Potential Impacts of Electric Aviation in the Kvarken Region

Stakeholder views in 2020

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UNIVERSITY OF VAASA REPORTS 22

Vaasan yliopisto
UNIVERSITY OF VAASA

Publisher
Vaasan yliopisto

Date of publication
April 2021

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Type of publication
Project report

Orcid ID

Name and number of series
University of Vaasa Reports, 22

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ISBN
978-952-476-947-1 (online)
http://urn.fi/URN:ISBN:978-952-476-947-1

ISSN
2489-2580 (University of Vaasa Reports 22, online)

Number of pages
35

Language
English

Title of publication
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Abstract

The aim of this interim report is to share the results from a survey that was conducted as part of the Interreg Bothnia Atlantica project named Finding innovations to Accelerate Implementation of electric Regional aviation (FAIR). FAIR is developing a methodology to support early and efficient commercialisation of electric-powered regional flights in the Kvarken region, which consists of the counties of Ostrobothnia, Southern Ostrobothnia and Central Ostrobothnia in Finland and the county of Västerbotten and municipality of Örnsköldsvik in Sweden.

The objective of the survey was to provide a background understanding concerning stakeholders' and experts' views on the potential regional effects of electric aviation (EA) in the Kvarken region. The online survey targeted experts and various project stakeholders and was opened during 16.-30.11.2020. The response rate was 24.8 %. The survey was one of the first activities in the project, and the questions arising from it will subsequently be considered within the FAIR network.

According to the results, the regional effects of EA are manifold and challenging to foresee. EA is generally viewed as a new and exciting opportunity and way for increasing collaboration in the Kvarken region. However, it should be noted that experts and stakeholder views are probably quite positive compared to those of the general public. Stakeholders definitely considered EA as a positive opportunity but understood that regulations and financing establish important preconditions for early implementation, which need to be considered carefully.

The inclusion and utilisation of new networks, ideas and skills related to the implementation of EA will certainly affect existing networks and working methods. New collaboration opportunities are likely to emerge, and there will probably be new opportunities for existing industries in the Kvarken region, such as energy technology companies, as some of their products may become important in the EA industry. The Kvarken region may also benefit from general interest, which arises from EA and an increase in accessibility. Altogether, implementation of EA is considered a promising, and natural step in the region's path towards specialising in environmentally friendly technology and solutions.

Keywords
Electric aviation, Kvarken region, cross-border cooperation, EGTC, regional development, FAIR-project

Funding

EUROPEAN UNION

Interreg
Botnia-Atlantica
European Regional Development Fund

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1 INTRODUCTION

The aim of this interim report is to share the results from a survey that was conducted as part of the project named Finding innovations to Accelerate Implementation of electric Regional aviation (FAIR). FAIR is developing a methodology to support an early and efficient commercialisation of electric-powered regional flights in the Kvarken region, which consists of the counties of Ostrobothnia, Southern Ostrobothnia and Central Ostrobothnia in Finland and the county of Västerbotten and municipality of Örnsköldsvik in Sweden (shown in Figure 1). The runtime of FAIR is May 2020 to June 2022.

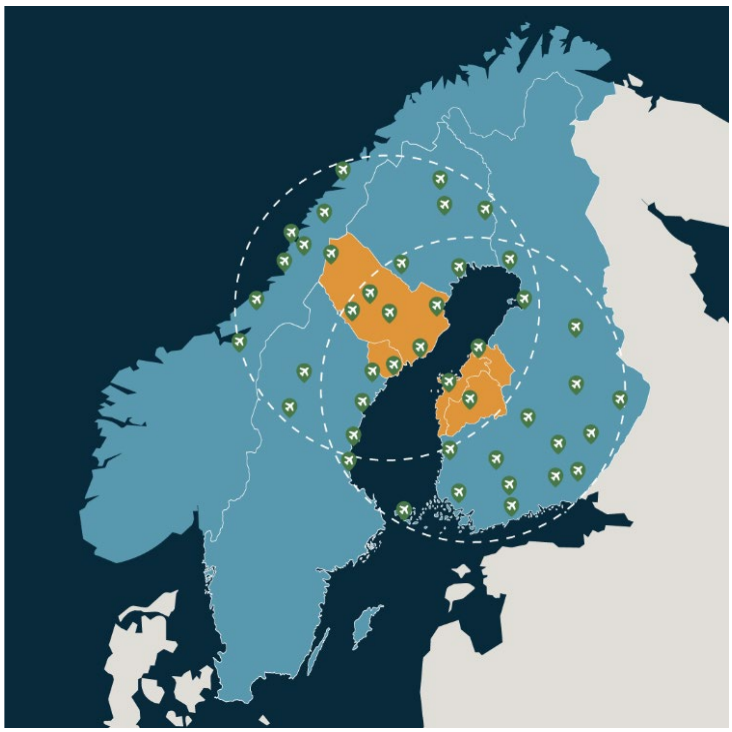

Figure 1. Kvarken region (Kvarken Council 2021a).

