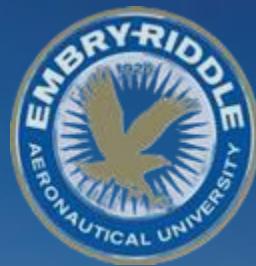
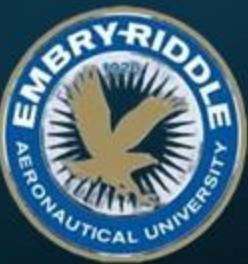


SOLARIS XIL-1



Embry Riddle Aeronautical University - Colleges of Business and Engineering

Meet Team APPA



Owen Dieterle, TL
Financial Analyst



Blake Paynter
Market Analyst



Cameron White
Geographic Analyst



Ashwin Garg
Design Analyst



Annabelle Stube, TL
Stability Analyst



Kiana Arroyo
Cost & Aerodynamics
Analyst



Percy Solomon
Constraint &
Structures Lead



Kevin Nadolne
CAD & Simulation
Lead



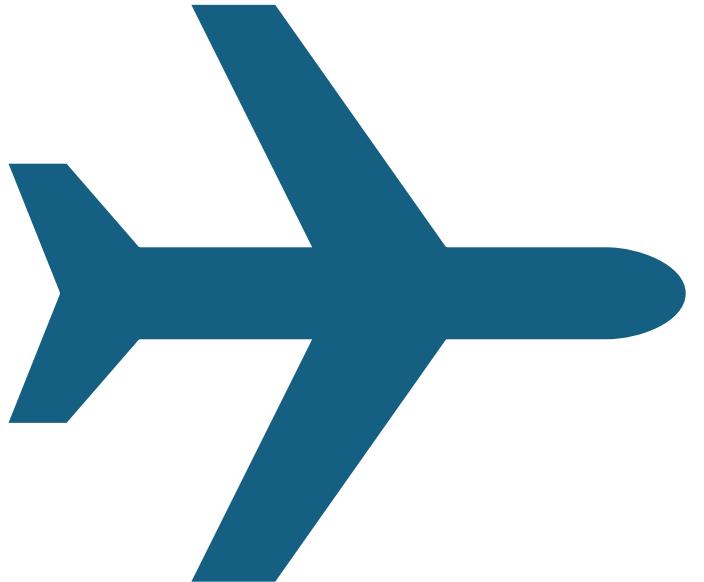
Alex Chidester
Performance Lead

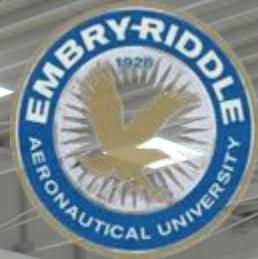
Introductory Design Requirements



Fixed Wing Regional Aircraft

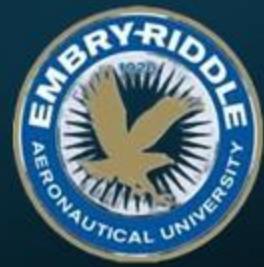
-  10-20 Passenger Capacity
-  Required mission range of 1500 nm, Optimized for 500 nm
-  Technical Innovation (New Primary System)
-  Emphasis on Environmental concerns – reduced impact
-  Determine Market Niche and Operations





Introducing
Solaris XIL-1

Aircraft Specifications



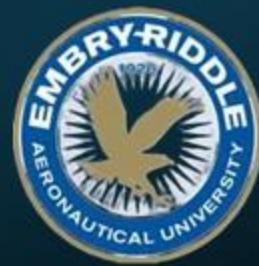
Dimensions

- Capacity: 12 Passengers
- Length: 68'
- Span: 71'
- Height: 19'
- Empty Weight: 11,900lb
- MTOW: 18,800 lb

Specifications

- VerdeGo Aero VH-5 Hybrid Electric Turbofan
- MAGIDRIVE 500 Electric Motor
- 4-Bladed McCauley Constant Speed Propeller
- Cruise: 250KCAS at FL150
- Service Ceiling at FL220

Aircraft Regulations

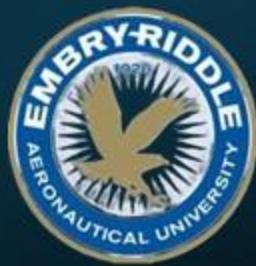


- The Solaris XIL-1 is fully compliant with FAA 14 CFR Pt. 23, Level 4, High Speed
- Allows for faster flight and ensures stringent safety measures

14 CFR Part 23 Regulations		Solaris XIL-1	
Level 4 Passenger Range	10 to 19	Passenger Capacity	12
MTOW	$\leq 19,000$ lbs	MTOW	18,800 lbs
High Speed Category	Mav Speed ≥ 250 KCAS	Max Operating Speed	300 KCAS

Goals

- Address gap in short range routes within the United States
- Introduce competition and luxury options to train travel for short range routes in Europe
- Improve fuel efficiency and reduce environmental impacts vs competition
- Reduce maintenance and operational costs
- Focus on cabin comfortability

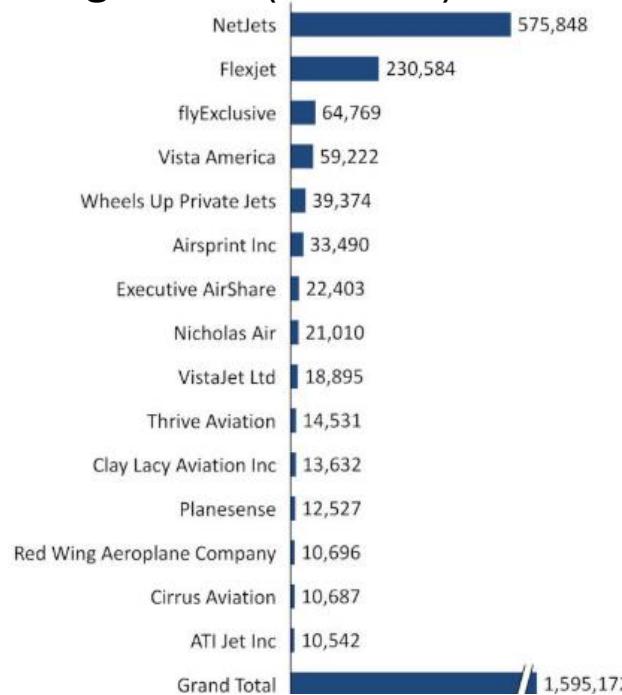


Market Clientele



Fractional Owners / Operators

Flight time (in hours) For 2024



JSX

Fleet size: 47

VISTA JET

Fleet size: 360

NETJETS®

Fleet size: 750

flyexclusive

Fleet size: 100

Flexjet

Fleet size: 320

WHEELS UP

Fleet size: 180

- 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

Market Research



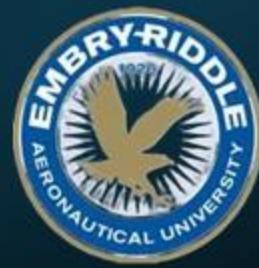
European Markets

- Geneva → Paris ~221 NM
- Istanbul → Ankara ~197 NM
- Milano → Rome ~262 NM
- Nice → Paris ~375 NM
- Paris → Milano ~215 NM

American Market

- 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

Soft Launch



Phase 2

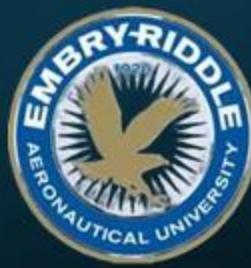
Full Market Rollout



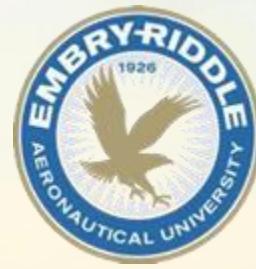
Phase 3

Scale & Optimize

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 Aircraft	\$117	\$475	\$57.00	49%	12%
Embraer	\$508.6	\$6,396	\$309.70	61%	5%
Gulfstream	\$851.6	\$8,621		0%	10%
				Average	7%

