E10 / Elektrisch betriebene Mehrzweckflugzeug für kürzere Strecken und höchste Umweltstandards

Regionaler Luftverkehr 2021
GREENER SKIES AHEAD *Regional*
Neue Chancen für Klimaschutz, Wirtschaft und Mobilität
Mittwoch, 24. November 2021

Calin Gologan
CEO und Gründer Scylax GmbH

Regional Air Mobility (RAM) challenges:

- For short flight **connections up to 500 km**, the **auxiliary time** (connection to regional airport, checking/safety/parking procedure) **takes longer than the flight itself.**

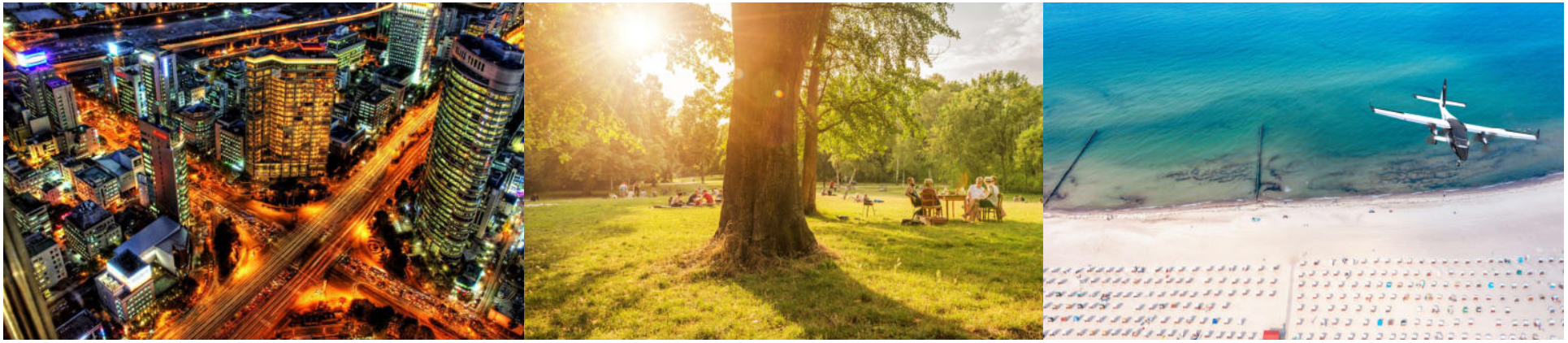
- Due to the **high noise** and long needed runway, airliners can not land close to cities and use the existing network of small airfields

- **Fast point to point business** traveling for distance up to 500 km is not possible

„The Bavarian future advisory board has pointed out the outstanding importance of **Regional Air Mobility** connecting smaller cities via electric Short Take-Off and Landing (eSTOL) low noise airplanes“

Prof.Dr. Hirzinger

We need Community Compatible Aircraft (CCA)



What makes an aircraft community friendly?

- low noise level
- operation on short runways
- steep climbing
- low nuisance factor
- no social and political opposition
- It provides new services and business opportunities for the local community
- friendly operation with communities, stakeholders will want Regional Air Mobility (RAM)
- RAM is a kind of VIP (use GAT or no terminals, no baggage service, no security, quick getting on/off)

The Solution:

The creation of an electric RAM network

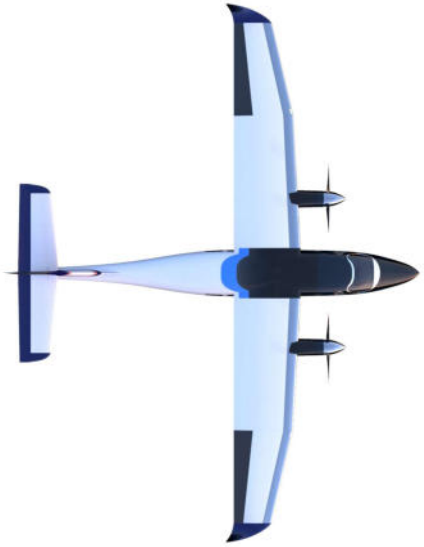
- Operates on small airfields, only 200m runway, **STOL** (short take-off and landing)
- Accesses inhabited areas due to extremely low noise (**55 dB**) and **zero CO2**
- Robust and safe operation under bad weather conditions
- **Up to 50%** lower operating costs
- Usage of existing small airfield and regional airports network
- Collaboration with existing small airlines
- Establishing of many new small but agile airlines
- Development of ”air connection as a service” business, in cooperation with partners

SCYLAX E10

Highlights

- Very low noise level of **55 dB** - equivalent to sound of light rain. access to inhabited areas
- e-STOL (Short Takeoff and Landing) – **Takeoff in less than 100 m**
- **Zero CO2 emission**
- Range: up to 300 km now (in ten years - 500 km)
- Robustness against strong side wind up to 40 kts . Optimized for operation in rough climates.
- Very low stall speed (VSO about 50 kts)
- Business class comfort for passengers:
  - over 800 mm seat abreast (leg room), 1.3 m cabin width
  - Extremely low level of noise and vibration
- Total traveling costs about **0.65 EUR/km**/passenger
- **50%** less operating costs
- Two large passenger/cargo doors: very fast getting on/getting off: 5 min stop and go
- Flexible change of configuration: passengers to cargo in 30 minutes

SCYLAX E10 Specifications



Propulsion: 2 electric engines (2x300kW)
Seat configuration business: 10 (1 pilot + 9 PAX)
Autopilot including start and landing (one pilot operation)

Estimated sales price: 2.5 Mio. €
Price for high speed charging stations: 0.1 Mio €