FAIR researches possible flight routes and socio-economic benefits of implementing electric aviation (EA) technology in the Kvarken region (Kvarken Council 2021a). The main objective is to develop efficient business models that support an early commercialisation of EA and a realisation of identified societal effects. This objective is achieved with cooperation from other stakeholders in the field of EA. FAIR will also increase the knowledge base concerning the regional effects of EA, propose activities that support the implementation of EA at the node level and apply a design-driven innovation process that is aimed at developing products, services and business models related to EA.

More information about the FAIR project is available on the project website: https://www.kvarken.org/en/project/fair/.

This survey has been conducted by the research team at the University of Vaasa, with the help of the University of Umeå research team. The aim of the project research conducted by the two universities in the work package is to analyse market conditions as well as socio-economic impacts and cross-border innovation structures concerning the implementation of EA. This interim report details the initial results of the research process. The authors of the report thank everyone who was involved and shared their thoughts and experiences!

2 BACKGROUND FOR INVESTIGATING ELECTRIC AVIATION IN THE KVARKEN REGION

Electric aviation (EA) is an emerging industry, whose development has been accelerated by rising concerns regarding the pollutions of air travel and its environmental effects. Many people feel quilty for travelling by air, which has become a challenge that many airplane manufacturers are considering in their new solutions and services. We have, for example, heard about major aviation companies (e.g. Airbus 2020) developing new hydrogen-based airliners and several smaller manufacturers investigating batteries as solutions to their passenger airplanes (e.g. Heart Aerospace 2020). This green transition is ongoing, and according to the previously mentioned manufacturers, there are hopes that the first battery-operated passenger planes could be operational by 2026 and the first hydrogen planes could be operational by 2035.

Alongside and in conjunction with automation and shared mobility, electrification is considered a field of innovation with major disruptive potential regarding not only transport industry but also transport and energy systems more broadly (e.g. Sprei 2018). Therefore, the effects of EA cannot be reviewed solely in relation to replacing existing, less environmentally friendly aircraft; they must be reviewed in reference to incremental and broader changes in transportation and society. Altogether, EA not only refers to less pollutions but also wider changes in society that are, especially due to the ongoing pandemic, difficult to foresee. EA's regional effects are, to a large extent, subordinate to wider societal changes, e.g. changing work life and political preferences. However, the implementation of EA can also enable new development paths on a regional scale. While the aviation industry as a whole is experiencing major changes, EA introduces various possibilities for sustainable mobility as well as a more balanced organisation of society that should be explored as part of the rapidly changing transportation scene regarding the transportation of both people and goods.

New energy solutions and electric vehicles do not automatically mean less environmental effects (e.g. Hawkins et al. 2012), but EA is associated with an emission reduction potential, especially for short-haul routes (Baumeister et al. 2020). However, views concerning the actual operating costs of EA are still being debated (Schafer et al. 2019). If lower operating costs can be achieved, they may enable smaller commercially viable flights. This idea is interesting to airline operators, as it may be one solution to shake up the airline industry, create new business models and offer new services, especially after the pandemic. Speculations from the expert interviews that were conducted prior to the survey pertained to future public transport operated by electric planes, airplane taxi services and several other sustainable ways of air travel, which also necessitate various changes to the regulatory environment.

Why then did the Kvarken region decide to especially investigate EA? The Kvarken region is mostly known for its unique nature (e.g. Unesco world heritage site), and its environmental values are also visible in several companies' strategies in the region. The region has several global energy technology companies, such as Wärtsilä, ABB, Danfoss and Northvolt, which are looking for sustainable energy solutions. The region also has one electric plane manufacturer, Heart Aerospace. EnergyVaasa in Vaasa is the largest energy technology hub in the Nordic countries, which consists of 160 companies (Vaasa 2021).

