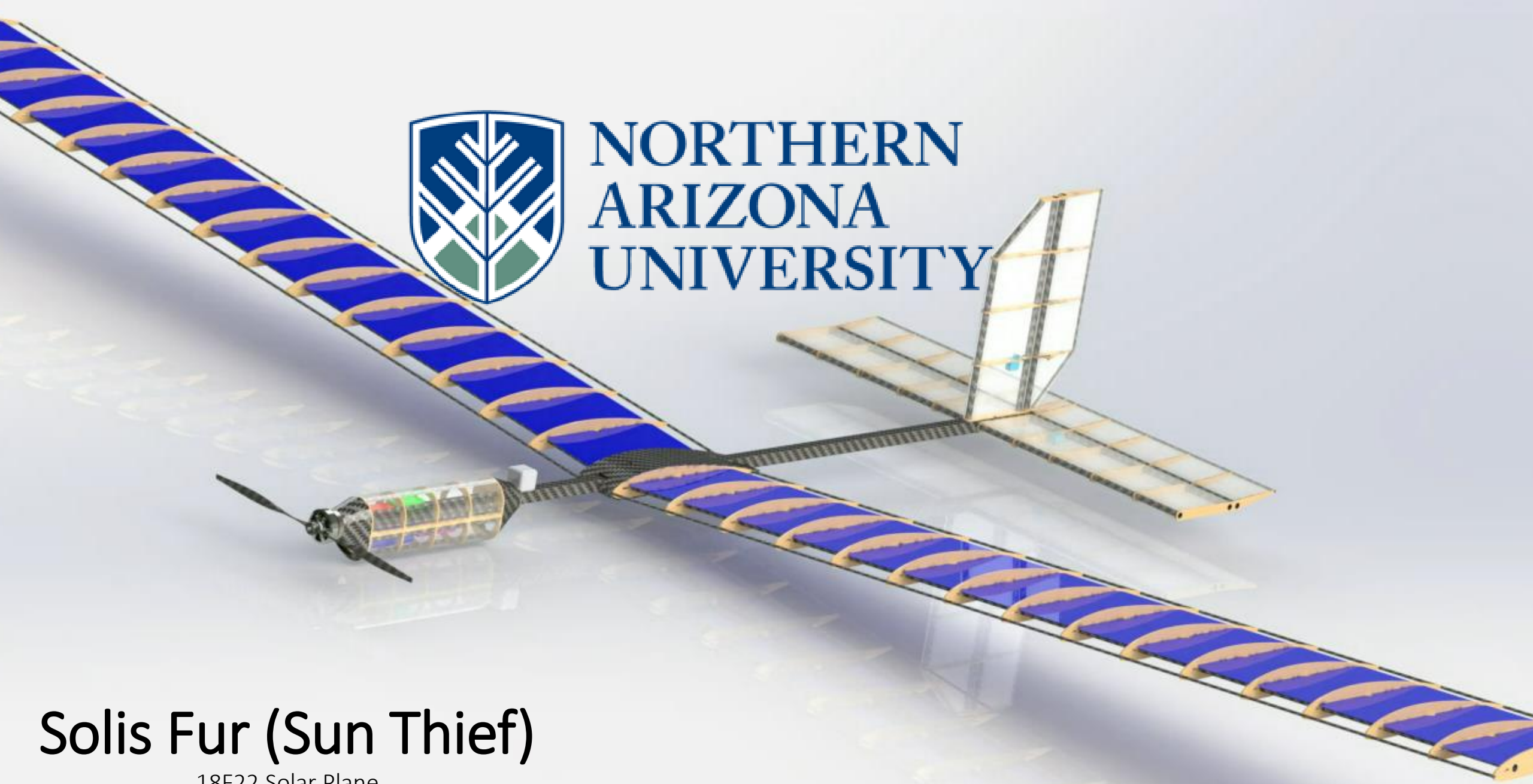




NORTHERN
ARIZONA
UNIVERSITY



Solis Fur (Sun Thief)

18F22 Solar Plane

The Team



Brandon Beaudoin
(Project Manager)



Michael Broyles
(Document Manager)



Nathan Zufelt
(Budget Manager)



Ethan Smith
(Client Contact)

