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Quarterly Vol. 01 - 2023 www.e-flight-journal.com

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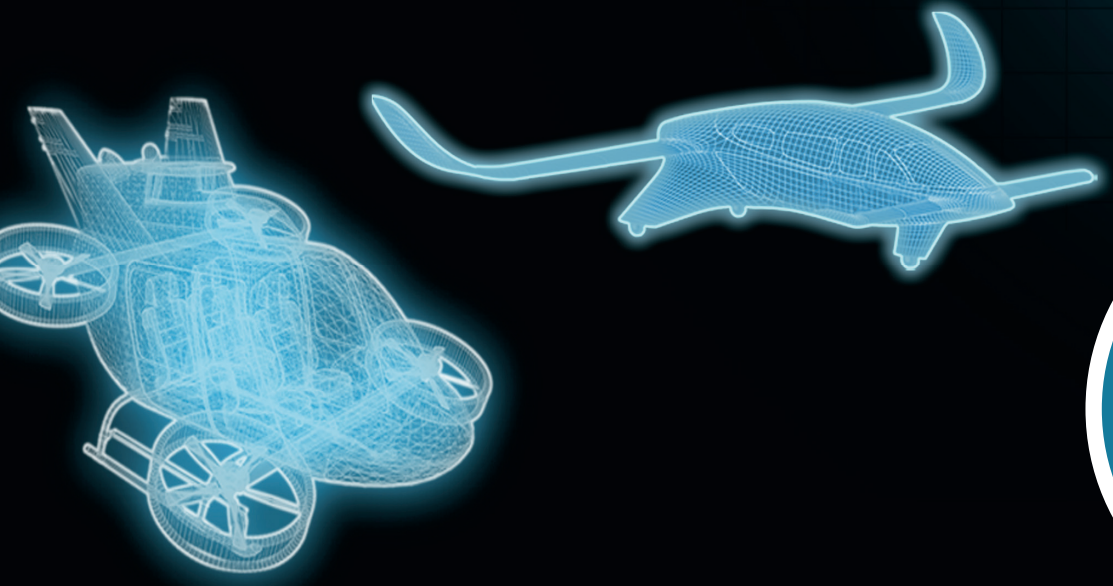

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AERO 2023 – Business as Usual?

916 iS: Just the present–future or both?

A new engine from Rotax, the 916 iS, will be presented at AERO in Friedrichshafenthis year. At a time when governments around the world are considering banning internal combustion engines in cars, does such a development still make sense? In the short and medium term, even for climate policy reasons:yes! Firstly, the engine consumes significantly less fuel than comparable conventional aircraft engines and therefore emits less CO2. In addition, the first electric ULs are preparing to replace conventional training aircraft, but they are not yet suitable as a replacement for cross-countryflights.

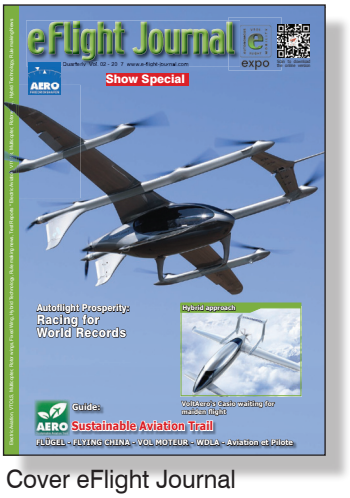
But there are other scenarios where modern engines like the 916 iS could definitely play a role.
After the German transportation minister insisted on an exception at the EU summit in March “Off for combustion engines in cars”, the synthetic fuels that are generated from (if possible: green) electricity are not yet in the tank, but alreadyon everyone’s lipsin the aviationdomain. It is undisputed that with the previous method only 20 percent of the electric energy used is converted into RFNBO (Renewable Fuels of Non-Biological Origin) and using it in cars therefore this solution does not make much sense. In aviation, however, where it will not be possible to fly by electricbattery for the foreseeable future, especially in larger aircraft due to the low energy density of the batteries, the fuels produced using the PTL process (Power To Liquid - current to liquid) could make sense. Because not only the development of the technology but also the change in the approval process for hydrogen technology - whether with fuel cells or direct combustion of hydrogen in engines - will be coming. Later on, switching to PTL eFuelswill be much easier. Many research institutes are currently working on significantly reducing energy loss during conversion. There are already some successful trials.

If the process is used to produce synthetic crude oil and convert it into synthetic kerosenefor large aircraft, then e-gasoline can also be produced in these refineries. It makes more sense to use synthetic gasoline in general aviation, i.e. where there are no electric alternatives, unlike in carswhich can already be largely replaced by electric cars today.

Of course, PTL technology only makes sense if the electricity used is generated from renewable energy. Significantly more green electricity is required if fossil oil is to be replaced by eFuel, which is technically feasible.

All these thoughts are taken into account at the AERO/e-flight-expo in the Sustainable Aviation Trail and in many lectures on this topic. In addition to the first certified ultralight e-training aircraft, the Elektra Solar, you will also find Pipistrel’s e-LSA Velis Electro and other electric aircraft. To boot, aircraft and eVTOLs with hydrogen or fuel cells will be present, as well as research institutes and companies working on eFuels. Ultimately, the new Rotax 916 iSwill be a step towards Sustainable Aviation, at least in the near future and during the transition to greener UL and GA aviation.

Willi Tacke



Cover eFlight Journal 1-2023

We the **eFlight Journal (eFJ)** founders are a team of aviation journalists and enthusiasts who created Flying-Pages. Publishing several aviation publications around the world. It started with the interest in electric flying in 2009.

We co-founded the e-flight-Expo in Friedrichshafen/Germany as part of the AERO, and established it as the largest show for electric aviation worldwide.

The eFJ is supported by FACC, Rolls-Royce, Rotax and many others.

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A new eVTOL made Successful maiden flight

The Chinese automaker Geely, which also holds shares in German eVTOL pioneer Volocopter, announced that its aviation subsidiary Aerofugia has successfully completed the first test flight of the AE200 eVTOL prototype. The maiden flight took place just two months after the company received the flight permit from the Chinese regulator CAAC to conduct test flights. The all-electric AE200 features eight propellers with four foldable for cruise flight and seats one pilot and four passengers. Aerofugia was formed by the merger of the American flying car developer Terrafugia, acquired by Geely in 2017, with the Chinese drone specialist AOSSCi in 2020.
www.aerofugia.com

Airbus and Boeing believe the future of eVTOL

At a symposium of the Vertical Flight Society, speakers from the two aviation giants Airbus and Boeing reaffirm their belief in the future of autonomous air taxi services. Both companies agree that unmanned eVTOL aircraft in particular are more predictable, safer, and cheaper to operate. The European Airbus consortium aims to certify its four-seater CityAirbusNextGen with a range of 80 km and a cruising speed of 120 km/h as a manned eVTOL by 2025.This will helptackle further development toward autonomous flying when the relevant regulations are in place. Boeing has teamed up with the eVTOL specialist Wisk Aero, who wants to do it without a pilot from the start and is developing an exclusively autonomous eVTOL. www.verticalmag.com

Lufthansa wants to train pilots on the electric DA40

The Austrian aircraft manufacturer Diamond Aircraft has announced that Lufthansa Aviation Training GmbH (LAT), which is responsible for training future pilots, will be the launch customer of the new electric DA40. Diamond Aircraft and LAT also signed a Letter of Intent to jointly research and develop opportunities for more sustainable flight training. From the end of 2023, the electric DA40 will then be tested in schools at the training location of LAT in Grenche, Switzerland. LAT plans to halve its net carbon emissions by 2030 compared to 2019 carbon emissions. The DA40 will be the first EASA/FAA Part 23 certified electric aircraft with DC fast charging capable of charging batteries to full in less than 20 minutes. Operating costs are said to be up to 40 percent lower than conventional piston training aircraft. www.diamondaircraft.com

