Electric Gliders

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Why Power a Glider ?

- The Promise of Freedom !
  From Tows, Landouts, Crews…
- Motor Penalties:
  - Weight
  - Cost and Complexity and Maintenance
  - Decision Altitudes Higher (stop Soaring to Land):
    Plan for motor out and not running situation
- Compromises for Different Missions
- Touring Motorgliders vs. Performance MGs
  (electrics are not for Touring)

Why Electric ? Gas Problems...

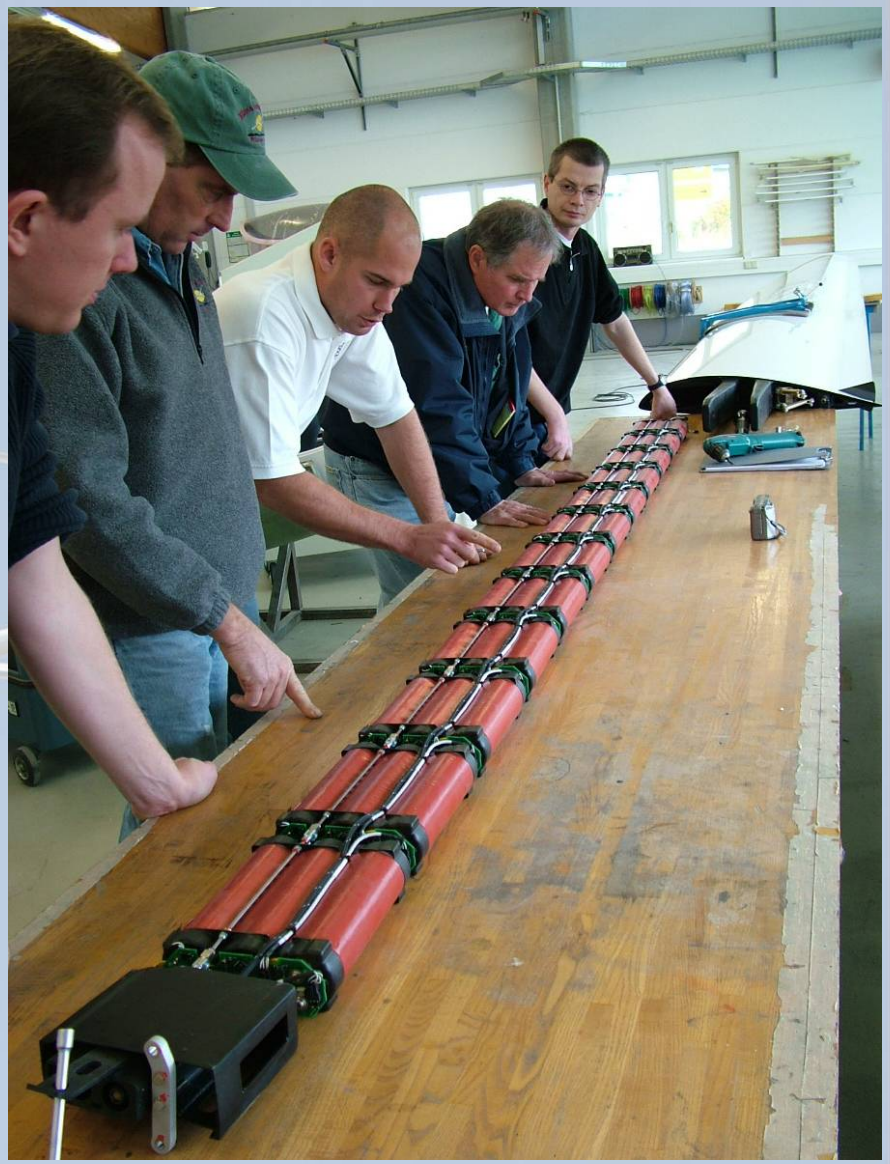
- Reliability (* Jonas De Rese PhD thesis at Delft University)
  - Both for the self-launching and sustainer engines, 30 % of the pilots have had an engine failure after having performed a successful test run at the beginning of the flight.
  - 30 % of the pilots indicate that some kind of damage was done to the aircraft as a result of having and operating an engine.
- Operational and Maintenance Difficulties:
  - Air-start time, difficulty, sink rate prior starting
  - Vibration, noise, heat, fuel, drive belts, etc.

