

Blade has projected eVTOL certification by 2025, but hopes to begin production even sooner.

Quiet is a key innovation of eVTOL. Reducing noise, emissions, and cost will help bring urban air mobility to more people in more places.

Blade are the first passenger service customer for BETA technologies six seat Alia eVTOL, ordering 20 units in April 2021.

Blade said its service with Alia will begin on select routes between its network of dedicated terminals in the Northeast U.S., where Beta has agreed to provide and install charging infrastructure at key locations.

Beta has committed that Alia will meet the necessary specifications required to operate on Blade's key routes prior to delivery. The aircraft has a projected range of 250 nautical miles (460 kms) and cruising speed of 170 miles per hour (nearly 275 km/h).

03

Venture- backed case studies in AAM infrastructure

Developing aircraft and drone solutions for commercial and humanitarian applications

Wingcopter 198

Delivery of heavy loads over long ranges

Optimized for cargo flights

Fail-safe power train architecture

Wingcopter 178

Covers distances up to 120km

Low noise emission

Carries heavy payload

Backed by

FUTURY REGIO GROWTH FONDS

AFRICAN DRONE FORUM RWANDA 2020

BMH BM H Beteiligungs-Managementgesellschaft Hessen mbH

DRONE FUND

Healthcare

Experts in delivery of healthcare goods, from vaccines to blood samples.

Groceries & Food

With special delivery solutions, delivering groceries and food in minutes.

Parcel & E-Commerce

Developing instant delivery solutions for postal services, retailers and e-commerce platforms.

Can be integrated into existing supply chains.

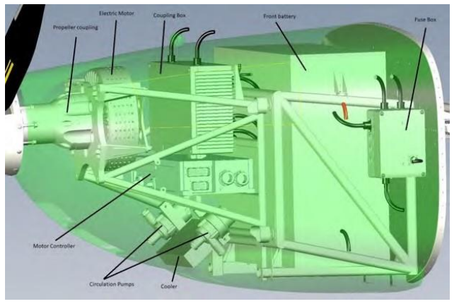
Intersite Logistics

Automate the delivery of spare parts, samples and other materials between factory sites.

03

Venture- backed case studies in AAM infrastructure

Providing electric propulsion and battery management solutions for both existing aircraft designs and future VTOL



Single Engine Dual Battery Pack System

Battery capacity: 50kWh

Max endurance: 90 mins

Modular Battery Pack

Battery fire management

Lithium ion cells

Backed by

Entire Propulsion Chain

Company's focus starts from the energy source and its management, to thrust and power, to pilot interface and battery management systems.

Electric Commercial Airplane

Partnership with Harbour Air and magniX for world's first certified all electric commercial airplane.

Product Offerings

H55's product offerings include battery packs, connectors, motor, motor controller, pilot interface and power controls.

Team

Tom Whitehouse
CEO

Tom Whitehouse has over twenty years' experience in the financing of early and growth stage sustainable technology businesses; in energy, transport, materials and manufacturing, and investment management.
He founded Leif Capital after a ten-year career as a foreign correspondent with the BBC and the Guardian.

Alex Westlake
Investor-in-Residence

Dr. Alex Westlake has over twenty years' experience in founding and financing sustainable technology businesses in Europe and Asia. He co-founded and led the £100m AIM IPO of Camco, a global emissions reductions business, and has raised over $1bn in project and carbon finance for over 1GW of renewable power across China.
He is Chairman of Microbas, a Swedish precision manufacturing business. His current portfolio of private investments is valued at more than $100m.

Prudence Johnson-Hill
Summer Associate

Prudence recently completed an internship at Leif Capital as an Equity Research Analyst.
She is currently completing a degree in Economics at the University of Bath, and is currently the Impact Management Director at 180 Degrees Consulting, providing pro-bono consulting to non-profits globally.

Leif Capital

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