Institute of Transport Economics
Norwegian Centre for Transport Research

ENGLISH

Summary

Knowledge base about an electric pilot-PSO-route Førde-Bergen

TØI Report 1963/2023 • Author: Inga Margrete Ydersbond • Oslo 2023 • 98 pages

In this report, we investigate the potential societal effects of a battery-electric pilot public service obligation (PSO) route between the two Norwegian cities Førde and Bergen, and what is needed to establish this route. The report finds that such an establishment will yield significant regional benefits, and support current regional policy goals, in particular better cooperation across Western Norway, as well as faster transport of employees and patients in the region. The passenger base is primarily people on business or other work-related trips. Prerequisites for success are that the route facilitates daily commuting, offers sufficient departures and that the tickets are reasonably priced. Widerøe wants such a route to be part of a network. The project's most important effect in a climate context, is its contribution to phasing in battery-electric aircraft nationally and internationally as rapidly as technically possible. In addition, such an introduction of battery-electric aircraft will contribute to reducing pollution. To establish such a PSO route, the following is needed: certified electric aircraft, pilots, aircraft engineers and systems around the aircraft, that airlines can achieve commercial operation of them, and that the route receives support for establishment and operation. Different types of state support is therefore essential.

This project has addressed the main question:

> **What kind of social effects can we expect if an electric pilot-PSO route is established between Førde and Bergen, and what will it take to establish this PSO route?**

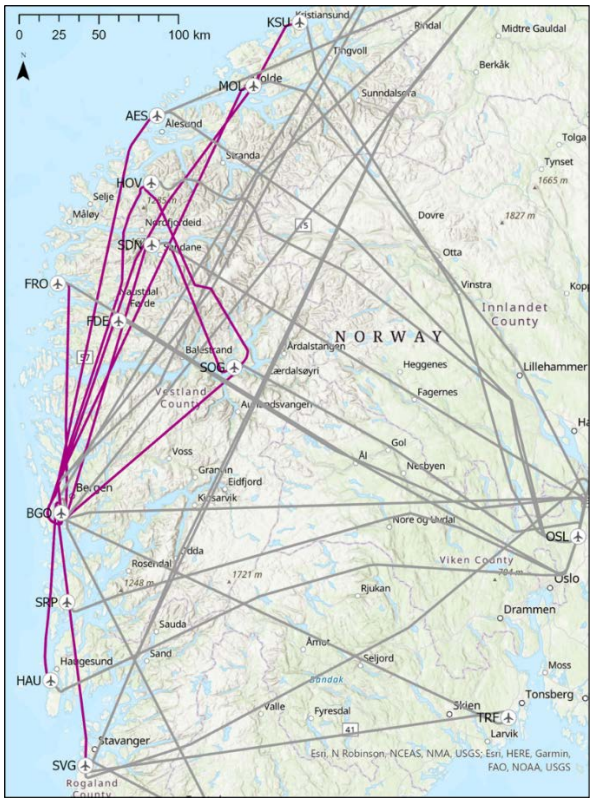
To handre this main question, the report has discussed a number of issues that have helped shed light on the topic, including: societal benefits, regional policy gains, technical and non-technical innovation needs, suitable aircraft types, technology status of suitable electric aircraft, incentive schemes and passenger base. Various methods have been used, such as in-depth interviews with 17 key informants, document analysis, review of existing research and reports, cost-benefit analysis and cost calculations. As far as possible, primary data have been used where they provide the best analyses.

The establishment of an electric pilot PSO route is likely to yield **major regional political benefits** in the form of opportunities for increased cooperation and better communication within Western Norway, innovation in services and products, more efficient operation of existing businesses, and opportunities for 'green tourism.'

There is probably a sufficient **passenger base** to establish an electric pilot-PSO route between Førde and Bergen, given that small aircraft are initially used, and that relevant passengers perceive it as attractive to fly electric aircraft on the route. Representatives of public and private enterprises in Førde and Bergen generally express a strong desire to reduce travel time between the two cities considerably by being able to fly by electric aircraft. Not least, the employees of the Helse Vest experience that today's transport services between the cities, ie. the use of cars and buses, entail such a high level of time spent, that it to some extent affects their ability to deliver good services to the population they are responsible for. It is primarily on business trips that it will be relevant to take an electric aircraft on the route to save time. For other types of travel, the majority of travellers, also in the future, will probably prefer to use a private car because of the great flexibility offered by car use.

The prerequisites for such a pilot PSO-route with electric aircraft to be successful are that **a sufficient number of departures are set up each way so that daily commuting is possible**, that routes are set up that **make it possible to reach morning meetings in Bergen and Førde**, and that **ticket prices are perceived as cheap or reasonably priced**. In addition, it is an advantage if the flights overall are as easy as possible to complete. For example, this could mean easy booking on board on the public transport they use to airports. Travelers must also have access to good information.