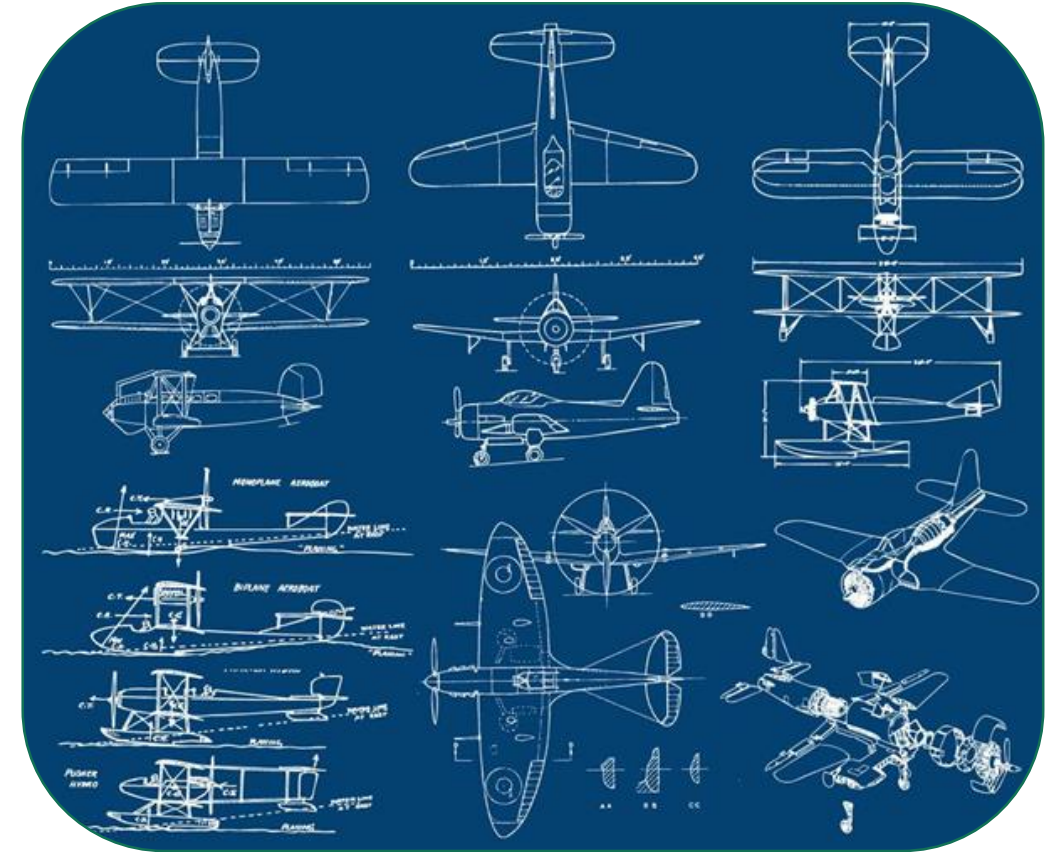


Jonathan Hernandez
(Website Designer)



Project Description

Explore the use of engineering principles to design and build a solar powered RC aircraft capable of sustaining indefinite flight while the sun is out.



Plane Schematic [8]



Project Sponsor / Customer

David Trevas, PhD

- Provided customer requirements.
- Crucial input for design requirements.

Sponsors

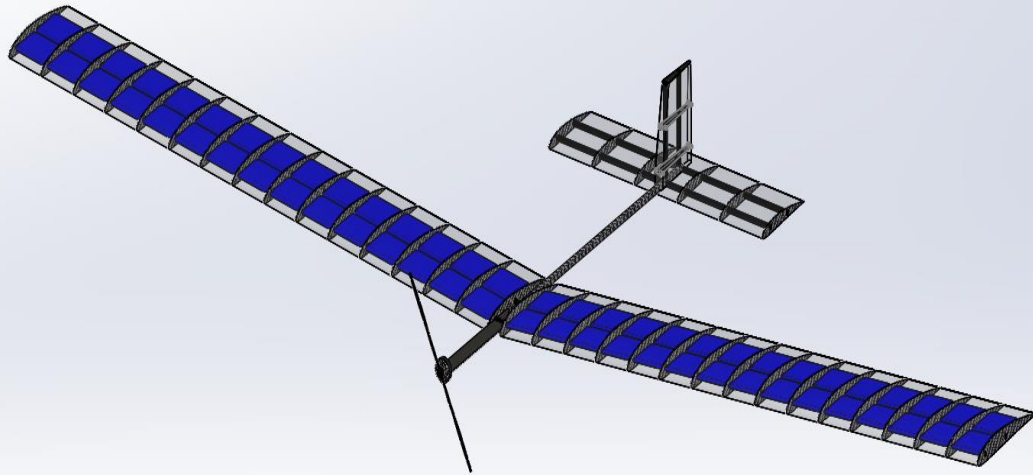
- Novakinetics Aerosystems
- Prometheus Solar
- Flagstaff Flyers
- Coconino High School

Why is this important?

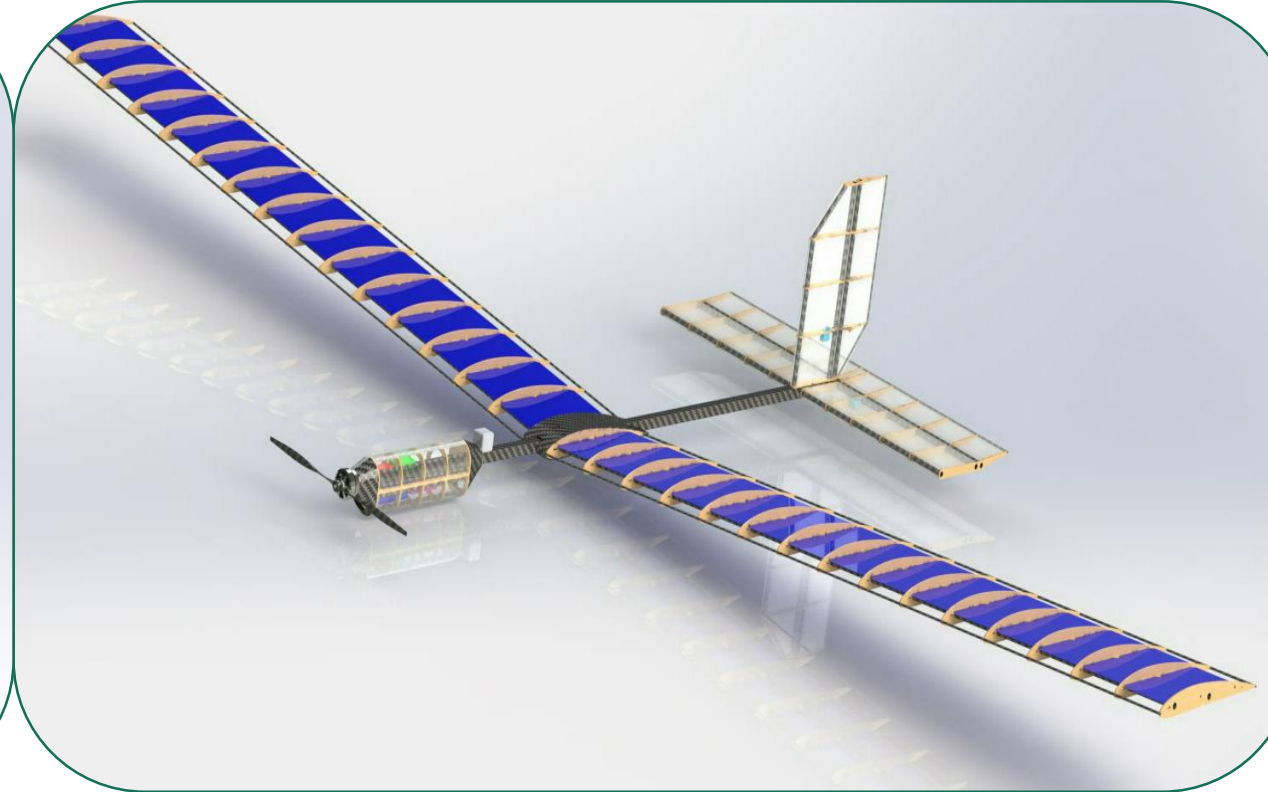
- Teaches students to use engineering principles in a real life application.
- Allows the use of renewable energy to power an RC plane.