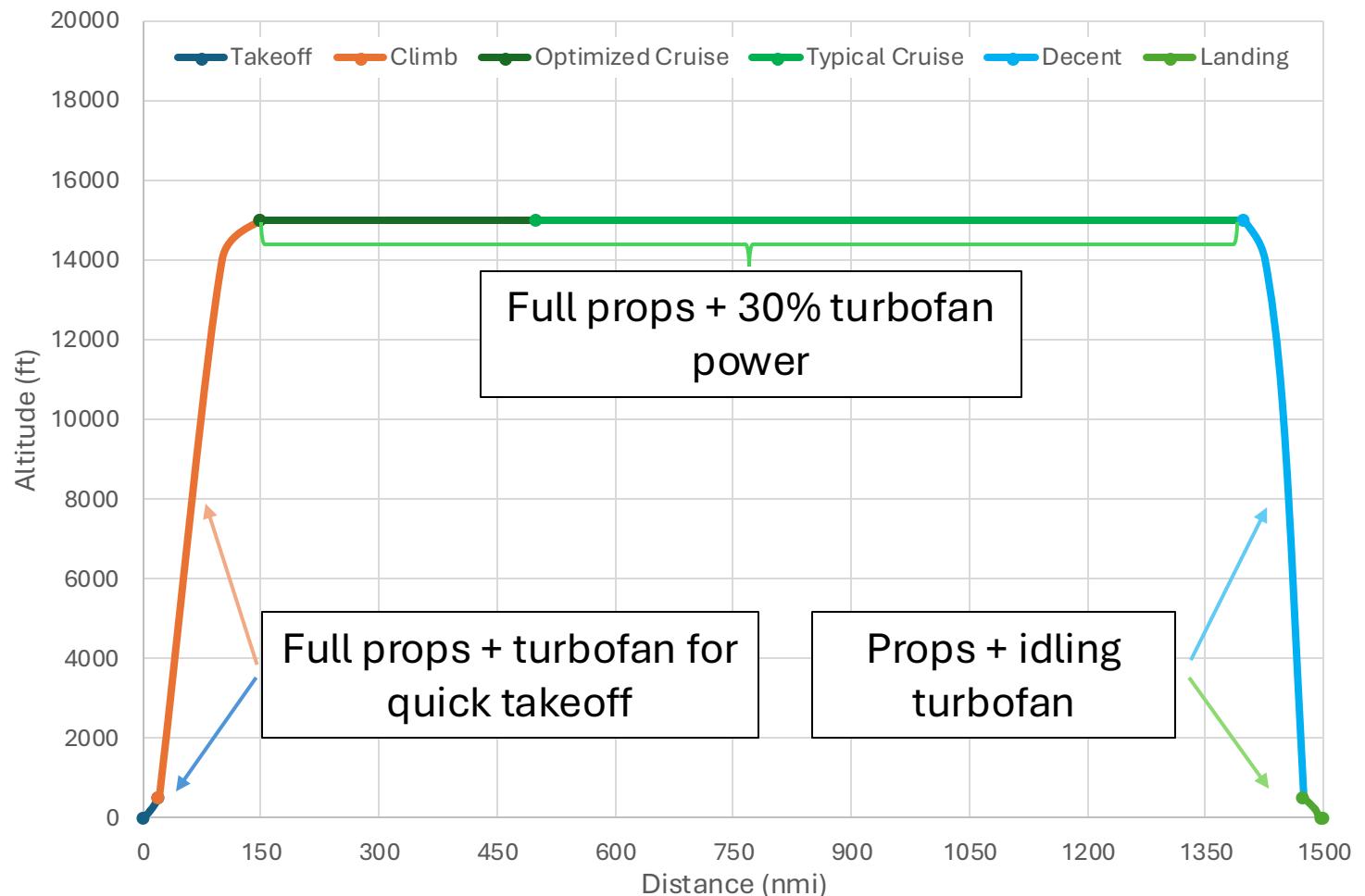


Aerodynamic Analysis

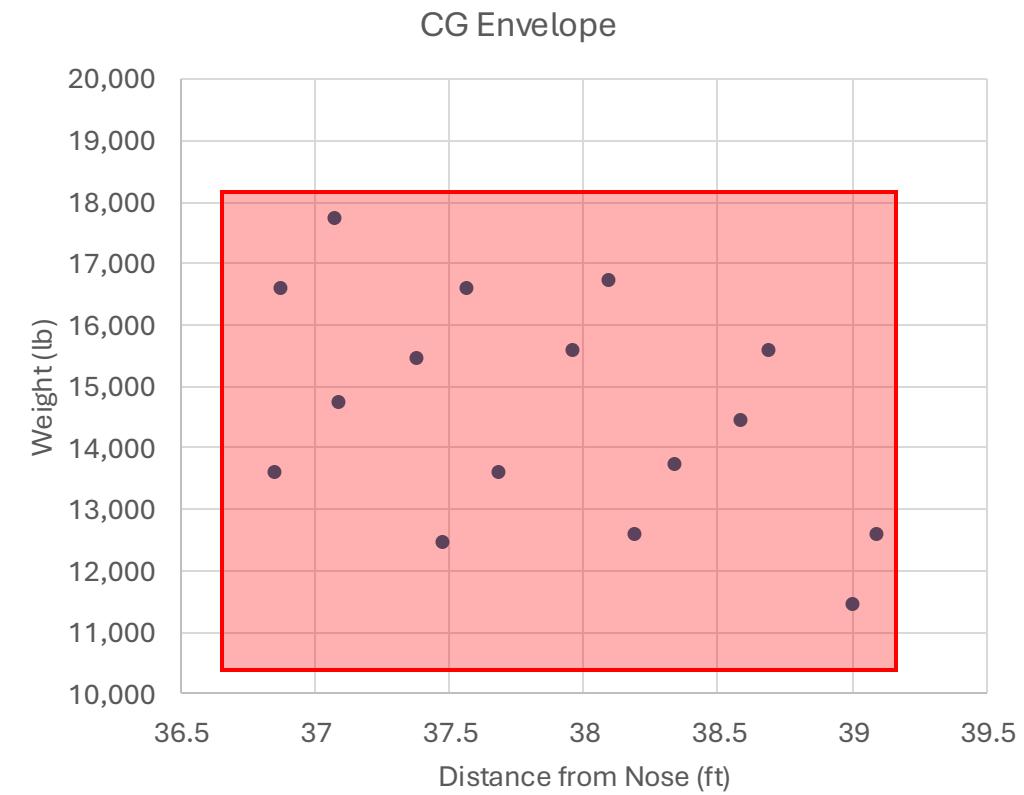
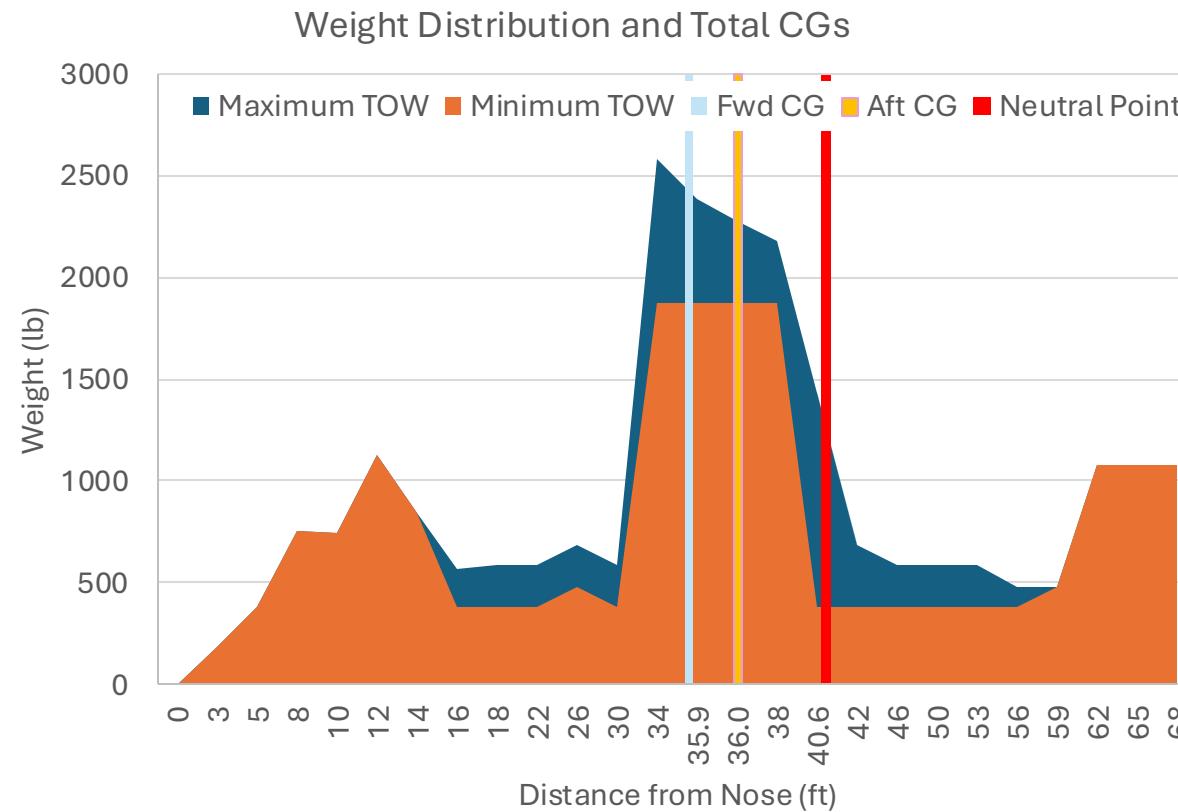
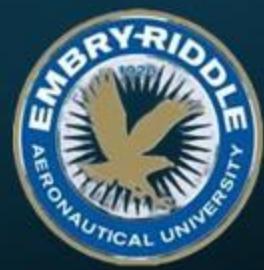
Mission Profile



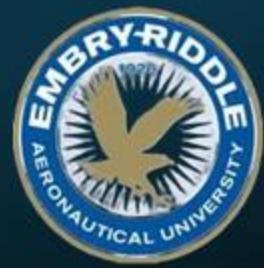
- Cruise altitude of 15,000 ft
 - Reduces climb and descent time
 - Improves fuel & propellor efficiency
- Optimizes for short-haul flight



Weight Distribution & CG Envelope



Lift Model

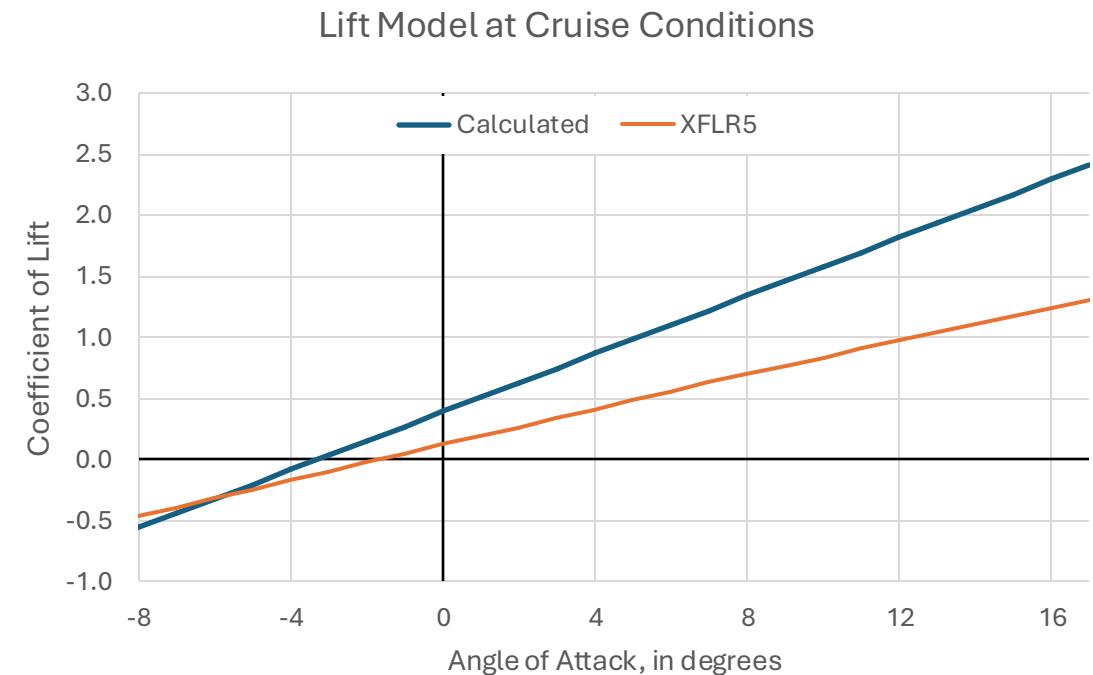


Design Approach:

- Wing: NACA 4415 airfoil
- High-lift devices: Fowler flaps and fixed slot aileron
- Tail surfaces optimized for control and stability

Key Performance Insights:

- Aircraft achieves required lift at cruise with margin
- Stall angle provides safe operating range
- Landing and takeoff coefficients meet mission needs



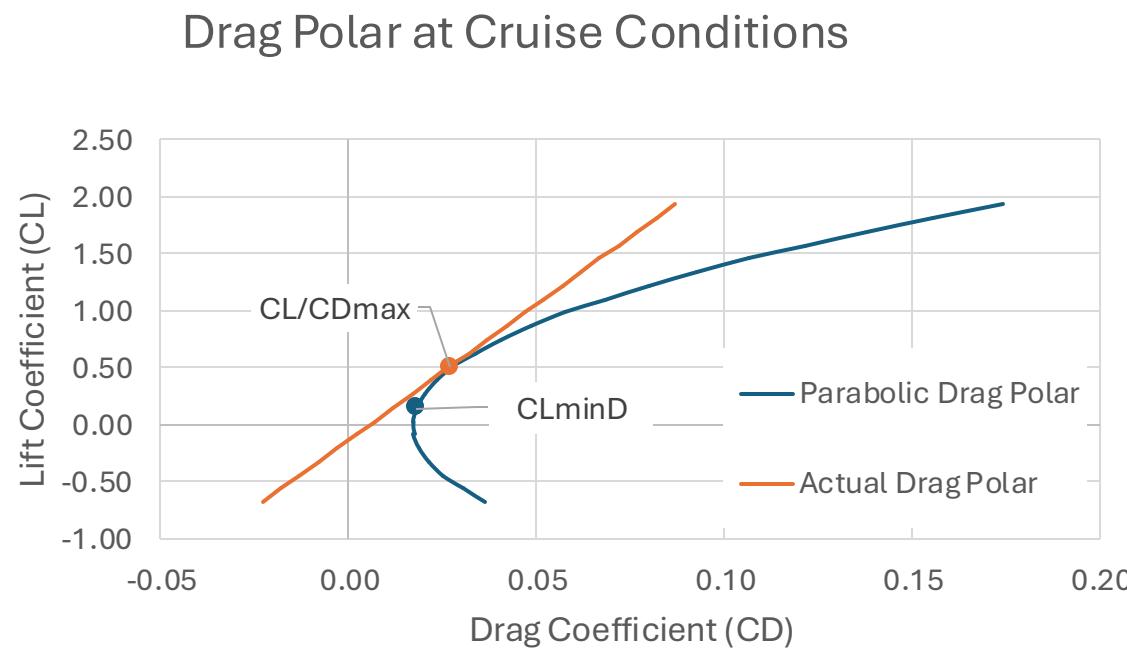
Bottom Line: Our configuration ensures safe, efficient flight with sufficient lift across all mission phases – confirmed by both in-house and software-based analysis

Drag Model

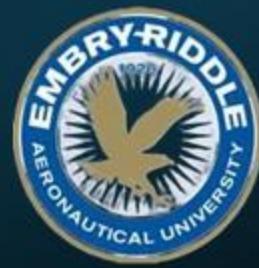


- Low drag at cruise
 - Confirms fuel efficiency
- $CL/CD = 11.7$
 - Matches or exceeds competitors
- XFLR5 matches analytical model
 - Confirms design robustness

Variable	Value
CL_{minD}	0.20
CD_0	0.02
L/D	11.7



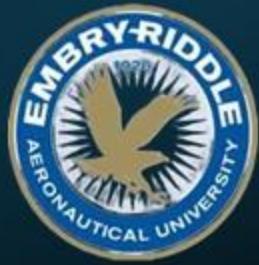
Stability and Controls



- Stable in all flight conditions
- Design prioritizes comfort and safety
- Validated by multiple simulation tools (Analytical, XFLR5, VSP)
- Meets key stability criteria
 - Longitudinal – pitch stability
 - Directional – yaw control
 - Lateral – roll behavior
 - Sideslip – crosswind resilience

