FAIR PROMOTES ELECTRIC AVIATION

INFOSHEET #4

ELECTRIC AVIATION FOR THE STRAIT OF KVARKEN

In this Infosheet we show that from a travel time perspective, aviation is a competitive alternative to other modes for travelling over the strait of Kvarken. With electric aviation, a possibility to develop prerequisites that may make regional aviation feasible is opened.

Currently, aviation over the Kvarken strait is not part of any regular commercial or public airborne traffic network. This may come as a surprise, given the advantage aviation would offer compared to alternative modes of transportation. Especially since a growing number of ferry passengers indicates that demand exists for travelling over the strait. Hence, either do travellers not value the shorter travel time enough to motivate a ticket by air, or is demand not stable enough to motivate an airline to open regular routes. The air taxi service offered by Jonair thus is a precious asset for the Kvarken region, but as is well known, the total cost of managing a regular route is higher compared with a taxi service.

If we broaden our perspective to aviation as such, during a considerable time returns to scale in airports, airlines and in the production of aircrafts altogether has pushed aviation towards fewer and larger units. Profitable intercontinental routes are prioritised. Hence, a regional network of aviation with small aircrafts and quite elementary airports, more like buss- and railway stations, have not been in focus, unless not geography, as in Norway, has given regional aviation a strong comparative advantage. But still, the Kvarken strait offers a geography where one would expect regional aviation to be competitive.

TRAVELLERS CONSIDER DOOR-TO-DOOR TRAVEL TIME

To illustrate the advantage aviation has for the travel time, we here compare door-to-door travel times over the strait. In the figure, travelling by car, high-speed rail, electric aviation and a jet aircraft are compared from a travel time perspective alone. Door-to-door travel time is the sum of transfer time [to approach and to embark a vehicle] and the time on the mode. In the figure, transfer time adds a fixed start time to each mode and gives the intercept with the vertical y-axis.

The car has the advantage of short transfer time from home or the work place, both at departure and at the destination. Public transport has a more extended transfer time to reach an airport, buss or railway station. Extended transfer time increases total travel time and reduces the average door-to-door speed of a mode.

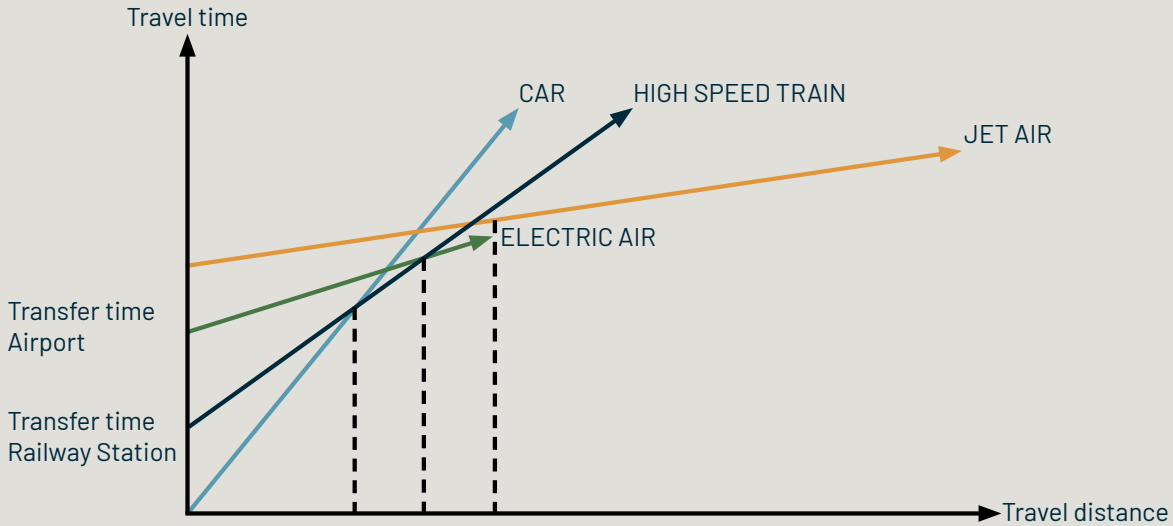


Figure: Door-to-door travel time for car, high-speed rail, electric aircraft and jet air with their market segments over distance.