Design Comparison



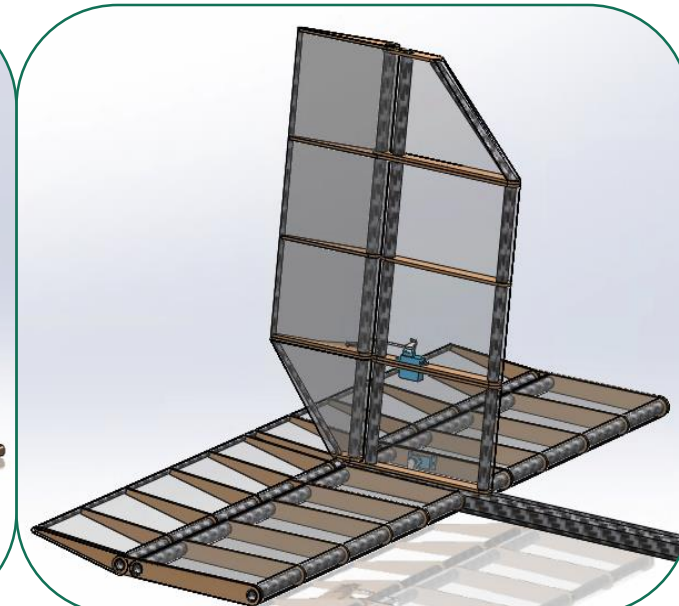
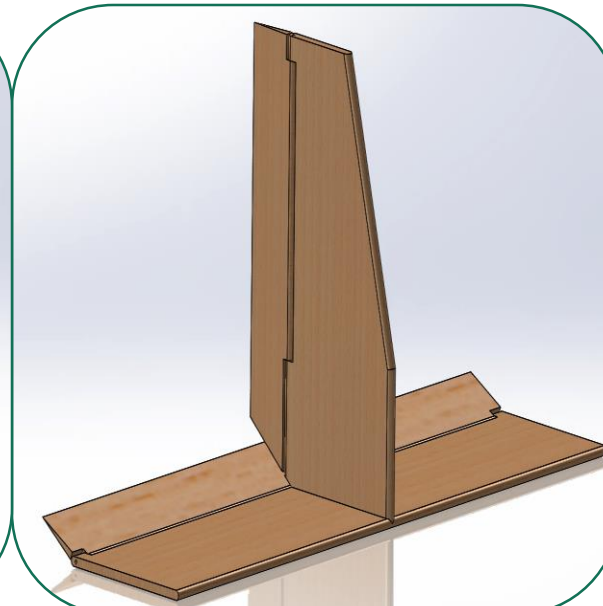
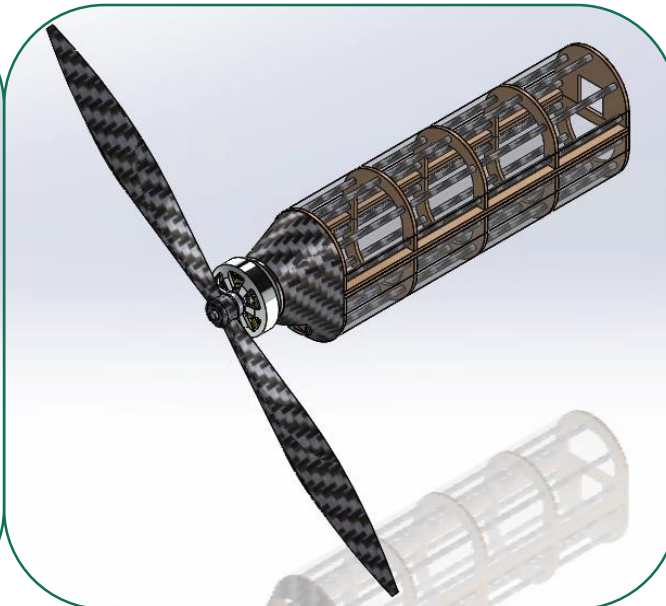
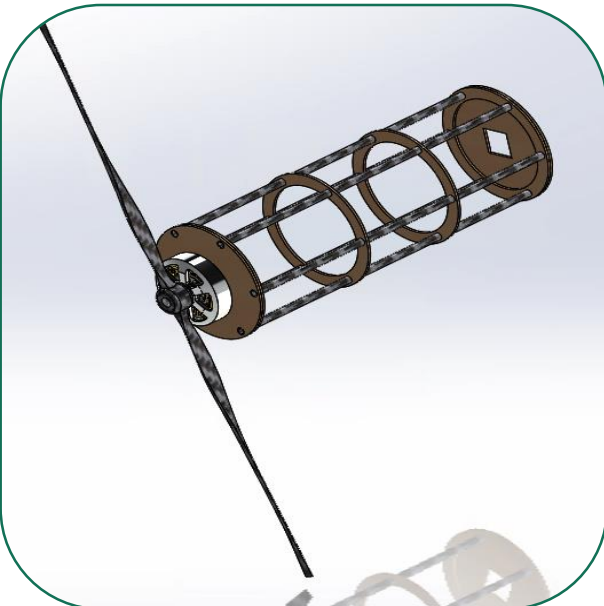
Initial Design



Current Design

Design Changes

- Re-designed tail
- Re-designed fuselage
- Re-designed wing mounting arms
- Extended tail boom length



