

Common - Emerging technologies/Aviation - Utilisation of biofuel etc. as fuel: Nordic Network for Electric Aviation (NEA) strives to introduce electric aviation in Nordic countries

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【概要 : Summary】

Ways to reduce the CO₂ emissions have to be considered for all transport modes, as the pressure is growing to achieve zero emission mobility by 2050. In an effort to reduce the aviation sector's GHG emissions, the International Civil Aviation Organisation (ICAO)'s Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) aims at starting with a voluntary pilot phase in 2021. However, it is already doubted that the CORSIA scheme will be able to sufficiently reduce CO₂ emissions. At the same time, the development of a low to zero emission propulsion systems for aircraft is the most difficult task, due to the still existing technical limitations to replacing combustion engines with environmentally friendlier propulsion systems. Besides the utilisation of biofuels there are currently very limited possibilities to switch to low or zero-emission propulsion for aircraft. In road transport, batteries are at the heart of the on going electric mobility uptake and the technology change from combustion engine to electric propulsion. The utilisation of electric propulsion systems is directly addressing the urgent need of reducing the increasing European CO₂ emissions in the road transport sector. However, in the aviation sector, batteries are not considered a solution for aircraft since the problems of battery weight and

the limited ranges need to be overcome. Nevertheless, some north European countries are considering to taking up the challenge to electrify aviation and they are investing much time and effort in the development of electric planes. There are currently several barriers to electrical propulsion, which include battery density, efficient electrical systems, effective system integration, and effective regulation/airworthiness solutions to enable new propulsion systems and architectures.

The reason for focusing on the development of electric planes is that much of the Nordic region with Norway and Iceland in particular has in wide areas the problem that the terrain limits the possibilities for building high-speed railway infrastructure. In many areas air travel is the only viable option to connect the communities with the urban centres. Therefore, in order to make aviation sustainable, the idea is to develop electric planes that can serve on short-haul routes in the Scandinavian countries. Electric aircraft represent new opportunities for air travel and a number of projects have been launched in order to explore the viability of electrification for aviation, ranging from short-range/urban applications to electric or hybrid designs for small regional aircraft. Given the current level of technology, electric propulsion is only realistic

for very small aircraft, while for larger aircraft, only hybrid-electric concepts could become feasible in medium term. The main task will be to overcome the technical difficulties surrounding the development of batteries and electric propulsion systems for the aviation sector. Ultimately, the electric propulsion for aircraft will only be meaningful and sustainable if this new technology will be based on an environmental friendly source of power generation from renewable energies.

【記事 : Article】

1. The development of electric aircraft

Besides the utilisation of alternative fuels, there is also the idea to use electric propulsion systems in aircraft for reducing air pollution and GHG emissions. Aviation start-ups as well as major aircraft manufacturers are working on replacing kerosene fuelled jet engines with electric propulsion systems. The aim is to reduce the emissions at the aircraft itself to zero, and to generate the necessary electricity by using completely renewable sources. The start-up companies as well as established aircraft manufacturers like Boeing and Airbus intend to launch an all-electric commercial passenger jets for short-haul routes within a decade. The major part of these projects is focusing on general aviation and urban air taxis and aim for all-electric propulsion for aircraft. Around 12% of the projects are focusing on the development of regional and large commercial aircraft concepts. However, in case of regional and larger commercial aircraft types, manufacturers are experimenting with turbo-electric hybrid propulsion with traditional hydrocarbon based fuels for greater range.

In 2010, a group of NASA researchers started to develop an aircraft based on electric propulsion and batteries. Meanwhile, the US start-up and electric aircraft manufacturer, Wright Electric, intends to build a commercial passenger plane that runs on batteries and seats 150 passengers for short-haul trips of up to 500 km distance. In September 2017, UK LCC EasyJet announced its cooperation with Wright

Electric in order to develop an electric 180-seater plane by 2027. Furthermore, another US start-up, Zunum Aero, which is partly financed by US aeronautics group Boeing, plans to bring a hybrid plane to the market by 2022. After abandoning a project for 100% electric planes last year, Airbus decided to refocus its efforts on developing a hybrid model, signing a partnership with British engine maker Rolls Royce and German industrial group Siemens. They intend to develop the hybrid-electric airline demonstrator E-Fan X, with four engines out of which one engine will be an electric engine.

