HONEYWELL UAM AND UAS

BUILDING THE FUTURE OF AERIAL MOBILITY

BANK OF AMERICA SECURITIES 2021 VIRTUAL TRANSPORTATION, AIRLINES, AND INDUSTRIALS CONFERENCE

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Honeywell | THE FUTURE IS WHAT WE MAKE IT

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STÉPHANE FYMAT

Leads unmanned aerial systems and urban air mobility business, which develops new products and serves as a systems integrator for both airframe makers and operators.

Fymat joined Honeywell in 2017 and previously led the marketing and product management team at Honeywell's BendixKing business unit, Honeywell’s avionics business for general aviation aircraft. Before joining Honeywell, he was founder and CEO of Smartplane, an advanced aerial mobility startup company. Fymat was also on the executive teams of Infrascale and Passlogix, two growth stage Internet and cybersecurity companies. He also currently serves on the board of directors of The Perlan Project, which built a high-altitude glider and claimed the world altitude record for wing-borne flight.

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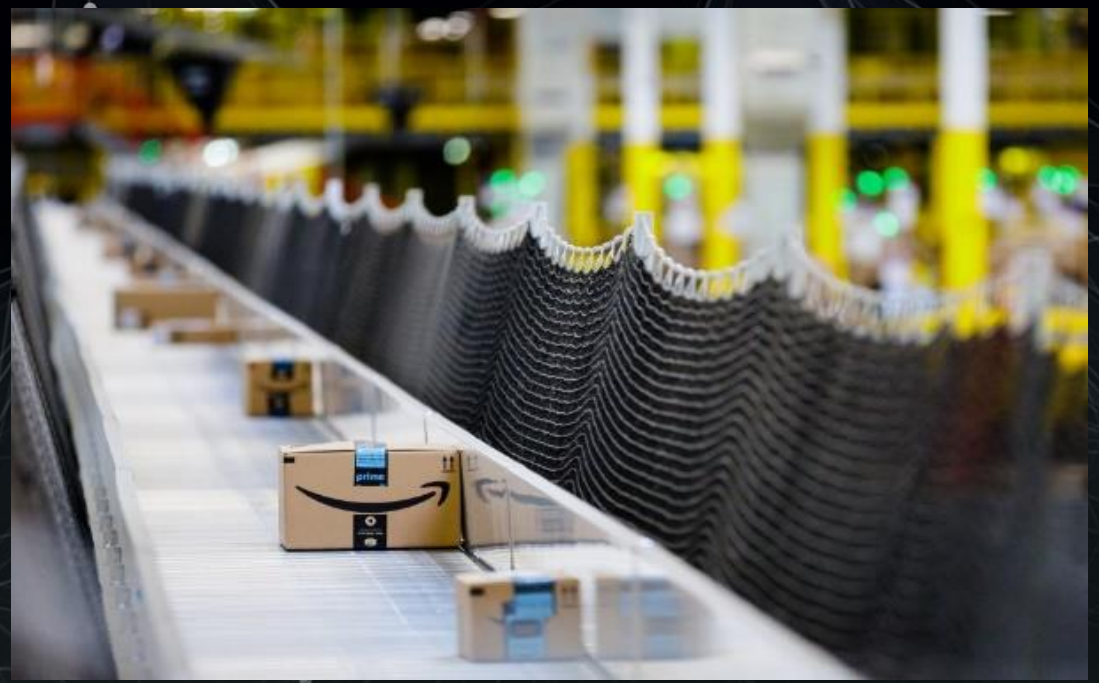
THE NEED FOR DISRUPTIVE INNOVATION IN TRANSPORTATION

UNLOCK THE 3rd DIMENSION OF MOBILITY

E-COMMMERCE LOGISTICS



OUR VISION

100-mile trip in 45 minutes by air taxi

Same-day package delivered anywhere by autonomous air cargo

URBAN AERIAL MOBILITY:
100 MILES IN 45 MINUTES BY AIR TAXI

Airport Transfer

JFK to Manhattan
UAM: 15 miles in 7 min
Car: 1 hour

Regional Mobility

Manhattan to the Hamptons
UAM: 94 miles in 39 min
Car: 2.5 hours

Supercommuting

Westport to Manhattan
UAM: 50 miles in 21 min
Car: 1.5 hours

Island Hopping

Boston to Martha's Vineyard
UAM: 70 miles in 29 min
Car + Ferry: 2.5 hours

MULTIPLE STEP CHANGES FROM THE HELICOPTER

Technology Inflections	Distributed Electric Propulsion	Advanced Flight Controls	Autonomy	Miniaturized Sensors