IFR operation

Anti-ice : wings, tails and propeller

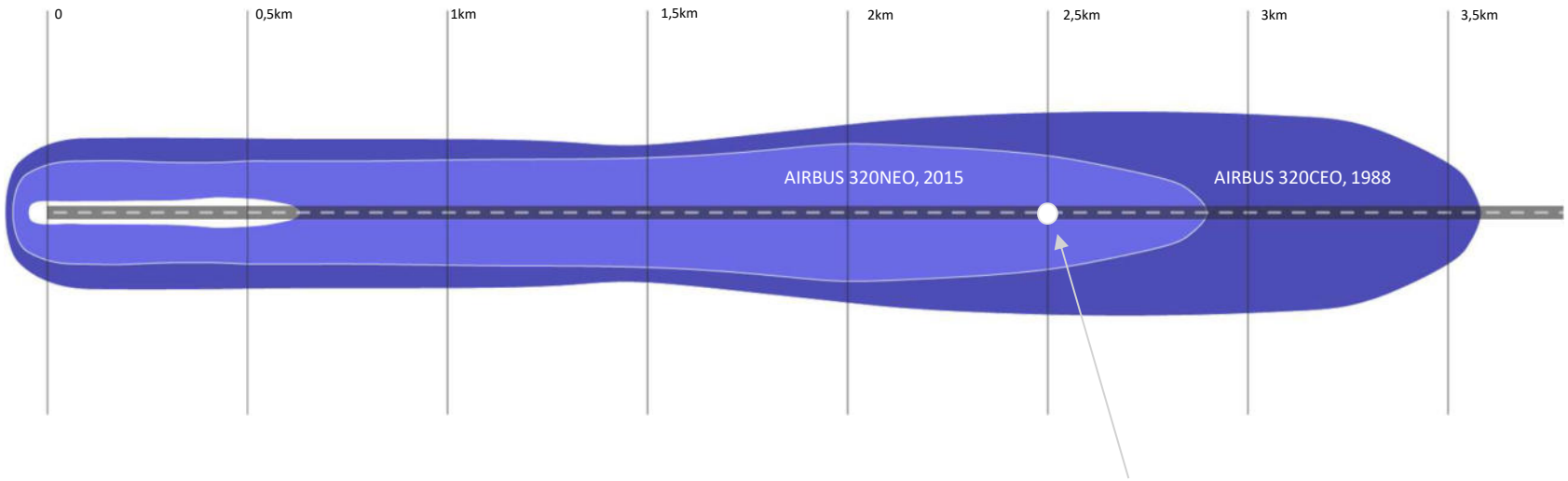
MTOW:	3,500 kg
Max. payload:	800 kg
Take-off distance: (50 feet obstacle)	160 m
Lift off distance:	100 m

Range (Today):	300 km
Range (in 10 years):	500 km
Max. cruise speed:	300 km/h
Econ. cruise speed:	250 km/h


55.dB
As loud as light rain

SCYLAX E10

eSTOL with a very low noise pattern



Noisepattern comparison: A320 CEO, A320 NEO, SCYLAX E10

Maximum Noise over 85dB

E10 noise level: 55 dB

Comparable to a quiet office

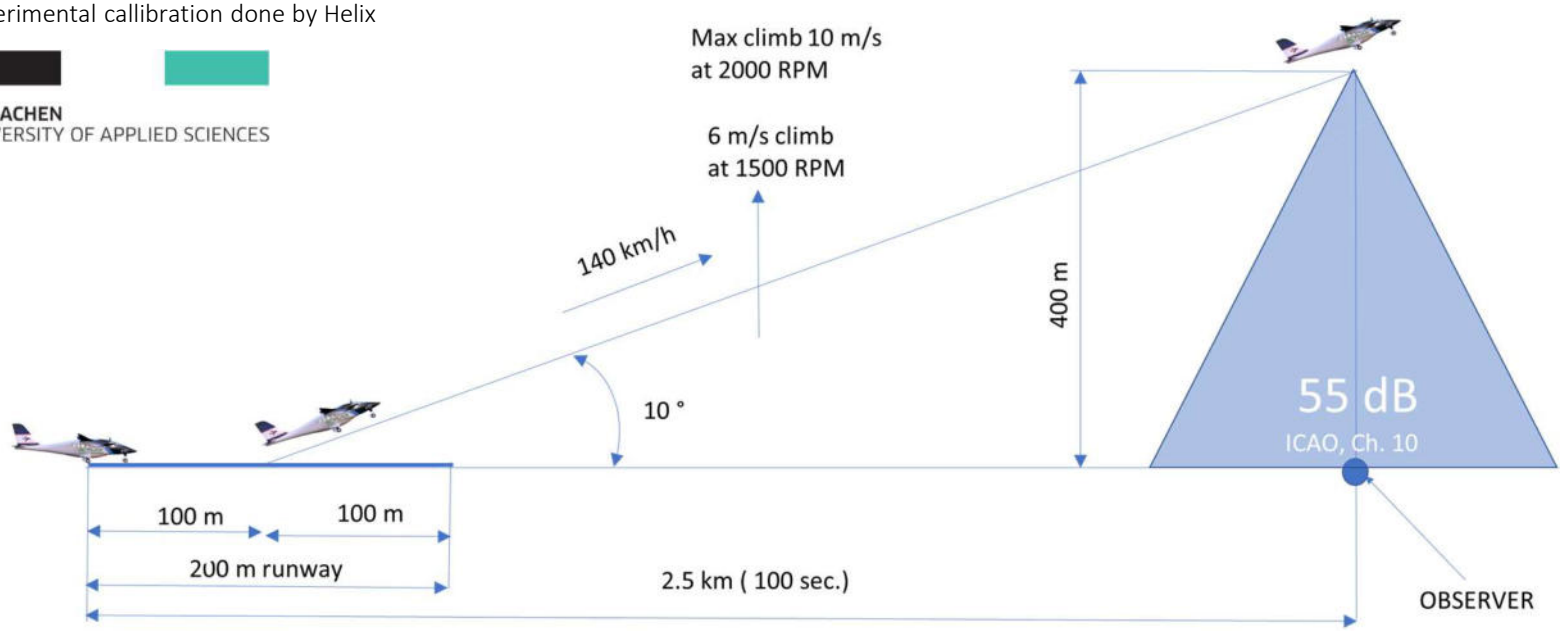
8 times lower noise level than A320 NEO

SCYLAX E10

eSTOL with a very low noise pattern

Noise calculations done by HELIX Propellers and
FH Aachen (University of Applied Sciences)
Acc. To ICAO Ch. 10; App. 16 and
experimental callibration done by Helix

