Progress Update 04

Embry Riddle Aeronautical University - College of Business and Engineering

Team APPA

Agenda

- STAKEHOLDERS
- DESIGN MISSION
- MARKETS AND COSTS
- WEIGHT MODEL AND STABILITY
- SEATING LAYOUT

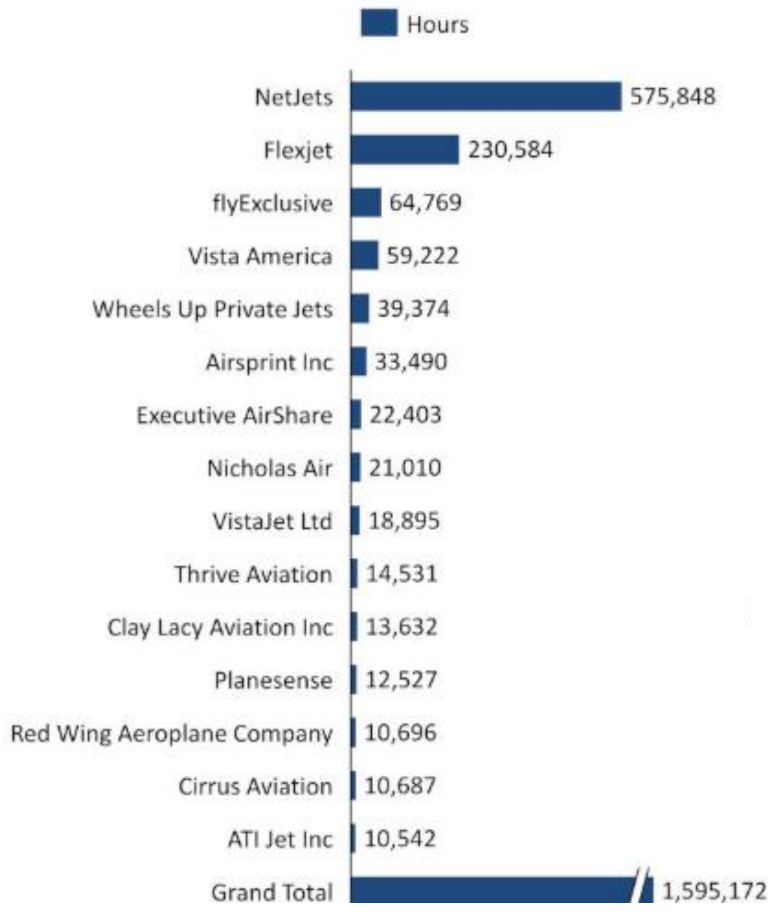
Design Foundations

- Fixed-wing regional aircraft
- Up to 12 passengers
- Highlight hybrid-electric technology
- Reduced emissions and noise
- Optimized cost for short-haul flights

Aircraft Regulations

The aircraft falls under FAA 14 CFR Pt. 23, Level 4, High Speed

Customer Requirements		**14 CFR Part 23 Regulations**	
Passengers	12	Level 4 Passenger Range	10 to 19
Range	1,500 nmi Optimized for 500 nmi	MTOW	≤19,000 lbs
Technical Innovation	Hybrid-Electric Propulsion System	High Speed Category	>250 knots
Reduce Environmental Impact	Fuel Efficiency Noise Reductions	Service Ceiling (Oxygen and pressurization required)	20,000 ft