Electric Advantages

- Reliable – electric motors usually start !
  Safety still precludes air-start without field.
- Fast air-start (Antares ~ 10 seconds)
- Typically automated systems - easy
- Low sink rate “engine out not running”
  (no cooling radiator) – lower decision height
- Low vibration and heat – low maintenance
- Negligible density altitude effect
- Plenty of disadvantages too !

Electric Power Issue: Batteries

- Every battery is a trade-off:
  - Energy density
  - Cost
  - Lifetime – Cycles, years
  - Max discharge current
  - Weight
  - Safety
  - Memory effects
  - Temperature requirements
- Battery Care and Feeding:
  Balancing, heating, cooling
  Significant complexity & cost.



Energy Density of Batteries

- Gasoline: 13 Kw*hr/lb, relative efficiency of gas/electric drive (.93/.15) or equivalent: ~ 2 kw*hr/lb effective energy
- SAFT Lion 300 w*hr/lb as used in Antares*, around 1/7th effective energy/weight of gas
- Nissan Leaf battery about the same, Kokam Lion about 90%.
- Electric motor weight makes up only a bit...
- Experimental batteries heading > 1kw*hr/lb Not yet real...

Enough Math: Glider Issues

- The energy you need to climb depends on aircraft weight; same for sustainer or SL.
- After you start a gas sustainer, you may spend a long time climbing to get high enough before crossing the woods home.
- Level flight takes much less power than climb
- Battery is ~2/3 of e-propulsion weight & cost
- Why make a e-sustainer ? Batteries need enough energy for a climb ! A powerful electric motor is inexpensive. If you're going to spend weight/cost for batteries, might as well make a self-launch.

Real Performance

- Distance in level flight specs sound great, But With full charge, and you will need to climb...
  - Cruise range specified as level / sawtooth
    Antares 20E example 76 / 103 nm
  - You're low in the boondocks:
    Climb 3000 ft using ~1/3 of battery power,
    then cruise 70nm sawtooth using ~2/3 battery.
  - Published numbers assume you had a full-charge (ie took a tow to launch)
- So far, no electrics for long-distance cruising: self-launch+reserve or sustainer only !

Lange Antares 20E and 23E

- High-end of glider performance and cost
  - Antares 20E: 56:1 Max L/D, >800 fpm climb-rate
    Typical 9000+ foot climb, >7500 at max gross
  - Antares 23E: 60:1 at 78 knots, ultimate for WGC
    Higher weight, lower climb altitude and rate
- >70 delivered (> total of all other electrics)

Taurus Electro 15m Side-by-Side

- Compared to pure glider, gas or electric adds 50% to price.
- With recommended optional larger battery:
  - 50 lbs heavier than gas-powered
  - Stated climb 6500 ft, or cruise ~ 1 hour
- Big cockpit, easy to taxi

FES Configuration

- Simpler than pylon, retrofit existing planes ?
- No pylon drag engine not running, instant on
- Drawbacks: Drag from prop (prop plus disturbed flow on fuselage), prop diameter
- Retrofit Issues – Maybe not...
  - Weight of non-lifting parts may preclude retrofit
  - Structural complexity (batt), Round nose
- Possibly a good solution for moderate performance sailplanes.
  Currently available on LAK-17B and Silent.