Airbus is also cooperating with SAS Scandinavian Airlines. They signed a memorandum of understanding for joint research into a hybrid and electric aircraft eco-system in order to explore the technology's potential. Furthermore, Norwegian carrier Widerøe announced in August 2019 that it would work with Rolls Royce on zero-emission aircraft to replace its ageing Dash8 fleet. In November EasyJet also announced that it has signed a MoU with Airbus to jointly assess the potential of hybrid and full-electric aircraft for short-haul flights across Europe, in order to supplement its partnership with Wright Electric.

In July 2019, Airbus also released the "Bird of Prey" hybrid-electric design demonstrator, which also employs significant bio-mimicry elements such as the blended wing and wing tips, which are inspired by birds of prey. Whether or not these designs ever come to manufacture, they are certainly guiding the industry towards large commercial electric aircraft. According to Robert Thomson (2020), there is an industry-wide shift towards developing electrically propelled aircraft visible and since 2016, the cumulative number of projects has increased and the number of electrically propelled aircraft projects grew by about 30% in 2019.

Recently, new Urban Air Taxi concepts have risen from 40% to 45% of all the development projects, according to the Roland Berger database. They represent the major category of electric aircraft projects. There are about 100 projects being

conducted around the world by cities, universities and potential operators to test and develop the Urban Air Mobility (UAM) ecosystem. General aviation is close behind, comprising around 85 projects globally. While projects in the category of urban air taxis and general aviation projects dominate in fully electric propulsion, current electrical systems technology still favours lower power and shorter distance flights.

Meanwhile, the European project IMOTHEP (Investigation and Maturation of Technologies for Hybrid Electric Propulsion) will investigate electric technologies for hybrid electric aircraft. A consortium of 33 key aviation industry and research stakeholders including manufacturers like Airbus, Leonardo, Safran, GE Avio, MTU, ITP and GKN, as well as European aeronautical research and higher education organisations is engaging in an ambitious research project on hybrid electric propulsion for commercial aviation. IMOTHEP is a 4-year Research and Innovation Action and receives a EUR 10.4 Million grant from the European Commission under the Horizon 2020 framework program. In the next years, the development of electric aircraft will further accelerate and also airlines, airports and governments will have important roles in this transition towards the utilisation electrically propelled aircraft.

2. Norway's approach to promote the introduction of electric aircraft

Norway is the largest oil and gas producer in Western Europe but it is also a pioneer and leader in the field of electric transport in Europe and beyond. Norway generates about 99% of its electricity in mainland from hydropower plants. With this electricity production from renewable energies background, Norway can focus on the electrification of the entire transport sector. For years, Norway has been the European country with the highest number of annual new electric passenger car registrations and it is also developing and operating electric vessels. Based on its policy

towards a consequent electrification of the entire transport sector, Norway, but also other Northern European countries are considering ways of developing and using electric planes for short-haul routes in the mid-term future. Therefore, the target to make all short-haul flights in Norway entirely electric by 2040 is an ambitious goal but it is also in line with the Norwegian governments' general policy to achieve an electrification of the entire transport sector. Also Norway's airport operator Avinor supported the plan that the country's short-haul flights should become entirely electric by 2040. Norway is aiming at becoming the first market in which electric aircraft represent a significant share. In fact, the target is that all flights lasting up to 1.5 hours should be flown by aircraft that are entirely electric, including all domestic flights and to neighbouring Scandinavian capitals.

In June 2018, Norway tested a two-seater electric plane, with Norwegian Transport Minister Ketil Solvik-Olsen and Avinor's CEO Dag Falk-Petersen taking a few minutes' flight around Oslo airport in an Alpha Electro G2 plane, built by Pipistrel in Slovenia. The Slovenian Pipistrel's aircraft Alpha Electro G2 is the first electric two-seater aircraft to be approved for commercial series production.

In the near future, Avinor plans to launch a tender offer to test a commercial route flown with an electric plane with 19 seats, starting in 2025. In the meantime, several companies are working to incorporate battery technology into regular-looking airplanes for greener, quieter, and more efficient flights.

Also Sweden aims for reaching the 2030 target that all domestic air travel should be fossil fuel free, and all international flights departing from Swedish airports by 2045. Finavia in Finland and Avinor in Norway have both introduced the first electric aircraft in their respective countries. There is also developing an electric aerospace industry in the Nordic countries, including the Swedish Electric Aircraft start-up

Heart Aerospace AB, and there are plans to open the world's first commercial airline with electric aircraft in Norway in 2023.