FH AACHEN
UNIVERSITY OF APPLIED SCIENCES

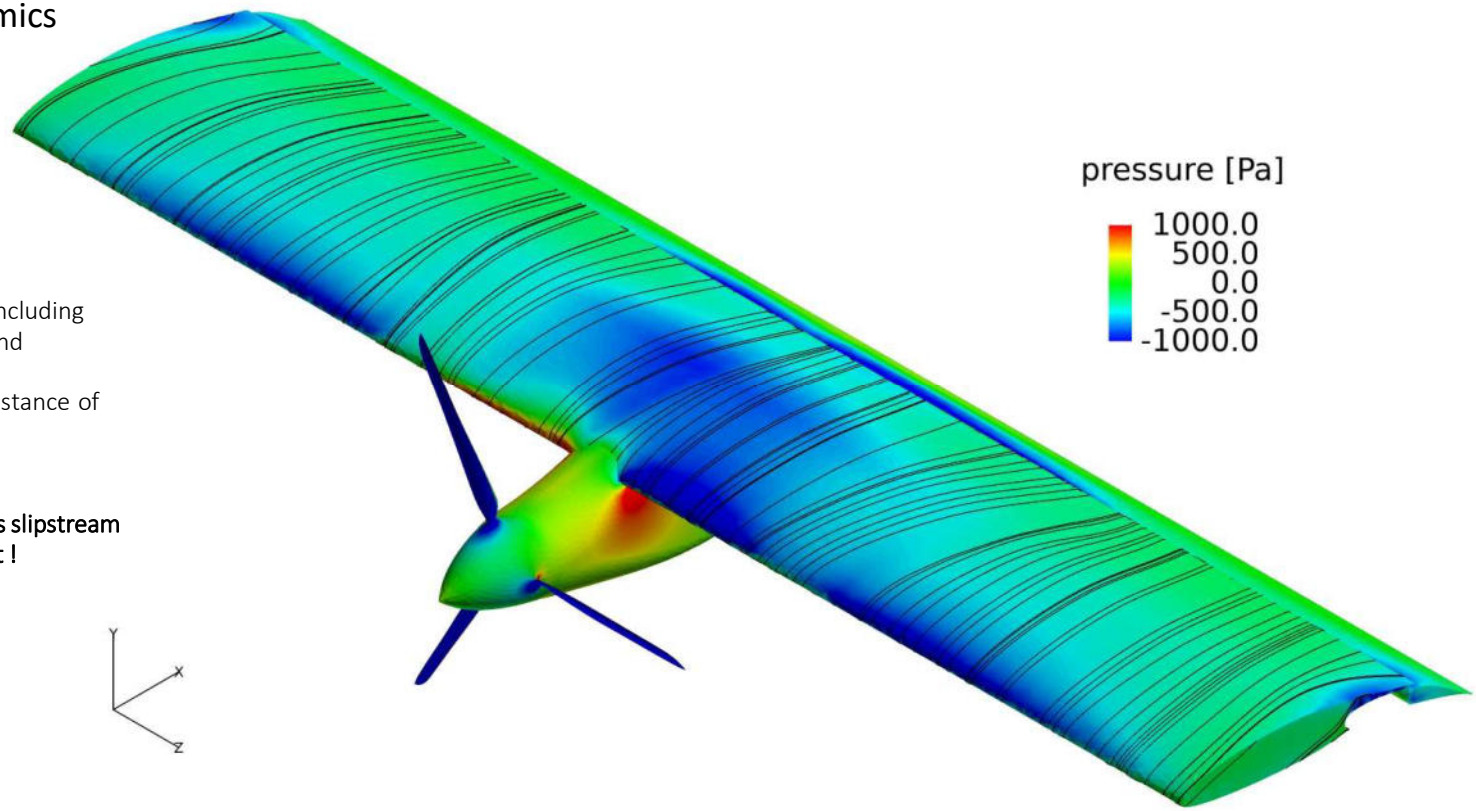


Just100m.

Thats it,
we are up in the air!

SCYLAX E10

Perfect aerodynamics



Detailed CFD Calculations including dynamic propeller model and fowler flap deflection demonstrated a start roll distance of **under 100 m**

At zero speed the Propellers slipstream generates about 1000 kg lift !

Performed by
CFD Consultants GmbH

In Ten Years,

the **E10** can cover legs up to 500 km,
25% of all EU connections.

No of passengers for legs under 500 km in Europe (2019)	173	Mio.
No of passengers for legs under 500 km in Europe (2040)	298	Mio.
Market for legs under 500 km in Europe (2019)	34,6	Bn/Year
Market for legs under 500 km in Europe (2040)	59,6	Bn/Year
Average ticket price	200	€