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Air Race eVTOL from Alauda

With the unveiling of the Mk4 design, Airspeeder prepares for manned eVTOL air racing. After more than 350 test flights and two demonstration races of its remote-controlled eVTOLAirspeeder Mk3, the Australian eVTOL startup Alauda Aeronautics has unveiled the design for the first manned air racing eVTOL. The Mk4 is said to have a top speed of 360 km/h and a range of 300km. While the remote-controlled Mk3 was 100 percent battery-electric, Alauda installed a 1,000 kW (1,340 hp) hydrogen turbogenerator in the manned version. The four pairs of ducted rotors are mounted on gimbals, with an AI-powered flight controller adjusting the pitch angle for takeoff and flight. With the carbon fiber monocoque with large air intakes and front and rear wings as well as short box wings in the middle of the body, the look of the Mk4 is reminiscent of a Formula 1 racing car. According to Alauda, flight tests are already underway. www.airspeeder.com
www.archer.com

The way of air taxis in Japan has been paved

The SWITCH engine concept, which is being developed by a broad-based technology consortium, is intended to enable a major leap towards climate-neutral aviation through the combination of different technologies. The international project is funded by the Clean Aviation research program of the European Union. A total of 20 projects are being supported with 700 million euros. MTU Aero Engines, Pratt & Whitney, Collins Aerospace, GKN Aerospace, Airbus, DLR and universities from Germany, Greece and Sweden are involved in SWITCH (Sustainable Water-Injecting Turbofan Comprising Hybrid-Electrics). The aim is to develop and test a new hybrid-electric drive that has the potential to reduce fuel consumption and CO2 emissions by up to 25 percent compared to current engines for short- and medium-haul aircraft.
www.clean-aviation.eu

eVTOL in Boxwing Design

The Australian eVTOL startup AMSL Aero has celebrated the first test flight of its VertiiaeVTOL aircraft. However, the prototype was still anchored to the ground with ropes when it first took off. With its unique box wing design, eight tilting propellers, and five seats, the manufacturer of the Vertiia promises a range of 1,000 km (620 miles) and speeds of up to 300 km/h (180 mph).
The machine was designed from the start to run on hydrogen fuel cells because the range is crucial in a country as vast as Australia which is larger than the 48 contiguous United States. The hydrogen is stored in tanks located on the outside of the wing connectors. The current prototype is of course still powered entirely by battery power. Intensive work is currently being done on the flight control system. www.vertiia.com

Lilium design places special demands on the batteries

With its many small, electrically driven and ducted “fan” propellers instead of large free-wheeling propellers, the German eVTOL startup Lilium jet looks decidedly elegant in the illustrious circle of eVTOL developments. But this elegance comes at a high price: significantly more energy is required for vertical flight during take-off and landing in particular than if this work were done by rotor-like propellers with a large diameter. On the other hand, the low-drag Lilium design undoubtedly has indisputable advantages in cruise flight, where the “big hum” of the competition naturally have a harder time. That is why Lilium sees the area of application of its eVTOL aircraft more on slightly longer distances than on “short-haul” with many hovering phases in quick succession.

Nevertheless, the Lilium concept poses very special challenges to the batteries used. Because for the “long-distance flights” Lilium envisages, these not only have to have a high specific energy but also an enormous power density at the same time, since they have to be able to cope with extremely high discharge rates in order to cope with the energy-guzzling VTOL flight phases.
In this context, it is of crucial importance that a battery is required that can still provide this high output power when the state of charge is low. After all, you don’t want to compromise on the range. Suppose the Lilium jet was near its range limit and an emergency occurred, forcing the pilot to draw on the (power) reserves so that the charge fell below 20 percent. Even then, the aircraft must still be able to perform a safe vertical landing--a flight maneuver that Lilium considers requires high battery output power for up to 45 seconds. So it’s a very special battery that the Lilium jet needs. But the German eVTOL developer is convinced that they will get these problems under control.

Lilium has acquired exclusive rights to some Ionblox battery products in the eVTOL space thanks to its multi-million-dollar investment in a battery company called Ionblox, formerly Zenlabs. The main difference between Ionblox and other lithium battery cell manufacturers is the use of a silicon-dominated anode, while most conventional cell manufacturers use graphite. Silicon anodes are able to achieve extremely high charging and discharging rates at an acceptable specific energy. However, when using silicon anodes, there are problems with the service life of such batteries, especially with a large number of charging cycles. However, Ionblox holds a number of patents in this area and seems to have made a good step forward in the fight against premature “battery death”.

Lilium assumes that the next generation of Ionblox batteries will already meet the high requirements that the Lilium concept places on energy storage and that these can be used when entering series production. Since the company has postponed its certification expectations to 2025, the Ionblox specialists still have some time to further optimize the battery packs. So we can continue to be excited. https://lilium.com

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Regulators, Investors

from around the World.

e flight Forum 2023

Where: TBD - CHINA
Real & online

When: November 2023

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Archer partners with Stellantis

The American eVTOL developer Archer wants to cooperate even more intensively with the Stellantis automobile group in the production of its Midnight eVTOL aircraft. With its various automobile brands such as Abarth, Alfa Romeo, Chrysler, Citroën, Dodge, Fiat, Jeep, Lancia, Maserati, Opel, and Peugeot, Stellantis is one of the largest car manufacturers in the world.

Under the terms of the agreement, Stellantis will bring advanced manufacturing technology and expertise, as well as experienced personnel, to continue and expand Archer's manufacturing operations in Covington, Georgia. Stellantis also intends to provide up to $150 million in capital for Archer to draw on at its discretion over the next two years. Archer plans to have its four-passenger plus pilot eVTOL Midnight certified by the FAA by the end of 2024 in order to be able to begin flight operations in 2025. Travelers in a hurry will then be able to fly to O'Hare Airport in just ten minutes from the existing Vertiport in downtown Chicago. United Airlines and Archer Aviation have chosen this route as the first route in a planned comprehensive eVTOL flight network. The eVTOL Midnight is powered by a total of twelve electric motors. The payload is said to be over 450 kg. According to the manufacturer, Midnight is optimized for flights over a distance of around 30 kilometers. However, this means that the aircraft has to be plugged in again after every single flight between the Chicago Vertiport and O'Hare Airport. After all, the loading time should only be ten minutes. And that's how long it will probably take the passengers to board and disembark. www.archer.com

Airbus and Norwegian Air Ambulance Foundation Jointly Study Air Medical Use Case of eVTOL

Airbus and the Norwegian Air Ambulance Foundation during the Heli-Expo show in Atlantaannounced that they are working together to study the application of Airbus' in-developmentCityAirbusNextGen eVTOLaircraft for air medical use.

The two parties said they will look at potential use cases for eVTOL aircraft in Norway with a view to integrating the operational requirements into the configuration of the CityAirbus vehicle. The project is expected to result in a roadmap for reducing emergency response times and improving patient outcomes by assessing how eVTOLs could complement existing helicopters already used by Norwegian Air Ambulance, including a mix of H135 and H145 aircraft.

