



Hydrogen Drones

Dollars & Sense



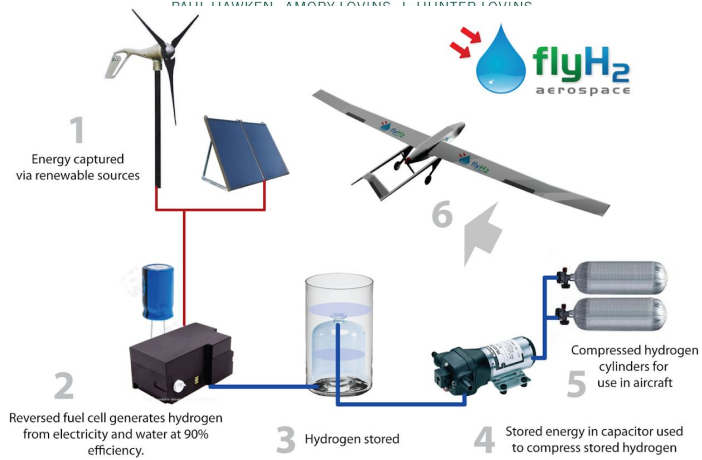
"An aircraft is a solution consisting of compromises"

- *Onno Huyser*

Natural Capitalism



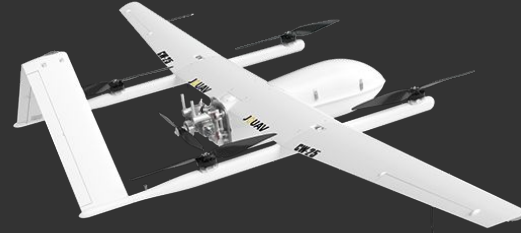
CREATING THE NEXT INDUSTRIAL REVOLUTION
"Hugely important... Natural Capitalism ought to be on the nightstand of every CEO."
— Thomas Pettinger Jr., former "Front Lines" columnist, Wall Street Journal
DAN HANSEN, MARY LOUNG, I. UNITED LEUNG



UAS flight endurance limitations



Multi-Rotors 2.5kg / 30 min on battery



Fixed-Wing-VTOL 4kg / 1.5h on battery, 4h on engines

Multi-Rotor has a linear relationship with payload; more payload \propto more power.

Fixed-Wing VTOL similar to fixed wing; but VTOL adds weight, drag & requires power augmentation.

Fixed-Wing has a non-linear relationship with payload; more payload \nrightarrow more power.



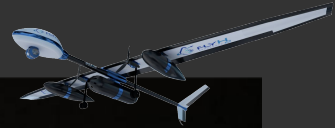
4. The problem with batteries



5. The problem with combustion engines

WE are adopting hydrogen as the next energy solution for UAS

Strategic partnership with H3 Dynamics, the H2 UAV propulsion and refueling specialist



Exceptional energy density hydrogen-based solutions gives us several orders of magnitude more flight endurance than batteries for the same weight.

Hydrogen can be made available from industrial suppliers or can also be produced in the field from drinking water.

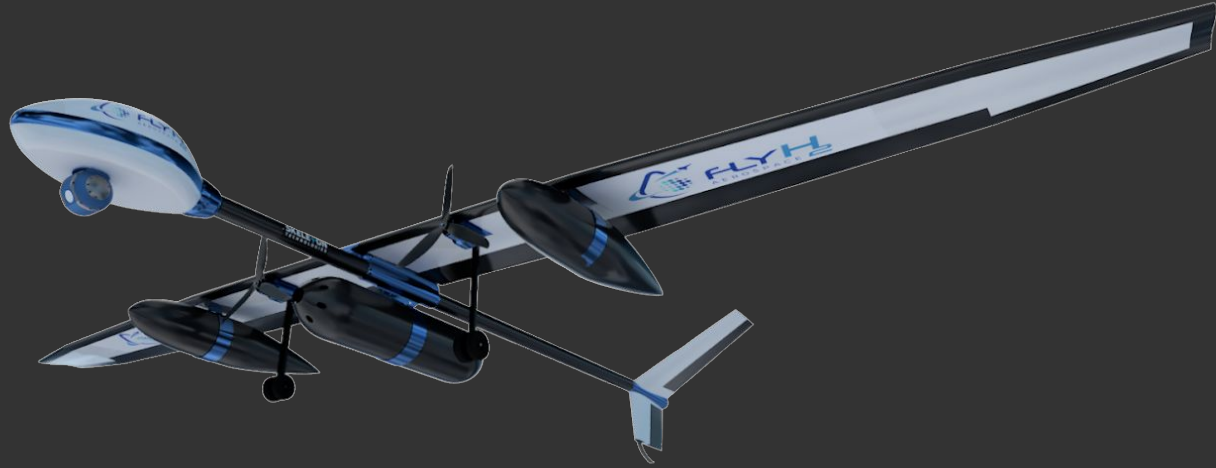
4. Hydrogen technology partnership



Our solution: an ultra-efficient hydrogen electric fixed wing UAS

Range & Endurance

Endurance over **16 hours**



Our solution: an ultra-efficient hydrogen electric fixed wing UAS

Payload Flexibility
20+ kg (Nose / 5 Pods)