Cross-border collaboration within the Kvarken region has a long history, and the regional actors have implemented several sustainability-oriented projects and solutions and projects for sustainable mobility. Perhaps the most notable of these achievements is the Aurora Botnia ferry, which is described as the world's most environmentally friendly passenger vessel (Wasaline 2020). The capital cities of the region, Umeå and Vaasa also have a mutual harbour company, Kvarken Ports. Furthermore, new opportunities are emerging via institutionalising cross-border collaboration, as the Kvarken council will begin as a European Grouping of Territorial Cooperation (EGTC) in 2021. This designation means that the region forms a legal entity in the future (Kvarken Council 2021b). In many ways, EA's development can be considered a natural step and a continuum in the region's path towards specialising in environmentally friendly technology and solutions.

3 OBJECTIVES OF THE SURVEY

The objective of the survey is to provide an understanding concerning stakeholders' and experts' views on the potential regional effects of electric aviation in the Kvarken region. The preparation for the survey was supported by 7 background interviews with local and national experts (from Ostrobothnia and Finland). The input of the interviews was used to gain a broader understanding of the potential regional effects and relevant issues affecting the development of EA, which helped in preparing the survey and gathering experts views internationally. The results will be applied at later stages of the FAIR project.

Categorisation regarding the numbers was similar throughout the survey: 1 means strongly against/very poor, 2 indicates against/poor, 3 means not agree nor disagree/fair, 4 indicates agree/good and 5 means strongly agree/really good. There was also an option to indicate if the respondent did not know the answer. The survey questions are attached to this report (Attachment 2).

The online survey was open during 16.-30.11.2020. The link was sent to a list of 189 persons, which consisted of the FAIR contact list, and additional persons who were considered important to gain relevant regional views about EA. It should be noted that this group of stakeholders was probably quite positive in their opinions of EA compared to the general public. However, they were also considered more apt to identify opportunities and consider the future, which explains why the survey was sent to these chosen experts.

3.1 Respondents

The respondents consisted of Finnish, Swedish and Norwegian experts as well as other experts and people who wished to be part of the FAIR research process. The response rate was 24.8% (47 answers), which can be considered relatively good, as the survey was targeted to experts. The 47 respondents well represented the different regions and worked within the Kvarken region as well as on the national level (Table 1). Twenty-nine responses were obtained from the Kvarken region, which consisted of 61.7% of all the responses. Over 61% of the respondents were working in the Kvarken area, which means that the answers can be considered relevant to the region. Overall, the respondents well represented both the region and the focus area of EA, and therefore, provided relevant insights concerning future development of EA in the Kvarken region.

Table 1. Respondent´s regions

REGION	n*	Percent
Finland, Kvarken region	11	23.4%
Finland, remainder of Finland	5	10.6%
Sweden, Kvarken region	18	38.3%
Sweden, remainder of Sweden	11	23.4%
Norway	1	2.1%
Other country, what: Spain	1	2.1%

*n=number of respondents

Different types of institutions were also represented quite well, as all categories received some replies. The majority of respondents were working in public organisations, but the number of large companies (50+ personnel) and small and medium-sized enterprises (SME) responses was also quite high (Table 2).

Table 2. Respondent´s organisations

ORGANISATION	n	Percent
Public organisation (airports, cities, regions, municipalities etc.)	19	40,4%
Company (50+ personnel)	6	12,8%
SME (less than 50 personnel)	6	12,8%
Higher education institute or research organisation	5	10,6%
Regional development organisation (Vasek, INTO Seinäjoki, etc.)	5	10,6%
NGO (chambers of commerce, etc.)	3	6,4%
Other, What:	3	6,4%

Institutions in the "other" category included export agencies that and individuals who were working in aviation-related positions or represented start-ups regarding future aviation technologies.

Of the ten companies and SMEs, many were focused on aviation industries and consultation. The respondents also represented the energy field and sustainable solutions. Altogether, the private sector respondents represented relevant types of industries regarding EA.

Most of the respondents were men, although the list of 189 persons included 59 women (31.2% of all the respondents), which means that the results reflect those of the original recipient list (Table 3).

Table 3. Respondent´s gender

GENDER	n	Percent
Male	35	74.5%
Female	11	23.4%
Do not wish to share	1	2.1%
Other	0	0%

Most of the respondents, aged 28 to 68, were born in the 1960s and 1970s.