The project will consider aspects of the anticipated ecosystem for eVTOL services, including infrastructure, traffic management, and energy sourcing and distribution. Airbus has indicated that it could extend the work to other countries in the Nordic region.www.airbus.com

H2FLY Tests Liquid Hydrogen Refueling

The Germa fuel cell aircraft developer H2Fly has completed initial ground tests to refuel its hydrogen-electric HY4 demonstrator aircraft with liquid hydrogen. The test was conducted in Grenoble in France at a facility operated by its partner, the industrial gas group Air Liquide as part of preparations for the start of a new round of flight testing this summer.

The tests for what H2Fly calls the filling procedure are part of the European Union-funded Project Heaven which is contributing to the European Commission's Horizon 2020 research and development initiative to demonstrate the feasibility of using a liquid, cryogenic hydrogen-powered fuel cell powertrain in an aircraft. Since December 2022, H2Fly, based in Stuttgart, has been leading the project's development.

During the tests, a new cryogenic hydrogen storage system designed by Air Liquide was filled with liquid hydrogen. In the next stage of the joint project, the partners will couple the storage tank to the fuel cell component of the HY4's powertrain.

In November 2022, H2Fly started the mechanical integration of Air Liquide's liquid hydrogen tank into the HY4 technology demonstrator after the tank had passed earlier vibration and leakage tests in September. Since 2020, H2Fly has conducted more than 100 takeoffs with the HY4 during flight testing that used an earlier version of the powertrain. Currently, the aircraft's range is around 750 kilometers (469 miles), and H2Fly aims to increase this to 1,500 kilometers.

Electric amphibious aircraft from Switzerland

The Swiss electric aircraft developer Jekta Swiss Aviation has received the first order for its planned PHA-ZE 100 electric amphibious aircraft powered by ten electric motors. According to Jekta, the company Gayo Aviation from Dubai (United Arab Emirates) has issued a declaration of intent to purchase ten aircraft that are to be used for luxury travel. The PHA-ZE 100 will offer space for up to 19 passengers and three crew members and will initially have a range of 150km. Jekta Swiss Aviation sees a global need for around 400 amphibious aircraft in the next five years, but the company does not expect its model to enter service before 2029. www.jekta.swiss

e-flight EXPO

E-FLIGHT-EXPO & SUSTAINABLE AVIATION TRAIL

Elektra Trainer

The AERO Sustainable Aviation Path, which was launched last year, will be further expanded in 2023. In addition to a hydrogen day with a focus on hydrogen-poweredpropulsion, the e-flight-expo award, which has been presented for 13 years, is now being expanded. This prize for electric flying is now complemented by another prize for outstanding developments in green energy sources and a jury who will grant a prize.

Flight Design F2e

SUSTAINABLE AVIATION PATH

With the three e-keywords Electric, Ecologic, Evolutionary, the e-flight Expo started 15 years ago as part of the AERO to document the revolution in light aviation. At the beginning of the e-Flight-Expo, electric planes and developments fit into the West Forum. Later they moved to Hall A7. There are now suppliers of products and aircraft in the field of climate-neutral, ecological flying in almost all exhibition halls. Therefore, AERO created the “Sustainable Aviation Path”, which leads interested visitors to the relevant manufacturers. The starting point is in Forum Ost. There you can not only see the eVTOL highlight of the fair, the eMagicOne, on the large lecture stage, but also the starting point of the “sustainability path”. Like all e-exhibitors, it is marked with a large green balloon.

GREEN TRAINER AIRCRAFT

Progress is being made with the electric training aircraft in all classes. After the certification of the Pipistrel Velis as EASA CS-LSA, the Elektra Trainer (see our sister publication “Flügel” 01-2023), the first two-seater electric airplane in the German UL class, has now received

Autoflight Prosperityy

its market approval. Other machines for the training market can also be seen at AERO. So Diamond Aircraft will show its eDA 40 again. In March, the company passed a milestone when Lufthansa Aviation Training (LAT) signed a letter of intent; a letter of intent stating that Lufthansa intends to purchase the Elektro DA 40 as soon as it is certified.

BRM and Flight Design also want to send their aircraft into the race with Part 23 approval. Like the DA 40, both machines have Part 23 approval with a combustion engine. But the e-approval is much more complex than just installing a new engine. As interest is shown by the Lufthansa Aviation School, there is definitely a need in the market.

AUTOFLIGHT

Hardly any other company has made such progress in the last two years as Tian Yu's company. Since AutoflightX was founded in Oberpfaffenhofen/Germany in 2018, it already showed the first two-seat prototype, a UL-eVTOL, the V-600, in 2019. The further develop-

Diamond eDA 40

BRM / H55

Pipistrel Velis with Eaton Charger

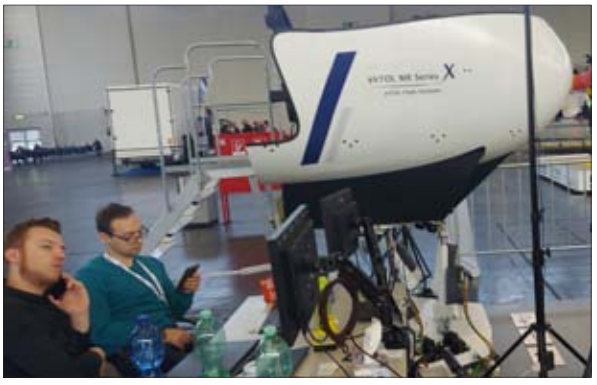
Ikarus C42 with fuel cell and electric motor

ment of a manned large drone took place in China because, among other things, the CAAC set up a test program that permits large drones to be used commercially without approval.

With the entry of the German investor Team Global, the company also returned to Germany and opened the subsidiary Autoflight Europe (the X has been removed). The German branch is primarily intended to apply for EASA approval, but also the complete development of approval software. While a team of engineers was being built up here, development continued in China. After the first complete transition (transition from vertical to horizontal flight) in spring 2022, four different prototypes followed. In March 2023, the company set a new world record for eVTOLs with a distance of over 250 kilometers. The takeoff weight of the aircraft during this flight was approximately two tons. The flight was not flown with the passenger variant with two pusher propellers, but with the "cargo" version which has a third pusher propeller attached to the cabin. "The passenger variant will continue to have two propellers," says company boss Tian Yu, "because the third pusher propeller leads to an increased noise level in the cabin. It doesn't matter for the freight version." This variant opens up the possibility of replacing the engine in the cabin with a combustion engine and thus achieving a significantly longer range. This time the company will only be present at AERO with a small stand and a large model of the Prosperity (2.5-meter wingspan). The first original aircraft within Europe is expected at the Paris Airshow in June 2023.

EVTOL AND CARGO DRONE

The company eMagic Aircraft, which surprised the audience last year with its single-seater eVTOL, has developed new lift propulsion and propellers. In addition to the manned machine that will fly in the UL category in Germany, an unmanned cargo version has also been developed on the same basis.



In 2023, the Technical University of Munich will not only bring its test vehicle to test eVTOL lift rotors (photo above), but also a „full motion“ eVTOL simulator developed last year (photo left).

SIMULATOR OF TUM

This year, the Technical University of Munich (TUM) is not only presenting the test car it has developed, with which the eVTOL hoist motors can be tested when driving forwards but also with a “Full motion” eVTOL simulator that TUM helped develop,in which the characteristics of different aircraft can be simulated.

Evolito

In the e-flight-Expo Hall A7 you will find the leading e-motor manufacturers who power aircraft from all over the world.