Low Cost: electrification and automation **reduce operating cost by 50-80%**

High Safety: multiple rotors and automated flight control **eliminate single point failure** and supports robust vertical takeoff

Quiet Operations: smaller rotors with low tip speed leads to **100x quieter operations**

Efficient Flight: ability to transition to fixed wing cruise flight **increase cruise efficiency by 6-10x**

$2-5M

Typical UAM Vehicle Price

$200k-1.5M

Potential Honeywell Content*

Example: Vertical Aerospace VA-4X

> All electric 4-pax air taxi
> 120-mile range at 150-200 mph
> Vertical takeoff and landing
> Honeywell fly-by-wire and flight controls

*Vertical VA-X4 shown for illustration purposes; quoted value range does not reflect exact Honeywell system content on VA-X4

AUTONOMOUS AERIAL LOGISTICS:
SAME-DAY DELIVERY ANYWHERE BY AUTONOMOUS CARGO

Fly Direct: takeoff vertically and fly from warehouse to warehouse – avoid traffic and airports delays

Scale eCommerce: deliver just-in-time to cut warehousing and pre-positioning costs

Increased efficiency: increase pilot productivity by 4x for middle-mile logistics

Reduce Cost: cut logistics last mile cost by 70 percent with delivery drones

Icons by James Fenton, Nhor , Vector Market, Noun Project

$0.8M-5M
Typical Heavy Autonomous Cargo Price

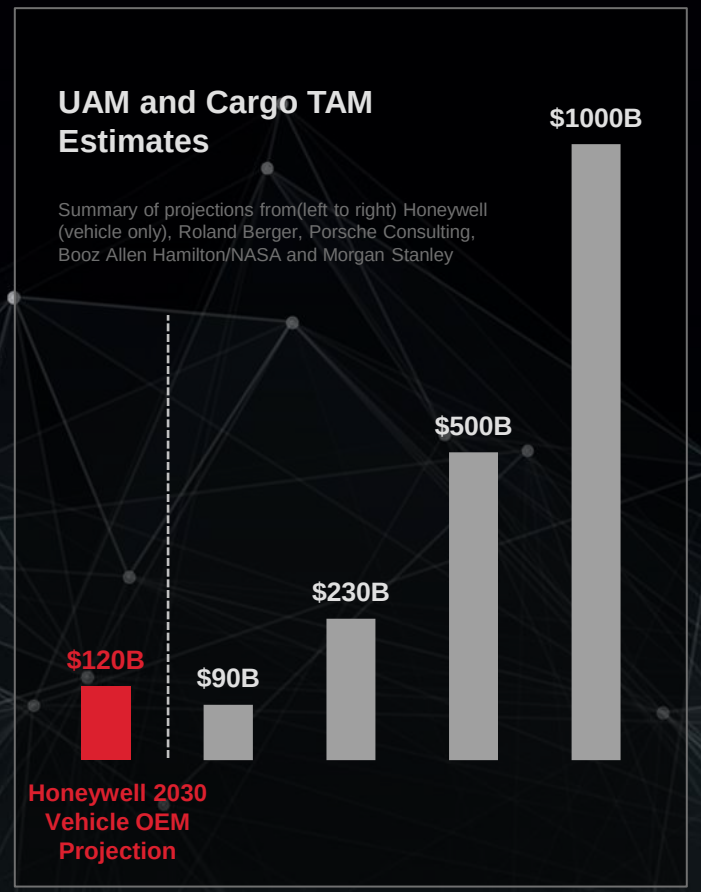
$100K-1.5M
Potential Honeywell Content

$25K-150K
Typical Delivery Drone Price

$5K-60K
Potential Honeywell Content

MARKET SIZE

Segment	Use Case	Examples	Start of Service	Approx. 2030 TAM
Air Taxi	- Air taxi - Airport transfer - Regional mobility	Lilium, Beta, Vertical Aerospace	2025	**Vehicle: $80 Billion** **HON Opportunity: $20 Billion**
Middle Mile Cargo	- Point-to-point cargo - Feeder cargo - Military logistics - Austere logistics	Pipistrel, Elroy	2023	**Vehicle: $35 Billion** **HON Opportunity: $10 Billion**
Local Light Parcel	- Last mile delivery - Austere logistics	Google, WingCopter, Amazon	2022	**Vehicle: $5 Billion** **HON Opportunity: $1 Billion**



Honeywell is well positioned to **address a ~$30B annual market** in 2030

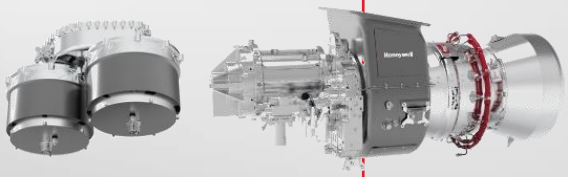
$7B in projected cumulative Honeywell pipeline over the next 5 years, $55B to 2030

Honeywell builds the **brains and muscles** of these aircraft.
We create the **critical systems** that make these new vehicles possible.