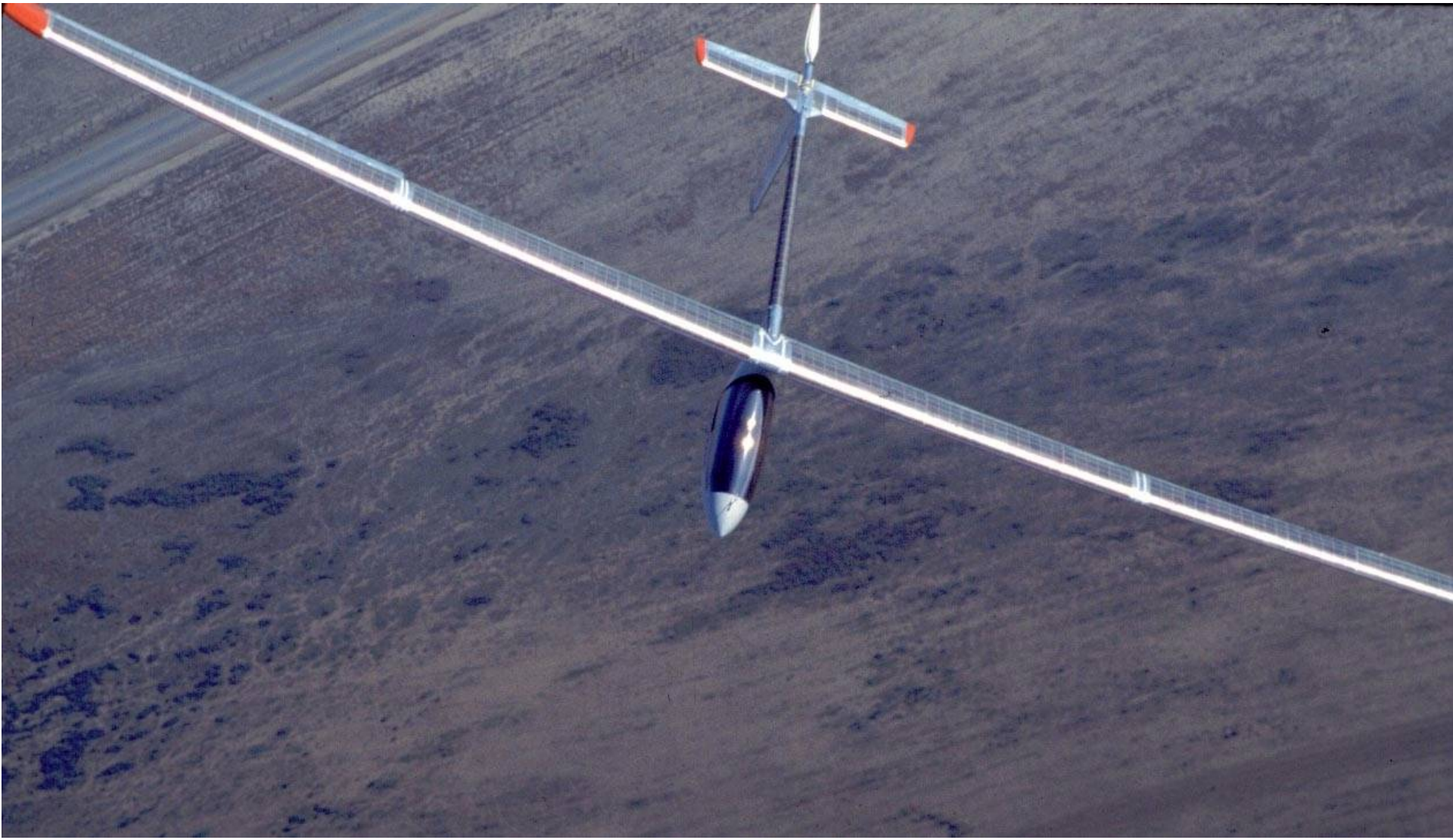
Alisport Silent Electro (LAK FES)

- Nose-mounted propeller 13.5m self-launch
- Compared to unpowered glider, about:
  - 50% more expensive (less difference after trailer, instruments, and options)
  - 25% heavier (160kg-205kg electric-190kg gas)
- Climb 5900 ft, or cruise 80 nm

LAK-17B FES

- Contemporary 15/18-meter glider
- Climb 3600 ft, or cruise 62 nm
- Only adds 80 lbs over pure sailplane !
- See the LAK-17B in the exhibit hall

Who Knows This Glider ?



Have Aliens Invaded ?

Who Knows This Glider ?

What happened here ?

6000 km range ?

Who Knows This One ?

Questions To Ask before buying...

- Climb altitude at your weight ?
- Cruise range sawtooth and level ?
- Battery lifetime ?
- Measured performance, power & glide ?
- Make sure range meets your needs !
- Number planes delivered to customers ?
- Flight Trial available ?
- Customer references

A List of Electric Gliders

- Eric Raymond's SunSeeker, SunSeeker II
- Lange Antares 20E and 23E, Schempp-Hirth Arcus E
- Pipstrel Taurus electro G2, Apis E
- Silent electric (original and FES)
- LAK 17B FES
- Waiex E
- Experimentals: Pipistrel G4, Icaré II, eGenius, Solar Impulse, Lange H2 and H3, Lazair E