Bottom Line: The aircraft is stable, safe, and easy to control – supporting pilot confidence and smooth passenger experience

Powerplant and Battery



Powerplant

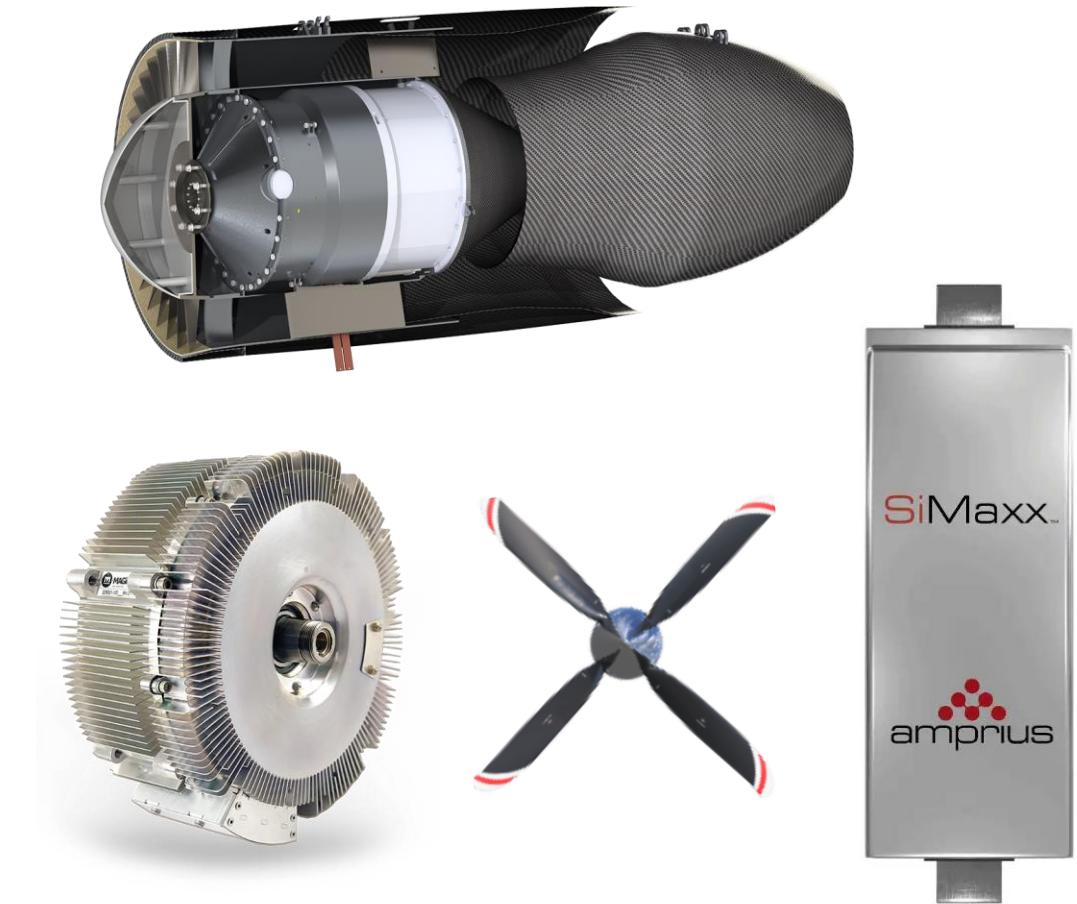
- VerdeGo Aero VH-5
- MAGIDRIVE Model – 500
- McCauley 4 - Bladed Constant Speed

Battery and Wiring

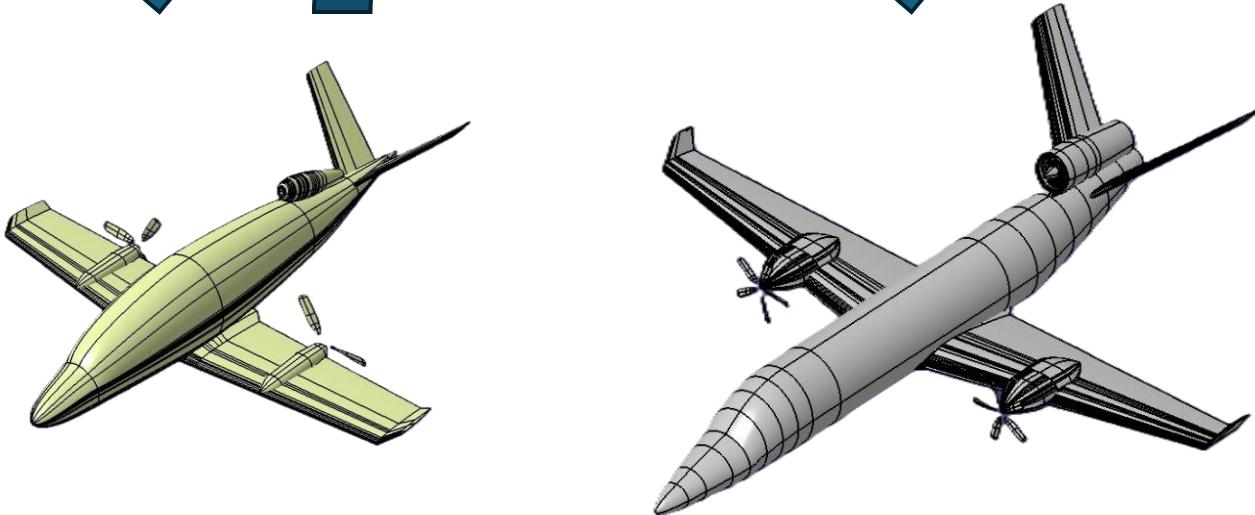
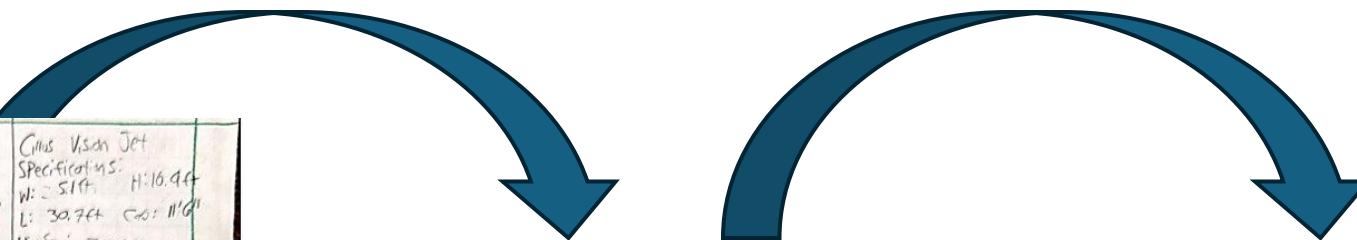
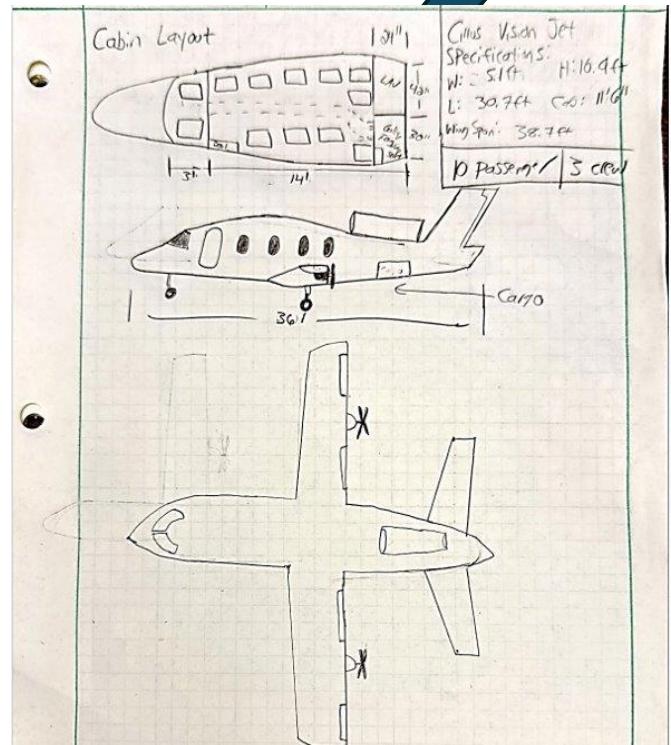
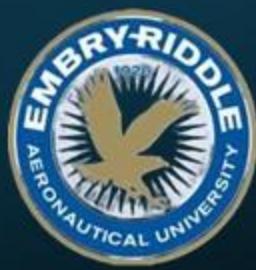
- Amprius SiMaxx - High Power
- Turboflex AWG G961-003 Wiring

Key Features

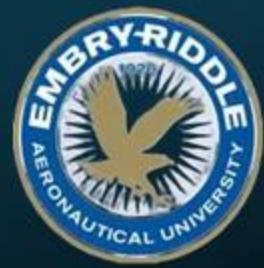
- **6-minute recharge to 80%**
- **5600 lb thrust**
- **Hybrid = redundancy + efficiency**