4 RESULTS FROM THE SURVEY

4.1 Opinions regarding regional effects

4.1.1 Regional effects of EA implementation

This question included 7 statements regarding how the implementation of electric regional aviation will affect the region; they varied from environmental effects to international recognition (Figure 2). Most of the respondents (47 persons) believe that the implementation of EA has many positive effects on the region. The majority of the respondents considered that the quality of the environment would improve due to possible implementation and predicted that the transportation system in the Kvarken region will be transformed.

The respondents also thought that EA will have a balancing effect on regional development by improving the accessibility of small cities and rural areas within both Finland and Sweden and especially within the Kvarken region. The Kvarken region was also considered to gain positive international visibility and international competiveness by implementing EA. The strongest agreement was that the implementation of EA would make the Kvarken region a pioneer in the field.

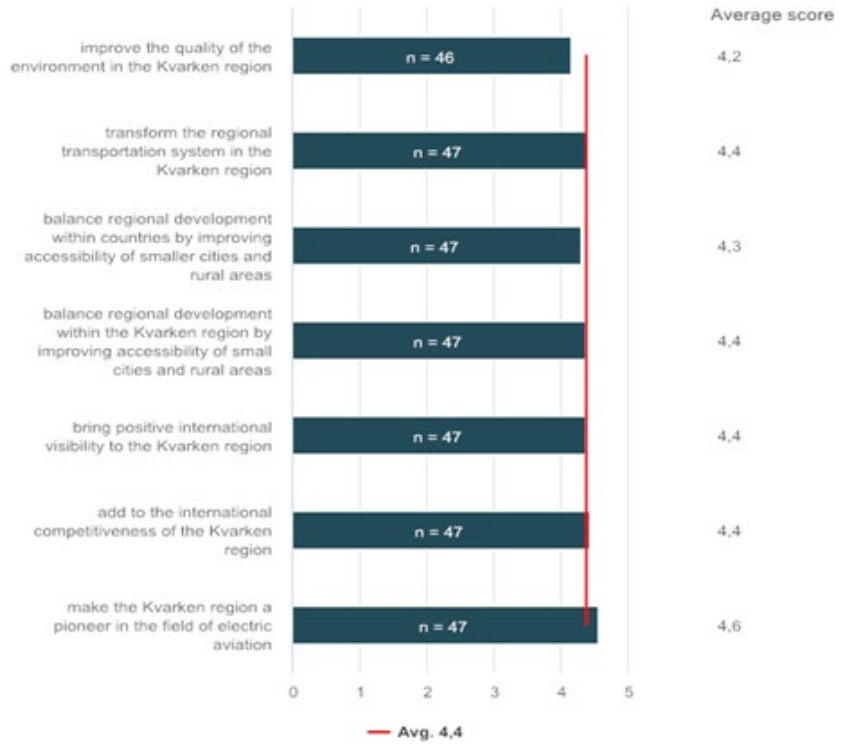

Figure 2. Regional effects

4.1.2 Specific impacts of early implementation

This question measures how early implementation of EA would concretely affect the regions and received 41 answers. Several answers pointed out that the Kvarken region would gain a considerable amount of positive global attention. The region could be seen as an innovative, sustainable and bold piloting area. These factors may raise the attractiveness and growth potential of the Kvarken region, as indicated by some responses:

> *"It will make the Kvarken region a lighthouse for others to follow in its path."*

> *"It will lift up the region as a pioneer and forward-thinker in the area of sustainable infrastructure."*

Many respondents also considered that accessibility to the Kvarken region would be increased. As a result, the Kvarken region's competiveness would improve. These positive impacts might support internal and external business relations and collaboration. Businesses could also benefit from EA in other ways according to the respondents. New business opportunities might be created with EA, both directly and indirectly. Supporting industry and operational models were mentioned more than once in the responses:

> *"Better accessibility, industrial boost, improved regional growth."*

> *"Early adopters of electric aviation as part of the regional transportation system, which will most certainly be an obvious part of a future ecosystem of various, interconnected, and sustainable modes of transportation for mobility in transformation."*

Some respondents were more careful and pointed out that being a pioneer has risks. EA was compared with space travel concerning the wide global interest but limited knowledge at the moment:

> *"Electric aviation is similar to space travel for most countries right now. Nobody has an idea of what it would be like, and interest is high—if people only knew that it existed. The story would be very tempting for various news and tech media globally."*

> *"Being a pioneer has its perks but also risks. It will give a lot to the area but requires a great deal of development (money)."*