MGM

Amrax

Geiger

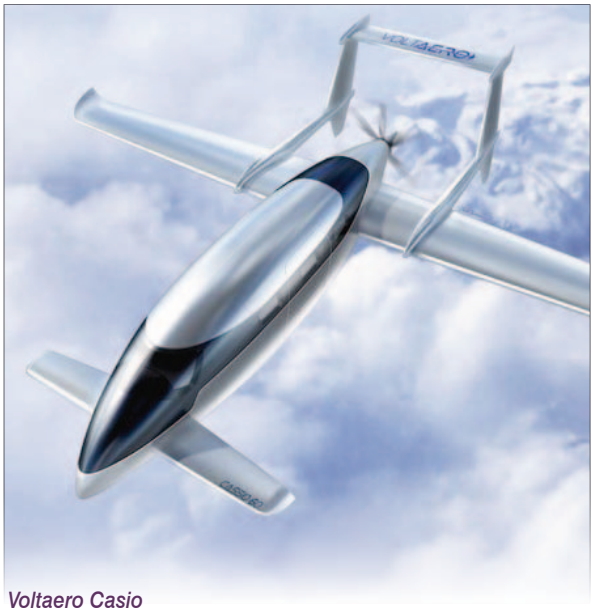
Nex AERO, das Brennstoffzellen eVTOL.

eMagic

AIR Atos Wing

NEX WITH FUEL CELL

A completely new exhibitor this year at the e-Flight-Expo is the startup Nex from Berlin. The company is developing a 4-seater eVTOL with a lift and cruise concept (rotors for vertical flight and separate propellers for forward flight). The special feature: the energy for the electric motors not only come from batteries but also from a fuel cell from the British company Intelligent Energie, which was specially developed for aviation and produces less waste heat.



Voltaero Casio

Avi Aircraft e-Dracula

Michael Kügelgen, co-founder of eMagicOne, is the e-Flight Award Winner 2022.

LECTURES AT E-FLIGHT EXPO

As in previous years, most lectures on the subject of electric flying will take place on the large stage in the East Forum. The host of the e-flight-expo panels is Flying-Pages publisher Willi Tacke. The lectures are given mostly in English because of the international experts. At the same time, with the expansion of the Sustainable Aviation Path, AERO has greatly expanded the lecture program on the topics of greener aviation.

The current status of all presentations can be found at AERO Web pages:
www.AERO.expo, on the AERO page of Flying-pages: www.aero.flying.pages.com and of course in the AERO App.

E-FLIGHT-EXPO AWARD

As has been the case for 15 years, the coveted e-flight award will also be presented in 2023. This year, the oldest international award for electric flying will be integrated into the Sustainable Aviation Award and honorsoutstanding developments in electric flying, from the three-axle aircraft to the eVTOL. The e-Prize is supplemented by a prize for “Energy Source for Aviation Propulsion”, which recognizes new developments in green energy supply for aviation, from batteries to synthetic CO2-neutral fuels to hydrogen solutions. The award is rounded off by the prize of the jury, which consists of international experts and journalists. The prizes will be presented at the reception on Friday evening from 5.30 p.m. in the East Forum. ✔

Companies at the SAT

A6-201	Garmin International, Inc.
A6-400	Avidyne Corporation

A5-121	Bundesamt für Zivilluftfahrt BAZL Sektion SIFS / SAR thj
A5-201	AOPA Germany, Verband der Allgemeinen Luftfahrt e. V.
A5-211	Deutscher Wetterdienst (DWD)
A5-215	ZHAW
A5-240	Lukasiewicz – Institute of Aviation
A5-300	EASA - European Union Aviation Safety Agency
A5-301	Berlin- Brandenburg Aerospace Allianz e.V
A5-301	Brandenburgische TU Cottbus-Senftenberg
A5-301	Innovence Airport Systems GmbH

A7-100	Aviation et Pilote
A7-100	Flying Pages GmbH
A7-101	Electric Power Systems
A7-101	Voltaero
A7-102	svt Products GmbH
A7-103	TU München - L.f. Flugsystemdynamik
A7-104	Electro.Aero Pty Ltd
A7-105	VerdeGo Aero Matt Kollar
A7-106	EGS Stromtankstellen AG
A7-108	eAvio d.o.o.
A7-110	ZeroAvia
A7-111	EVOLITO LTD
A7-115	Pie Aeronefs SA
A7-120	Zuri.com SE
A7-122	AEROS Ltd.
A7-124	ALAMO Engineering GmbH
A7-124	Helix-Carbon GmbH
A7-124	LZ design d.o.o.
A7-124	VOCUS GmbH
A7-201	eMAGIC Aircraft GmbH
A7-203	Deutsches Zentrum für Luft- und Raumfahrt (DLR)
A7-205	Aerospace Valley
A7-205	Air Systems
A7-205	Avions Mauboussin Techn'Hom 3
A7-205	Beyond Aerospace
A7-205	Blue Spirit Aero
A7-205	Copelectronic
A7-205	Emitech
A7-207	e+a Elektromaschinen und Antriebe
A7-207	Verein Cellsius
A7-208	Tianjin Santroll Electric Technolog
A7-217	Duale Hochschule Baden Württemberg Mannheim
A7-219	Universität Stuttgart Institut für Flugzeugbau (IFB)
A7-221	Kasaero GmbH
A7-221	PS-HyTech GmbH
A7-221	Technische Hochschule Würzburg-Schweinfurt
A7-227	Martin Steffen
A7-300	Electric Aircraft Concept
A7-300	MGM COMPRO s.r.o.
A7-300	XSun
A7-301	NEX Aero GmbH
A7-302	AERODelft
A7-302	AutoFlight Europe GmbH
A7-302	Bosch General Aviation Technology GmbH
A7-302	Electrify-In Switzerland
A7-303	Jetpel GmbH
A7-304	ELEKTRA-SOLAR GmbH
A7-305	Geiger Engineering GmbH
A7-307	A.I.R. & Co. GmbH
A7-310	BRM AERO, s.r.o.
A7-310	H55 S.A.