Development Summary



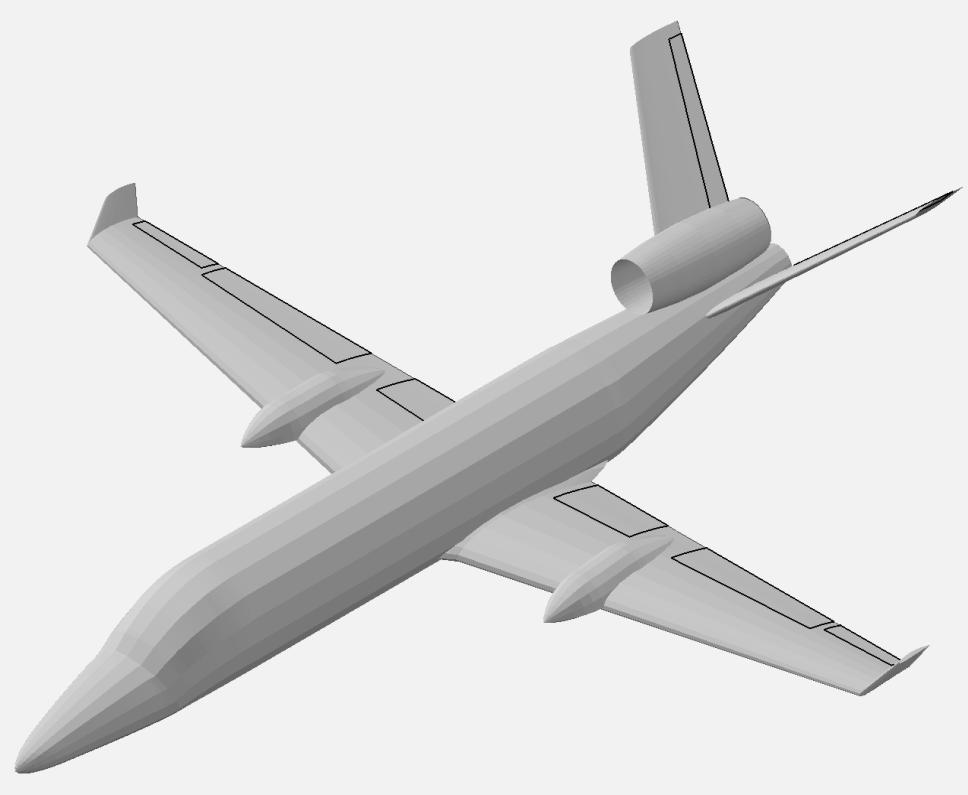
Aircraft Modeling

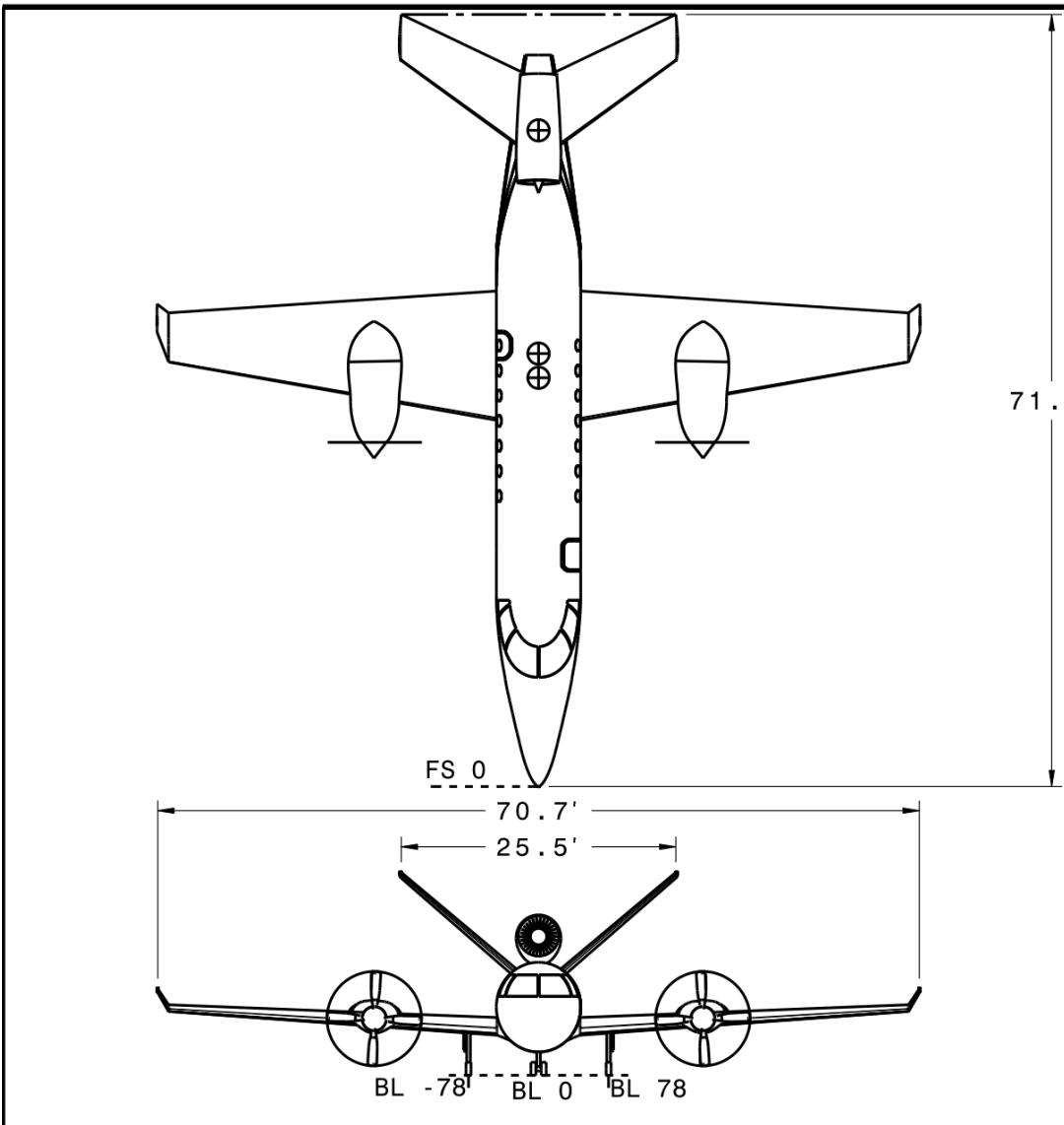


CATIA Rendering

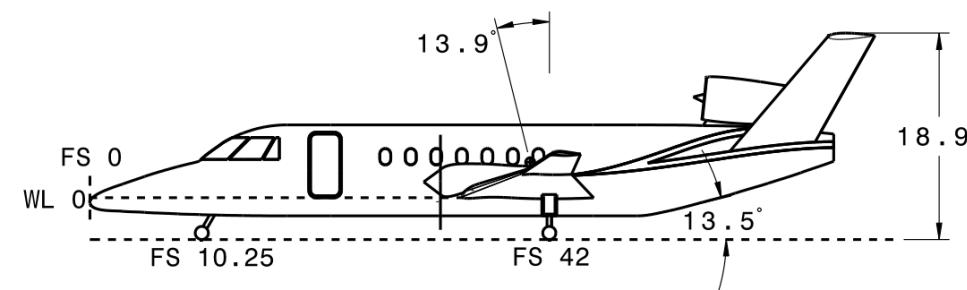


VSP Rendering



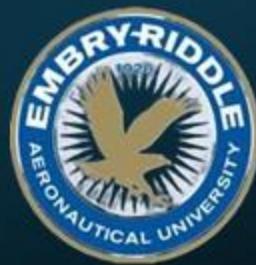


SURFACE	WING	V-TAIL
SPAN (FT)	70.7	33.0
AREA (FT ²)	476	194
MAC (FT)	7.36	6.0
ROOT CHORD (FT)	10	7.5
TIP CHORD (FT)	3.8	4.3
AIRFOIL	NACA 4415	NACA 0009



LONGITUDINAL M = 0.4	CL	CD	CLa	CDa	Cma	CLq	Cmq	CLM	CDM	CmM	CLde	CMde
FL150	0.390	0.0196	6.67	0.220	-1.41	11.1	-10.8	0.22	0.0	0.0	-0.481	1.06
LATERAL M = 0.4	CyB	C1B	CnB	C1p	Cnp	Clr	Cnr	Clda	Cnda	Cydr	Cldr	Cndr
FL150	-0.0664	-0.137	-0.059	-0.565	-0.015	0.179	-0.154	0.133	-0.0072	-0.0965	-0.0668	0.117

EMBRY-RIDDLE AERONAUTICAL UNIVERSITY DAYTONA BEACH, FLORIDA		
TEAM NAME: APPA - FOXTROT SOLARIS XIL-1		PART NAME:
DRAWN BY: KEVIN NADOLNE	CLASS SECT: AE 420 - 02	DATE: 04 - 13 - 2025
		SHEET 1/1



Performance

Metric	Value	Impact
Takeoff Distance	3194 ft	Operates from regional airports
Climb Rate	2,700 ft/min	Fast climb, minimizes flight time
Cruise Speed	250 KCAS @ FL 150	Matches jet-class speeds
Max Range	1,500 nm	U.S. coast-to-coast flexibility
Landing Distance	1,900 ft	Short runway ops enables
L/D Ratio	11.7	Efficient hybrid cruise
Thrust Available	3,126 lbf	65% more than required

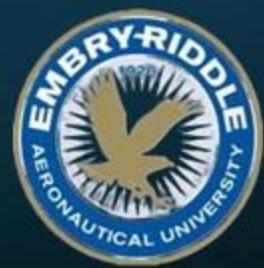
Bottom Line:

The aircraft meets or exceeds all mission requirements with hybrid-electric propulsion

Range

- Supplemental 15 mins of 100% Battery Power for Redundancy
- 250 KCAS meets ideal range and propellor efficiency
- Solaris XIL-1 outperforms competition in Fuel Efficiency

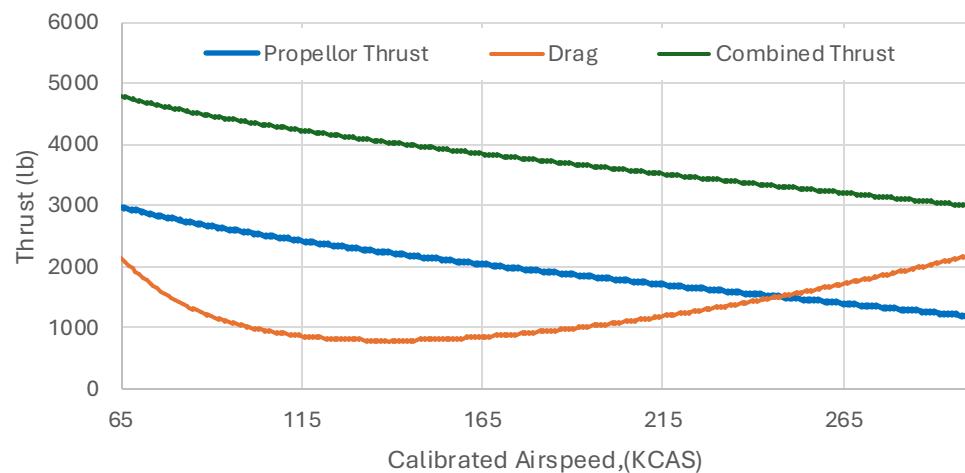
Rival Aircraft	Solaris XIL-1	Cessna Sky Courier	Embraer Phenom 300	Beechcraft King Air-350
Range (nm)	1500	900	1971	1806
Cruise Speed (KCAS)	250	210	464	303
Ceiling (ft)	22,000	25000	45000	35,000
Fuel Capacity (lb)	3300	4826	5353	5192
Passengers	12	19	9	11