4.1.3 Concrete innovation potential

The question asked specifically for inputs of EA for service, product and business model innovations to acquire ideas for new innovations. Forty-three answers were obtained from respondents. The survey participants expected that some service innovations could be

created. Especially tourism in the whole Kvarken region would substantially benefit from the implementation of EA. Accessibility to the region would improve with new flight routes to smaller cities and rural areas. Aviation could also establish some Mobility as a Service (MaaS) features that could make the flight service even more comprehensive. Electric aviation may also reduce travel times:

> *"New opportunities for services supporting the tourism industry."*

> *"Aviation on-demand as part of mobility as a service."*

Electric aircrafts may also carry packages or minor to major volumes of products inside the Kvarken region.

> *"Deliveries of packages or minor to major volumes of products might be beneficial, but I assume there are load limits to how much the planes are able to lift."*

Product innovation potential was considered promising. A supporting industry for EA could rise in the region. Battery technology could also create other innovations for the transport chain. Airports may need to create new innovations so that the full potential of EA could be achieved. Charging systems and technical applications are examples of these innovations:

> *"Development of products supporting more efficient transport chains, where EA is one leg of refined battery technology."*

> *"Airports as multimodal and sustainable hubs for new business models for electrification."*

> *"Plenty of possibilities. Even a small sector like (just one example here) aircraft ground support systems will have a revolution."*

The respondents saw that the implementation of EA enables new business models. For example, regional air traffic could become a whole new area of business. Electric aircrafts could be part of a public transportation system such as flying busses or air taxis. A mixture of different types of vehicles in new types of hubs could spur new businesses. As EA is a new way to arrange transportation, a successful implementation model could be introduced to other regions and motivate new business model innovations:

> *"New operators, especially air-taxi based businesses."*

> *"Electric aviation as public transport can be tested in the region. New business models for aviation can be tested and 'exported' if successful."*

4.1.4 State of the current cross-border activities in the Kvarken region

Questions 3 and 4 mapped the views of the respondent concerning the current state (Figure 3) and future state (Figure 4) of diverse cross-border activities and how EA might change them. Accessibility to transportation in the Kvarken region is considered relatively weak in the current state; when compared to other domains, most of the responses to this question were negative. After the early implementation of EA in 2050, respondents considered the accessibility to be very different. Of the total respondents, 55.32% considered the state of transportation to be excellent.

In the other domains—covering sociocultural coherence, state of the economy and technological development, and state of the environment, as well as institutional/legal coherence—the implementation of EA is considered to introduce positive changes. The improvement is not radical but a step forward in all cases. Accessibility is considered to change most, which makes sense given the focus on new transportation modes.