SD-12	Tex
B4-100	Deutscher
B4-102	LAA CR - L
B4-113	Deutscher
B4-201	AVI srl
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A4-105	XAEROS AvioPower GmbH
A4-140	Ampaire Inc
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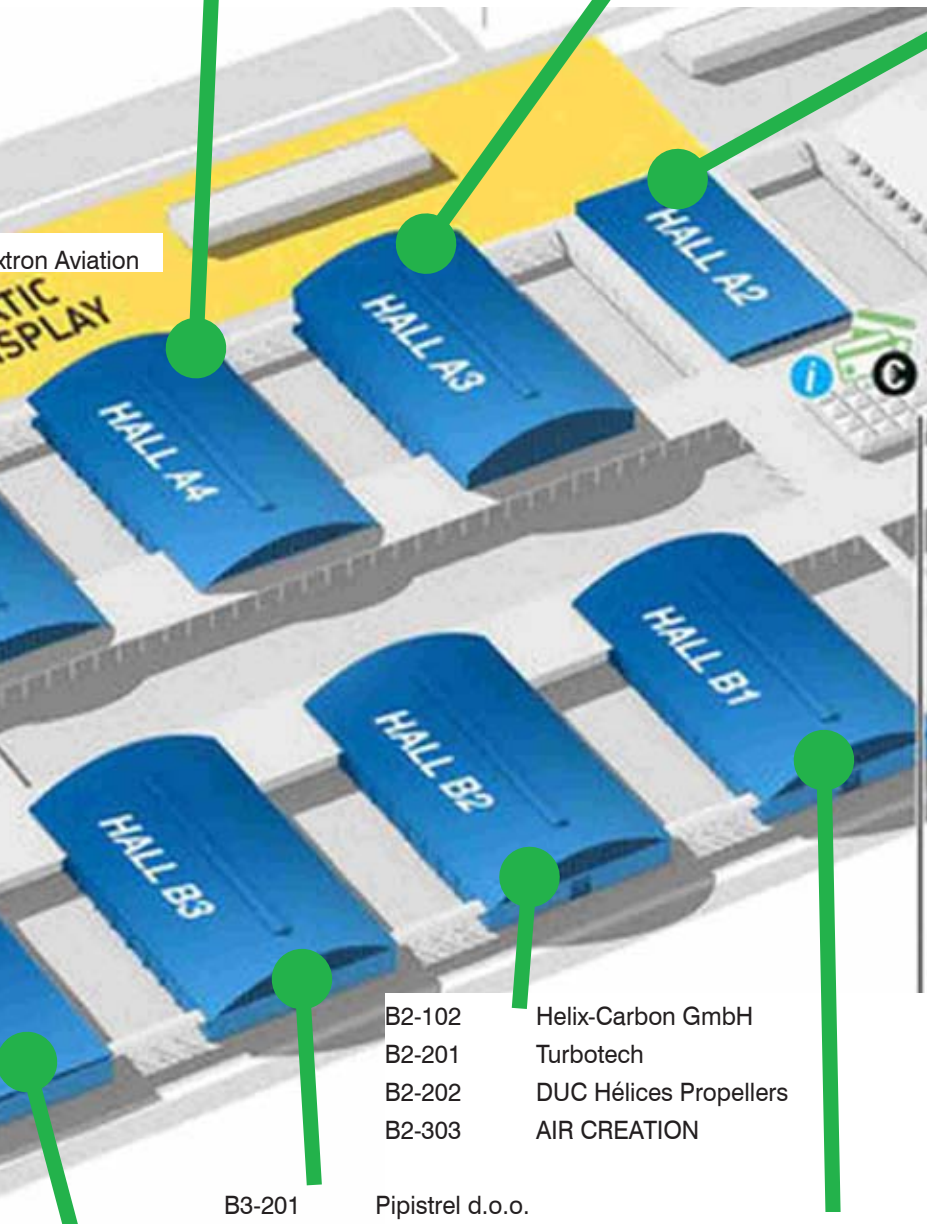
A3-205	BRP-ROTAX GMBH & CO. KG
A3-207	BendixKing
A3-402	Piper Aircraft, Inc.



A2-317	Aster Co. ,Ltd.
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A2-407	Zenadrone Inc
A2-408	Deutsches Rettungsrobotik-Zentrum e.V.
A2-408	Eurocommand GmbH

B2-102	Helix-Carbon GmbH
B2-201	Turbotech
B2-202	DUC Hélices Propellers
B2-303	AIR CREATION

B3-201 Pipistrel d.o.o.

B1-101	Flight Design general aviation GmbH
B1-106	DYNON AVIONICS, INC.
B1-201	Breezer Aircraft GmbH & Co. KG
B1-202	Flight Design general aviation GmbH
B1-203	Zall JIHLAVAN airplanes s.r.o.
B1-203	Zall SKYLEADER a.s.
B1-301	COMCO IKARUS GmbH
B1-303	Evektor-Aerotechnik a.s.

r Ultraleichtflugverband (DULV) e.V.
Light Aircraft Association of the Czech Republic
r Aero Club e.V.

Companies in alphabetic order at the SAT

Company	Hall, booth No
Aster Co. ,Ltd.	A2-317
A.I.R. & Co. GmbH	A7-307
ADAC Luftrettung gGmbH	A2-202
AERODelft	A7-302
AEROS Ltd.	A7-122
Aerospace Valley	A7-205
AIR CREATION	B2-303
Air Systems	A7-205
ALAMO Engineering GmbH	A7-124
Ampaire Inc	A4-140
AOPA Germany, e. V.	A5-201
AURA AERO	A4-221
AutoFlight Europe GmbH	A7-302
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BendixKing	A3-207
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Beyond Aerospace	A7-205
Blue Spirit Aero	A7-205
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BRM AERO, s.r.o.	A7-310
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Dronivo GmbH	A2-401
Duale Hochschule Baden Württemberg Mannheim	A7-217
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	A7-124
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Quantum-Systems GmbH	A2-407
Remote Vision GmbH	A2-208
S.W.I.S GmbH	A2-401
Sky Drone Europe SML GmbH	A2-103
svt Products GmbH	A7-102
Swiss Helicopter AG	B5-101
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WFB Wirtschaftsförderung Bremen GmbH	A2-216
XAEROS AvioPower GmbH	A4-105
XSun	A7-300
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Text: Willi Tacke. Photos: Flying Pages, Elektra Solar

Exclusive

1. Flight-Report:

ELEKTRA TRAINER

an everyday-use electric airplane

Calin Gologan has been working on electric aircraft for more than ten years. With the Elektra Trainer, for the first time, a plane has reached the point where it is ready for series production and also appeals to a wider audience. Two-seater, 2.5 hours flight time plus reserve - these are the key data that could convince flight schools and flying clubs - despite the high purchase price. At the AERO 2023, the machine will not only draw attention to itself with the DULV type certification but also with approval for glider towing. The CEO of Flying Pages Willi Tacke was the first journalist in the world to have the opportunity to fly the ElektraTrainer.

Silent cockpit: When traveling at 120 km/h, you can talk without a headset - thanks to the whispering engine; but you have to dress warmly.

After a flight time of almost 1 hour and 15 minutes from a trip from Memmingen (Germany) to the nearby Alps near Kempten, we are back at the Sierra reporting point and ask for the landing information when the controller replies: “Delta Mike Yankee Tango, I have two more airliners approaching here. Can you go ahead from the approach for runway 24 into holding and wait for the two to land?” With most other electric airplanes already in existence, that would be a sweat-pleasing request now as these airplanes — if still in the Air - after 75 minutes of flight time, they would have used their battery capacity to the point of exhaustion. But Uwe Northman only replies calmly: “Roger, go to the holding and watch out for the two airliners”. A look at the large LCD display shows me why he is so relaxed: Both batteries still show more than 60% charge and since we are only consuming just 11 kw at 120 km/h when cruising, the computer shows more than two hours (!) of flight time with this type of flight. We watch the landing of the last Airbus with interest and then need another eight minutes because the wind is still blowing at well over 20 knots. That’s why we don’t set the flaps until the very end and when the earth has us back, both battery displays are still over 50%. For me, this means the successful end of the first flight with a machine that could revolutionize flight school operations. Because with a flight time of over 2.5 hours plus reserve when fully loaded, this electric ultralight is absolutely suitable for everyday use and can be used not only for traffic patterns but also for cross-country flights.

Bundesrepublik Deutschland
Der Beauftragte

Einzelzulassungsschein
für Luftsportgeräte
Single Type Certificate
Nr.: E898-23 1

Already two hours before this impressive flight, I had experienced the first surprise of the day. There was a rather casual appointment to fly with the Elektra trainer, but since the trees at my home in Murnau were bending in the strong westerly wind around 10 a.m. on Friday morning and the clouds were hanging very low, I wasn’t serious about the flight so I called the Elektra Solar test pilot Uwe Northmann. “I flew yesterday. The wind was even stronger then and that worked well. It should also be nicer in the afternoon,” Normann convinces me. And indeed, when I arrived at Allgäu Airport in Memmingen, it cleared up. However, it still whistles properly. Uwe has already rolled the machine out of the hangar and is at the pre-flight check. Five minutes later I climb on the wing to sit in the left seat. Getting started is a bit unusual because the airplane has a glider landing gear with a large spring-loaded wheel in the fuselage and two small wheels on the wing tip and a small wheel on the tail. “This version is ideal for glider pilots because it has the lowest resistance and therefore the longest flight time. For normal UL and Echo pi-

Low drag with a high glide ratio and an efficient propulsion system are the secrets of the two-seat training aircraft.