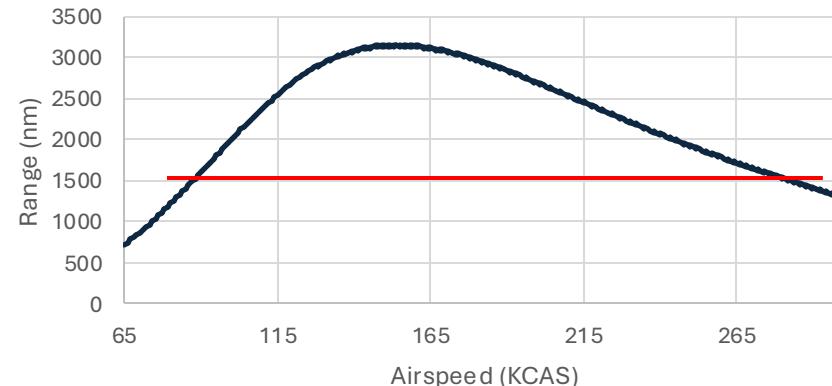
Performance Graphs



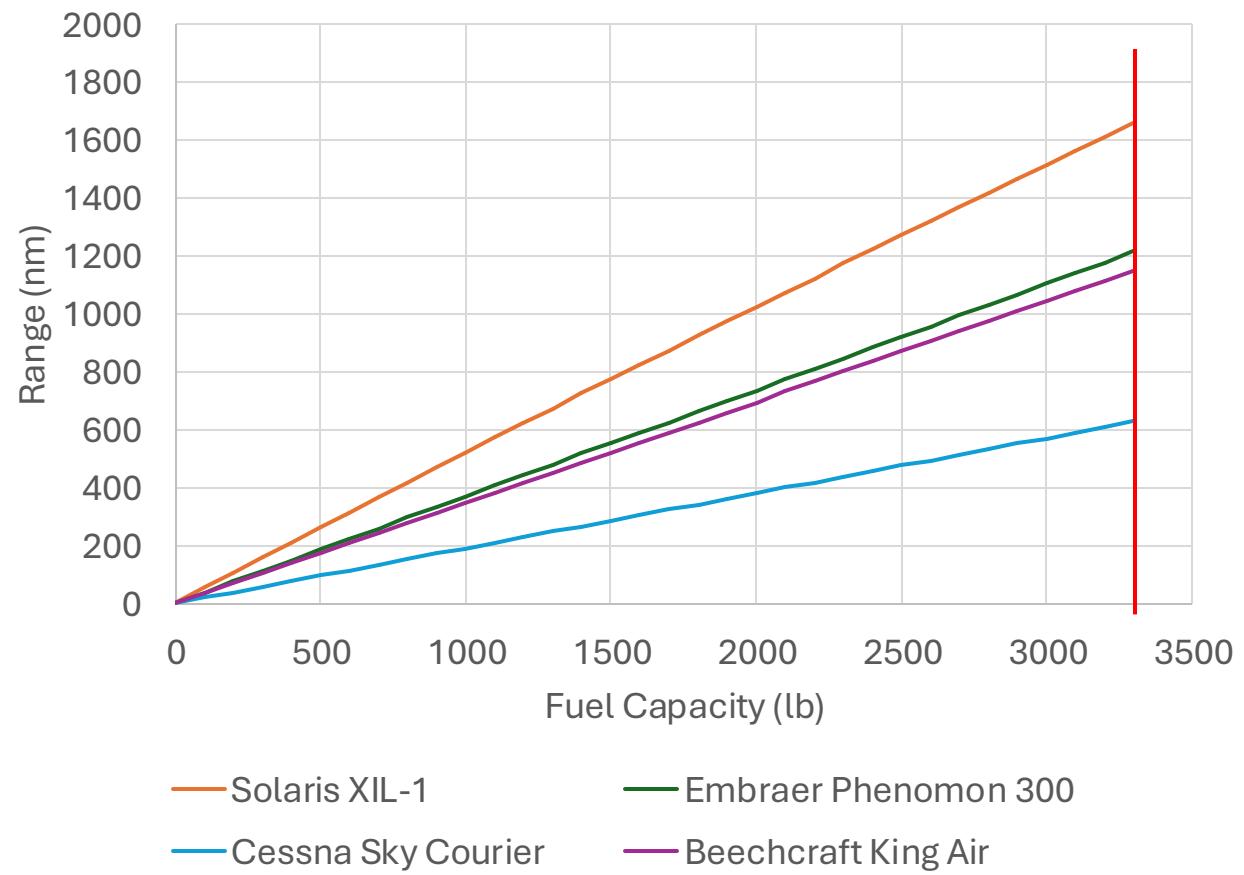
Thrust Performance at Cruise



Range vs Airspeed



Range vs Fuel Capacity

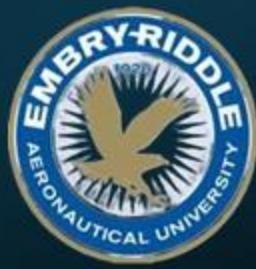




Layout Options



Economy Seating Layout

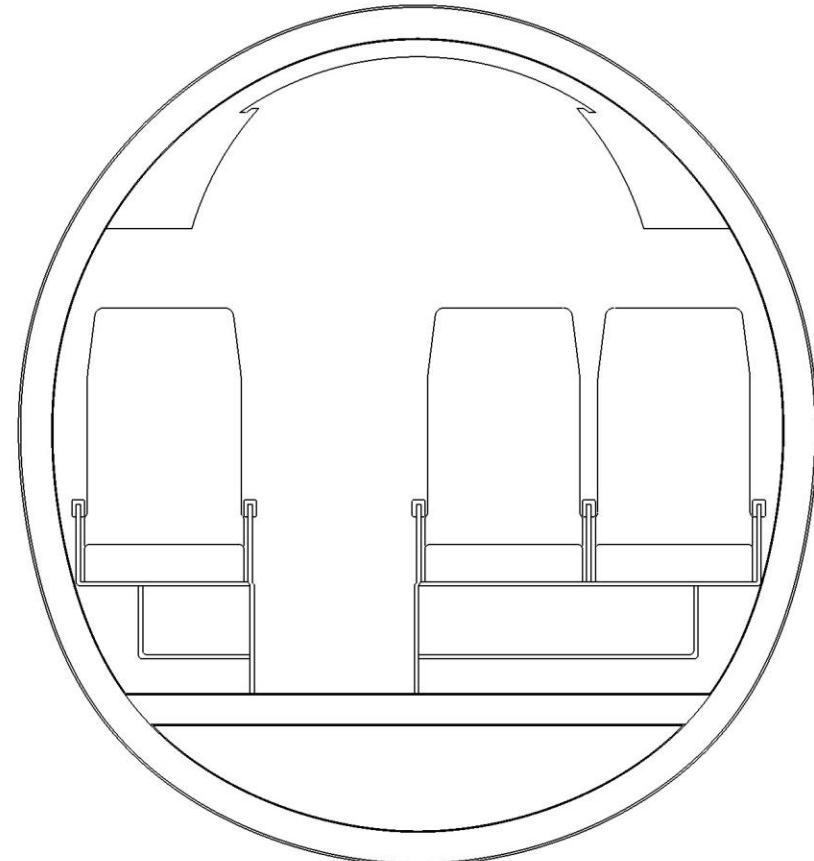


Cabin Cross Section

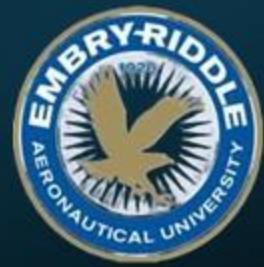
- Cabin Height – 74”
- Cabin Width – 85”

Economy 2x1:

- Seat Width – 18.3-18.5”
- Seat Pitch – 43”
- Aisle Width – 18.5”
- 12 seats



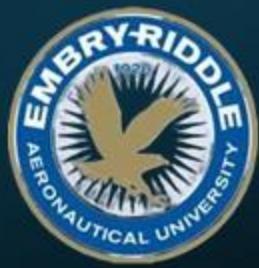
Economy Seats



Geven Essenza

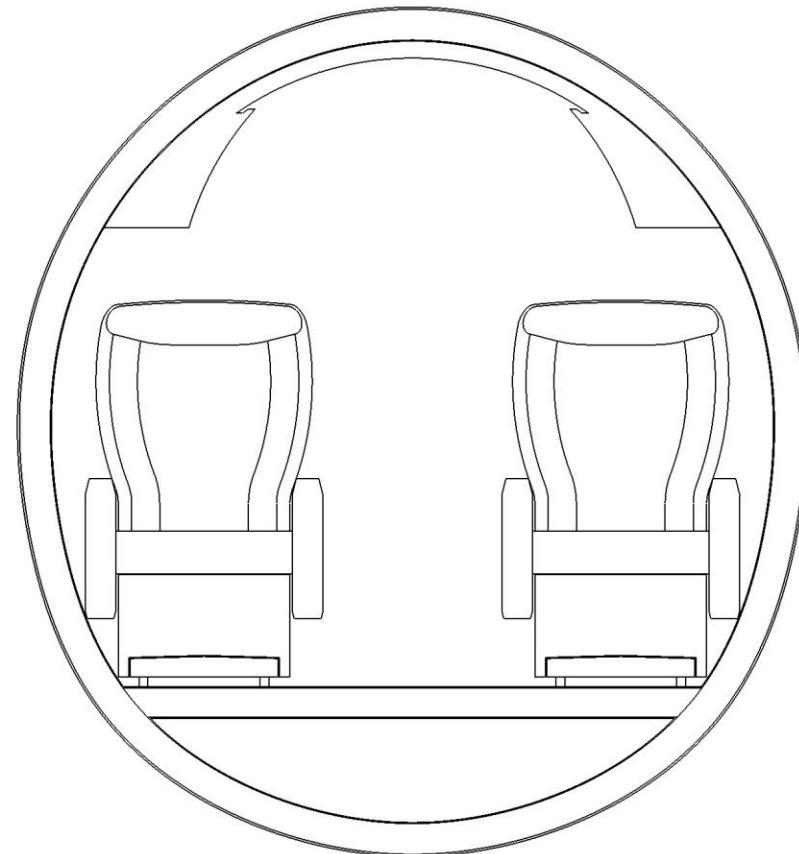
- Lightweight
- Durable with anti-corrosion material
- Various entertainment capabilities
- In seat power

Business Seating Layout



Coach 1x1:

- Seat Width – 20.7”
- Seat Pitch – 34”
- Aisle Width – 21”
- 8 seats

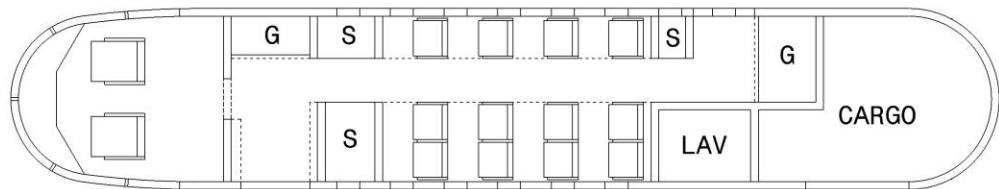
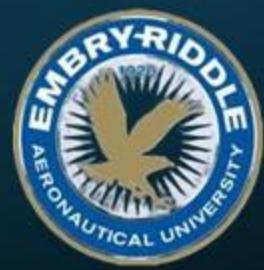


Business Seats

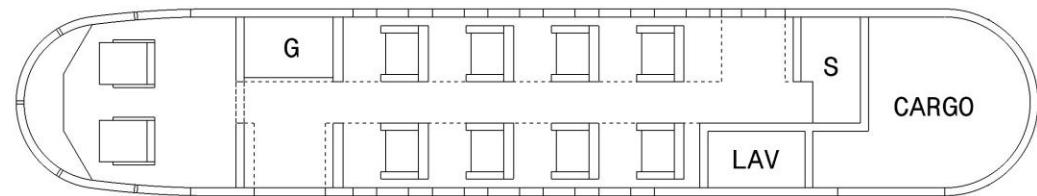
- Seating in 1-1 configuration
- Geven Comoda
 - 60 inch recline
 - Lightweight
 - In seat tray table
 - Entertainment and comfort features
- Option for club seating
- Divan option



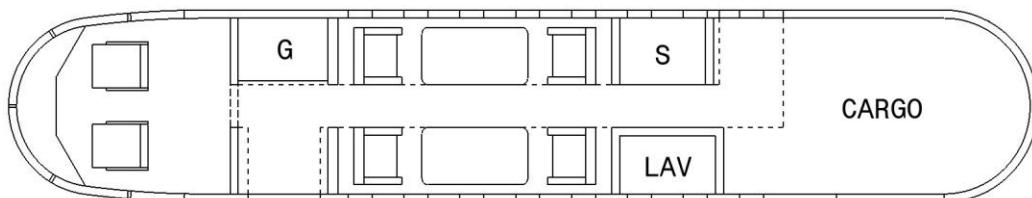
Internal Layout Configurations



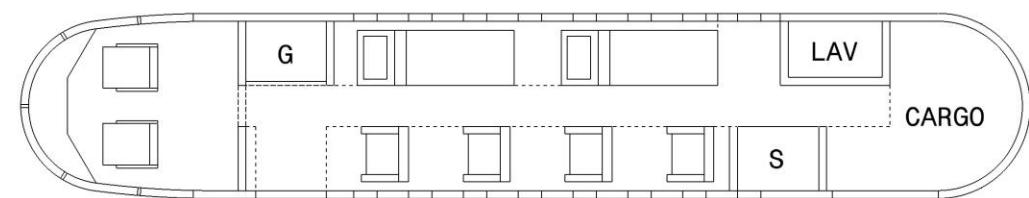
Economy – 12 PAX



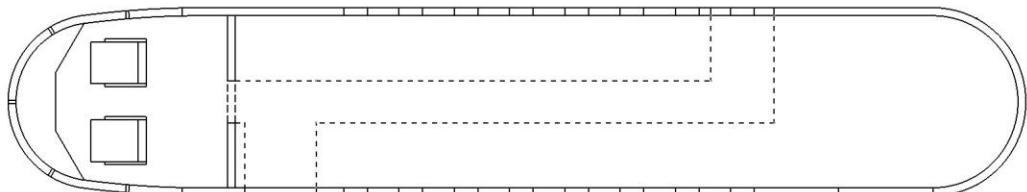
Business – 8 PAX



Combi – 4 PAX



MedEvac – 4 + 2 PAX



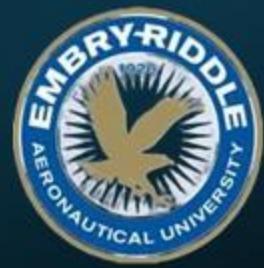
Cargo – 1152 cubic feet

S – Storage
G – Galley
LAV – Lavatory



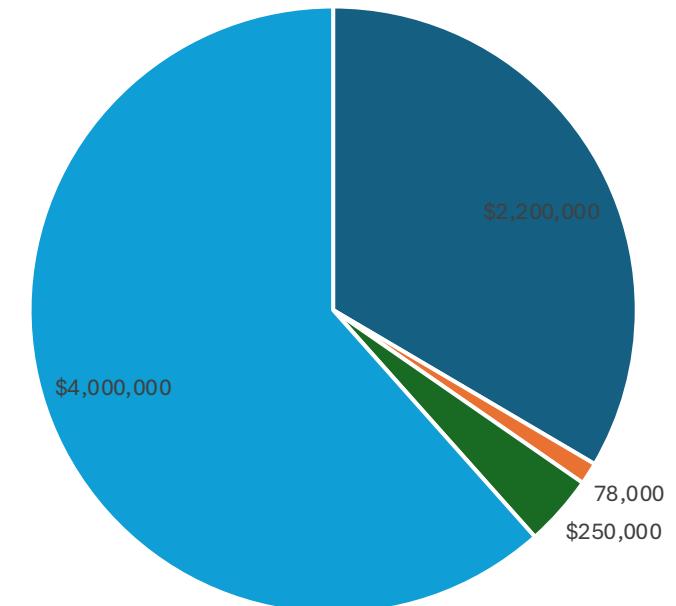
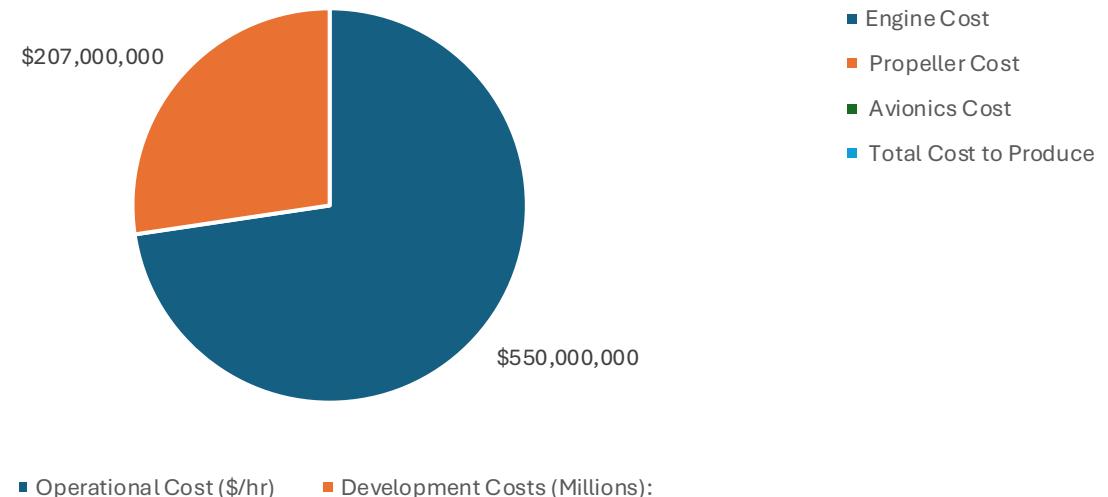
Cost Analysis