Deloitte - Europe's future aviation landscape, The potential of zero.carbon and zero-emission aircraft on intra-European routes by 20240, April 2021

eVTOL vs. eSTOL

Comparison

Aircraft	*Lilium e-VTOL*	*SCYLAX E10 e-STOL*	*Tecnam P-VOLT*
MTOW (kg)	3175	3500	3600
Range (km) , actual battery technology (250Wh/kg)	180 (no operation reserve)	300 (30 Min. Operation reserve included)	
Range (km) , 2026 battery technology (320Wh/kg)	260 (no operation reserve)	400 (30 Min. Operation reserve included)	
Range (km) , 2030 battery technology (400 Wh/kg)	350 (no operation reserve)	500 (30 Min. Operation reserve included)	
Cruise glide ratio	18	20	
Power unit efficiency (%)	72	80	
Price (Million EUR)	2.5	2.5	
Max. Cruise speed (km/h)	300	300	
Ticket price (250 km leg) - EUR/Pass/km	>1	0.65	
Design/certification risk	very high	low	
Complexity	very high	low	
Enter in service	2024 (2 years for EASA certification - optimistic)	2027	2026
Cruise power (kW)	220	200	
Hover power (kW)	2750		
Power in landing phase (kW)	at least 2750 kW, critical with low battery SoC (10%)	max. 50 (zero noise)	
Noise level (dB)	60 dB at 100 m (no actually mesuremeant method defined)	55 dB, Acc. to ICAO Ch. 10, Anex 16 method	
Start distance (m)	0	100	700
No. of seats	7	10	
Cabin volume(m^3)	6	8	

eVTOL vs. eSTOL concepts:

Unicorns vs. workhorse

- e-STOL aircraft are based on approved **robust concepts without design and certification risk** in comparison with e-VTOL aircraft
- In the landing phase, when the batteries are quite empty, an eVTOL aircraft requires a huge power for hovering and transition. This produces a high noise level, stresses the propulsion system and shortens strongly the battery life.
- eVTOL requires significantly more battery reserve not usable for the mission.
- eSTOL aircraft have a **much better aerodynamic efficiency**.
- eSTOL is **much safer** aircraft for passengers in case of an emergency and/or of a system failure because of indispensable huge power for landing of eVTOL.
- eSTOL aircraft with 100 m start distance and 55 dB noise level can land on each short strip, practically
- no difference to an e-VTOL aircraft with respect to the infrastructure.
- eSTOL provides a **significantly higher tolerance to wind and gusts** which allows to fly safely under worse weather conditions.

Digital Aircraft Platform (DAP),

combines autopilot with sensor data processing and cloud technologies.

DAP is the basis for all control and monitoring elements of the aircraft.

DAP incorporates **autopilot** to support the pilot and to increase the efficiency and safety of operation:

- Single pilot operation will save 10-15% from operation costs . One pilot less, one passenger more
- Real-time connection of the aircraft to third party services providing data relevant for aircraft operation (including emerging services for autonomous operation)
- Reduce pilot workload (pilot will be an operator)
- Pilot workload: aviate, navigate and communicate
- Automatic take off and landing
- Full autonomous operation, e.g., for cargo flights

DAP simplifies aircraft operation and maintenance. The life of each essential part (like batteries, motor, propeller, structure) is monitored in real-time, analyzed and documented continuously.

DAP provides cloud-based data analysis which helps to optimize inspection and maintenance of a single aircraft as well as to perform global optimization of aircraft fleet operation

E10 Operation models:

A rugged and reliable multi-talent

Short distance island/mountain hopping

E10 can take off and land in stormy weather with over 40 kts side wind, even when ships can not travel in such extreme conditions.

Regional mobility

Point to point connections for range up to 300 km in one hour. Start and land on more than 500 small airfields in Germany and 5000 in USA.

Cargo transportation or mixed model (passengers + cargo)

Overnight freight in a shortest time from small airfrields without disturbing comunities. Can transport a volume of 8 m^3

Real possibility

for future Revenue opportunities:

- Cargo
- Business Charter
- Taxi flights
- Military operators
- Medical transport
- FTOs (Flight Training Organizations)
  Multi-engine training and for advanced training for CPL and ATPL
- Island hopping/flightseeing
- Skydiving airlift
- Individuals
  Personal transportation as a modern alternative to conventional General Aviation aircraft

Launch customer for island hopping operation:

Frisia FLN:

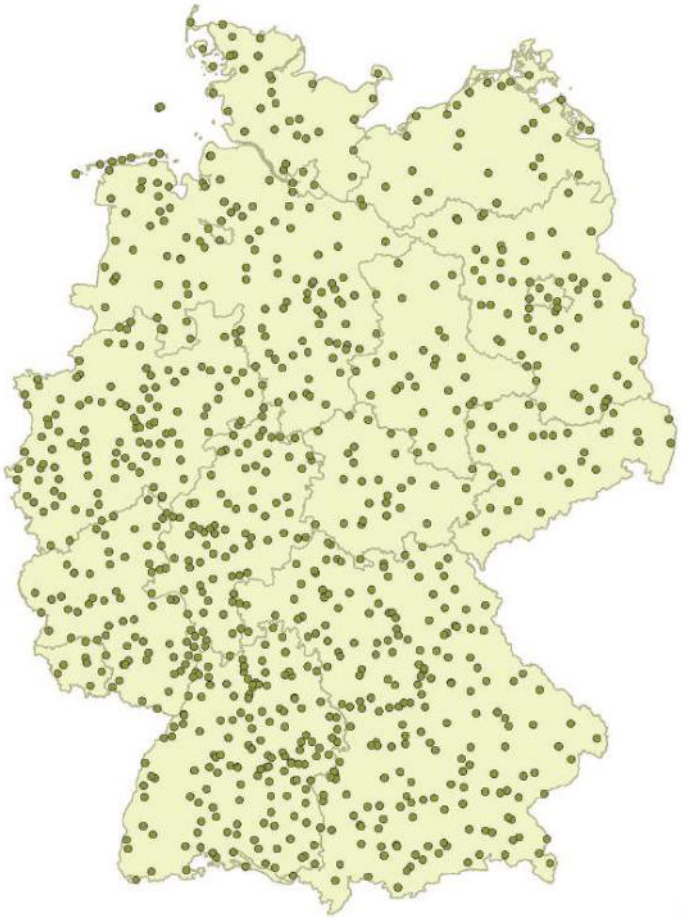
Air connection between the islands
and the mainland in northern Germany

- Traveling distance 20 km
- Average travel time 5 minutes
- 50 years of profitable operation
- E10 has 2X lower operating costs compared to BN2
- Substitution of 10 BN2 with E10

Frisia FLN as an approved AOC (Aircraft Operation Certification) and MOA (Maintenance Organization Approval) is planned to be our first operation Airliner for island hopping in the northern part of Germany.