A new paradigm of **automated avionics, smart sensors and advanced connectivity simplifies flight**, expands the operator pool and builds a path to autonomy

Multiple motors and actuators require **fly-by-wire** to control. Honeywell has the only dedicated solution in the segment.

State-of-the-art miniaturized **thermal management** cools motor and avionics and keeps passengers comfortable in the cabin



Compact, reliable **electric motors** producible at automotive scale. Fly long range missions with **turbogenerators** and hybrid power

Vertical VA-X4 shown for illustration purposes; does not reflect exact Honeywell content on aircraft.

FOCUS: SIMPLIFIED VEHICLE OPERATIONS

Modular, extensible avionics designed for **Simplified Vehicle Operations (SVO)** and transition to **autonomy**

With simplified interface and operations, we aim to radically **reduce pilot training requirements by 10x** from 400 to 40 hours

FOCUS: OPTIMIZED COMPACT FLY-BY-WIRE

Fly-by-wire: extremely reliable flight computers and sensors working together to translate pilot commands into safe maneuvers. Electric aircraft, particularly those that can takeoff vertically, **must have fly-by-wire.**

Contemporary airliner fly-by-wire
Each size of a bookshelf

- Flight Computer #1
  260 lbs., 4 ft^3
- Flight Computer #2
  260 lbs., 4 ft^3
- Flight Computer #3
  260 lbs., 4 ft^3

Advanced airliner fly-by-wire
Each size of a bookbag

- Flight Computer #1
  70 lbs., 0.6 ft^3
- Flight Computer #2
  70 lbs., 0.6 ft^3
- Flight Computer #3
  70 lbs., 0.6 ft^3

Honeywell Compact FBW
Each size of a book


3.5 lbs., 0.1 ft^3


3.5 lbs., 0.1 ft^3


3.5 lbs., 0.1 ft^3

Proven heritage and safety in today's air transportation system

Built for the future of aerial mobility

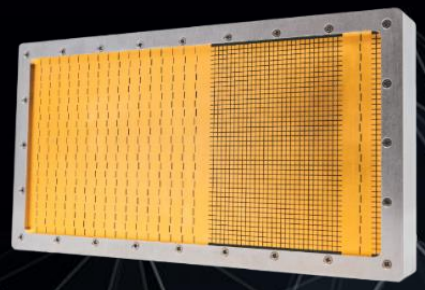
FOCUS: DETECT AND AVOID AND AUTONOMY

Autonomy is key to **unleash the full economic potential** of UAM and autonomous cargo aircraft

Autonomous aircraft must **sense and understand** their environments

Honeywell's radar-based system can automatically **detect and avoid aircraft and obstacles in any weather – day or night**

We **enable seamless autonomy** with landing zone alignment, ground obstacle avoidance and GPS-denied navigation



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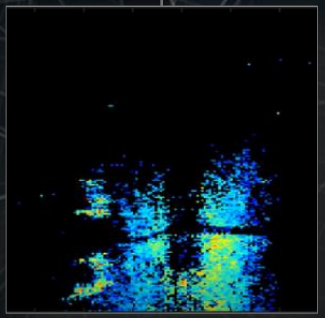
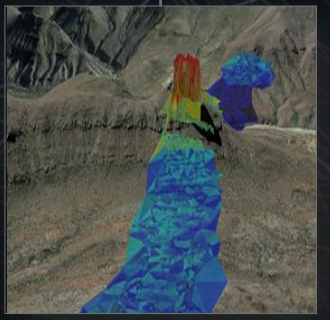
Detect and Avoid Aerial Traffic



Landing Zone Clearance



GPS-Denied Navigation

FOCUS: ELECTRIC PROPULSION

Electric Propulsion

Electric propulsion enables emission-free flight, vertical takeoff and high safety

Honeywell offers reliable, high powered motors that can be mass produced at automotive scale

We deliver not only the complete electric propulsion solution but also optimized end-to-end integration with cooling, avionics and fly-by-wire

Hybrid Power

Pair proven Honeywell turbine engines with compact generators for efficient long-range flight