Cost Analysis

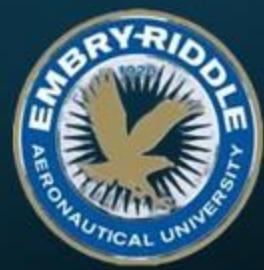


- Development Costs: \$207 Million
- Unit Cost: \$6.34 Million
- Target Price: \$7.29 Million
- Operational Cost: \$550/hr

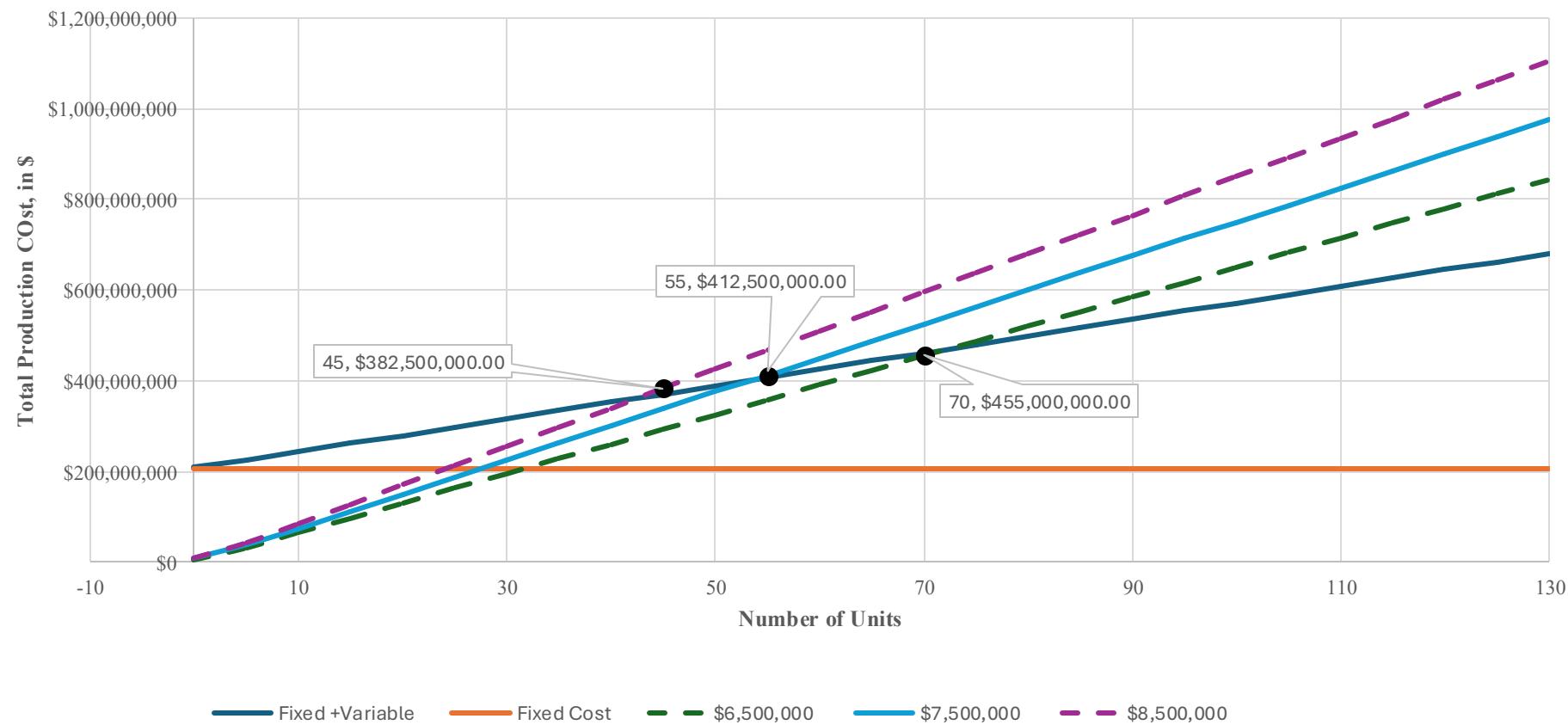
Cost That Make-Up the Min. Selling Price of \$6.6 mill.



Cost Analysis



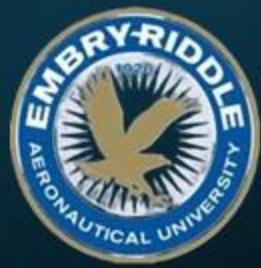
Breakeven Analysis for Various Selling Prices



Cost Benchmarks



Aircraft	Seats	Range	Unit Cost	Propulsion
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
Solaris XIL-1	12	1,500 nm	\$6.34M	Hybrid-electric

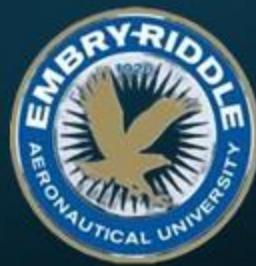


Maintenance Cost per Flight Hour

- Airframe
- Propulsion
- Avionics + Electrical
- Environmental, Hydraulics, Landing Gear
- Misc. (Interior, AD compliance, inspections)

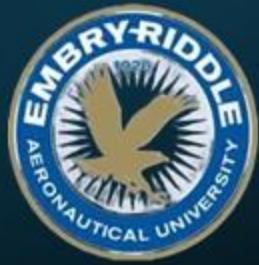
\$450–\$675 per flight hour

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 XIL-1	\$580.00

Revenue & Markup Strategy

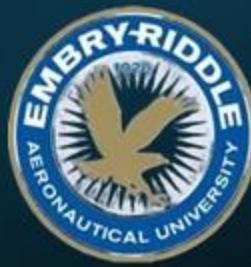


Target Selling Price Range: \$6.97M – \$7.29M

Unit Production Cost: \$6.34M

Proposed Markup: 10–15%

Marketing Assumptions



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

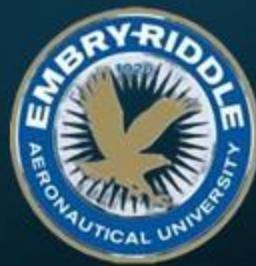
Raw material costs reflect composite-heavy structure

Avionics aligned with next-gen FAA certification needs

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

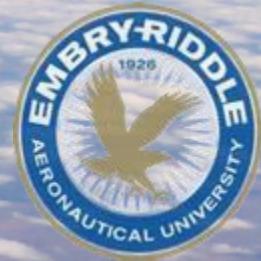
Manufacturing labor hours match complexity of hybrid systems

Quality control budgeted at ~1.4% of total unit cost



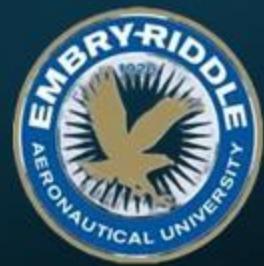
Marketing Budget

Budgeting	%	Million \$
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



Environmental Considerations

Environmental Impacts



Energy

- 46% total energy required reduction [3]
 - Combination of power required to charge batteries and fuel

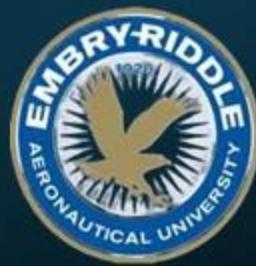
Noise

- 50% reduction in perceived noise [3]
- >10 dB reduction in maximum sound pressure level at takeoff

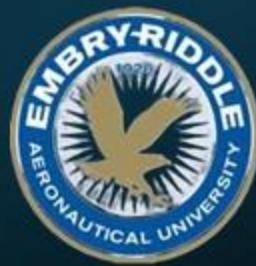
Emissions

- 73% reduction in CO₂ emissions [4]
 - Using Swedish power grid

Conclusion

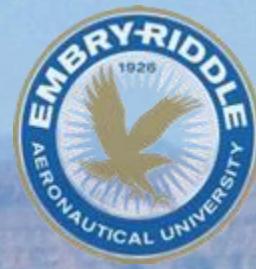


- 12 passenger hybrid-electric aircraft
- Engineering Impact
 - Hybrid-electric design reduces emissions
 - Meets FAA regulations
 - Performs Safely
- Business Case
 - Low operation cost
 - Strong market fit
 - Scalable model

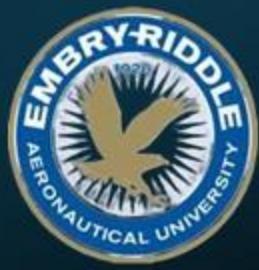


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- [3] Balack, P., Atanasov, G., Hesse, C., "Conceptual Design of Silent Electric Commuter Aircraft," 2021,
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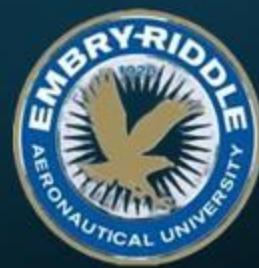
The background of the slide is a photograph of an airport runway in a desert environment. In the foreground, a small white propeller aircraft is positioned on the dark asphalt runway, facing towards the viewer. To the left, another similar aircraft is parked on the grassy shoulder of the runway. In the distance, a larger, single-engine propeller aircraft is captured in flight, moving away from the viewer. The surrounding landscape is a vast, arid desert with rolling hills and mountains under a clear blue sky.

Questions?