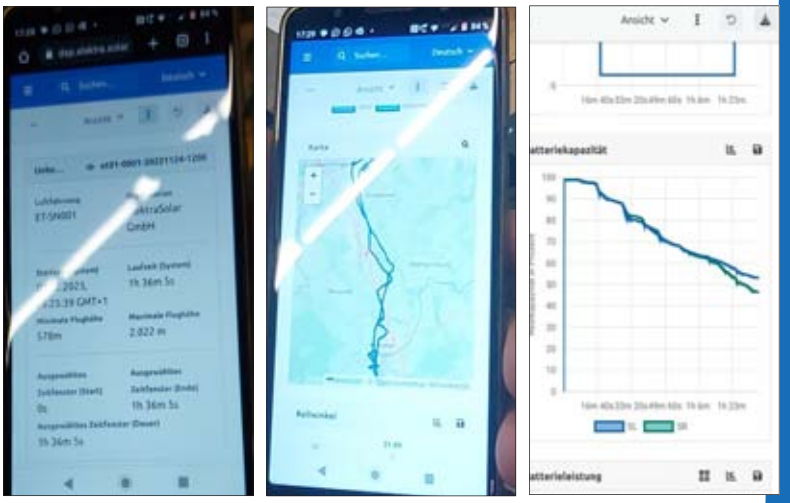
lots, this will certainly take some getting used to. In the long term, we will offer three versions. In addition to the unicycle variant, there is also one with a fixed tail wheel and one with a nose wheel. The first three pre-series machines will probably have a tail wheel," explains Uwe Northmann.

After the systems have been checked, we immediately request taxi clearance. Starting, warming up - none! So we go to runway 24 and matching the direction of the runway there are 24 knots of wind, which fortunately is aligned with the runway.

While the Airbus taxis in front of us to the very beginning of the runway, the controller asks us whether half the length of the runway would be enough for us if we

The display is a high-performance computer with military security standards: it runs both the nav, the engine monitoring, and the DAP, which monitors the aircraft, records the data, and transmits it live.

The instrument panel: analog instruments as backup, two TQ radios, and a BRS rescue system; the yellow button operates the tow release.



The comfortable seat can be adjusted to three positions.

taxied onto the runway in the middle of the runway before the airliner.

So we only have 800 meters at our disposal, but thanks to the strong wind from the front and the 80 kw motor we only need a ridiculous 20 meters and are airborne. We climb at 4.5 meters per second and soon turn towards the Alps in the south at traffic pattern altitude. In crab walk with a surface diagonally ahead goes to the mandatory reporting point Sierra. As we approach the foothills, it becomes clear that strong winds also cause strong turbulence and that the pure carbon fiber wing also transmits this directly to the cabin. After a few hard hits, I pull the shoulder straps a little tighter. At times we fly in the updraft and soon we are under the clouds. Now the sun is even coming out and it's getting quieter, so I can do some handling tests. Due to the relatively long wingspan, the Elektra Trainer has a rudder setting reminiscent of gliders. When rolling with the aileron, the machine responds directly, but it requires significantly more effort than when initiating pitching movements. The machine reacts not only very quickly, but also sensitively. In order to fly clean turns, a significant use of rudder is also required.

REDUNDANCY IN THE DRIVE

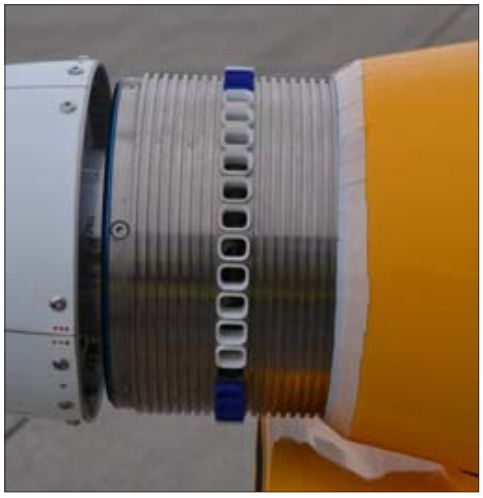
In the calmer air above the small clouds, we fly at the maximum speed. I push the controllers of the two motors forward. This is like a "real twin" allerdig, with the difference that the two Geiger engines drive a single variable-pitch helix propeller via a common shaft. With the trim button on the stick, nose down - and the machine picks up speed. After a few seconds we reach the Vne of 180 km/h in level flight, the double motor now consumes 33 kw and the onboard computer indicates that with this power input, we only have 32 minutes of flight time before we reach the reserve. We check the speed with the GPS. Then we go back to the cruising speed of 120 km/h and the consumption drops to the minimum of 11.4 kw for the level flight. And after just a few seconds, the computer again shows almost two hours of remaining flight time. How comforting!

The rolling speed is just under four seconds at 120 km/h, which is completely ok given the relatively large wingspan. In the stalls, the machine is good-natured despite its relatively high wing loading. At half throttle it hangs on the prop, the rudders become soft, but the machine can still be steered. Below 80 km/h, the Elektra Trainer can tip to one side, but as soon as you release the stick, the aircraft is fully controllable again. With flaps and no throttle, the trainer shows the same characteristics, but at a lower speed.

If we let off the gas all the way, i.e. switch off the engines, the prop turns windmill slowly. The minimum sink rate is now around 1.2 meters per second. "We're still working on being able to use the motor's electronics to bring the propeller to a complete standstill, which would improve the minimal sink rate while gliding," explains Nortmann. "We are also working with manufacturer Helix on a feathered propeller. In connection with extended wingtips, this could be very interesting, especially for glider pilots."

The machine is already interesting for gliding clubs for a variety of reasons, and not just because of the wing extensions and the landing gear, which is similar to a glider. From the beginning, the Elektra trainer was also designed for glider towing. A corresponding coupling was planned from the beginning because the climb values measured since the first flight exceeded the calculations. The single-seater climbs at over eight meters per second, while the two-seater still climbs at a rate of four to five meters per second.

As soon as the towing trials, which are currently in full swing, have been completed, a meeting with interested gliding clubs is to take place later this year at the Oberschleißheim airfield near Munich. "Energy recovery is also an issue for the towed version," says Elektra Solar boss CalinGologan. "The drive system and the battery are designed for this. We have already done the first tests, but that only brings 1 to 2% at the moment. But if you tune the propeller for it and plan for fast descents like you need in glider towing, our engine supplier Geiger says that can save up to 10%."



The 65 volt dual motor from Geiger.

DAP

In order to make the machines even more attractive, especially for flight schools, a team led by Konstantin Kondac, the second managing director of Elektra Solar, has developed a close-meshed electronic monitoring system for the trainer, the "Digital Aircraft Platform" (DAP).

"The DAP monitors and records all of the aircraft's control and monitoring elements. All aircraft parameters are monitored in real-time. The pilot receives intelligent support, and in critical situations, protective algorithms are automatically activated. The system simplifies the operation and maintenance of aircraft. The lifetime of each essential part (such as batteries, motor, propeller, structure) is monitored, analyzed, and continuously documented," explains Kondac. The data is continuously transmitted via a data line and can be viewed by the customer at any time on a cell phone or PC.

low-voltage systems

Waiting until the Airbus (arrow) has landed.