The slope of a line is given by the average speed of the mode. Low speed implies a steep line. Hence, the time it takes to cover a given distance is increased. The figure shows how transfer times and the speed of each mode will structure the market over distances. Obviously, when we only consider travel time one mode is the optimal choice at each distance.

Cars dominate short distances. The line for cars starts at the origin due to the short transfer time. At some distance, high-speed rail will prevail over the car, for longer distances jet air takes over the market for travelling. How will electric aircraft change this picture?

We have assumed that electric aviation will use smaller aircrafts with less security checks and thus a shorter transfer time in terminals. It may over time also be attracted to airports located closer to residential and working areas. Thus, the transfer time will be shorter compared with jet air, but still longer than by car.

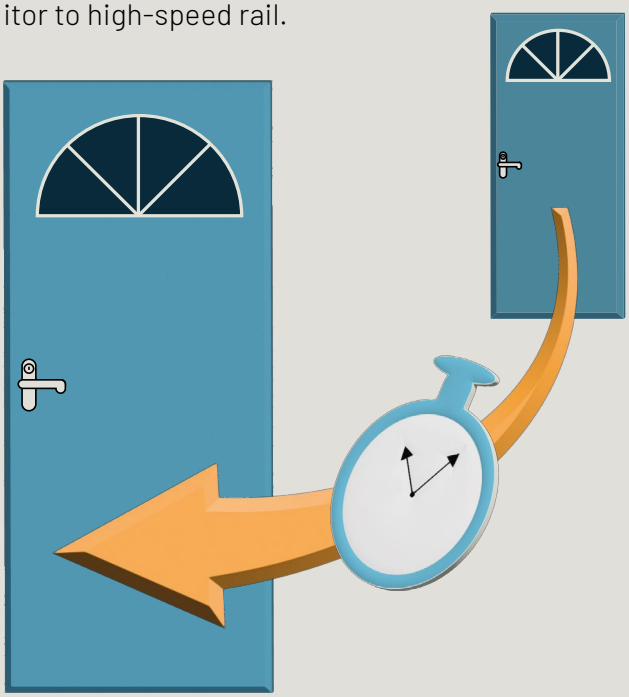
Hence, electric aircrafts would have to compete with cars and rail over short distances. This gives an inner limit for their competitive distance. As far as we can see now, there will also be an outer limit for the range of electric air due to capacity constraints of batteries. Hence, jet air (preferably based on non-fossil fuel) will compete with electric air over the same distances as it today outcompetes rail. Most interesting is to observe that electric air and high-speed rail may compete over the same distances. This implies that

- Where there are no high-speed railways, electric aviation will be competitive from a travel time perspective. The environmental argument against aviation will disappear.
- On a route where there is a competing high-speed railway, the outcome may be more difficult to foresee. For society, it will be important to take into consideration the full costs of the two modes, especially before new investments in costly and fixed railway infrastructure is made.
- Cars are very flexible and will for some travellers be competitive at most distances.
- In directions without land-based communication, such as over straits, seas and mountainous areas, electric aircraft may be very competitive.

We have here focused on travel time since it is an important factor for choice of mode. However, our analysis may easily be generalised to include fare, comfort, service, security, luggage constraints, waiting time, etc. Customers weight these attributes differently, have diverse preferences and may have budget constraints. In such an extended model our aggregate outcome would in much resemble, but a mode would never alone completely dominate a distance.

ELECTRIC ENGINES OPENS FOR NEW DESIGNS AND NEW CONSEPTS WITHIN AVIATION

In the pipeline of electric aviation is the electric VTOL (eVTOL). An eVTOL offers transportation that lie between an aircraft and a helicopter. It only needs a so called "heliport" to land and take-off. Those may be located very near or in built up areas. This will shorten transfer times drastically. An eVTOL will thus compete with both cars and public transportation over short to medium-long distances. It may offer time efficient commuter alternatives between home and office that is similar to a taxi. A door-to door trip with eVTOLs and an electric aircraft may thus be a strong competitor to high-speed rail.



CAN AVIATION ACROSS THE STRAIT OF KVARKEN BE COMPETITIVE?