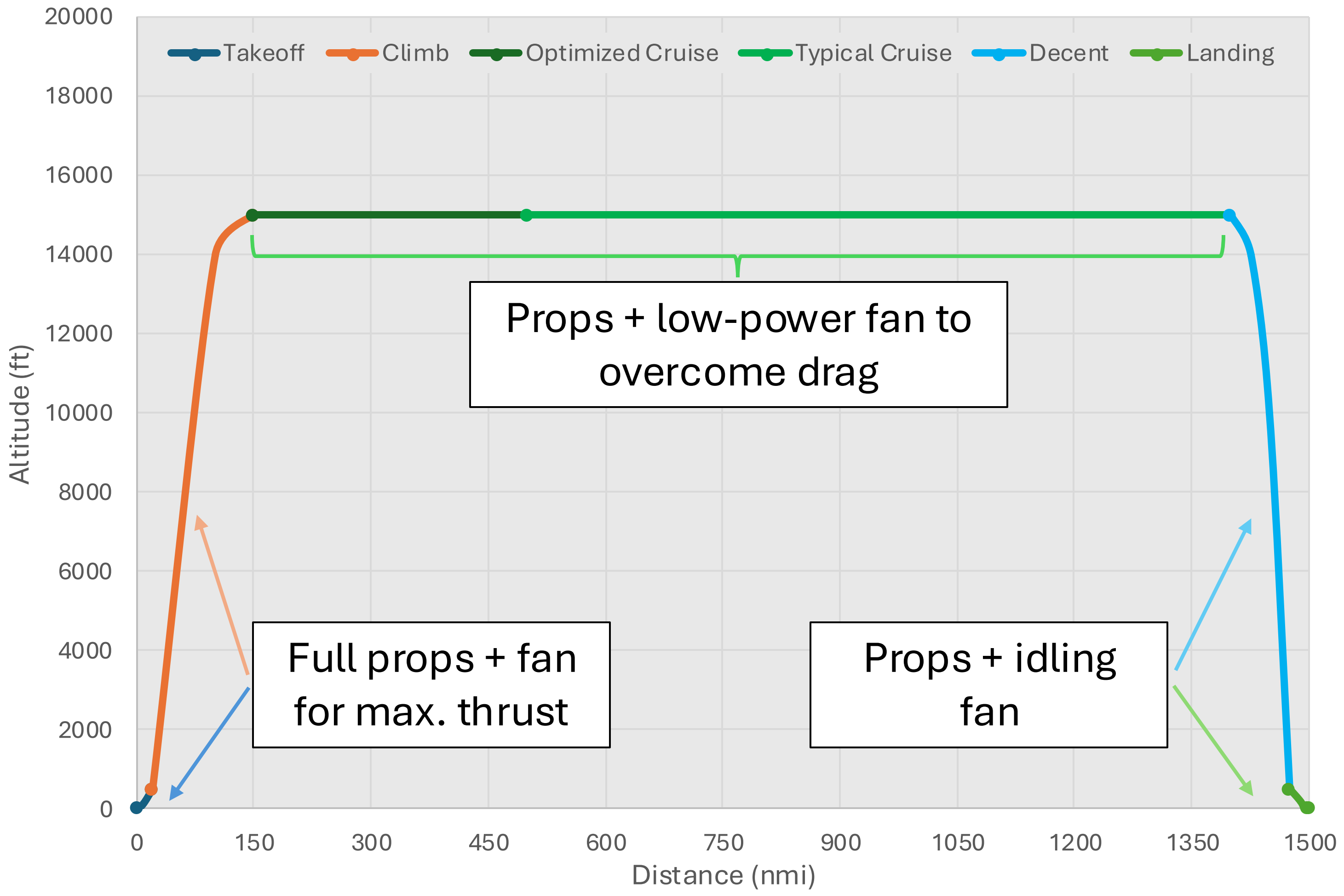


Market Clientele

- Fractional Owners/Operators
- Possess substantial upfront capital investment
- Demonstrated track record of safety
- Consistent market demand
- As of January 31st, fractional operators collectively operate 3,886 aircraft
- Identified market gap for shorter-range aircraft catering to regional travel needs

Mission Profile

- Cruise altitude of 15,000 ft
    - Reduces climb/decent time
    - Improves fuel & propellor efficiency
- Optimizes for short-haul flight



Markets for Europe

- Geneva → Paris ~ 221 NM
- Istanbul → Ankara ~ 197 NM
- Milano → Rome ~ 262 NM
- Nice→ Paris ~ 375 NM
- Larnaka → Tel Aviv ~ 183 NM

AIRPORT 1		AIRPORT 2		YTD CURRENT YEAR
LSGG	Geneva International	LFPB	Paris Le Bourget	304
LTBA	Istanbul Atatürk	LTAC	Ankara Esenboğa	173
LIML	Milano Linate	LIRA	Roma Ciampino	161
LFMN	Nice Côte d'Azur	LFPB	Paris Le Bourget	139
LCLK	Larnaka International	LLBG	Tel Aviv International	119

Markets for America

- New York → Palm Beach ~ 900 NM
- New York→ Chicago ~ 650 NM
- New York → Miami ~ 1,080 NM
- Los Angeles → Las Vegas ~ 202 NM
- Boston → New York ~ 190 NM

Market Implementation Strategy

Phase 1

Phase 1: Soft Launch

Begin with a pilot program involving select partners and early adopters in the U.S. and Europe Focus on building brand trust, validating the offering, and gathering feedback from fractional operators. Conduct demo flights on popular short-haul routes like NYC–Palm Beach and Geneva–Paris to showcase value.

Phase 2

Phase 2: Full Market Rollout

Launch targeted digital marketing campaigns and exhibit at major aviation expos such as NBAA BACE and NBAA EBACE. Expand presence through partnerships with regional air services and aviation firms. This phase aims to drive adoption and solidify the brand in the market.

