

## 【欧州】【航空】

Aviation - Environmental Issues: Development of electric aircraft - after EASA type certification, fully electric aircraft makes world's first flight from the Alps to the North Sea - including recharging pauses

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### 【概要 : Summary】

In the aviation sector, the reduction of GHG emissions is a challenge due to the still existing technical limitations to replace the conventional kerosene-based aircraft propulsion with environmentally friendlier propulsion systems. Besides the utilisation of alternative fuels, which are already used in commercial aircraft, some other technologies are considered as alternative propulsion systems, like electric propulsion for aircraft. Several aircraft manufacturers, aviation start-ups as well as major aircraft manufacturers like Boeing and Airbus are working on replacing kerosene fuelled jet engines with different propulsion alternatives, including electric propulsion systems. In future, electric aircraft or air taxis could cover short-haul or urban flights and present new opportunities for air travel and markets, like new sub-regional aviation.

However, there are still several problems regarding the utilisation of electric propulsion that have to be overcome. This includes battery density, efficient electrical systems, effective system integration, and effective regulation as well as airworthiness solutions to enable new

propulsion systems and architectures.

Nevertheless, electric aircraft represent one starting point to make aviation more sustainable and they represent new opportunities for air travel. A number of projects have been launched in order to explore the viability of electrification for aviation, ranging from short-range and urban air taxi applications to electric or hybrid designs for small regional aircraft.

The Slovenian company Pipistrel produces electric aircraft and on 10 June 2020, the European Aviation Safety Agency (EASA) announced the type certification of the Pipistrel Velis Electro, the first type certification of a fully electric aircraft.

The Velis Electro is the first electric two-seater aircraft that has been approved for commercial series production by EASA. Meanwhile, the Pipistrel Velis Electro made a successful flight in several legs from Switzerland to the North Sea island Norderney in Germany.

### 【記事 : Article】

1. Background of electrification of aircraft  
The development of a low to zero emission propulsion systems for aircraft is the most difficult task, due

to the still existing technical limitations. Besides the utilisation of biofuels, the options for a replacement of combustion engines and kerosene-reliant propulsion systems with environmentally friendlier solutions is currently still limited. So far, large planes are not feasible for electric propulsion due to the battery weight, design problems, limited capacity and limited range. Nevertheless, some countries like Norway are considering to taking up the challenge to electrify aviation. Considering the availability of batteries that could be used as source of energy for the electric propulsion of aircraft, it is currently expected that 6% to 10% of commercial airline flights could be electric by 2050.

In future, hybrid-electric aircraft capable of carrying 50 passengers could be flying on short-haul routes by the early to mid 2030s. However, besides the technical problems, before all-electric passenger aircraft could come into commercial operation, the new aircraft systems need to meet the specific power, weight, and reliability preconditions. A first step into the commercial utilisation of electric propulsion for aircraft has been done by the construction of light aircraft and the type certification of the first electric small aircraft by EASA in June 2020.

## 2. Electric plane trials

With more than 30 years of experience, the small aircraft designer and manufacturer Pipistrel is specialized in energy-efficient and affordable high-performance aircraft. It has designed nine different experimental and serially produced electric aircraft. It has also developed propulsion systems, including batteries, power controllers and electric motors, for small and general aviation class of aircraft for NASA and Siemens, among others. With involvement in standardisation committees, i.e. ASTM F44.40, F39.05, SAE AE7-D, Pipistrel is helping to enable the future market of hybrid-electric aviation.

The Pipistrel's Velis Electro electric plane is a

6.5 metres long two-seater aircraft with an empty weight of 428 kilos including battery. The plane's payload is 172 kilos and the maximum flight altitude is 12,000 feet. The two batteries with a nominal voltage of 345 volts each have a capacity of 11 kWh. The range is approximately 130km and the aircraft can remain airborne for about one hour per charging. Pipistrel's aircraft Alpha Electro G2 is the first electric two-seater aircraft to be approved for commercial series production.

Pipistrel's electric aircraft development has also attracted the attention of Norway's airport operator Avinor. The Norwegian government is considering ways to achieve a carbon emission reduction in the aviation sector and is considering to taking up the challenge to electrify aviation. On 18 June 2018, Avinor's director Dag Falk Pedersen successfully completed the first flight of an electric powered airplane in Norway with the Norwegian Minister of Transport Ketil Solvik-Olsen as passenger in a Pipistrel Alpha Electro G2 two-seater electric plane. On 20 June 2018, Avinor announced that the country's short-haul flights should become entirely electric by 2040. The public operator of Norwegian airports aims to be the first in the world to make the switch to electric air transport. All flights lasting up to 1.5 hours could be flown by aircraft that are entirely electric, according to Avinor. Consequently, in Norway, electric planes should then cover all domestic flights and those to neighbouring Scandinavian capitals.

Meanwhile, the Pipistrel Velis Electro aircraft received EASA's type certificate for an electric aircraft and its electric engine.

## 3. Certification of electric propulsion systems of planes

The Pipistrel Velis Electro is the world's first fully electric aeroplane ever to receive EASA's type certification. The two-seater Velis Electro, intended primarily for pilot training, is an important aircraft in terms of technological

innovations and cost-efficiency.