The ferry between Vaasa and Umeå takes 195 minutes (3.3 hours), not including transfer times. The ten-hour route by car around the Gulf of Bothnia is an alternative to the ferry. The distance of this route is 835 km and would take 600 minutes without stops, at an average speed of around 85 km/h. A third alternative is to fly Vaasa-Helsinki-Arlanda-Umeå, a distance of 1 250 km. The travel

Table: Approximate distance (km), travel time (min) and speed (km/h) by mode for travelling over the strait of Kvarken. Sources: Google Maps, Traffic Analysis: Elflyg – början på en spännande resa, Rapport 2020:12, own calculations.

Route and mode	Distance (km)	Transit time (min)	Travel time, main mode (min)	Total travel time (min)	Average speed main mode	Average speed of trip, km/h
Vaasa – Haparanda – Umeå (Car)	835	0	600	600	85	85
Vaasa – HEL- ARL – Umeå (Jet Air)	1 250	220	160	380	470	200
Vaasa – Umeå (New Ferry)	110	100	195	295	35	25
Vaasa – Umeå (Electric Air)	110	100	30	130	220	50
Vaasa – Skellefteå (Electric Air)	190	100	40	140	285	80
Karleby/Jakob. – Skellefteå (Electric Air)	150	100	35	135	255	65
Vaasa – Örnsköldsvik (Electric Air)	100	100	30	130	200	45
Vaasa – Umeå (eVTOL)	110	30	50	80	130	80

time in the air would be approximately 160 minutes; adding transfer time to include two aircraft changes at airports, the total travel time could reach 380 minutes, at an average door-to-door speed of 200 km/h.

In the table we compare those alternatives for travelling between Vaasa and Umeå with the option to fly with an electric aircraft. We also compare flying between Skellefteå, Karleby-Jakobstad/Kokkola-Pietarsaari and Örnsköldsvik. Lastly, we include a possible eVTOL between Umeå and Vaasa. Travellers choosing electric aviation from Örnsköldsvik or Umeå to Seinäjoki would have similar travel times as those travelling from Skellefteå to Vaasa or to Karleby/Jakobstad. We have assumed transit times to be 100 minutes for all flights not involving a change of aircraft.

In the table we also observe that the average speed of a flight depends on the distance travelled. It takes time to get permission to start, taxi out, take off and to reach cruising speed. Hence, a short distance flight never reaches the average speed possible at a longer distance. This also implies that the cost per km travelled (not shown in the table) becomes higher for short distance flights. On the routes from Skellefteå to Vaasa and to Seinäjoki (not shown in the table) speed differences may be more conspicuous, but this would not make the ferry, for example, a competitive alternative. Instead,

- Electric aviation will, from a travelling time perspective, be a competitive alternative for many routes over the Kvarken strait.

A fast and smooth boarding process would increase the competitiveness of electric air. An eVTOL may offer this possibility. In the table we assume in total only 30 minutes for approach, boarding and embarking to the destination for an eVTOL. An eVTOL with a large enough operating area may thus also compete with an aircraft on shorter distances, such as over the Kvarken strait.

HOW CAN THE KVARKEN REGION GAIN POSSIBLE BENEFITS FROM REGIONAL AVIATION?

Weak or strongly seasonal demand may explain why a regional airline over the Kvarken strait not has been successful. With larger populations on both sides of the strait, the likelihood of more business connections and other forms of exchange, and hence for the existence of a regular airline, would increase. Therefore, actors in the Kvarken region should first of all never lose their focus on the growth of the number of inhabitants in the region, that is to create an attractive region. But actors could also establish the region as a producer of a wide array of equipment and

services demanded by the new growing industry for transportation based on electric drivetrains. The location of units for battery production in the region is a sign that this is a real option for the region. Batteries should thus not be the endpoint in a development of a regional transport-oriented industry based on electrically powered communication.