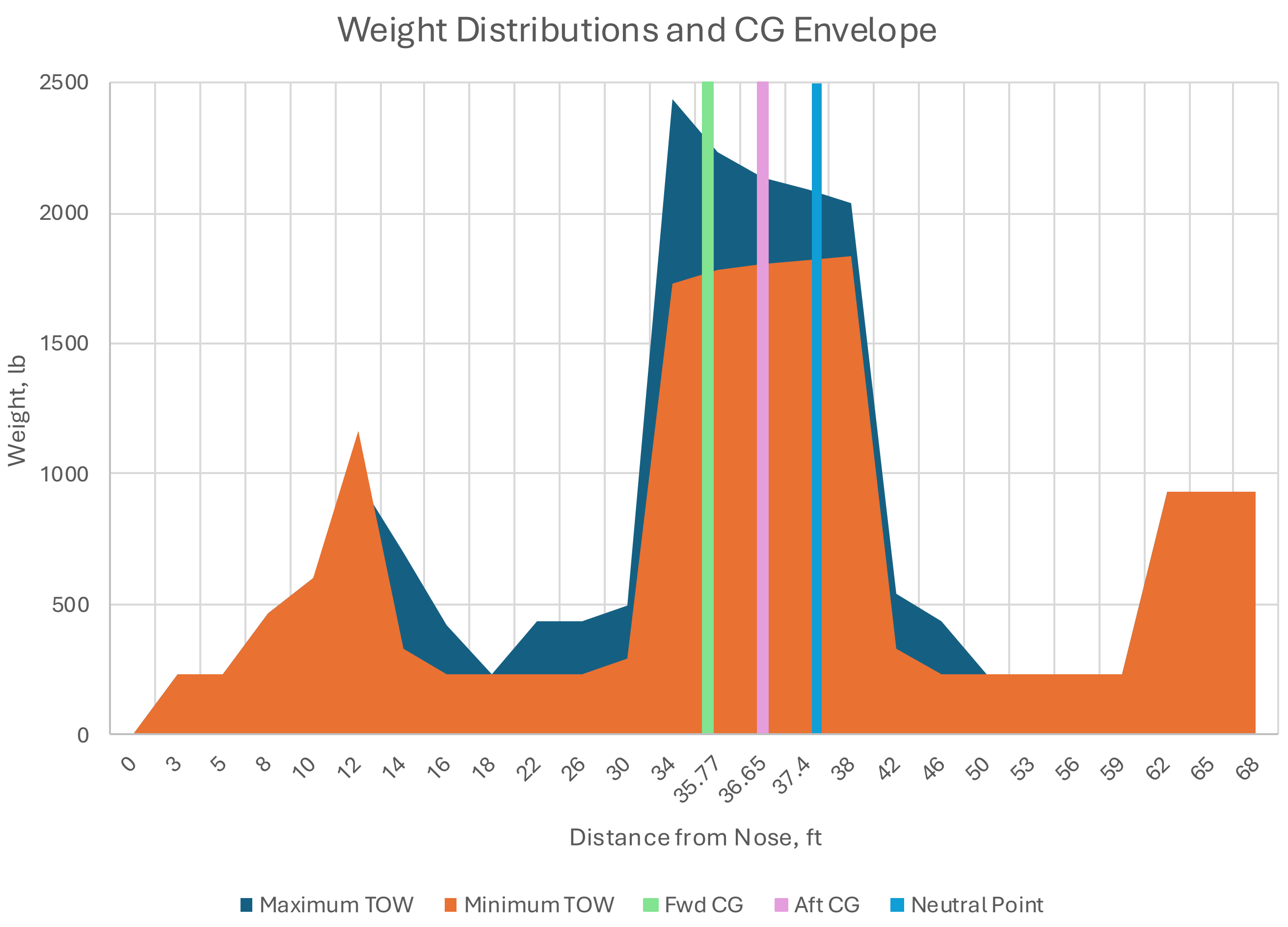
Phase 3

Phase 3: Scale & Optimize

Ramp up manufacturing capabilities to meet growing demand while pursuing international certifications for global expansion. Focus on optimizing logistics, streamlining operations, and scaling efficiently. The goal is long-term sustainability and operational excellence.

Weight Distribution & CG Envelope

MTOW	W_0	15,400 lb
Structural Weight	W_E	5,100 lb
Turbofan Weight		2,100 lb
Propellors and Motors		500 lb
Design Fuel Weight	W_F	3,000 lb
Payload Weight	W_P	3,030 lb
Battery Weight	W_B	1,100 lb
Crew Weight	W_C	570 lb



Lift Model

- Based on Gudmundsson's Wing and Lift Enhancement.
  - Utilizing NACA 4415 airfoil for the wing, and Clark Y fixed slot airfoil for the ailerons and its single slotted fowler flap configuration for the elevator.

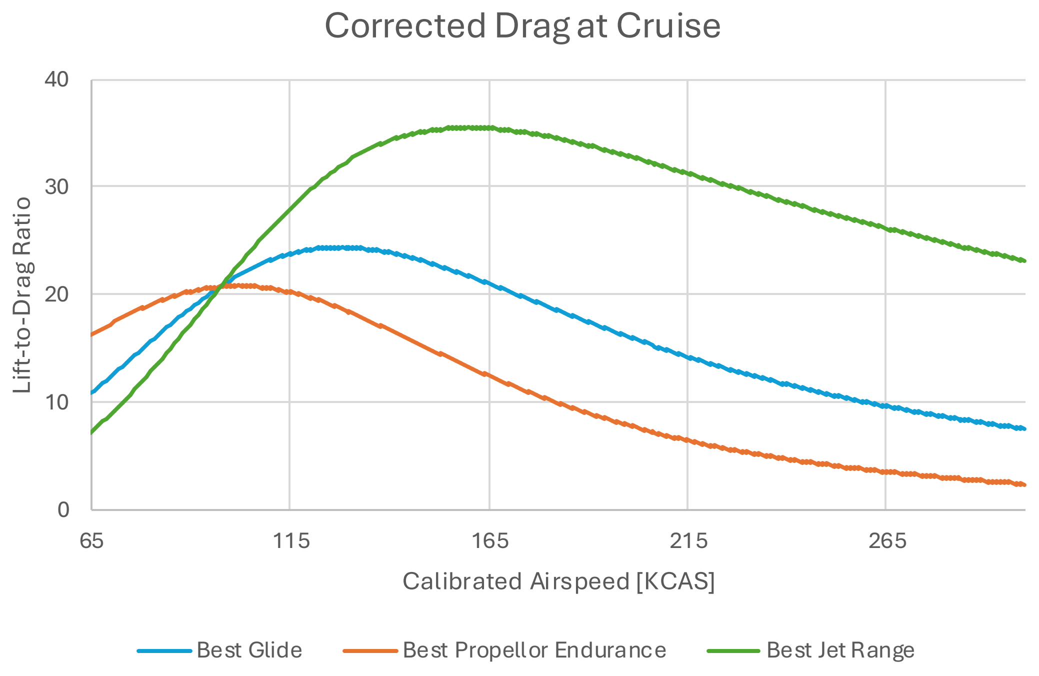
Weight	V_c	S_w	α_c	α_{ZL}	C_L	C_{Lc}	C_{LT-O}	α_{TO}	Total Lift
15,400 lb.	$432\,\frac{\text{ft}}{\text{s}}$	$476.1\ \text{ft}^2$	-2.99º	-4.53º	0.354	0.153	1.21	4.3º	16,303 lb.

For the whole Aircraft.

Drag Model

- Using mixed boundary layer analysis for a complete airplane, calculate the minimum drag coefficient.