In contrast to most competitors such as Pipistrel, Flight Design, or BRM Aircraft, Elektra Solar does not use a 400-volt system but only 65 volts. This has the disadvantage that, for example, the cables have to be thicker and therefore heavier, but it also has the advantage that there are no dangers from high voltage during operation, maintenance, and a possible accident. Of course, this also made the DULV UL approval easier and faster, which the Elektra trainer received in January ten days before my flight.

CONCLUSION

With the trainer, Elektra Solar has succeeded in creating an amazingly well-rounded electric aircraft that, with a maximum flight time of 2.5 hours plus 30 minutes reserve (depending of course on the selected flight performance), should be of interest to all the clubs and flight schools that have been looking forward to it for a long time waiting for an electric aircraft that is suitable for everyday use, that is whisper-quiet and could solve the noise problem at many airports. Of course, a single flight can only be a snapshot and give a first impression of the machine and the entire system. Now the aircraft and the manufacturer have to prove that the aircraft can deliver these performances over the long term and that the manufacturer can mass-produce and maintain this machine. If there were still the price: the manufacturer calls a whopping 250,000 euros (the first three copies should cost 200,000 euros) including charger. But of course, the acquisition costs also pay for a large part of the operating costs that a combustion engine would cause in the future (maintenance/fuel, etc.).

In order for the amortization to work and the hourly price to drop to 60-70 euros, the batteries and the entire plane really have to last as long as the manufacturer Elektra Solar promises. And if you consider that there are now also combustion ULs for more than 200,000 euros and that the prices for e-aircraft will certainly drop significantly in the next few years (similar to electric cars in recent years), then Elektra trainer can herald the start of a new generation of trainer aircraft. ✔

A7-304
A2-210

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Universal Hydrogen's testbed airplane is a retrofitted 40-seat Dash-9 regional jet making the demonstrator the world's largest airplane powered by hydrogen fuel cell electric propulsion taking the title from ZeroAvia in less than two months.

Hydrogen Flight is picking up the pace

One turbine engine on the Dash-8 demonstrator of Universal Hydrogen was replaced with a 750kw electric motor powered by hydrogen fuel cell

The aviation industry has not seen a flight record being broken so quickly for a long time, but now we are witnessing such an exciting historic moment in hydrogen aviation development. In less than two months, the record of the largest airplane powered bya hydrogen fuel cell was set by a startup and then broken by another startup. The more exciting time of hydrogen aviation is yet to come.

On 19 January 2023, the American startup ZeroAvia made the first flight of its 19-seat Dornier 228 testbed aircraft retrofitted with a full-size prototype hydrogen-electric powertrain on the left wing of the aircraft. The flight took place from the company's R&D facility at Cotswold Airport in Gloucestershire, UK, and lasted 10 minutes. It set the world record as the largest aircraft in the world powered by a hydrogen-electric engine. The aircraft completed taxi, take-off, a full pattern circuit, and landing. The landmark flight forms part of the HyFlyer II project, a major R&D programme backed by the UK Government's flagship ATI Programme, which targets the development of a 600kw powertrain to support 9-19 seat aircraft worldwide with zero-emission flight.

As the aviation community was still excited about the flight of ZeroAvia, on 2 March 2023, that's just a little over a month from the record flight of ZeroAvia, another American Startup Universal Hydrogenbroke the record by flying a 40-seat ATR 72 regional aircraft converted to run on hydrogen fuel cell electric propulsion on one engine. The testbed airplane, nicknamed Lightning McClean, took off from Grant County International Airport (KMWH) in Washington state and flew for 15 minutes, reaching an altitude of 3,500 MSL. The ATR 72 has one original turbine engine replaced with a 750kw electric motor powered by a liquid hydrogen fuel cell.

The flight, conducted under an FAA Special Airworthiness Certificate, was the first in a two-year flight test campaign expected to culminate in 2025 with entry into passenger service of hydrogen fuel cell powered regional airliner. Representatives from Connect Airlines and Amelia, the US and European launch customers for the hydrogen airplanes, respectively, were on hand to witness the historic flight.

Both ZeroAvia and Universal Hydrogen have made remarkable achievements and friendly competition is good for the hydrogen aviation industry which is still at a very early stage.

The modular hydrogen distribution system at the airport envisioned by Universal Hydrogen

The liquid hydrogen tank used on Dash-8 demonstrator airplane by Universal Hydrogen.

The 750kw electric motor used on Dash-8 demonstrator airplane by Universal Hydrogen

ZeroAvia's testbed airplane is a retrofitted 19-seat Dornier 228 regional airplane

ZEROAVIA

The twin-engine Dornier 228 testbed used by ZeroAvia aircraft was retrofitted to incorporate ZeroAvia's hydrogen-electric engine on its left wing, which then operated alongside a single Honeywell TPE-331 stock engine on the right. In this testing configuration, the hydrogen-electric powertrain comprises two fuel cell stacks, with lithium-ion battery packs providing peak power support during take-off and adding additional redundancy for safe testing. In this testbed configuration, hydrogen tanks and fuel cell power generation systems were housed inside the cabin. In a commercial configuration, external storage would be used and the seats restored.

ZeroAvia said that at the test flight all systems performed as expected. This is the largest ZeroAvia engine tested to date, and places the company on the direct path to a certifiable configuration to be finalized and submitted for certification in 2023, with this programme also serving as key to unlocking speedy technology development for larger aircraft. ZeroAvia's 2-5 MW powertrain programme, already underway, will scale the clean engine technology for up to 90-seat aircraft, with further expansion into narrow body aircraft demonstrators over the next decade.Of note, this flight test campaign is being conducted under a full Part 21 flight permit with the UK CAA, which is a much more stringent set of requirements compared to the E-Conditions framework ZeroAvia used for its 6-seat prototype test flights in the prior years. This signifies the maturity of the company's processes and design approaches and its readiness to proceed toward full commercial certification of its powerplants.

ZeroAvia will now work towards its certifiable configuration in order to deliver commercial routes using the technology by 2025. The Dornier 228 will conduct a series of test flights from Kemble and later demonstration flights from other airports. Almost exactly two years ago, ZeroAvia conducted the first of more than 30 flights of a six-seat Piper Malibu aircraft using a 250kW hydrogen-electric powertrain.

This latest achievement follows ZeroAvia's previous world-first milestones, starting with 6-seat prototype flights of a Piper M-Class airframe in 2019, and the world's first commercial-scale 6-seater hydrogen-electric powered flight in September 2020. The 2020 prototype was a part of the HyFlyer I programme in the UK. Unlike the previous tech demonstrator programme, ZeroAvia's 600kW engine being developed under HyFlyer II is a commercial-intent programme.

The hydrogen-electric powertrain on board was fueled using compressed gaseous hydrogen produced with an on-site electrolyzer. To enable hydrogen production on site, ZeroAvia and HyFlyer II partner the European Marine Energy Centre (EMEC) have delivered and

As Universal Hydrogen, ZeroAvia's Dornier 228 also replaced just one turbine engine with electric motor for safety reason. Can you tell which side is the electric motor?

A detailed image of the electric motor used on ZeroAvia's Dornier 228 testbed.

operated the Hydrogen Airport Refuelling Ecosystem (HARE), a microcosm of what infrastructure will look like in terms of green hydrogen production, storage, refueling, and fuel cell powered flight. The system's electrolyzer capacity was doubled earlier this year from its initial design for the latest project.