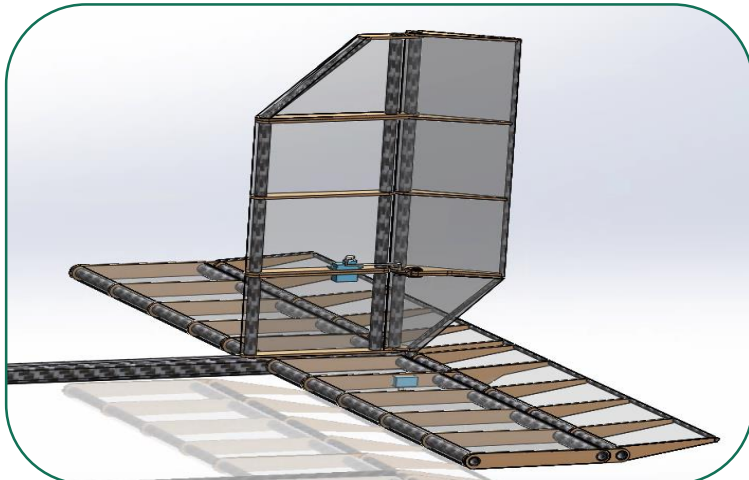
Fuselage Changes

Tail Changes

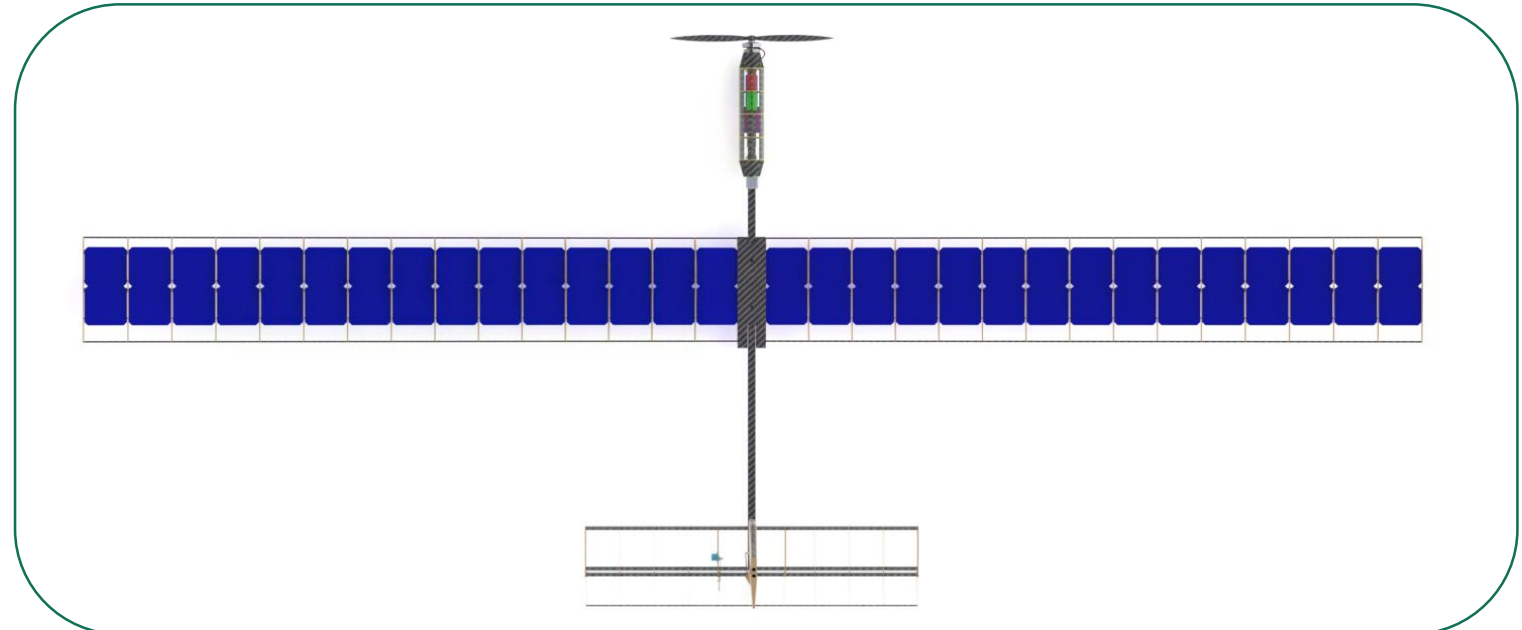
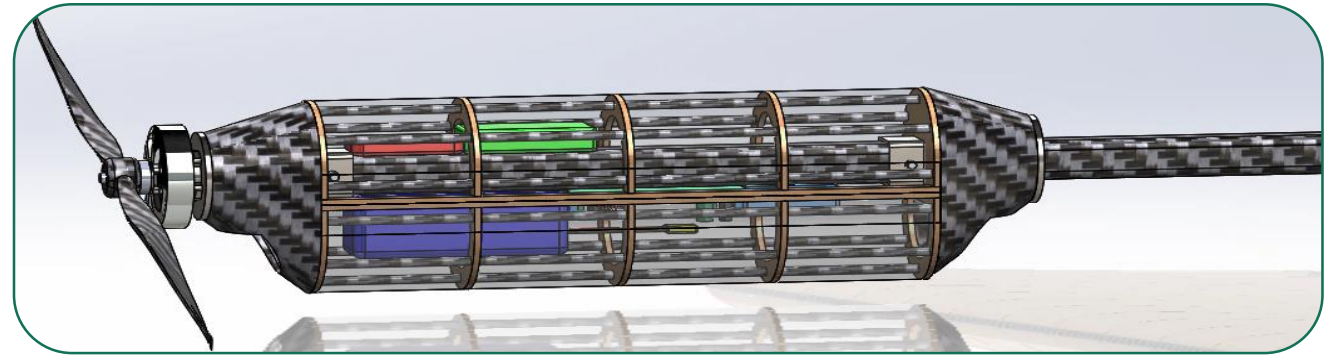
Proposed Design

Specifications:

- Wing span: 14ft
- Anticipated Weight: 7.8lbs
- Number of solar cells: 60
- Flight duration: Indefinite