TOTAL CRUISING DRAG			
Total Drag Coefficient	C_D =	1.68E-02	
Total Drag Count	ΔC_D =	168	
Air Density Altitude	ρ =	0.001496	slug/ft^3
Cruise Speed	V =	531.9	ft/s
Drag Force at Cruise	**D =**	**1696.6**	lb
Cruise Lift-to-Drag Ratio	**L/D =**	**9.61**	
TOTAL TAKEOFF DRAG			
Lift Induced Drag at Climb	C_Di =	0.0620	
Total Drag Coefficient	C_D =	0.078	
Lift-off Speed	V =	149.373	ft/s
Air Density	ρ =	0.00238	slugs/ft^3
Drag Force at T-O	**D =**	**984.973**	lb



Stability and Controls

- Hand calculations:

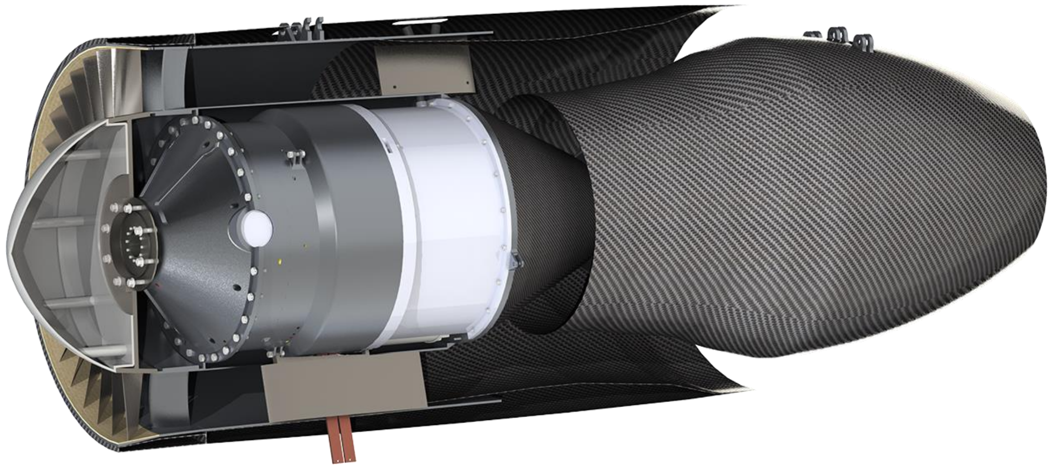
Variable	Value	Unit	Stable?
$C_{M\alpha}$	-0.0216	per °	Yes
$C_{Y\beta}$	-0.0017	per °	Yes
$C_{N\beta}$	0.0027	per °	Yes
$C_{L\beta}$	-0.0008	per °	Yes

- VSP calculations are still in progress

Propulsion

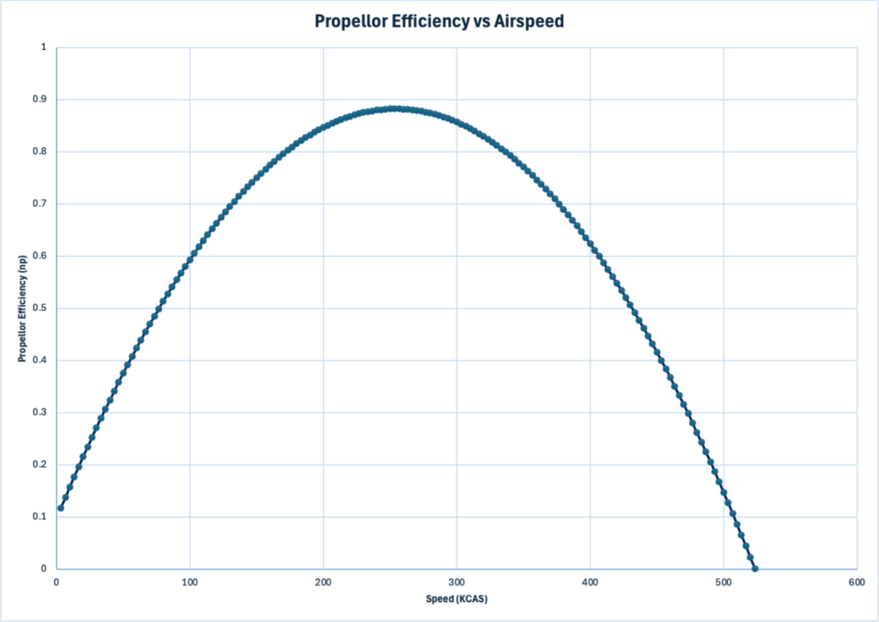
- **VerdeGo Aero VH-5**
    - Hybrid-electric turbofan
    - Can generate power in series and/or parallel
    - Generates forward thrust and electrical power during cruise
    - Entry Service Date: 2031
- **Electric Puller-Props**
    - Driven by two MAGIDRIVE 500 kW motors
    - Powered by the Amprius High Power Battery
    - Two 105" Diameter McCauley 4-Bladed Propellors
    - Will be able to be feathered if not in use (e=0.8)
    - Utilizing larger props as they have a higher efficiency than smaller props

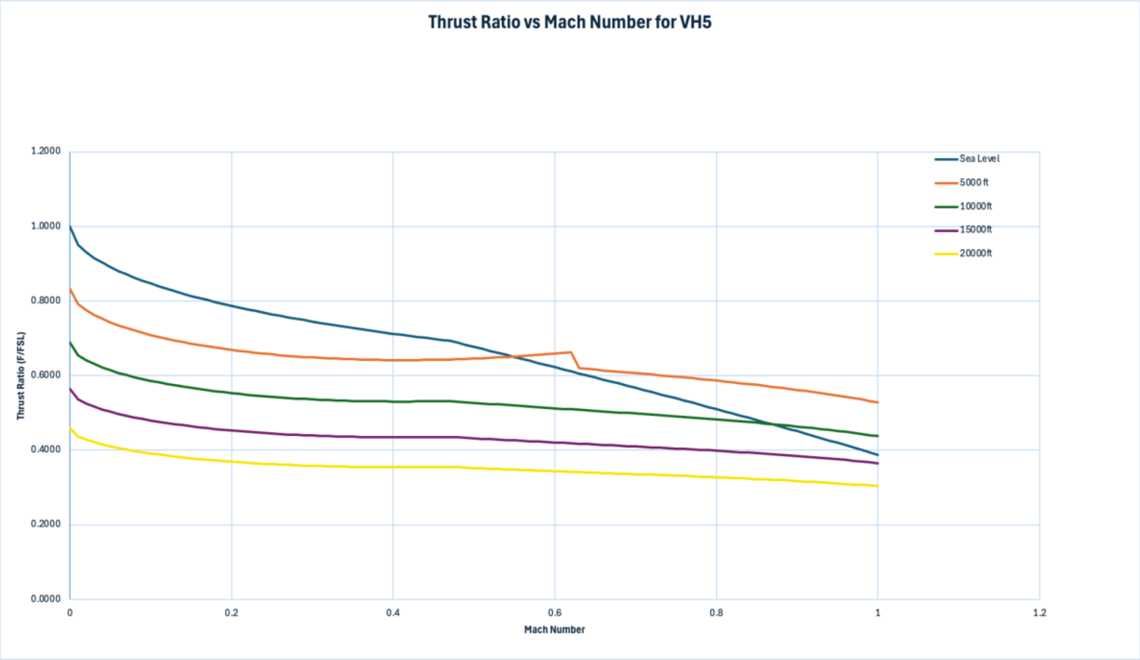
Will Generate a Combined Thrust of around 6000lbs at SSL