160 KILOWATT
ELECTRIC PROPULSION UNIT (EPU)

SPEED
1000 – 1800 RPM

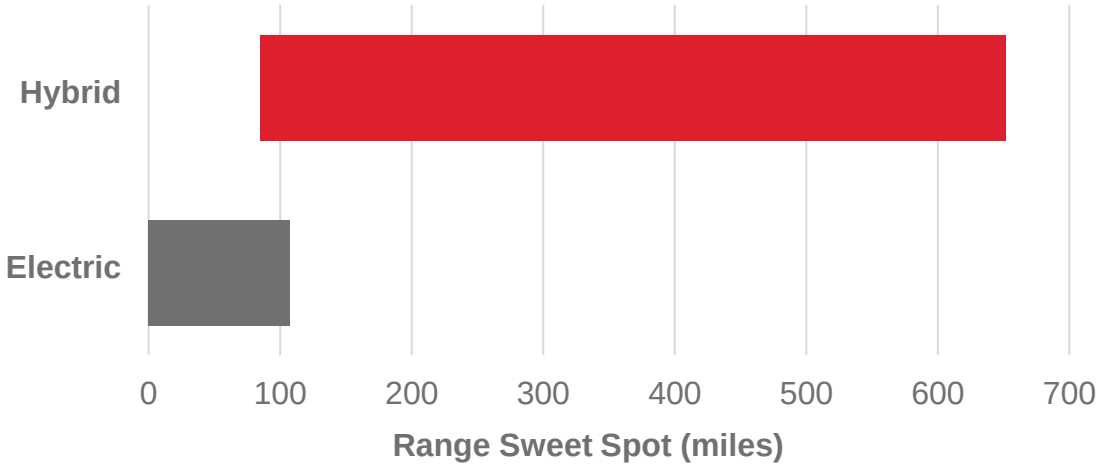
EFFICIENCY
90% efficiency for complete EPU

FLEXIBLE AND OPTIMIZED
Geared or direct-drive to balance torque and weight

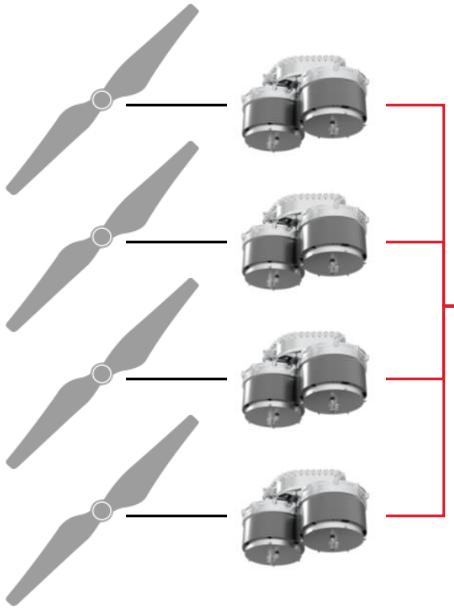
COMPACT DESIGN
~1 ‘x 2’ x 1.25’ (L x W x H)

- Industry leading power density (20% less weight)
- Modular and scalable motor customizable to wide range of vehicle designs and power requirements
- **Honeywell DENSO** partnership: aerospace safety meets automotive scale

FOCUS: HYBRID POWER



Compact Honeywell motors for distributed electric propulsion



Honeywell 1MW Turbogenerator

Turboelectric configuration shown – other architectures with varying levels of battery hybridization and turbine prime movers are possible

Hybrid power extends air taxi and autonomous cargo range. Takeoff vertically and fly NY to Boston, LA to San Francisco, London to Frankfurt and Seoul to Osaka

Best of both worlds: Pair energy-dense turbine with power-dense distributed electric propulsion to achieve vertical takeoff, highest safety and optimized performance

HONEYWELL IS WINNING

Integrated avionics and fly-by-wire for Vertical Aerospace VA-4X high speed air taxi

Fly-by-wire and SATCOM for Pipistrel Nuuva 300 autonomous cargo drone

Fly-by-wire for dual-use heavy cargo drone

Integrated avionics and propulsion systems for UAM leader

Compact fly-by-wire system for UAM leader

High assurance detect and avoid demo with major logistics operator

SATCOM for long-range logistics drone

SATCOM for dual-use logistics drone

$500 Million in content wins; $3 Billion more pending. $7 Billion in pipeline over next 5 years

Honeywell is the **leader** for UAM FBW, avionics with SVO and aerospace grade motors that can be built at automotive scale

Honeywell has highly-differentiated high assurance detect-and-avoid systems and multi-function cooling systems

We are building pervasive aerial autonomy – **to launch a revolution in aerial transportation and logistics**

Electric Motors
and Controllers

Thank you

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