The airline Widerøe wants such a pilot electric flight route to be part of a network. Below are all the routes in Western Norway. This clearly shows that a network of electric air routes north and south of Bergen Airport Flesland may be created, and that the whole of Western Norway can be one network.



Climate and environmental effects

The case, the battery-electric pilot-FOT route between Førde and Bergen, contributes to reduced external social cost of damage through lower greenhouse gas emissions, lower local emissions, less congestion and accidents. The most important advantage from a climate perspective, however, is that the case can be one of the steppingstones for faster phasing-in of electric aircraft nationally and internationally. This is very important, as new technologies, including those that provide electrification of aviation, are essential to achieving aviation's climate target of net zero emissions by 2050. Creating such a route is also likely to contribute to a number of positive so-called non-priced effects, such as less noise around airports overall if many routes are electrified, that travelers avoid flight shame, that companies more easily achieve climate certification, that it becomes easier for Norway to reach climate policy goals, and that it can provide network benefits for airlines.

Pros and cons of the case

Almost all informants believed that the case of an electric FOT route between Førde Airport (Bringeland Airport, FDE) and Bergen Airport (Flesland Airport, BGO) is suitable for the introduction of electric aircraft in ordinary passenger transport. Advantages of the case are that:

- With only 125 kilometres between airports, it is a distance first generation of battery-electric passenger aircraft will be able to operate, while meeting aviation's strict requirements for energy reserves and for alternative airports to land at.
- The passenger base is likely 'thin.' Thus, it can be operated fairly efficiently with the first models of battery-electric electric aircraft for passenger transport with few seats and short range. This route is likely to get good occupancy if it becomes attractive, which will support profitability for the airline (operator) operating it.
- There is strong local support for such a project from a number of local actors, including Sunnfjord municipality and Vestland county.
- The airports have sufficient network access for charging, at least initially.
- Alternative means of travel take considerably longer. Driving takes about an hour longer in total one way.
- The weather is demanding during the winter months, but not so demanding that it will be difficult/impossible to operate such a route through parts of the winter, as it may be in North Norway, according to the informants.
- Vestland County Council has much experience with development contracts to develop new environmental technology.
- Widerøe has its hub near Flesland and performs maintenance of its aircraft there. Therefore, it will be easiest from a logistics angle to carry out maintenance on the aircraft at Flesland, if Widerøe operates them. In addition, there will initially be few people with the right expertise to do such repairs and maintenance. Easy access to certified aircraft technicians is important as initially there is likely to be an increased need for maintenance and supervision of electric aircraft because the technology is new. Presumably, technicians are needed to be available at all airports, the electric planes go between initially.
- The efficient use of electric aircraft probably requires electric planes to 'stay overnight' at the airport they will be at before taking off for the first morning flights. Far from all small airports have hangars, but Bringeland airport already has this.
- Creating such a route will not contribute to destroying/disturbing other operators by taking parts of the traffic base from commercial routes on routes.

There are major costs associated with introducing many types of new technology in transportation, especially initially. This also applies to electric aircraft. The major drawback of the case is the large costs of the project in the form of purchasing electric aircraft, establishing charging infrastructure, training qualified staff and so on. There is thus no commercial basis for the establishment of passenger routes operated by electric aircraft in Norway today. However, much of the technology that has been developed in recent decades has been developed after support from the authorities and facilitation through various regulatory measures. This applies, for example, to various types of renewable energy and battery-electric vehicles. Furthermore, the public sector will also lose tax revenues as a result of the tax exemptions granted by electric aviation.

Aircraft types suitable for the route

Battery-electric aircraft, both passenger aircraft (initially this will be commuter aircraft size) and seaplanes, are suitable for the route. Eventually, eVTOLs may also be used, but this assumes that their range is improved. Various hybrid aircraft can also be used. In this context, battery-electric aircraft have a number of advantages, including that they:

h) has very high energy efficiency, highest of all propulsion systems
i) probably is less expensive in operation and maintenance than other types of technology,
j) are probably easier to get certified than hydrogen-electric aircraft,
k) does not have the same safety challenges as hydrogen-powered aircraft;
l) can take off from short runways, such as from Bringeland Airport, as opposed to the ordinary aircraft on today's market
m) in contradiction to hydrogen-powered aircraft do not contribute to 'escaped hydrogen' and condensation trails from water vapour,
n) don't need to have double the engines and energy storage, as hybrid aircraft running on both sustainable aviation fuel and electricity will have.