Performance

- Targeted Final Goals vs current calculations.



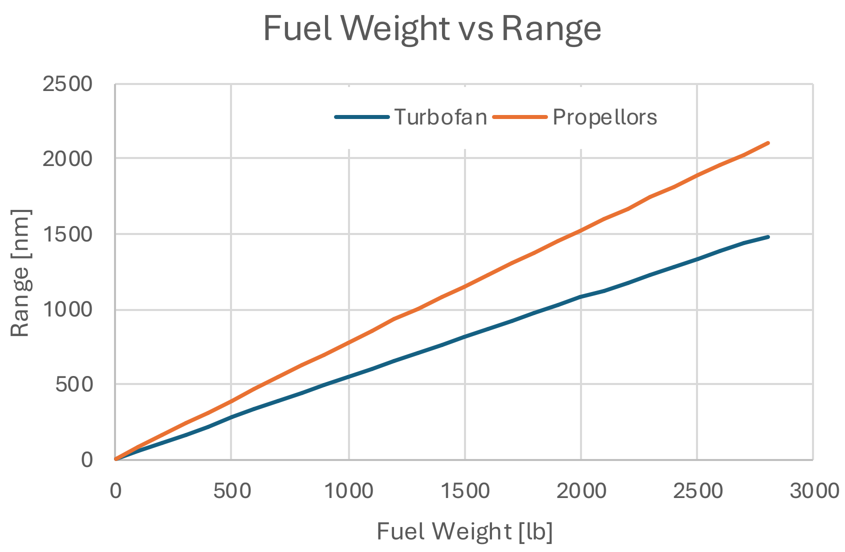


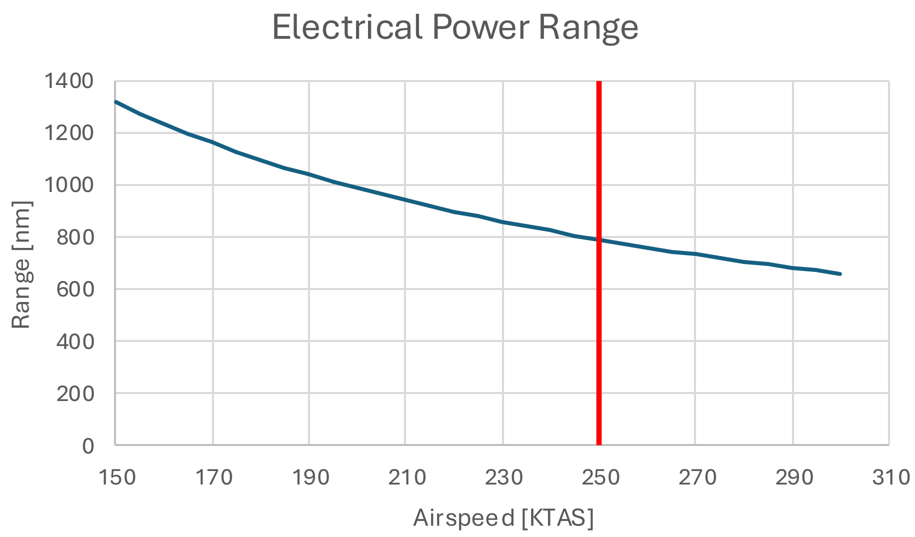
	Current Calculation	Targeted Goal
T/W	0.37	0.3-0.4
L/D	9.6	10-12
MTOW	15,400 lb	15,000 lb
Combined Max thrust at cruise	4200 lbf	4,000 lbf
Ground Roll	2100ft	3,000 ft
Landing Distance	2300ft	2000ft

Range

- Battery Range meets 500nm optimized range
- 250 knots meets ideal range
- 1100 lb 400 wh/kg batteries