Proposed Tail



Top: Fuselage, Bottom: Top View

Manufacturing Quantified

Construction Completed

- Full wing structures..... 100%
- Bottom fuselage shell 100%
- Vertical stabilizer w. integrated rudder.....100%
- Horizontal stabilizer w. integrated elevator100%
- Power system wiring harness.....100%
- Control systems wiring harness.....100%
- Control systems installed100%

60% Completed

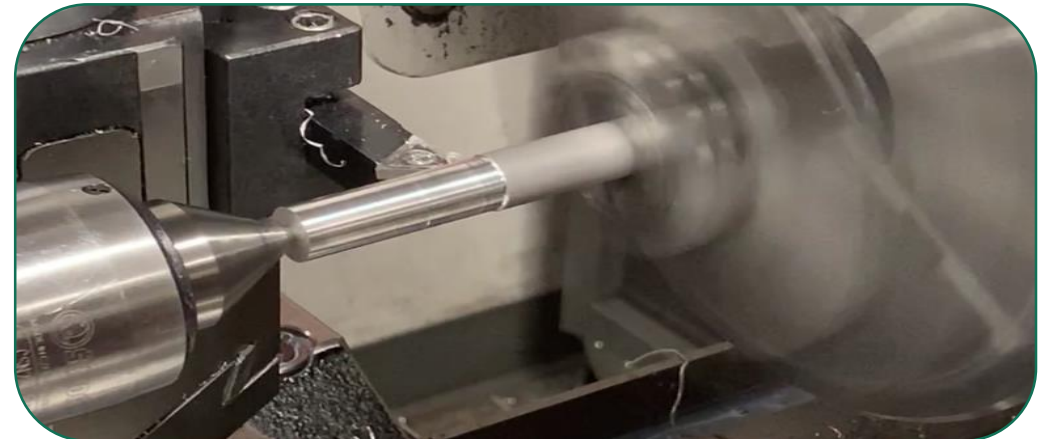
Construction Needed

Percent Completed

- Carbon nosecone20%
- Fuselage positioning brackets.....75%
- Top fuselage shell0%
- Solar panel inset.....0%
- Solar panel soldering.....0%
- Ultracote covering material0%
- Wing mounting arms75%
- Carbon wing shroud0%