3. The Nordic Network for Electric Aviation (NEA)

While the Scandinavian countries are focusing on making air travel more sustainable and are starting to develop an electric aerospace industry, their efforts have been individual by country so far. However, now, the Nordic Network for Electric Aviation (NEA) has been created, which will offer a platform for coordinating efforts together in order to accelerate the introduction of electric aviation in the Nordic countries. Funded by Nordic Innovation, as an organization under the Nordic Council of Ministers, the NEA initiative is expected to strive the efforts to develop electric aircraft. The Nordic Network for Electric Aviation (NEA) gathered several key players from all over the Scandinavian countries and as a Nordic network it works on infrastructure, industry issues and new business models. NEA will organize workshops and other events to build knowledge and cooperation in the Nordic countries. Currently, the NEA project is a collaboration between twelve partners from six Nordic countries. The partners include the research institute RISE (Sweden), SAS Scandinavian Airlines (Denmark-Sweden), Heart Aerospace (Sweden), Elfly AS (Norway), Air Greenland (Greenland), Iceland Air (Iceland), Finnair (Finland), Braathens Regional Airline (Sweden), Swedavia (Sweden), Avinor (Norway), Finavia (Finland) and NISA Nordic Initiative Sustainable Aviation (Denmark). In December 2019, NEA had a kick off meeting in Östersund for setting up a plan for each project. According to NEA, the fastest, most affordable and sustainable transportation for regional travel is electric aviation. In order to achieve that, gathering knowledge and people from many different sectors is necessary. Although the Nordic countries have a substantial airport infrastructure that could connect regions, the current traffic flow tends to be nationalized

and centralised to the Nordic capitals. The network has four focus areas with clear objectives for driving the growth of electric aircraft. They include standardizing electric air infrastructure in the Nordic countries, developing business models for regional point-to-point connectivity between Nordic countries, developing aircraft technology for Nordic weather conditions and creating a platform for European and global collaborations.

Meanwhile, on 28 January 2020, the Finnish government-owned airport operator Finavia joined the NEA coalition of Nordic actors pushing for the introduction of electric aviation across the region. Finavia has joined NEA to enhance the development of electric aviation, in order to accelerate the introduction of electric aviation in the Nordic countries. As an airport operator Finavia wants to find out what kind of development electric flying will require from airports, according to Finavia's Technical Director Henri Hansson. Since 2018, Finavia has been funding a fully electric aircraft that had a successful test flight at Malmi Airport in Helsinki in summer 2018. Joining the NEA is the next step in contributing to the development of electric flying and is a part of Finavia's climate program to decreasing CO2 emissions at the airports. According to Finavia, CO2 emissions per passenger across its stock have fallen by 68% over the past ten years, from 2.2kg to 0.7kg between 2007 and 2018. All 21 of Finavia's airports achieved carbon neutrality in 2019 and the next target is zero emissions. According to Hansson, electric aircraft would be "especially suited" to short-haul routes. According to Hansson, in Finland, the first electric passenger aircraft is expected to fly on a domestic route by the end of 2020s.

Aside offsetting emissions, Finavia's regional airports use renewable sources of energy such as pellets for heating. By becoming a partner of the Network for Electric Aviation, Finavia will contribute to the development of electric flying, which will then become part of Finavia's climate programme, aims at reducing CO2 emissions at its

airports. On the 28th and 29th January 2020, the NEA network members met in Helsinki, Finland. In the meeting hosted by Finavia and Finnair, the members discussed electric aviation in workshops. The topics included standardizing electric air infrastructure in the Nordic countries and developing aircraft technology for Nordic weather conditions.

4. Prospects for a future with electric aircraft

Electric propulsion for aircraft could cause a paradigm shift in the aviation sector and the joint target of the Nordic initiative to promote electric aviation is to accelerate the development of electric aircraft. It has the potential to make flights environmentally friendlier. It could also open up new markets of aviation, including new sub-regional aviation. The electric propulsion for aircraft promises to increase fuel efficiency and to reduce GHG emissions, among others. Furthermore, electric aircraft for short-haul flights could represent new opportunities for air travel. Several international manufacturers are currently working on their development. However, in the near future, only the introduction of hybrid systems seems to be realistic and feasible, while fully electric planes for more than two passengers have still to be developed. Therefore, initiatives like NEA are important to focus the efforts of several players and thereby to accelerate the development of electric planes with the targeted to pushing for the introduction of electric aircraft across the region.

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