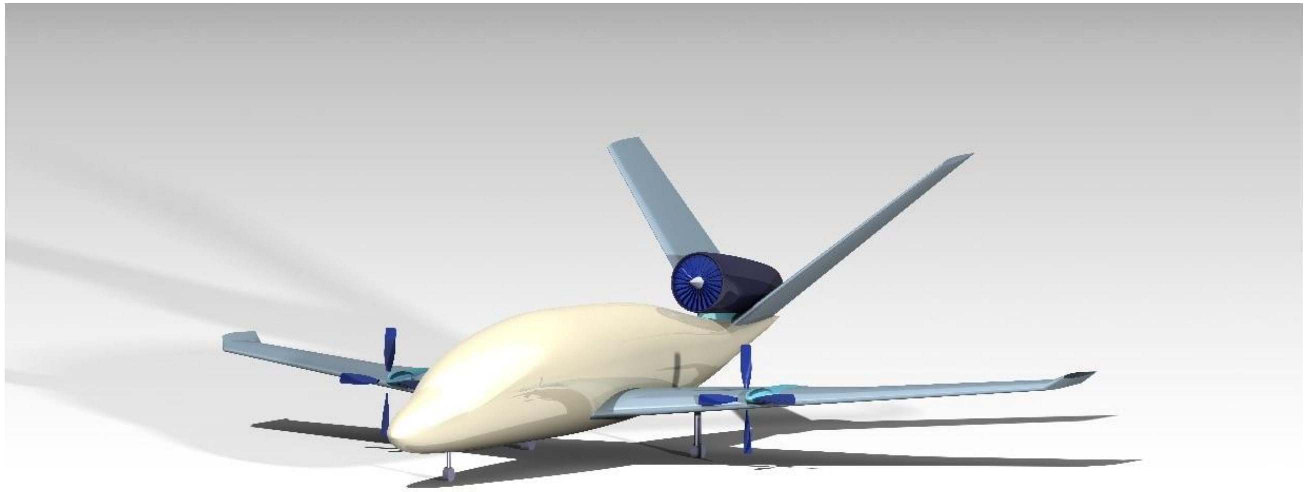
	VH-5 in Forward Flight	VH5 in Electrical Generator
TSFC (100% throttle)	0.34 lb/lb/hr.	0.48 lb/lb/hr.
% Engine Power Required for Cruise	60% (2129 lbf)	30% (100kW to charge) remaining in forward thrust)
Optimized Fuel Capacity	3000 lb	3000 lb





Aircraft Model

- Finalized seating and sizing
- CATIA model and drawings in progress



Parameter	Value	Units
Wing Span	68	ft^2
Wing Area	476	ft^2
Fuselage Length	68	ft
Fuselage Max Width	7.8	ft
Projected HT Span	21	ft
V-Tail Area (Actual)	306	ft^2

Cost Analysis continued

Certification Cost: $146,000,000 for 500 AC

Development Cost: $9,918,000 For 500 AC

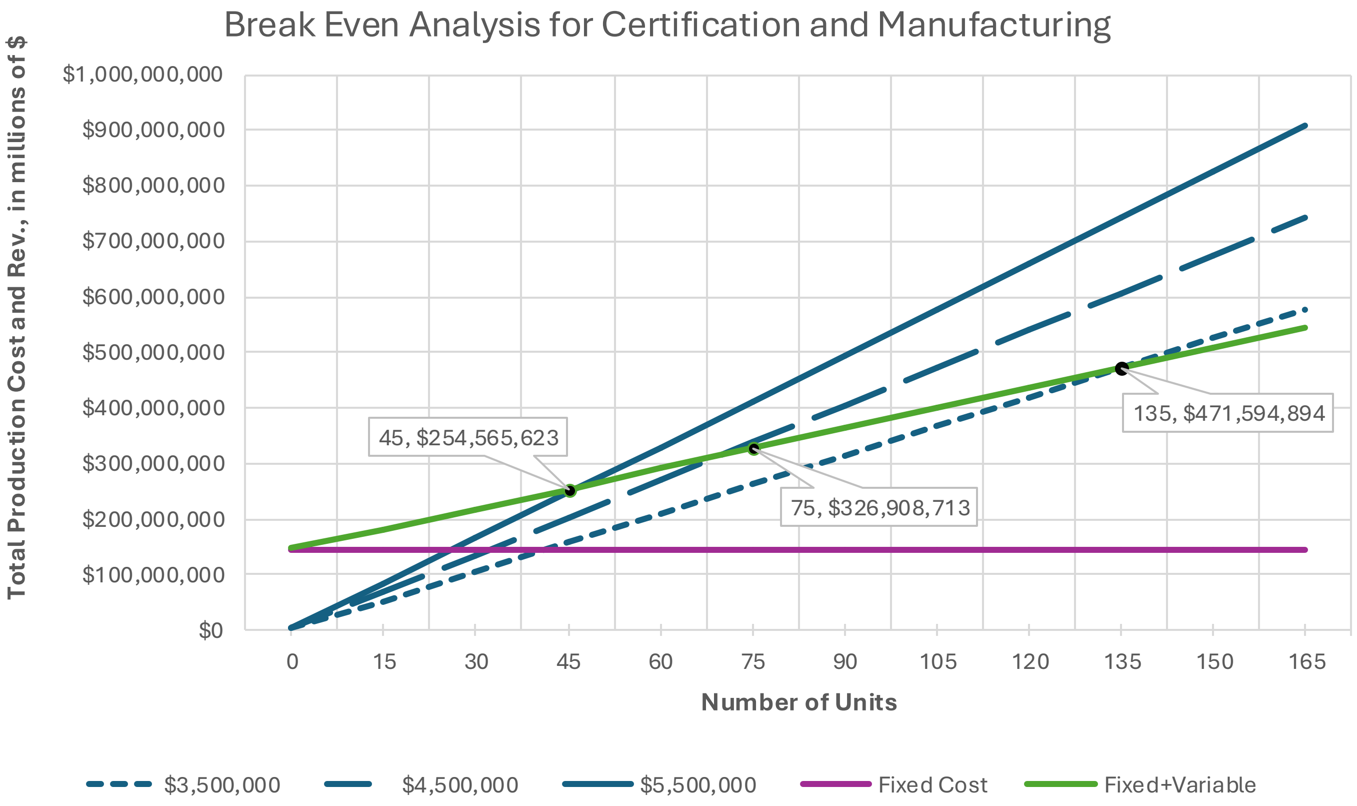
Manufacture/Production Cost: $304,590,000 for 500 AC

$610,000 per AC

Break Even Point: 75 units.

Total Fixed Cost: $146,051,000

Unit Variable Cost: $2,412,000



Cost Analysis continued

- Targeting regional airlines & charter markets.
- Maintenance cost advantages over legacy aircraft.