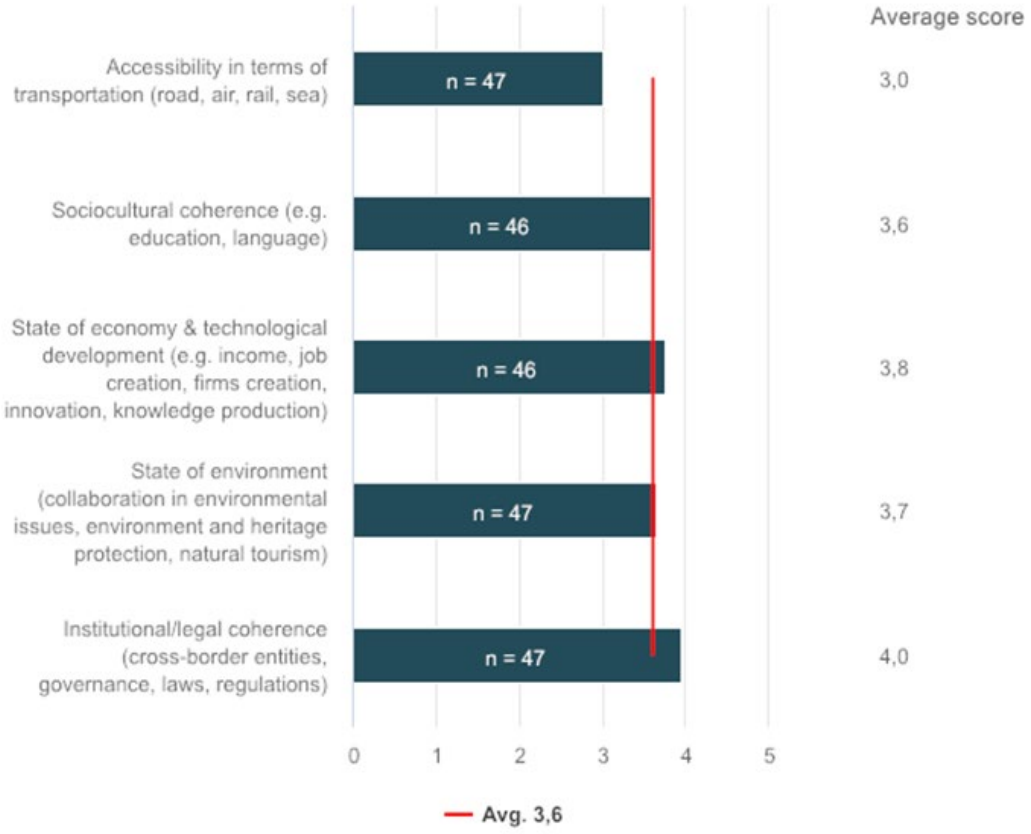

Figure 3. Current cross-border activities

4.1.5 State of the cross-border activities in 2050 in the Kvarken region after the implementation of EA

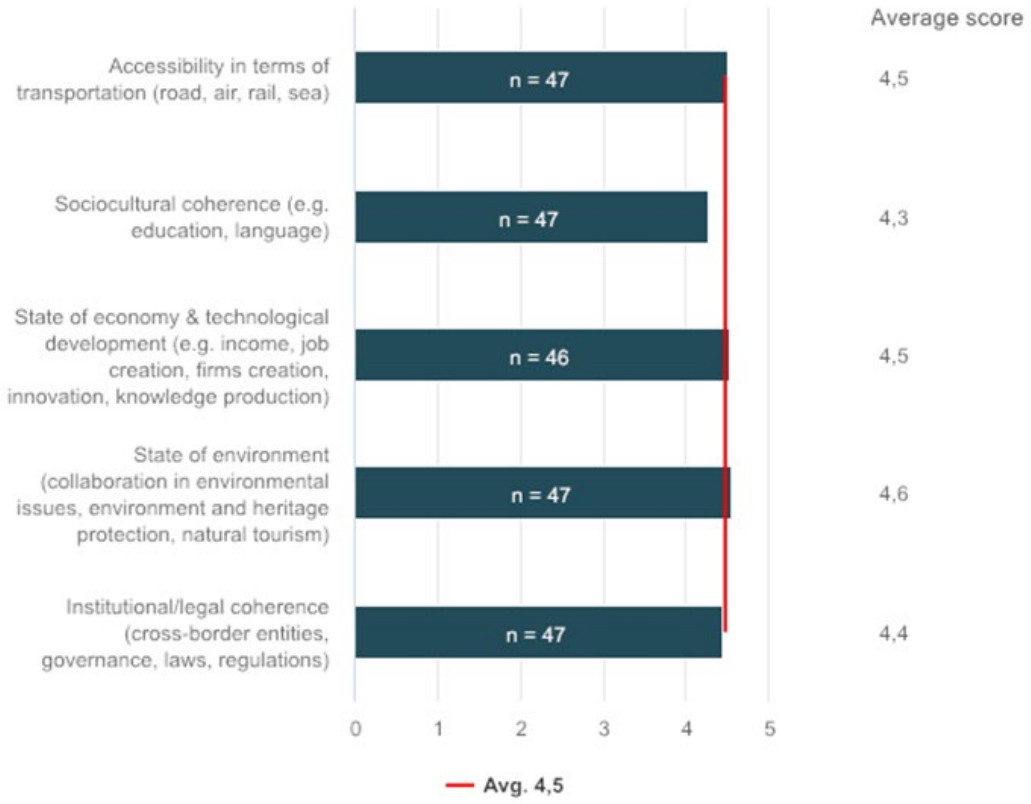

Figure 4. Cross-border activities in 2050

4.2 Opinions regarding cross-border cooperation CROSS-

4.2.1 Electric regional aviation and its effects on cooperation

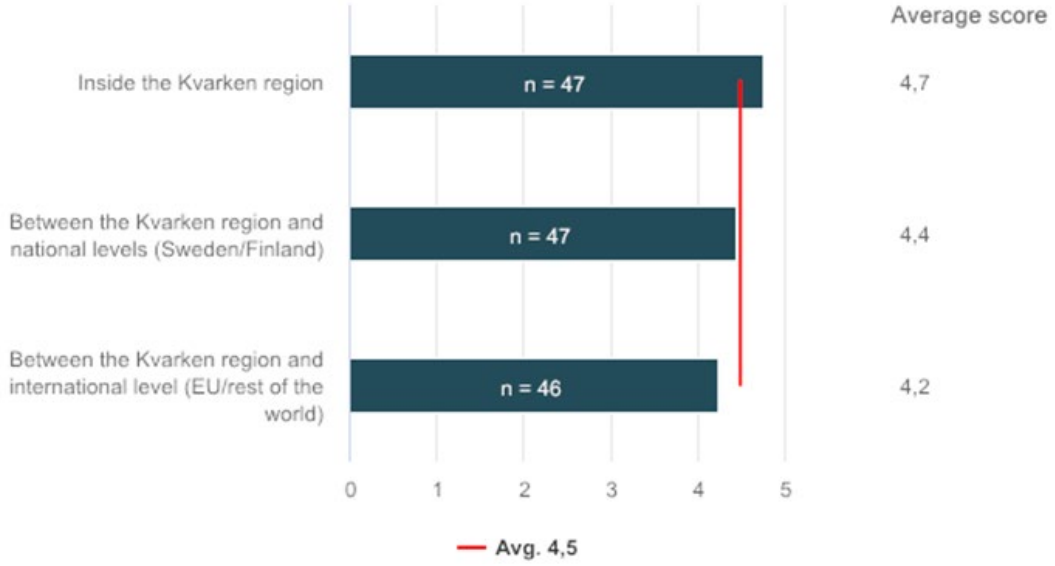

Figure 5. Effects of EA on cooperation.

This question examined whether implementation of EA is considered a regional, national or international collaboration process (Figure 5). The opinions of the respondents seems to be that the implementation of EA will especially increase regional collaboration but will also have positive effects on the national and international levels.

The respondents (74.47%) suggested that the implementation of EA could have strong positive effects on cooperation inside the Kvarken region. The results also point out that cooperation between the regional level and the national level could improve. The majority of respondents thought that the implementation of EA could have either some positive effects (44.68%) or strong positive effects (40.43%) for cooperation on the national level. The cooperation between the regional level and the international level was also considered to have a positive impact on the implementation. Half of the respondents stated that cooperation may cause some positive effects, and almost one-third of the respondents predicted a strongly positive impact. No negative effects on cooperation were identified.

4.2.2 Opinions concerning changes in cooperation

This question sought ideas on how the cooperation would concretely change in the region and received 39 answers. Participants indicated easier accessibility as a key factor for improving cooperation. Cooperation would benefit from new connections in the Kvarken