The first flight follows significant commercial momentum for ZeroAvia in recent months, including an engine order from American Airlines, a partnership agreement with OEM Textron Aviation and infrastructure partnerships with airports including Rotterdam, Edmonton International and AGS Airports. With 1,500 engines on pre-order, partnerships with 7 aircraft manufacturers, and a number of fuel and airport partnerships, ZeroAvia is well positioned to lead the industry's transformation to a clean future.

ZeroAviainitially targets a 300-mile range in 9–19 seat aircraft by 2025, and up to 700-mile range in 40–80 seat aircraft by 2027. Based in the UK and USA, ZeroAvia is on track for commercial operations in 2025. The company's expanding UK operations are supported by grants from the UK's Aerospace Technology Institute and Innovate UK, and ZeroAvia is part of the UK Government's Jet Zero Council.

UNIVERSAL HYDROGEN

In this first test flight, one of the airplane's turbine engines was replaced with Universal Hydrogen's fuel cell-electric, megawatt-class powertrain (750kw to be exact). The other remained a conventional engine for safety of flight.The company's powertrain is built around Plug Power's ProGen family of fuel cells specially modified for aviation use. One of the unique aspects of the design is that the powertrain does not use a battery—the fuel cells drive the electric motor directly—drastically reducing weight and cost. The motor, a modified magni650 electric propulsion unit, and power electronics were supplied by Everett-based magniX. Seattle-based AeroTEC assisted with engineering efforts, including the design of the modified nacelle structure, aircraft systems design and integration, as well as aircraft modifications and installation of the Universal Hydrogen powertrain onto the flight test aircraft, accomplished in less than 12 months.

The test flight comes on the back of successful demonstrations in December 2022 of Universal Hydrogen's modular hydrogen logistics system conducted at the company's engineering center in Toulouse, France.

The company, backed by GE Aviation, Airbus Ventures, Toyota Ventures, JetBlue Ventures, and American Airlines, as well as several of the world's largest green hydrogen producers and top-tier financial investors, plans to springboard from regional airplanes to larger ones and to hydrogen fuel deliveries for other mobility applications using its modular logistics network. The founder and CEO Paul Eremenko said, "More than half of aviation CO2 emissions today come from the A320 and 737 family of aircraft," "Both Airbus and Boeing will need to replace these venerable airplanes with a new design starting development in the late-2020s and entering passenger service in the mid-2030s. Making their successor's hydrogen airplanes is a goldenopportunity—perhaps the only opportunity—for aviation to get anywhere near meeting Paris Agreement emissions targets without having to curb aviation traffic volumes."

The company has a rapidly growing order book, today totaling 247 aircraft conversions from 16 customers worldwide, totaling over $1 billion in conversions backlog and over $2 billion in fuel services over the first ten years of operation. Connect, which will begin regional turboprop service this spring, has placed a first-position US order with Universal Hydrogen to convert 75 ATR 72-600 regional airplanes to hydrogen powertrains with purchase rights for 25 additional aircraft conversions. ✔

The hydrogen refill system at the airport envisioned by ZeroAvia, which is different from Universal Hydrogen's concept.

The summary of the record flight and the cargo variant of Prosperity I which was used for the record-setting flight. Besides the two propellers used on the passenger-carrying model, it also has an additional propeller on the cabin because cabin noise is no concern for cargo application.

Silent to new record

On 23 February 2023 the eVTOL startup Autoflight flew the latest prototype of its "Prosperity I" five-seat eVTOL continuously for 250.3 kilometers in JiningCity, Shandong province, China. The distance is three kilometers longer than the247.36 kilometers covered by Joby Aviation's S4 eVTOLprototype during a test flight in July 2021, thus claiming a world record for the longest flight by an eVTOL aircraft with a gross takeoff weight in 2 metric ton class on a single electric charge.

Autoflight considers the flight a key milestone in its efforts to achieve EASA-type certification in 2025 and to prove the aircraft's ability to operate commercially up to 250 kilometers in distance at speeds above 200 km/h. AutoFlight plans to expand the flight envelope for the current version of the Prosperity I prototype later this year at a U.S. base under development at Napa County Airport in California.

The prototype is the 4th generation of the four-seat Prosperity I. The flight was remotely piloted as it completed 20 circuits of a predefined flight track. To accurately track the distance flown, the prototype installed two additional GPS tracking devices provided by ForeFlight and Stratus GPS to run in tandem with its own cockpit suite to prove the record-setting flight.

Besides the distance record, another perhaps less noticed but equally remarkable thing demonstrated in this flight is the full transition flight of the prototype from vertical lift to horizontal cruise. The full transition is widely regarded in eVTOL domain as the most difficult phase of the flight. Few full-scale lift-and-cruise eVTOL prototypes in the world have achieved this critical maneuver so far.

If the new prototype appears to be more aesthetically appealing, it should be because the industrial design work for the aircraft was done by the famous automotive designer Frank Stephenson who is known for his work on car brands such as Ferrari, Maserati, McLaren, and Mini.

A more apparent difference in appearance is the configuration of the new prototype from previous ones. The new prototype now has a unique setup of three cruise propellers with two at the rear of twin booms and one at the rear of the fuselage instead of the one and two propellers on

The passenger-carrying model of Prosperity I. There're two propellers at the end of the beam

previous prototypes respectively for cruise flight. The propellers for vertical flight remain the same at ten units as in previous prototypes. The company mentioned that the Prosperity I design is not yet frozen and the aircraft being used for flight tests is not a conforming prototype.

Founded in 2017, Autoflight targets to provide global customers with logistics delivery and passenger-carrying solutions. It established an R&D and airworthiness center in Augsburg/Germany in 2022, a business and operation center in the United States, and a manufacturing center inKunshanCity near Shanghai in China. In 2021 AutoFlight raised $100 million through a Series A financing round led by European technology investor Lukasz Gadowski and his Germany-based company, Team Global. In October 2021, it reported the first flight for a proof-of-concept version of the passenger-carrying eVTOL aircraft that it then called the V1500M which evolved into the current model.

Autoflight takes a product development approach of "from small to large, from cargo to passengers". With this plan in mind, Autoflight developed the cargo version V2000CG on the same platform as Prosperity I and has jointly formulated the certification basis for the cargo model with the Chinese regulator CAAC in 2022. The car-

Flight data and the prototype at the beginning of the record flight.

Interface of the flight data tracking. The prototype installed two additional GPS tracking devices provided by ForeFlight and Stratus GPS to run in tandem with its own cockpit suite to record and prove the record-setting flight.

go model successfully passed the design review meeting with CAAC's designated committee in early February this year.

In October 2022, AutoFlight appointed a new U.S.-based leadership team led by Eviation Aircraft's founder and former CEO, Omer Bar-Yohay, as the Global President to achieve its objective of having the aircraft certified and ready to start commercial services in 2026. The company also named Joby Aviation's former head of business development, ChadCashin, as its chief commercial officer last year. Autoflight set up the R&D and certification center in Augsburg, Germany in January 2022 and recruited Mark R Henning, the former manager of Airbus EC135 and H145 helicopters, as the general manager of Autoflight Europe.

In March this year, Autoflight received an order of 205 Prosperity eVTOL in both cargo and passenger-carrying models from Singapore-based fleet-management and air-transport company EvFly. Who expects to receive the first 10 Prosperity aircraft in 2025 to operate in Middle Eastern markets such as the United Arab Emirates and Saudi Arabia.

Flight data and the prototype aircraft near the end of the record flight.

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