Estimated Unit Cost of Aircraft

Total Estimated Cost: $6.34M

Key Components:

Engineering Labor	Tooling Labor	Manufacturing Labor	Avionics	Hybrid Powerplant	Raw Materials	Quality Control
$25,140	$22,500	$240,000	$250,000	$2.21M	$3.5M	$91,000

Cost Breakdown by Function

	Hours	Rate	Total
Engineering Labor	400	62.85	$ 25,140.00
Tooling Labor Rate ($/hr)	500	$45.00	$ 22,500.00
Manufacturing Labor	6000	$40.00	$ 240,000.00
Cost of Avionics ($ per aircraft)			$ 250,000.00
Cost of Hybrid Powerplant ($ per aircraft)			$ 2,208,839.00
Raw Material Cost ($ per a/c)			$ 3,500,000.00
Total Cost of Quality Control (%)			$ 91,000.00

Cost Benchmarks from Comparable Regional Aircraft

Aircraft	Seats	Range	Unit Cost	Notes
Tecnam P2012	10	950 nm	~$2.5M	Piston twin
Cessna SkyCourier	19	900 nm	~$6.5–8M	Turboprop
Dornier 228	19	700 nm	~$7M	Turboprop
Our Aircraft	10–20	1,500 nm	$6.34M	Hybrid-electric

Cost Modeling Assumptions

Hybrid-electric systems are 15–30% more costly than traditional turboprops

Raw material costs reflect composite-heavy structure

Avionics aligned with next-gen FAA certification needs

Engineering cost reflects recurring design efforts (not full R&D)

Manufacturing labor hours match complexity of hybrid systems

Quality control budgeted at ~1.4% of total unit cost

Revenue & Markup Strategy

Unit Production Cost: $6.34M

- Proposed Markup: 10–15%
- **Target Selling Price Range: $6.97M – $7.29M**

Revenue Justification:

- Comparable aircraft (Cessna SkyCourier, Dornier 228) priced $6.5M–$8M
- Buyers willing to pay premium for hybrid-electric, sustainable solutions
- Lower lifecycle operating costs enhance long-term ROI for operators

- Projected First-Year Sales: 10–15 units
- Estimated Revenue: $70M – $110M (depending on markup and orders)

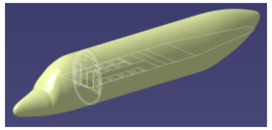
Understanding Marketing Expenses

Company	SG&A	Revenue	Selling & Marketing Expenses	% of SG&A	% of Revenue
Bombardier Inc	$478	$8,665	$266.00	56%	3%
Cirrus Aircarft	$117	$475	$57.00	49%	12%
Embraer	$508.6	$6,396	$309.70	61%	5%
Gulfstream	$851.6	$8,621		0%	10%
				Average	7%

Marketing Budget

BUDGETING	%	$ MIL
Branding	10.0%	$0.80
Digital Campaign	32.5%	$2.60
Traditional Advertisement	5.0%	$0.40
Events & Trade Shows	25.0%	$2.00
Customer Engagement	20.0%	$1.60
Partnerships	2.5%	$0.20
Miscellaneous	5.0%	$0.40
	100.0%	$8

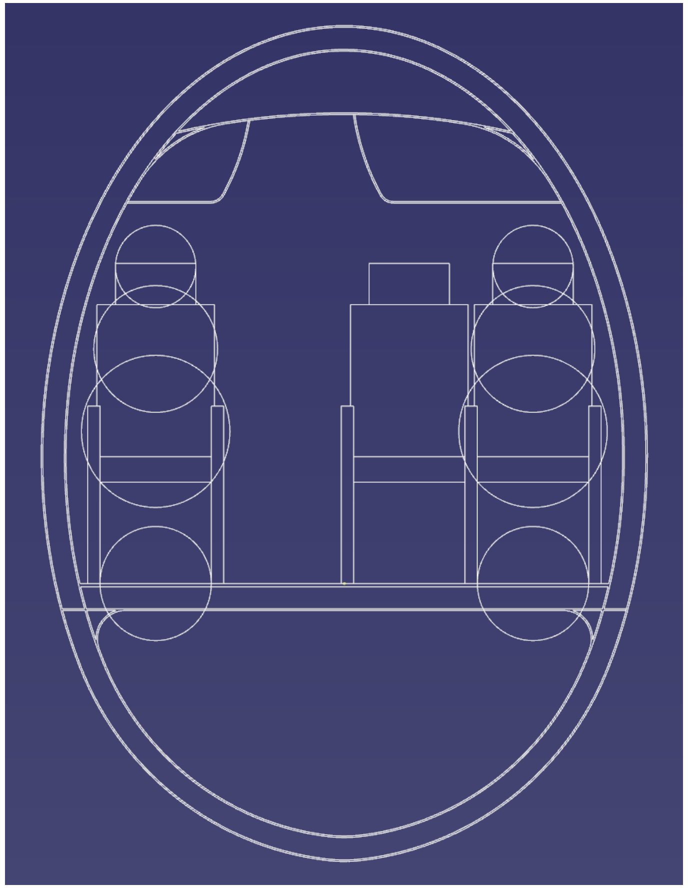
CATIA Layout

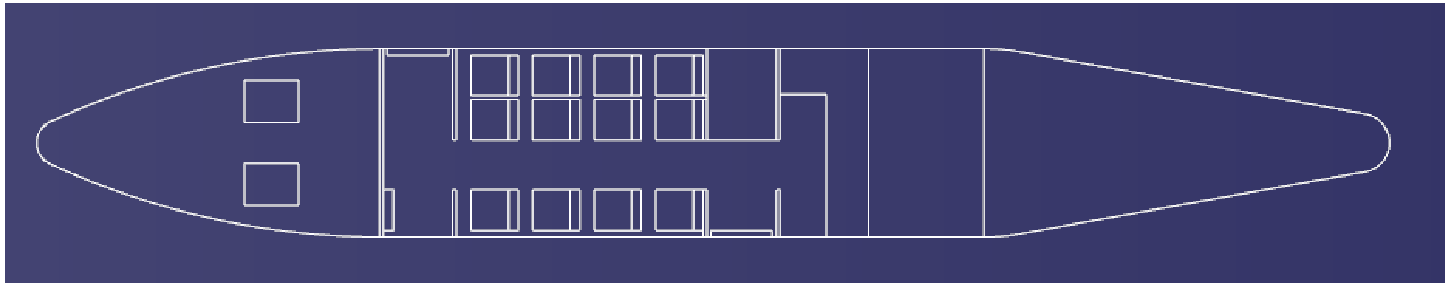


Cabin Height – 74"