Range & Endurance
Endurance over 16 hours

Ease of Operation
76 km/h cruise
Autonomous
Slow Flying & Docile
Quick Refuelling

Reliability & Redundancy
Fault Tolerant Design
Certified (DO168)
Waterproof (IP77)

Autonomous Short Take-Off / Landing
< 100m take-off / landing roll



Early fuel cell prototype



Fixed-Wing Drone Operations



Operators Cert



Extremely Happy Team

2015

2017

2019

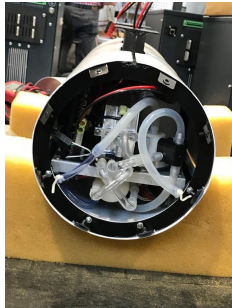
2021

2023

Award Winner 2015



Pod Prototype



Award Winner 2017



Prototype Development



Successful Tests





Maiden Flight

28 February 2023





Key Application

Technology Market Fit & Anchor Market: Using “pod” system for Biocontrol at scale.

What is Biocontrol: releasing beneficial insects as biological pest control.

Drones allow for more efficient and targeted release of beneficial insects, reducing labor costs and improving coverage: protecting ecosystems from invasive species + cleaner agriculture.



Flight duration: 6-10 hours

350 ha per flight

Much larger areas, cheaper & faster.



Flight duration: 25 minutes

20 ha per flight

Slow and expensive

COST DRIVERS

Industrial Hydrogen Cylinder

100 grams / hour

@ \$30 ~ \$ 50 / kg (USA) = \$0.50 / hour

@ \$100/kg (South Africa) = \$10 / hour

>> Option to make it on-site with H2-FIELD



Dragonfly V

FC System : @1700hrs = \$ 13.17 / hr

COPVs: @5000 cycles = \$ 0.17 / hr

Booster Pump: = \$ 1.60 / hr

Hydrogen (USA): = \$ 2.50 / hr (approx)

= \$ 17.44 hr

COST DRIVERS

Industrial Hydrogen Cylinder

100 grams / hour

@ \$30 ~ \$ 50 / kg (USA) = \$0.50 / hour

@ \$100/kg (South Africa) = \$10 / hour

Li-Ion Batteries

147 Ah / 12S Batteries (x3) = \$3,000

Life @ 300 cycles = \$10 / hr

Life @ 100 cycles = \$30 / hr

Dragonfly V

FC System : @1700hrs = \$ 13.17 / hr

COPVs: @5000 cycles = \$ 0.17 / hr

Booster Pump: = \$ 1.60 / hr

Hydrogen (USA): = \$ 2.50 / hr (approx)

Hydrogen (16 Hours) = \$ 17.44 hr

Batteries (2 Hours @ 300 cycles) = \$ 10.00 hr

Batteries (2 Hours @ 100 cycles) = \$ 30.00 hr

Team in the Field

3 Pilots, Vehicle + Accom = \$800 / day

Hydrogen Benefits

Larger Service Area from Single Base

= No Moving Base (Time Costly)

No B-VLOS Concerns

= No worrying re batteries at 20%

= No worrying re ageing batteries

No In-Field Charging

= Higher Cadence Operations

Long Life

= Less Maintenance. Less Shipping.

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COPVs: @5000 cycles = \$ 0.17 / hr

Booster Pump: = \$ 1.60 / hr

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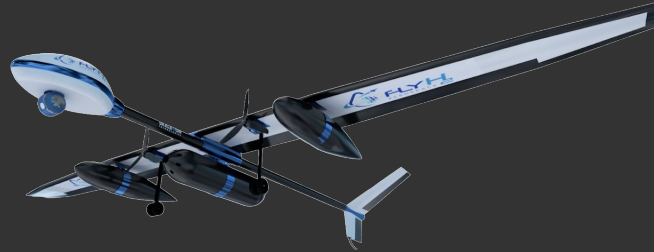
Hydrogen (16 Hours) = \$ 17.44 hr

Batteries (2.2 Hours) = \$ 10.00 hr

Multi-Rotor (20 Minutes) = \$?

H₂ = Lowest Cost of Operations

Major cost advantage over other high-scale biocontrol methods used today



Robinson 44 Helicopter

Operational Cost: \$800 / hr
Game Counting Example: \$0.60 / ha

Dragonfly V UAS

Operational Cost: \$130 / hr
Game Counting Example: \$0.14 / ha

Cessna 172 Airplane

Operational Cost: \$400 / hr
Game Counting Example: \$0.38 / ha

Our solution boasts operating costs **less than 1/3** of a Cessna and **less than 1/4** of a R44



We are excited about the future

Our solution can compete on cost with traditional flight methods

(and)

Can cover more area in less time, lowering cost of drone flight operations

(and the added benefit of proving fuel cell tech commercially without requiring constant lithium mining)

(or emitting carbon dioxide into the atmosphere)



Thank you

Mark van Wyk

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