Wing jig used to epoxy ribs



Wing Mounting Arms on lathe

Current State of Manufacturing



Wing weight: 1.22lb



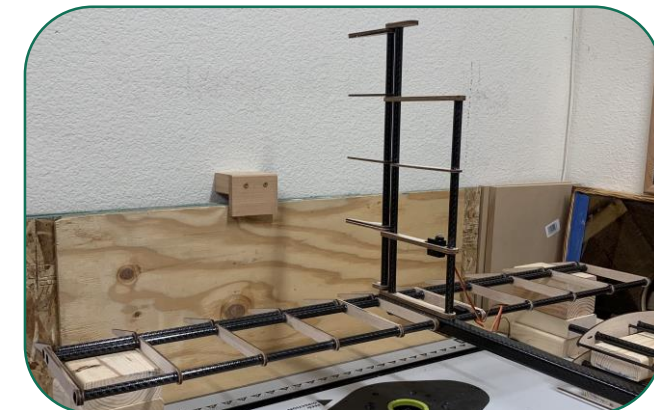
Bottom fuselage shell



Supporting structure



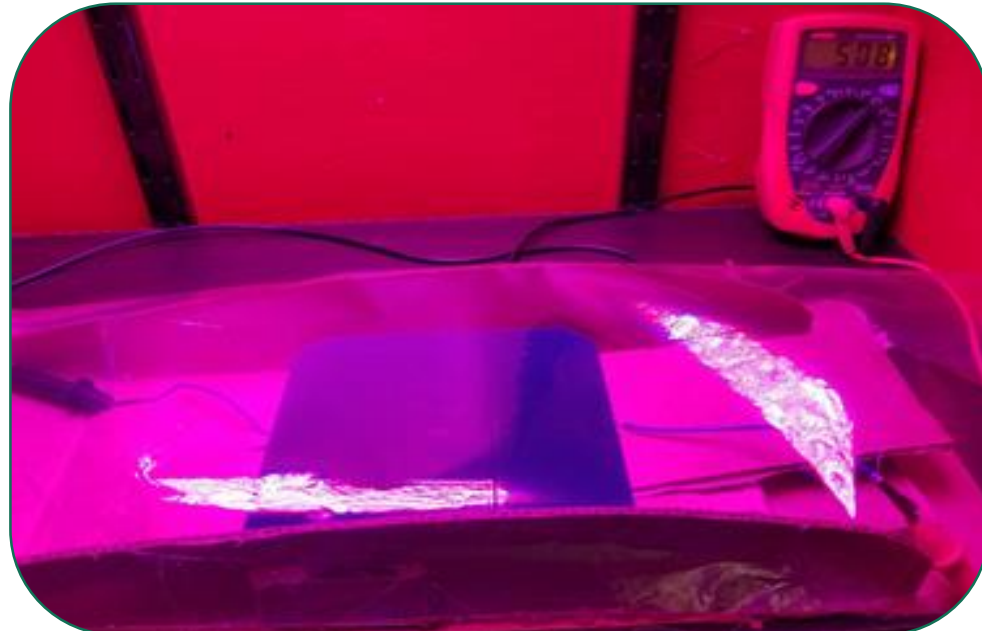
Nosecone molds, wing arms



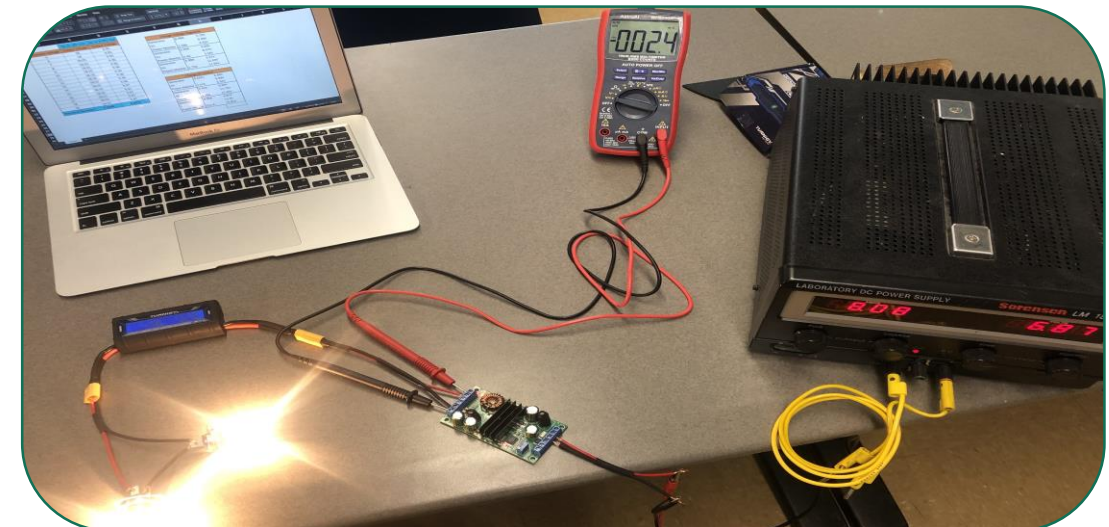
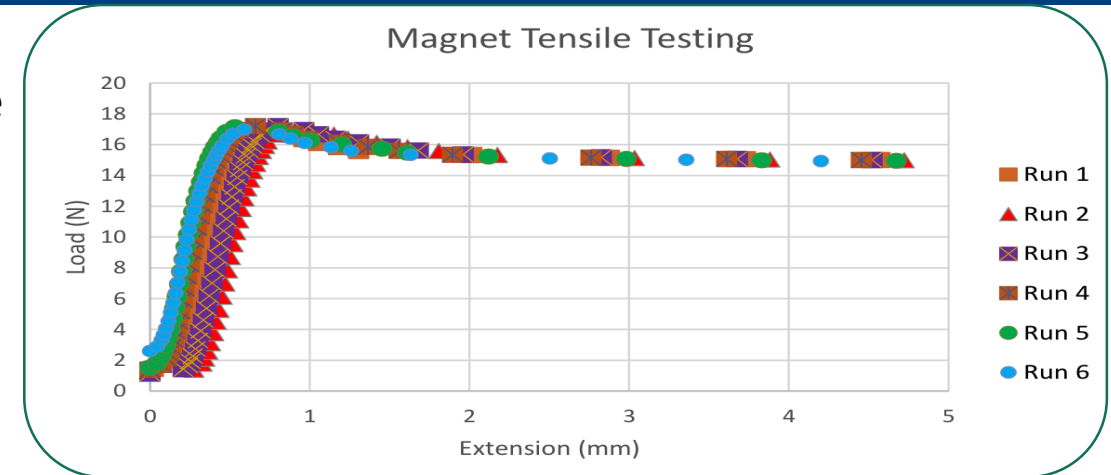
Tail

Effect of Analytical Analysis

- Helped decide how many magnets to use to support the fuselage
- Came up with a way to determine solar efficiency
- Verified accurate control of voltage regulator



Ultracote transparency test



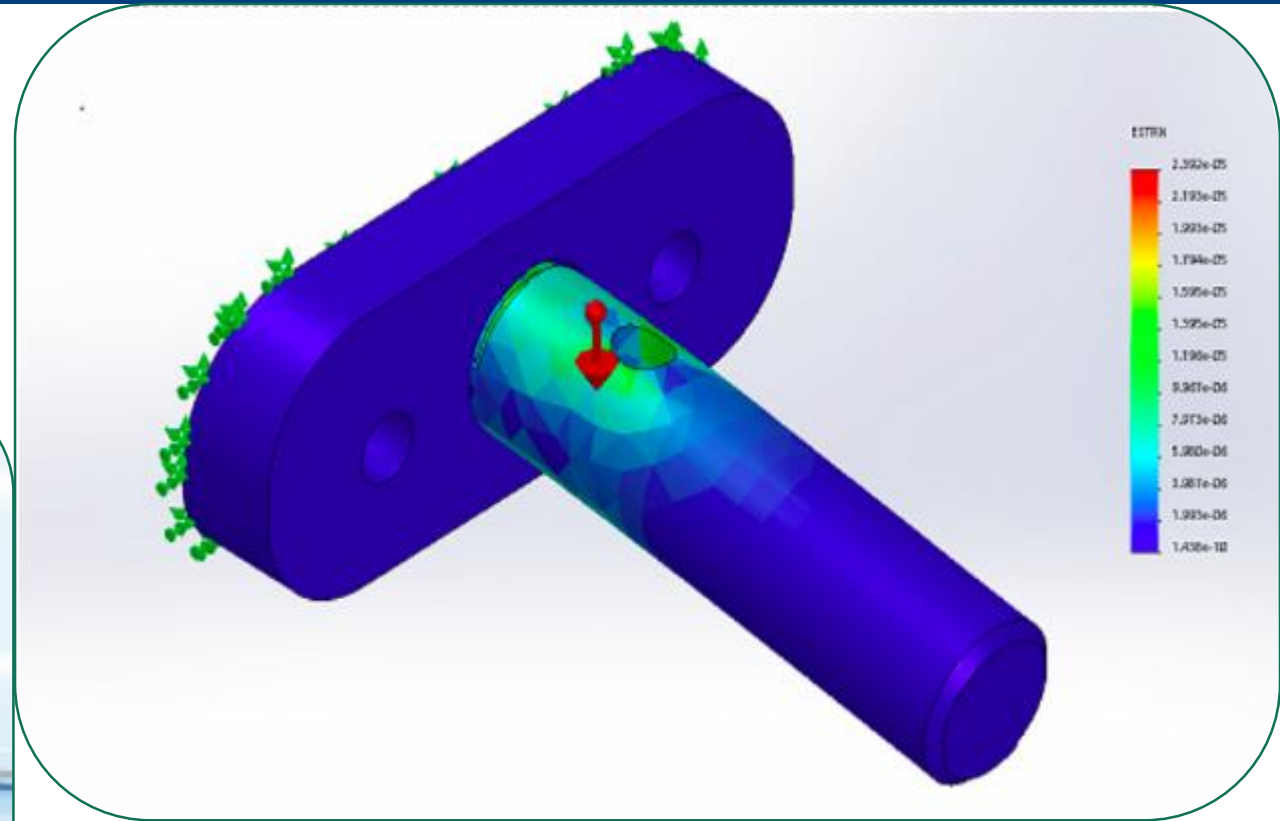
Voltage regulator test

Effect of Analytical Analysis

- Ensured that wing mounts would be strong enough
- Ensure that enough thrust will be produced