Additional Aerodynamic Analysis

Performance

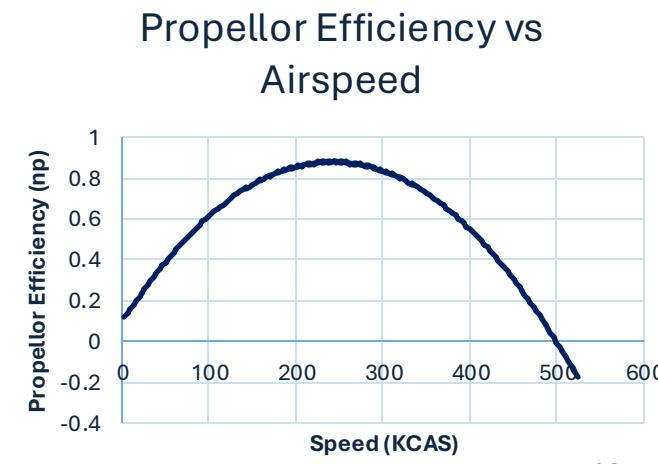
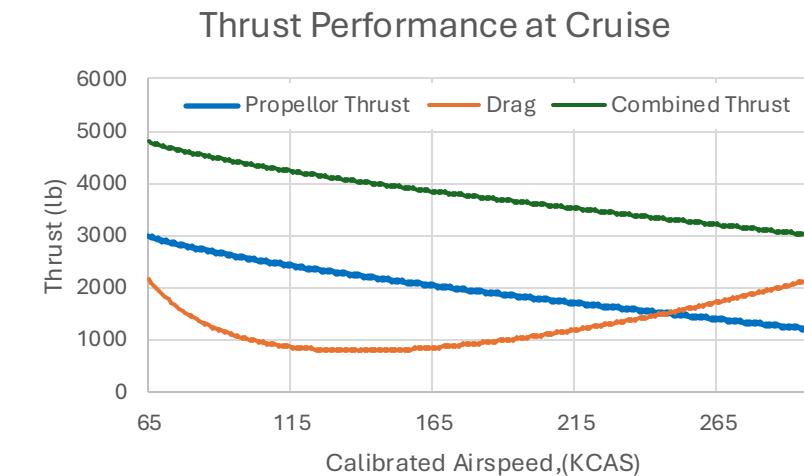


Takeoff	
T/W	0.3
MTOW	18,875 lb
Ground Roll	1731ft
Takeoff Distance	3194 ft
Liftoff Speed	98 kts

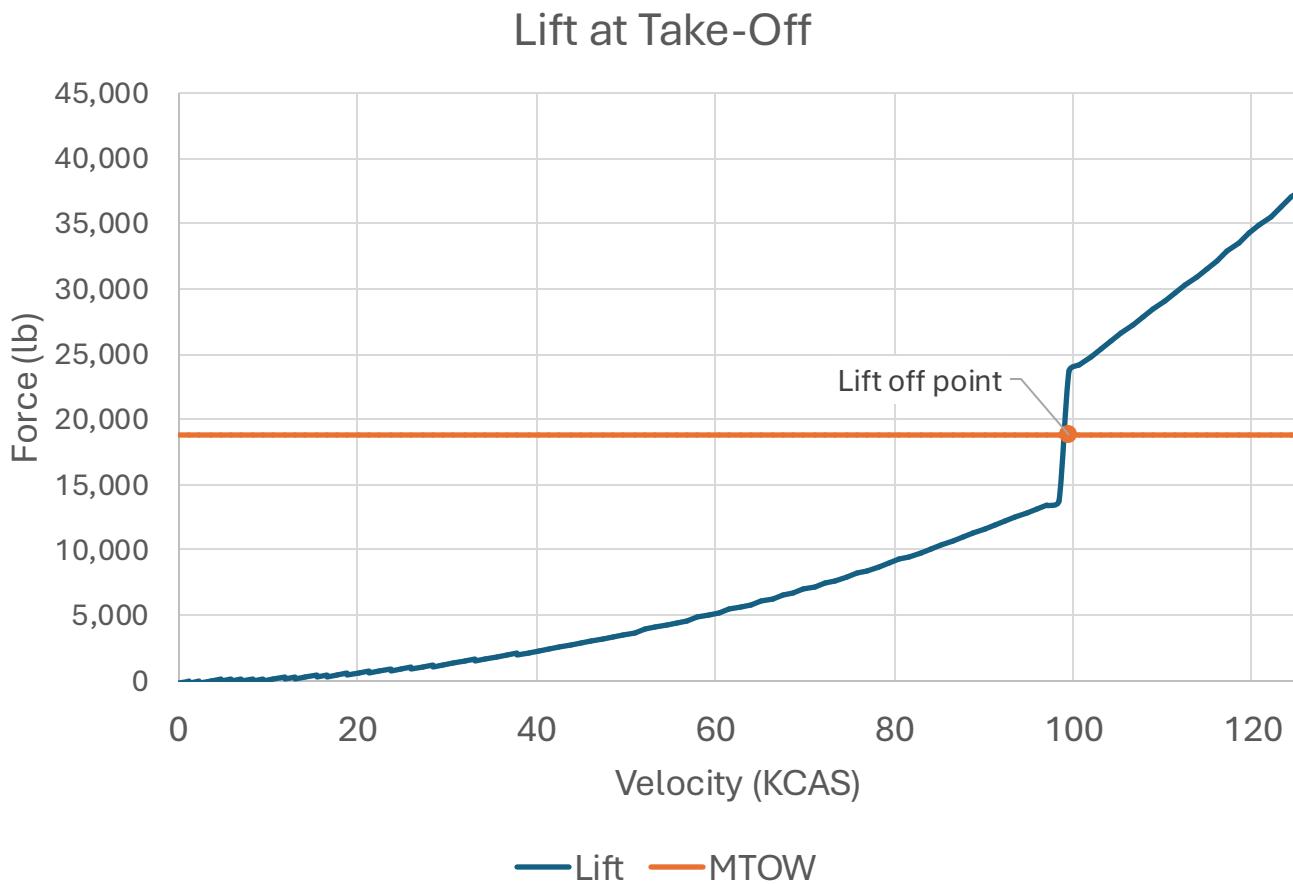
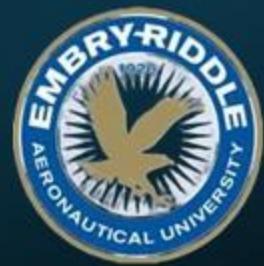
Climb	
Rate of Climb	2744 ft/min
Max Climb Angle	10.3 deg
Time to Cruise	7 min
Climb Velocity	190 kts

Cruise	
VCruise	250 KCAS
L/D	11.7
Ceiling	22,000 ft
Thrust Required	1907 lbf
Thrust Available	3126 lbf

Landing	
Rate of Descent	1156 ft/min
Min Angle of Descent	2.5
Landing Distance	1900 ft
Glide Speed	182 kts
Landing Speed	101 kts

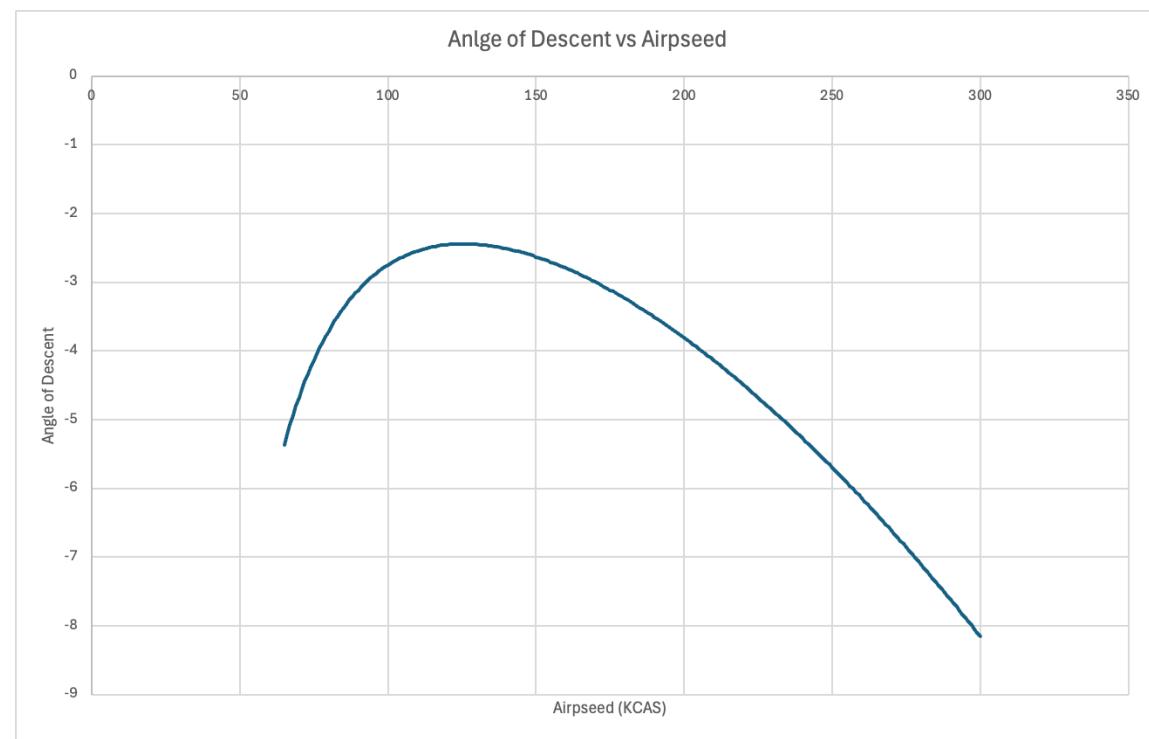
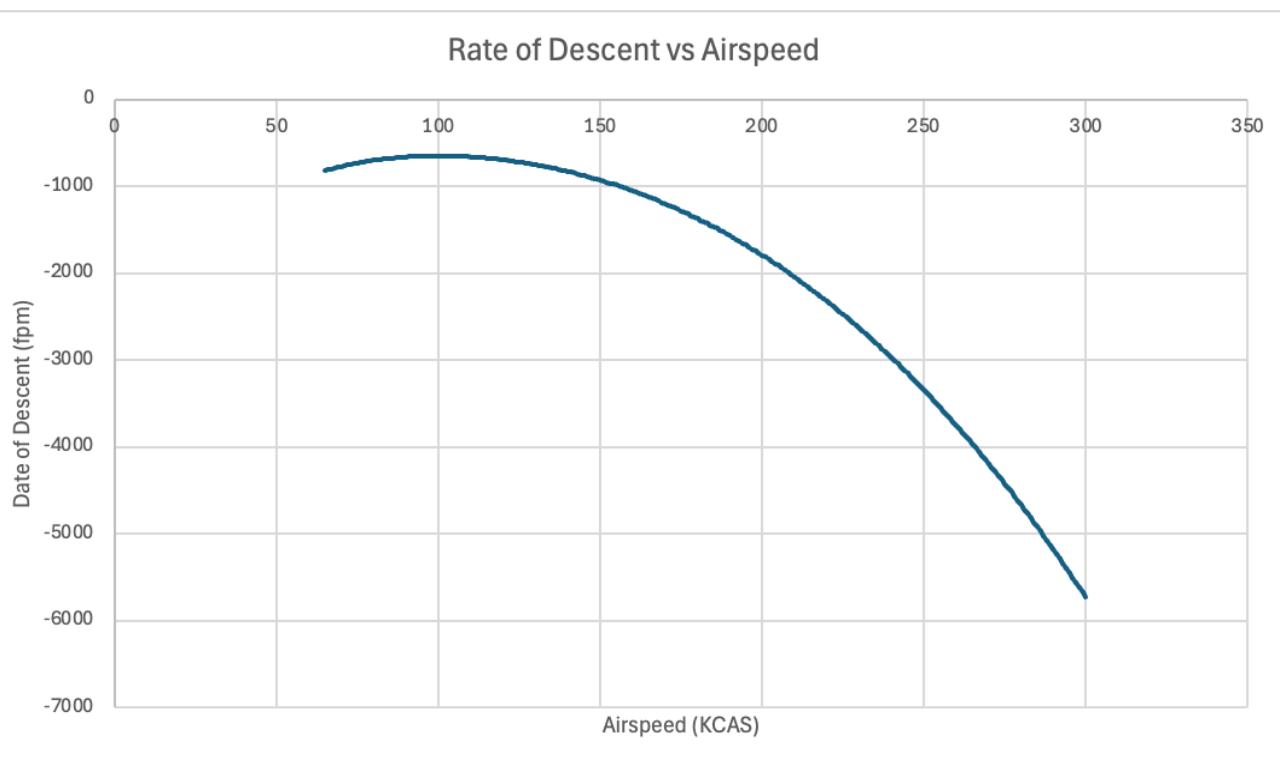
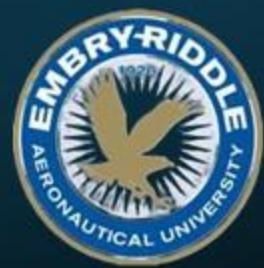


Take-Off Model

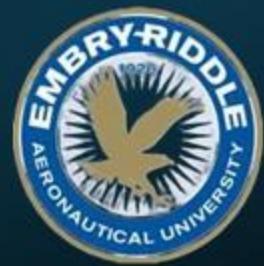


- Take off Speed of 98 KCAS
- Flaps are deflected at 15° for a 5° takeoff angle of attack.