This operation can be extended later for other island hopping and regional mobility.

Current aircraft: Britten Norman BN2



Map of regional airports in Germany

Regional mobility:

New local airlines based on existing network of airfields

- Many people commuting by car spending hours in traffic or by crowded train
- Leveraging existing airfields will reduce initial investments

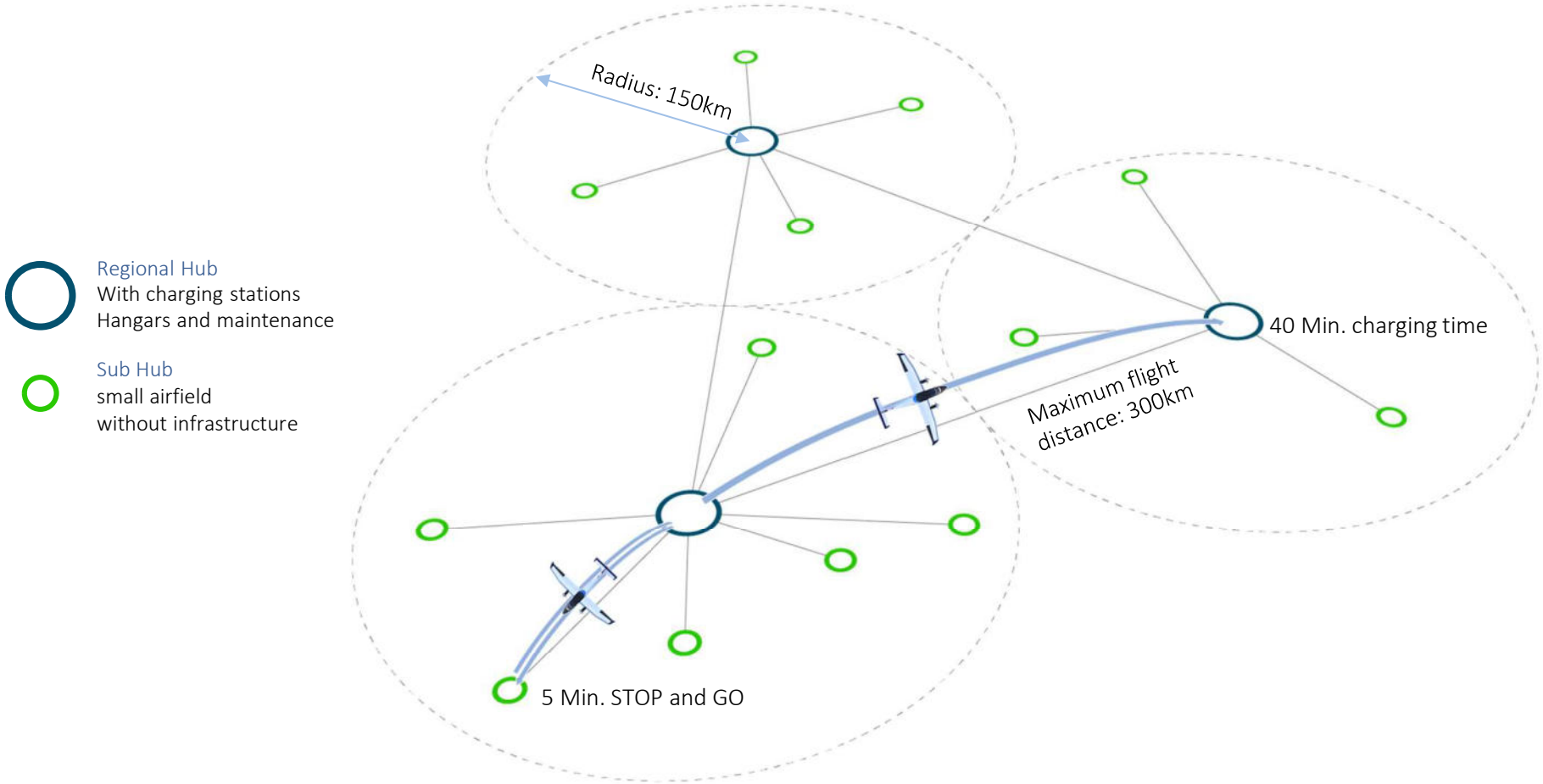
Germany:

- Over **500** airports/airfields
- Only 3 of them are capacity constrained
- Over 90% of the total population is closer than 20 miles from the nearest airport

USA :

- Over 5000 airports/airfields
- Only 30 of them overtake more than 70% of the total US passengers
- Only 17 of them are capacity constrained
- 60% of the total population is closer than 10 miles from the nearest airport
- 95% of the total population is closer than 25 miles from the nearest airport

E10 Regional Mobility Network



RAM Airport Smart Grid

A green growth opportunity

Due to missing infrastructure,
power from German wind and solar energy farms
Can´t be fed into the public grid.
A dense network of energy storage systems
could be a keystone to solve this issue