Cabin Width – 90.5"

- Lavatory + Galley in Rear
- Cargo Area





- 2 Pilots
- Jump Seat for Crew
- 12 PAX

Seat Width – 19"

Seat Pitch – 32"

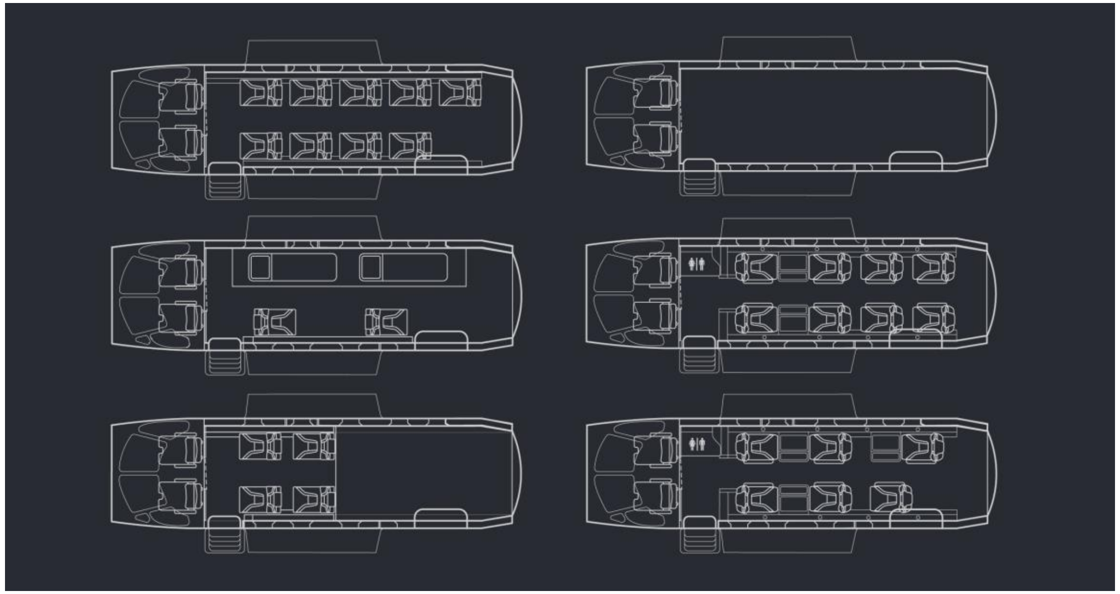
Aisle Width – 19"

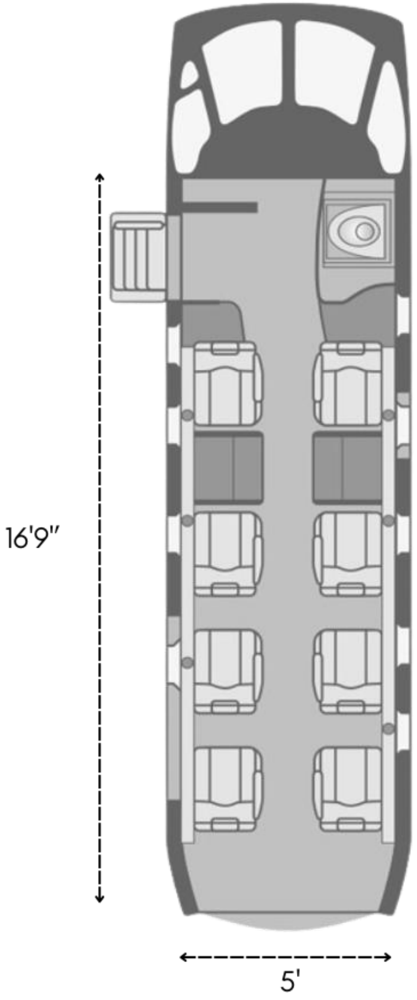
Seating in Economy style

- ❖ Seat models
  - Geven Essenza
- ❖ Lightweight seats
- ❖ Features
  - 27-29" pitch
  - Anti corrosion material
  - Ergonomic and optimized for space
  - Easy to perform maintenance

Seating in Business

- ❖ Seat models
  - o Geven Comoda
- ❖ Features
  - o 60 inch recline
  - o Lightweight
  - o In seat tray table
- ❖ Option for club seating




16'9"
5'

Maintenance Cost per Flight Hour

- Airframe: \$100–\$150/hr
- Propulsion: \$150–\$250/hr (lower than conventional turboprop)
- Avionics + Electrical: \$50–\$100/hr
- Environmental, Hydraulics, Landing Gear: \$100/hr
- Misc. (Interior, AD compliance, inspections): \$50–\$75/hr

- → Total: \$450–\$675 per flight hour

Comparable Operating Costs

Aircraft	Approx Operating Cost/Hr
HondaJet HA-420	$1,134.90
Cessna SkyCourier	$1,212.50
Pilatus PC-12	$1,400.00
Cirrus Vision SF90	$1,000.00
Embraer Phenom 300	$3,300.00
Embraer Phenom 100	$1,000.00
Solaris	$580.00

Operational Cost Assumptions (2040 Projections)

- Insurance: $20,000–$40,000/year
- Inspections: $10,000–$20,000/year
- Hangar Fees: $10,000–$15,000/year
- Jet Fuel: $6–$15/gal
- Electricity: $0.15/kWh
- Crew Members: 3
- Pilot Salary: $130,916/year
- Flight Crew Hourly Rate: $26.50/hr