The main disadvantages of battery-electric aircraft are that current battery technology limits how far aircraft can fly, because the energy density of the batteries is much lower than that of jet fuel, and because the batteries are heavy. However, there are steady breakthroughs in battery technology and the energy density of batteries is increasing year by year, so it is impossible to say how great this limitation will be in the future.

Technology status of current electric aircraft

The review of battery-electric aircraft shows that as of spring 2023, there are primarily one current passenger aircraft models to fly the route, and possibly also one battery-electric seaplane. The first model is likely the nine-seater battery-electric aircraft model is the Alice from aircraft manufacturer Eviation, which has nine seats. This is the first battery-electric airliner to begin test flights. The first test was in September 2022. This model is expected to be commercially usable from 2027, if battery technology develops in line with Eviation's leaders' expectations. Below are Eviation's Alice and Elfly AS' Noemi.

Photo: Eviation.

Illustration: Elfly AS.

Technology development takes time, and it is impossible to know when the various models will be certified for ordinary passenger flights. How quickly the various technology models will be ready for commercial use is very difficult to estimate, but aircraft manufacturers expect that the aircraft they produce can be flown commercially from 2027–2028. The higher the energy density of the batteries, the longer routes the electric aircraft will be able to fly. If there are delays in the development of electric aircraft in relation to the plans, there may also be new alternatives or models that are relevant to consider in addition to those mentioned.

Expected effect of incentive schemes and what kind of incentive packages are needed to phase in electric aircraft

Incentive schemes are needed to make it profitable for the relevant airlines to be at the forefront of investing in battery-electric aircraft, to further train their pilots and aircraft technicians, and to restructure the organisation to also handle new aircraft types. The airlines that currently operate PSO routes in Norway are Widerøe and Danish Air Transport (DAT). Incentives that will make it easier for them to invest in electric aircraft include: a combination of investment support, guarantees for the second-hand values of electric aircraft and increased contract length on PSO routes, for example 10–15 years. In addition, it is advantageous if the tax system for aircraft is changed to provide many more tax exemptions for zero-emission aircraft, and that they are not penalized for possibly being heavier than similar conventional aircraft. Exemptions from VAT, air passenger tax, take-off tax and landing tax until 2040 are relevant examples. Widerøe and a number of other actors, including organisations working for a sustainable transformation of the transport system, such as the environmental organisation Zero, ask for an 'electric car policy for the air.'

In addition, support for research and development projects for electric aircraft from Enova and others will be beneficial. To introduce all these instruments in combination with putting even more clear, and also time-bound political goals for the attainment of zero emission aviation are probably important to support and motivate for early further investment in electric aircraft in the aviation industry nationally and internationally. Various informants emphasize that it would be desirable to have PSO-R&D routes, i.e. routes with a public service obligation as part of a research and development project. Widerøe Zero emphasises that if such PSO-R&D projects are to be established, it is important that they are included in their design so that they can participate further in the process of tendering projects.

Based on the study's analyses, we recommend considering the following incentives and incentive packages for phasing in electric aircraft in Norway:

1. It is important to have clear, quantified, time-defined, national policy objectives. The new national aviation strategy, *Sustainable and Safe Aviation*, states, among other things, that Norway will be a pioneer for electric aircraft, and that the first electric aircraft will be phased in on the FOT routes starting in 2028-2029. In addition, aviation will contribute to achieving a 55% reduction in greenhouse gas emissions by 2030. However, at the national level in Norway today, unlike in the other Nordic countries Sweden, Denmark and Finland, there are no specific national targets for when, for example, national aviation should have zero emissions. The Norwegian national goals should be even clearer and more ambitious. Such objectives are important as motivation, and also as security, to continue to develop technology for aircraft manufacturers and others, such as airlines, as well as investors for aircraft manufacturers and airlines. Their investments are made with a decades-long perspective, so it's important for them to know that they're making the right investments.
2. It is important to create a national and Nordic market for electric aircraft in ordinary passenger transport. This can be achieved through various types of economic instruments, such as exemption from take-off and landing tax, VAT, continued exemption from passenger tax and through money set aside to establish charging infrastructure for electric aircraft. Increased contract length on PSO routes, for example 10-15 years, will be positive for airlines, because it will then be easier to make investments in electric aircraft pay off. Airlines also need investment support, guarantees of the second-hand value of the aircrafts, and access to favorable loans. In addition, it makes sense to set environmental requirements for PSO routes, such as the use of zero- and low-emission technology.

3. Research and development probably need more support than today, and not just through establishing an electric pilot PSO route/one R&D project, although this is a start. It probably needs dedicated Programmes in the Research Council of Norway, Enova and Innovation Norway that can support the development of electric aircraft, and where those involved can contribute to assessing the research applications received in this area.