SCYLAX E10

Training Aircraft,
Towing Aircraft,
Motorgliders,
Self-launching gliders,
E-VTOL

Main power source:
Local Renewable Energies

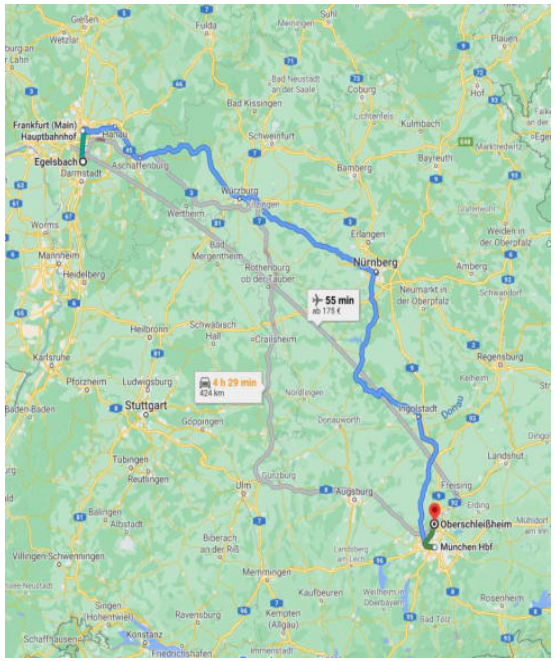
public
GRID
As secondary source

Airport Charging
Infrastructure

Carbon neutral last mile
Cargo transport.
Amazon, DPD, UPS already operate fleets
of electric transporters

Airport Charging Infrastructure

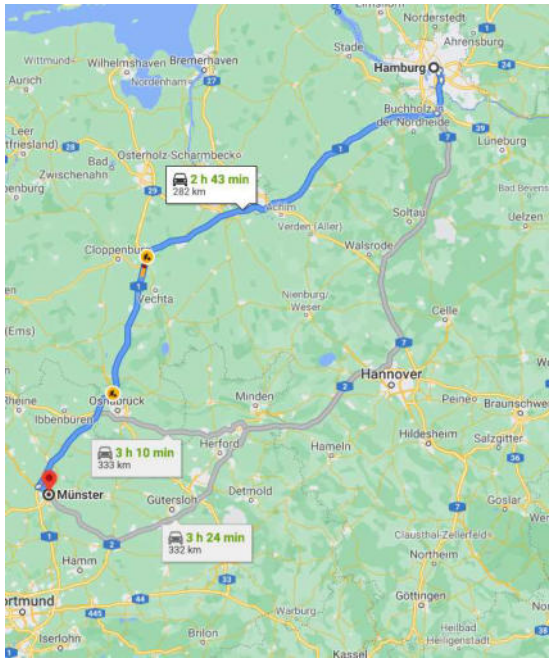
2X 150 kW
15 min. loading time per 100 km flight



Example 1:

Munich/Oberschleißheim to Frankfurt/Egelsbach

Ticket price for a flight : 199 EUR

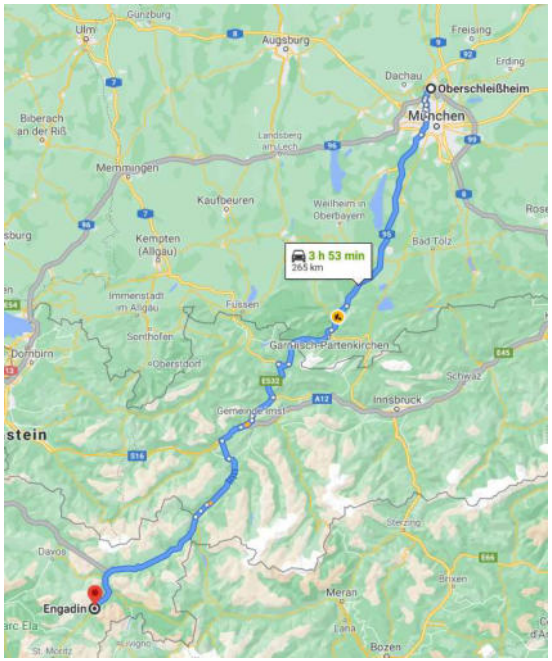


Example 2:

Münster (regional airport)- Hamburg HAM

240 km

Ticket price : 164 EUR

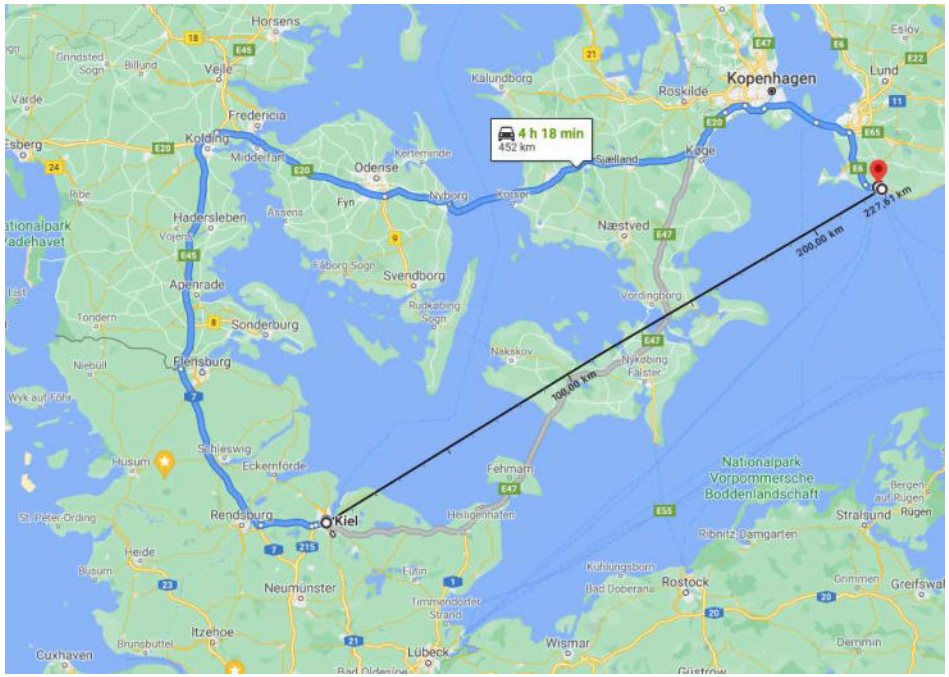


Example 3:

München Oberschleißheim – Engardin

217 km

A door to the Alps – Ticket price : 150 EUR



Example 4:
Kiel (Ger)-Trelleborg (SWE)