Wing mounting arm analysis



Thrust stand test

Testing Plans

Flight Plan

- Flagstaff Flyers suggested a dry lake bed for the initial test flight.
- Open space with little vegetation to do the wide slow turns the plane needs.
- No airstrip at this location, but the plane is hand launch/land.
- Fly for as long as possible.

Customer Requirement Analysis

- The solar array will be tested on the ground to see the power behavior, prior to flying.
- An individual analysis has shown the motor and prop power consumption and thrust.
- On-board data logger will record all energy flows, which will be analyzed to ensure self sufficiency.
- On-board camera will record the flights.

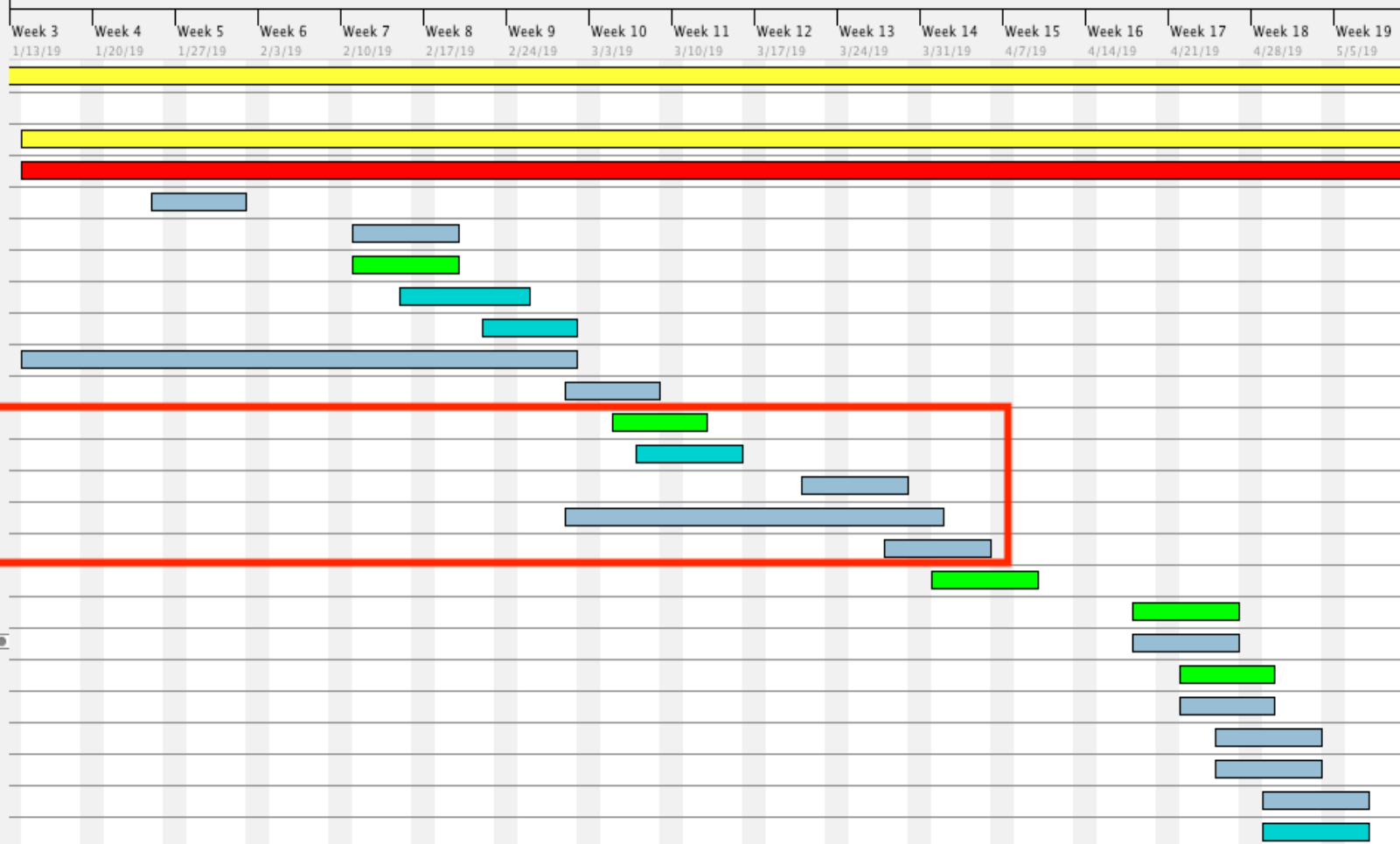
Meriam
Air Park



Schedule

Name	Begin date	End date
• Research	9/6/18	5/10/19
• Design	9/6/18	12/14/18
• Build	1/14/19	5/10/19
• Semester 2	1/14/19	5/10/19
• Website Check 1_2	1/25/19	2/1/19
• Hardware Review 1	2/11/19	2/19/19
• Hardware Review 1 Presentation	2/11/19	2/19/19
• Peer Evaluation 1_2	2/15/19	2/25/19
• Individual Analytical Analysis	2/22/19	3/1/19
• Complete Wing Construction	1/14/19	3/1/19
• Midpoint Report	3/1/19	3/8/19
• Midpoint Presentation	3/5/19	3/12/19
• Peer Evaluation 2_2	3/7/19	3/15/19
• Website Check 2_2	3/21/19	3/29/19
• Finish Plane Construction	3/1/19	4/1/19
• Poster and Operation Manual Draft	3/28/19	4/5/19
• Product Testing Presentation	4/1/19	4/9/19
• Final Presentation, Poster	4/18/19	4/26/19
• Poster and Operation Manual	4/18/19	4/26/19
• Presentation, Hardware Review 2_2	4/22/19	4/29/19
• Hardware Review 2	4/22/19	4/29/19
• Final Report and CAD Package	4/25/19	5/3/19
• Final Report	4/25/19	5/3/19
• Website Check 3_2	4/29/19	5/7/19
• Peer Evaluation 3_2	4/29/19	5/7/19