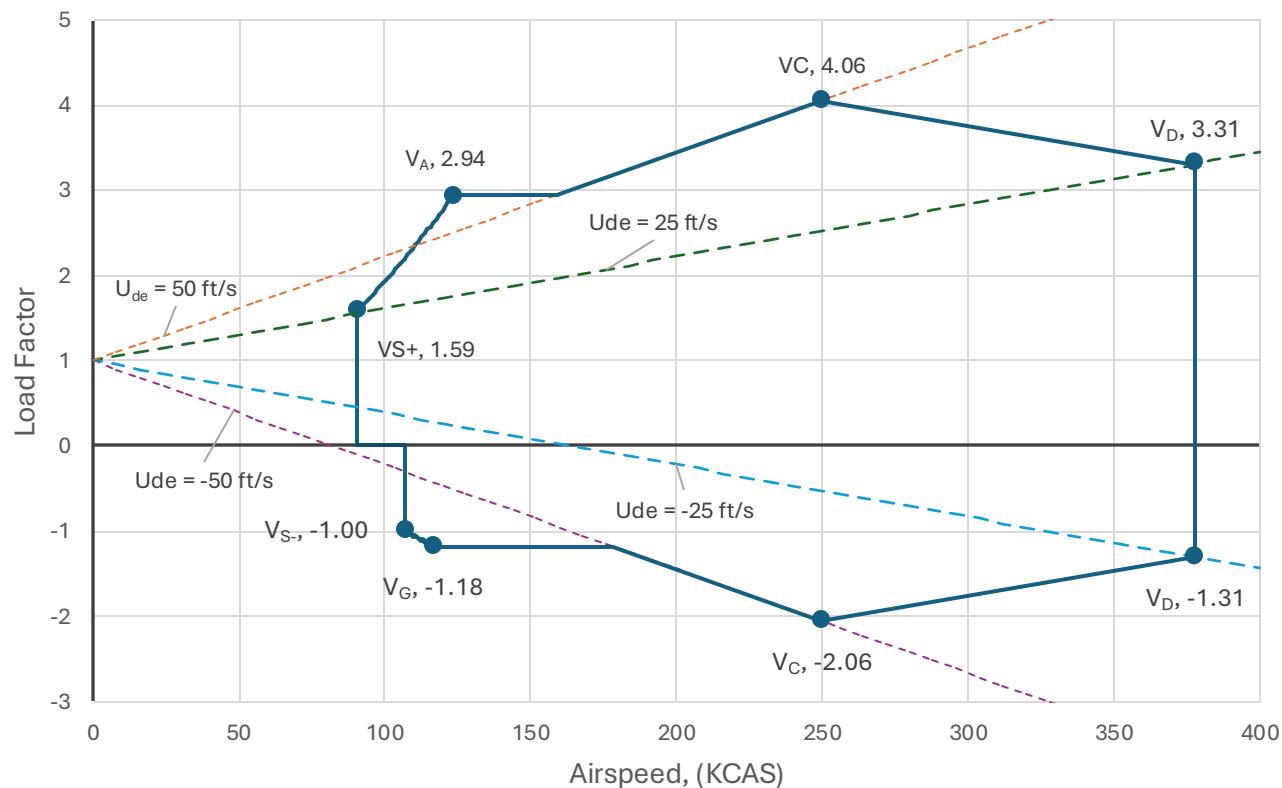
Descent Performance



Structural Envelope

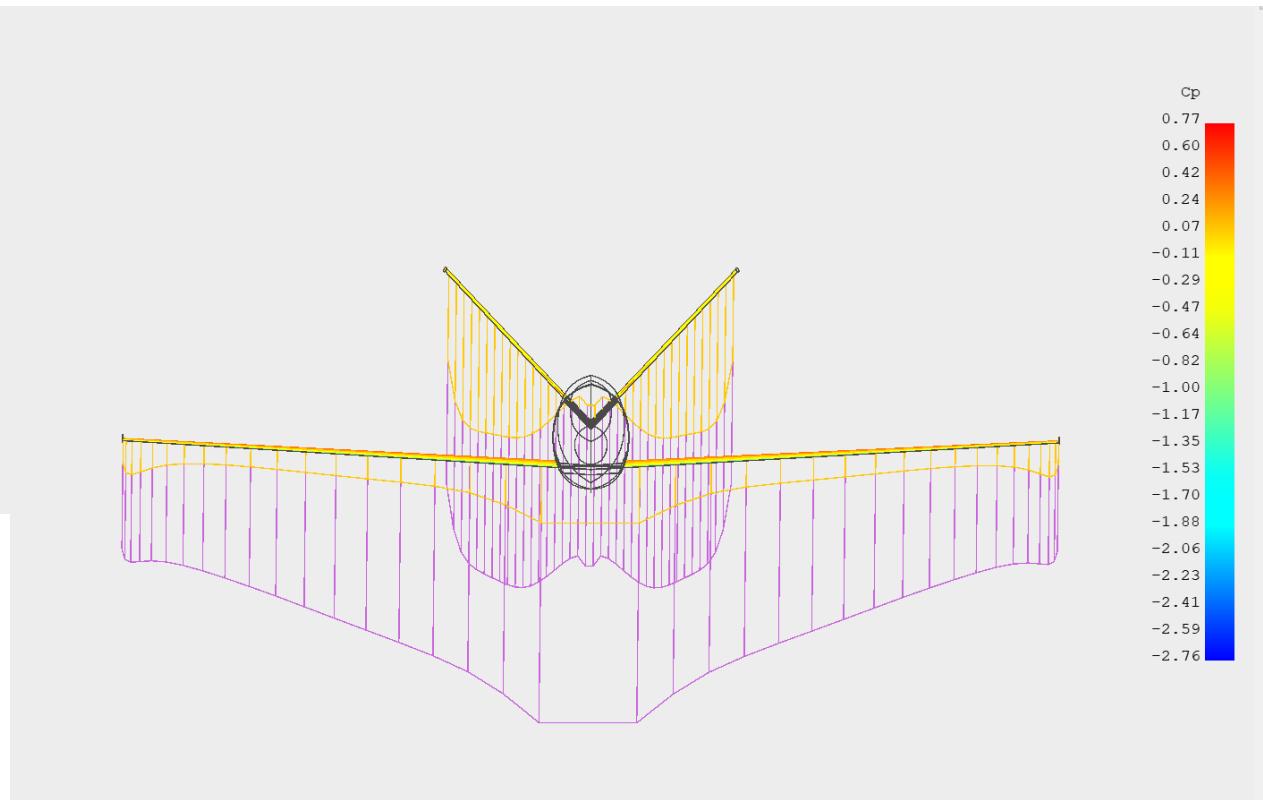
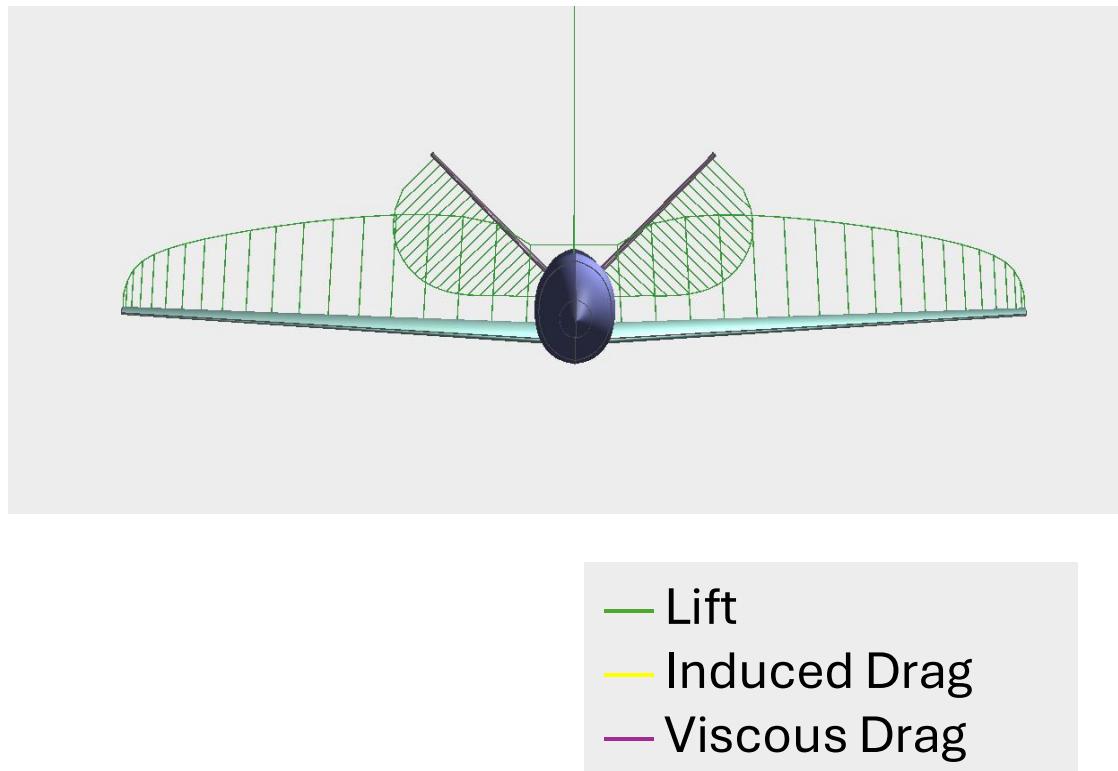
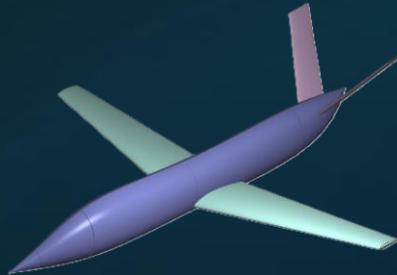


V-n Diagram

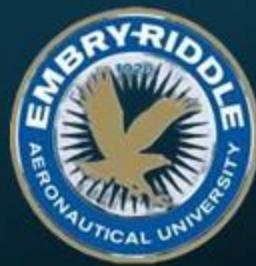


Parameter	Value	Unit
Positive Load Factor	2.94	g
Negative Load Factor	-1.18	g
Positive Stall Speed	90.66	knots
Negative Stall Speed	107.28	knots
Maneuvering Speed	155.46	knots
Negative Maneuvering Speed	196.44	knots
Cruise Speed	250	knots
Dive Speed	378	knots

XFLR5 Simulation



Selected Powerplant

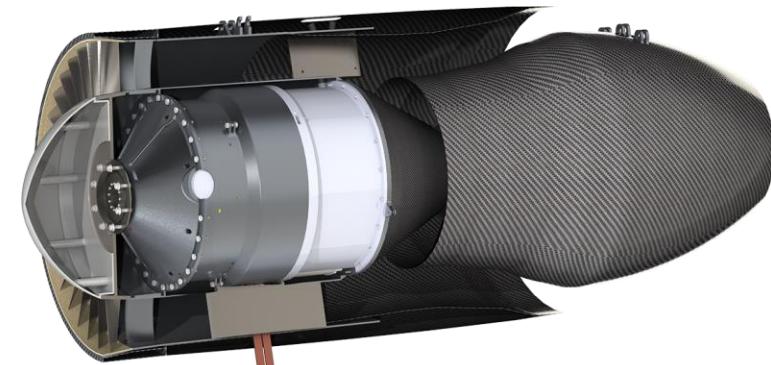


VerdeGo Aero VH-5

- Weight (lb): 2100
- Max Rated Thrust (lbf): 3600
- Max Electric Power (MW): 1.5
- TSFC (lb/lbfhr): 0.34

Advantages

- Hybrid Electric
- Low TSFC/PSFC
- Parallel and series power generation
- Forward Thrust and electrical power during cruise



MAGIDRIVE Model - 500

- Dry Weight (lbs): 220 x 2
- Max Rated Power (KW): 500 x 2

Advantages

- Integrated motor to decrease power loss
- High Motor Efficiency (96%)
- Feathered propellor option
- Utilizing Large Props for Higher Efficiency

McCauley 4 - Bladed

Constant Speed

- Diameter (in): 105
- Propeller Efficiency: 0.85
- Dry Weight (lbs): 100 x 2

- **Provide a Combined Thrust of 5600lbs at SSL**
- **Twice the required minimum allow excellent takeoff performance**



Selected Battery



Amprius SiMaxx - High Power

- Power Capacity (kWh): 200
- Energy Density (Wh/Kg): 400
- Discharge Rate: 10C
- Cycle Life: >500

*anticipated by 2040

Wiring: Turboflex AWG G961-003

- Length Required (ft): 96.5
- Diameter (in): 0.431
- Weight (lbs): 40.7
- 0.005 V drop/ft
- VAC (volts): 3000
- Material: Copper

Advantages

- Can be charged to 80% in 6 mins
- Can provide 15 min of Endurance at 100% power without turbofan for redundancy
- Can Handle up to 1.2 MW of power
- Durable