By car:
4h 31min via E47, 324km
4h 18min via E20, 452km

No commercial flights are currently available

Flight with the **E10** from
Kiel KEL – Vellinge/Söderslätt
Flight time: **50min**
Ticket Price: 149,5€

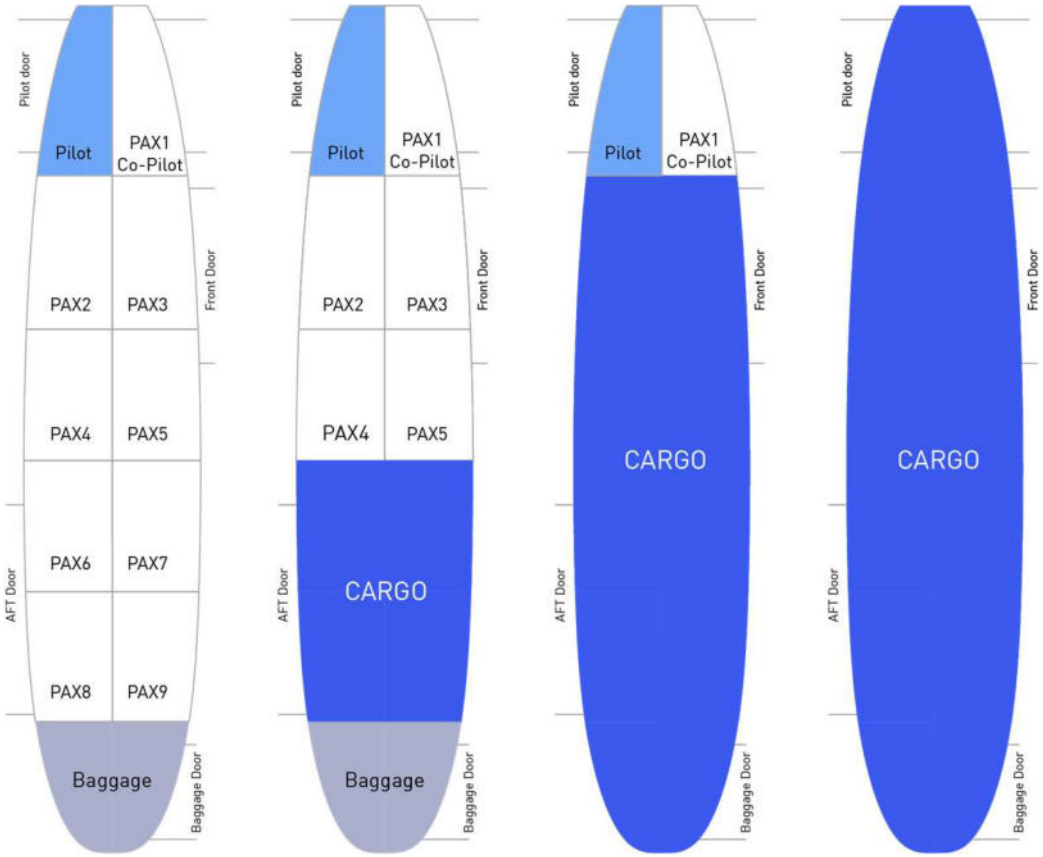
Last mile transport with taxi or public transit
-to Trelleborg city center: 15 min
-to Malmö city center: 27 min

3. Cargo Transportation

- 8 m³ cargo volume
- Or mixed model
- 5 passengers and 4 m³ cargo volume

- Advantage: increase aircraft loading factor reducing general operation costs

- Due to the very low noise level E10 can operate also during the night in order to be used for overnight shipping (the most profitable business for FEDEX , AMAZON and UPS)



Total Operation costs E10

including Airport and Airline costs

BENEFITS FOR AIRLINE OWNERS:

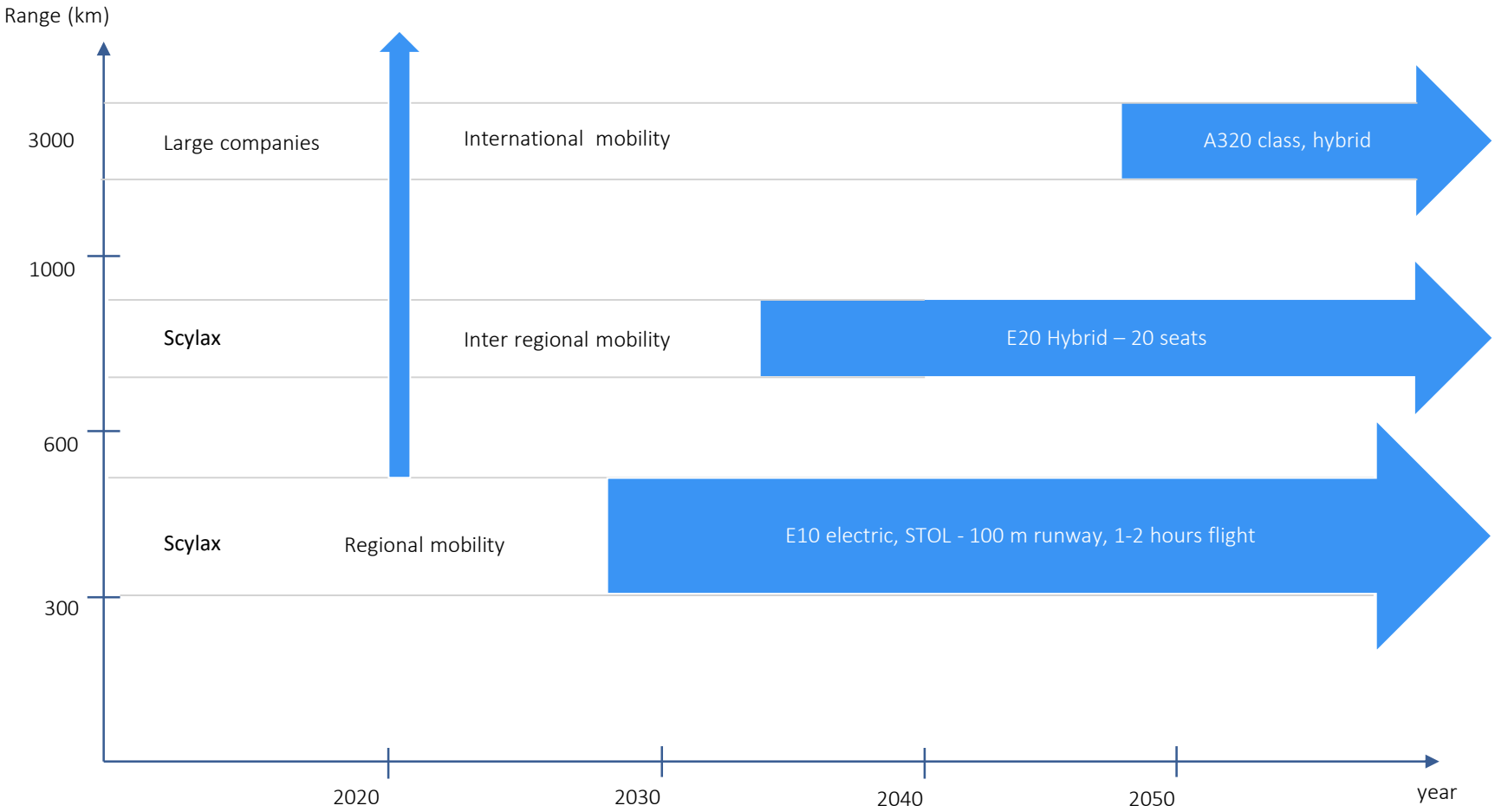
UP TO 50% LESS OPERATIONAL COSTS
MANY NEW DESTINATIONS