On 18 May 2020, EASA type certified the Pipistrel Velis Electro aircraft's engine, the E-811-268MVLC, as the first electric engine. On 10 June 2020, EASA also followed up with the first type certification of a plane flying with that engine. The drive of the Velis Electro and the battery are liquid-cooled. In the approval procedure, the aircraft's system had to withstand malfunctions, overheating and mechanical stress. EASA's certification team was composed of EASA staff, but included also experts from the Swiss and French authorities, in order to prepare and facilitate the entry into service of the Velis Electro aircraft in these two countries. This EASA type certification was the Agency's first for an electric engine and the electric aircraft itself. It yielded many new experiences for the future certification of electric engines and aircraft, which is also by EASA considered a growth area in the coming years in line with the aims of environmental protection. Accordingly, this type certification is one important step on the way to achieving an environmentally sustainable, emission-free aviation.

The head of the General Aviation Department at EASA commented that also for EASA, the type certification of this aircraft marked a significant dual milestone. EASA Executive Director Patrick Ky stated it was "an exciting breakthrough", as this Pipistrel electric plane would be the first of many e-planes EASA would certify, "as the industry pursues new technologies to reduce noise and emissions and to improve the sustainability of aviation". The project also brought important learning that will support future certifications of electrically powered engines and aircraft.

According to the founder and CEO of Pipistrel Aircraft Ivo Boscarol, the type certification of the Pipistrel Velis Electro is the first step towards the commercial use of electric aircraft, which makes the utilisation of emission-free aviation feasible. It is considerably quieter than

other aeroplanes and produces no combustion gases at all. The successful EASA Type Certification is an uncompromised affirmation of the safety of the plane's design.

Pipistrel plans to deliver the first 31 Velis Electro planes to customers in 7 different countries already in 2020. With more than 400 flight hours and 25 pilots introduced to the predecessor Alpha Electro, the company is convinced of the suitability of electric flight, in particular in the daily flight school environment. Initially, Pipistrel will distribute 12 aircraft on 10 airfields over Switzerland. Each base will be equipped with 150 m<sup>2</sup> of photovoltaic panels, producing electricity for 12,000 flight hours per year on the Velis Electro.

#### **4. Several world's first: The light aircraft Pipistrel Velis Electro sets new benchmarks**

The Velis Electro has a realistic range of around 100 kilometres, but this did not stop the Swiss flight instructor for electric aircraft, Marco Buholzer and his team, to try to set several world records during a flight from the airport Schänis near Zurich in Switzerland to the island of Norderney in North Sea, off the German coast.

The challenge was, among others, to find small sports airfields along the route that had the necessary electricity connection ideally with 32 amperes to recharge the aircraft's batteries, every 100 km distance for about one hour. However, since none of the airfields had the proper electricity connections in place, the ground crew, had to drive ahead with the charging infrastructure in order to provide the aircraft with the necessary recharge.

During the trip, which started on 1 September 2020, the crew tried to set a new world record in the following seven categories regarding the performance of an electric aircraft:

- Lowest energy consumption over 700 kilometres
- Highest average speed over 700 kilometres

- Highest altitude ever reached by an electric aircraft
- Fastest climbing performance from 0 to 1000 meters, 1000 to 2000 meters and 2000 to 3000 meters
- Fastest average speed over 100 kilometres
- Lowest number of stopovers over a distance of 700 kilometres
- Longest electrically flown distance in 24, 48 and 56 hours.

The pilot reached Norderney on 2 September 2020 concluding a successful flight with several re-charging stopovers. According to the flight and organisation team, this landing of an electric aircraft after a more than 700 km flight divided in several legs due to recharging marks a milestone in electric mobility.

## 5. Outlook

This first flight over a distance of several hundred kilometres by the Pipistrel Velis Electro aircraft is a bit of a reminiscent of the first 106 km long distance road trip in history with an automobile, driven by automobile pioneer Bertha Benz in 1888, for field testing the first patent “Motorwagen” of Karl Benz. In the same way as that road trip was a key event in the technical development of the automobile, the Velis Electro aircraft flight from Switzerland to Norderney could also earn some significance for the development of electric aircraft in future. The flight proved that it is possible to fly an aircraft, however small, for over an hour and then continue flying after an hour of recharging. It can be considered being an important step on the way to steer aircraft propulsion systems from combustion engines and turbines, into a new direction that could enable electric aircraft based on renewable energies to enter the market. The accelerated development in the battery technology would be a key factor to enable the development of electric propulsion for aircraft and it will decide if and to what extent electric planes will become reality. In fact, as long as electric propulsion for larger aircraft is not developed yet, the aviation

sector will have to rely on alternative fuels to reduce its GHG emissions. In the short to medium term, biofuels will have the greatest chance of reducing CO2 emissions in aviation, to reduce the aviation industry’s reliance on conventional fossil fuels. However, electric propulsion systems for aircraft could be expected to be introduced for short-haul aircraft operations in the 2035–2040 timeframe. The type certification of the Pipistrel Velis Electro aircraft’ type approval and first flight over 700 km in several legs is the first step towards this commercial use of electric aircraft. Besides the technological problems of electric propulsion, there will be other issues to be considered, including the need to introduce the adequate regulatory policy, certification and airport infrastructure requirements.

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