2019



Budget

- Total Budget: \$2500
- Total Spent as of 3/12/19: \$2036.10
- Remaining Budget: \$463.90
- Still need to purchase: camera, wood for display sign, plane display stand, team polo shirts
- Over 100 hours of construction
- \$1200 Figurative wages @ \$12/hr

Description	Vendor	Qty	Cost Ea	Cost
Hobby Sky 360KV Motor	Amazon	1	\$20.80	\$20.80
Turnigy 30A Plush ESC	Amazon	1	\$19.02	\$19.02
Turnigy 2200mAh Battery	Hobbyking	1	\$33.80	\$33.80
20 Ga Wire	Amazon	1	\$7.04	\$7.04
Kester Soldering Flux	Amazon	1	\$12.93	\$12.93
Parkzone DSV-130 Servo	Amazon	2	\$14.99	\$29.98
Eagle Tree V4 Data Logger	Amazon	1	\$69.99	\$69.99
80 ct. C60 Solar Cells	Amazon	1	\$364.49	\$364.49
Fr Sky Taranis Radio Transmitter	Amazon	1	\$289.00	\$289.00
15A Voltage Regulator	Amazon	1	\$20.71	\$20.71
2x300mm Servo Linkage	Amazon	1	\$11.17	\$11.17
Ultracote Covering Material	Amazon	4	\$15.49	\$61.96
JR Extension Wires	Amazon	1	\$16.99	\$16.99
Eagle Tree RPM Sensor	Amazon	1	\$14.99	\$14.99
Eagle Tree Airspeed Sensor	Amazon	1	\$42.99	\$42.99
Eagle Tree GPS	Amazon	1	\$79.99	\$79.99
Cotton Gloves	Amazon	1	\$10.99	\$10.99
XT-60 Plug	Hobby King	1	\$3.41	\$3.41
0.507 X 96" Round Carbon Fiber Tube	Rockwest Composites	4	\$55.99	\$223.96
0.88 X 66" Square Carbon Fiber Tube	Rockwest Composites	1	\$128.00	\$128.00
0.197 X 78" Carbon Fiber Rod	Rockwest Composites	11	\$17.58	\$193.38
0.46 X 60" Round Carbon Fiber Tube	Rockwest Composites	4	\$36.99	\$147.96
1/8" Balsa Wood Sheet	National Balsa	4	\$26.00	\$104.00
Double Sided Foam Tape	Amazon	1	\$16.99	\$16.99
3 x 2mm Magnets	Amazon	1	\$8.99	\$8.99
Gorilla Glue Epoxy	Home Depot	3	\$5.96	\$17.88
T88 Epoxy	Amazon	1	\$27.80	\$27.80
3/16" Clevis Pin 3/4" Length	Grainger Industrial Supply	1	\$7.88	\$7.88
Deans Plug	Horizon Hobby	1	\$2.89	\$2.89
18x6 Aeronaut Folding Propeller	Esprit Tech	1	\$19.00	\$19.00
Aeronaut 2-Blade Spinner	Esprit Tech	1	\$25.00	\$25.00
Aeronaut Yoke	Esprit Tech	1	\$10.00	\$10.00
			Total Purchased	\$2,036.10
			Left In Budget	\$463.90



References

- [1] "Solar Plane Passes New Test," Financial Tribune, 03 March 2015. [Online]. Available: <https://financialtribune.com/articles/energy/12392/solar-plane-passes-new-test>.
- [2] [Online]. Available: <https://www.theguardian.com/environment/2016/jul/26/solar-impulse-plane-makes-history-completing-round-the-world-trip>.
- [3] RCTESTFLIGHT, "Youtube," RCTESTFLIGHT, 24 June 2017. [Online]. Available: <https://www.youtube.com/watch?v=CmjY6cHafsU>. [Accessed 9 September 2018].
- [4] G. Vega, "ULSA - About", Cefns.nau.edu, 2018. [Online]. Available: <https://www.cefns.nau.edu/capstone/projects/ME/2017/SAEAeroRegular/About.html>. [Accessed: 22- Sep- 2018].
- [5] [Online]. Available: https://www.amazon.com/dp/B01C6B1EQO/?coliid=I145XQ0LTRVOOV&colid=3FUK3ANG2AN0V&psc=0&ref_=lv_ov_lig_dp_it
- [6] [Online]. Available: <http://www.hangarone.co.nz/os-10-size-333-watt-motor-oma38101050-p-5458.html>
- [7] [Online]. Available: https://www.amazon.com/dp/B078K2W2TY/ref=twister_B078KCXF86?_encoding=UTF8&th=1
- [8] "Free Vector," [Online]. Available: <https://www.freevector.com/airplanes-blueprint-19757>. [Accessed 24 September 2018].
- [9] Glider, [Online]. Available: <https://aviation.stackexchange.com/questions/21112/why-can-gliders-fly-for-so-long>
- [10] "Thrust Testing", [Online]. Available: <https://www.rcgroups.com/forums/showthread.php?1827301-Super-Simple-Test-Bench-for-motors-and-props>
- [11] "Stabilizer (aeronautics)", [Online]. Available: [https://en.wikipedia.org/wiki/Stabilizer_\(aeronautics\)](https://en.wikipedia.org/wiki/Stabilizer_(aeronautics))



Questions?