Flight	Norddeich-Juist	Norddeich-Juist	Münster-Hamburg IFR	Munich-Oberschleissheim to Franfurt Egelsbach VFR
Aircraft	*BN2 Islander new (island hopping)*	*E10 (island hopping - 20 km leg)*	*E10 (250 km leg, regional airport operation)*	*E10 (270 km leg, small airport operation)*
Flight ticket selling price/km €	2	2	0,65	0,65
Total operattion costs	1863	1557	660	565
Costs/Pass/km (EUR)- zero profit	1,55	1,15	0,39	0,34
Ticket price (EUR)	42	42	171	184
Turnover/year/AC	684.480 €	770.040 €	1.316.250 €	1.316.250 €
Profit/year/AC (EUR)	122.532	260.797	524.153	637.856

The operation costs include: aircraft depreciation, energy costs, maintenance, insurance, pilot, hangar, airport fees, ticket service, AOC operation

Future business cases

commercial electric flight



Cargo E10 H2-hybrid unmanned

- Over night delivery service
- Range 1000 km
- Freight volume 8 m³/ 272 ft³
- Max. payload 1200 kg
- Manned and unmanned operation

E20 H2-hybrid

- Scaled version of E10 (1 pilot + 19 passengers)
- Same power units and wing central section
- Operational range 700 km + reserve
- Takeoff in less than 100 m
- Hybrid batteries + H2
- Cargo operation, 15 m³ freight volume

The Team behind SCYLAX

Calin Gologan, CEO, Engineering and Technology , overall coordination.
More than 40 years experience in aerodynamics,load assumptions, structure calculations and tests, simulation, certification and electric aircrafts R&D. Design of awarded General Aviation aircraft.
CEO and co-founder Elektra Solar GmbH and Scylax GmbH

Rosario De Luca, CEO, Management, Engineering, Finance.
Over 27 years of extensive management and technical skills in commercial and military aircraft projects with the major OEMs like Airbus, Boeing and Leonardo.
CEO and co-founder of Scylax GnbH and EADCO GmbH.

Olaf Weddermann, CEO Frisia FLN
proxy holder and e-mobility coordinator at Frisia AG,
CEO of Friesonaut

Prof. Dr. Gerd Hirzinger, Shareholder, Senior Expert and Advisor.
Since 1992 he has been director at DLR's Institute of Robotics and Mechatronics, which became one of the biggest and most acknowledged centers for applied robotics research in the field worldwide, including not only robot development for space and terrestrial applications, but also aircraft control and optimization (including UAV's and solar-electric stratospheric flight).
Co-founder and shareholder of Elektra Solar GmbH.

Dr. Konstantin Kondak, CTO, Shareholder, Management, Engineering.
Head of the technological development, Elektra-Solar GmbH, and Head of the Flying Robots Group, German Aerospace Center (DLR), Institute of Robotics and Mechatronics, Munich, Germany.
CEO of Elektra Solar GmbH.

Partners and work distribution

SCYLAX GmbH, Project owner, project management

- Elektra Solar GmbH (main shareholder) – structure design, digital platform, autopilot, battery system, power supply distribution, composite parts, certification, general assembly, system integration
- FLN FRISIA-Luftverkehr GmbH Norddeich (shareholder) launch customer, AOC operator island hopping & regional mobility
- TQ-Aviation (shareholder Elektra Solar) electronic manufacturing and certification, cockpit integration
- EADCO GmbH engineering support
- Rolls-Royce Deutschland Ltd & Co KG Electric drive system (motor, motor controller, batteries)
- HELIX Carbon GmbH Variable pitch propeller
- DLR - Deutsches Zentrum für Luft- und Raumfahrt Flight control, Battery system

ELEKTRA SOLAR

10 years experience in manned and unmanned electric flight

A decade of pioneer spirit, passion for aviation and engineering excellence

Elektra One Solar – The first electric aircraft with German UL Certification (Oktober 2021)

10 km altitude unmanned flight with elektra Two Solar (Oct. 2019)

Thank you!

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