WORK PACKAGE
WP 1 - Regional effects of electric aviation

AUTHORS
Lars Westin, Umeå University

CONTACT INFORMATION
WP Coordinator Lars Westin
lars.westin@umu.se

DOWNLOAD AND READ THE FULL REPORT *"TOWARDS ELECTRIC AVIATION IN THE KVARKEN REGION"*

ABOUT FAIR

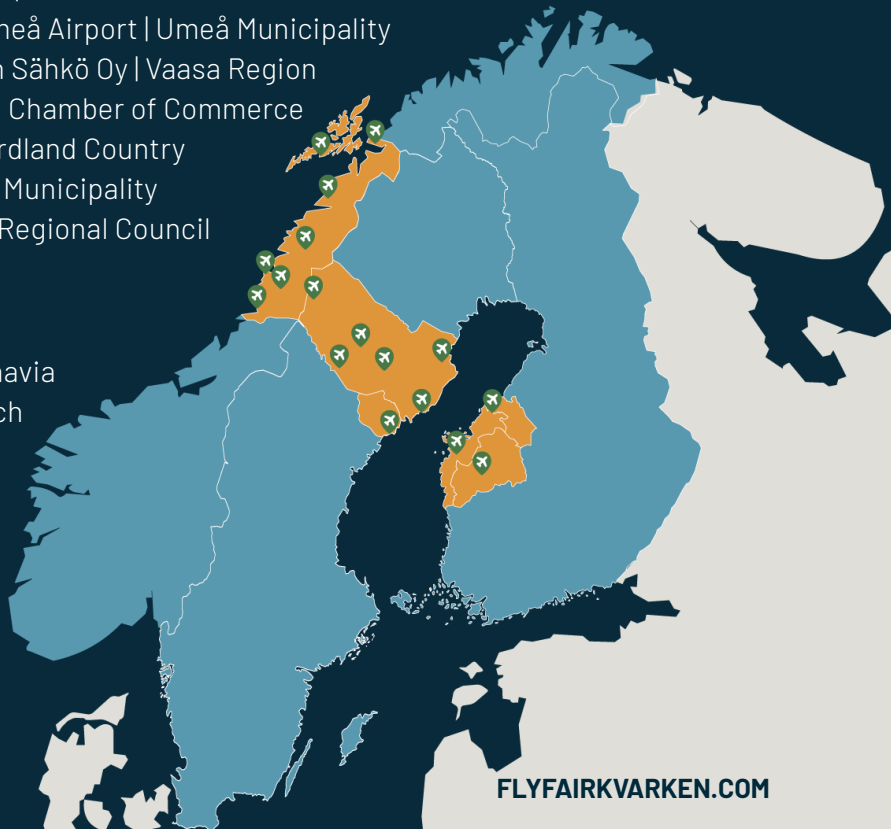
FAIR (Finding innovations to Accelerate the Implementation of electric Regional aviation) is to be seen as a first step of preparing the Kvarken region for an early implementation of electric aviation. The project increases the knowledge base about electric aviation, investigates the possibilities and surveys both the needs and the required technical investments.

FINANCIERS

Interreg Botnia Atlantica | Region Västerbotten | Regional Council of Ostrobothnia | Kvarken Council (Lead part)
BioFuel Region BFR AB | City of Vaasa | FAB Kronoby Flyghangar | Into Seinäjoki Oy | Lycksele Flygplats AB
MidtSkandia | Ostrobothnia Chamber of Commerce | RISE Research Institutes of Sweden
Skellefteå City Airport AB | Skellefteå Kraft AB | South Ostrobothnia Chamber of Commerce
Storumans Kommunföretag AB | Swedavia Umeå Airport | Umeå Municipality
Umeå University | University of Vaasa | Vaasan Sähkö Oy | Vaasa Region
Development Company, VASEK | Västerbotten Chamber of Commerce
Örnsköldsvik Airport AB | Nord University | Nordland Country
Municipality Brønnøy Municipality | Alstahaug Municipality
Helgeland Regional Council | Indre Helgeland Regional Council
Rana Utvikling

SUPPORTING PARTNERS

Air Traffic Network | BSR ACCESS | ELISE | Finavia
Funktionshinderrådet Umeå | Future Cleantech
Solutions | Green Flyway | Grön Flygplats
Heart Aerospace | Helsinki Electric Aviation
Association ry | Jonair | Luftfartsverket
NEA – Nordic Network for Electric Aviation
Umeå kommunföretag AB | Umeå Institute
of Design | The Swedish 2030-secretariat
Transportföretagen



FAIR PROMOTES ELECTRIC AVIATION

KVARKENRÅDET
MERENKURKUN
NEUVOSTO

EUROPEAN UNION
Interreg
Botnia-Atlantica
European Regional Development Fund