region as face-to-face meetings were considered to build trust and conversation among the actors. Cultural exchange might also be increased via this type of interaction. The workforce might be able to commute more freely from their homes to their jobs.

Reasonably priced, efficient, environmentally friendly, and flexible modes of travel in the region would facilitate face-to-face meetings and foster in-person collaboration. Geographical challenges such as the constraints posed by the Baltic Sea would have a less negative impact on connectivity among enterprises. Improved east-west connections and accessibility to areas that have less connections may introduce new actors and cooperation to the Kvarken region's business life:

> *"Frequent e-flights are low in cost and environmental effects. This combination means that more people & companies would like to use e-flights and replace ferry & car travel for practical reasons. This change will create a considerable number of advantage for local companies."*

> *"Both the use of flights for meetings, events, and business and the market that is developed from electrical aviation with know-how, maintenance, etc."*

> *"Cooperation is made easier if the means of transport are more efficient, for example, cooperation in technology industry, healthcare, and tourism."*

> *"Working would be easier for employees if companies could be located even at distances 100-300 km. Of course, working should be performed remotely but quick & inexpensive transport would make weekly commuting to workplaces a reality. Other efficient support services, such as robot buses for connecting traffic services, are needed."*

4.2.3 Kvarken region as a new Nordic EGTC

This question measured whether the respondent was aware of the Kvarken region's upcoming European Grouping of Territorial Cooperation (EGTC) status, which is a European legal instrument designed to facilitate and promote cross-border cooperation. Only respondents who knew about the status answered the next question, which concerns EGTC's possibilities.

Of the 47 respondents, 17 (36.17%) were aware of the upcoming status.

4.2.4 EGTC's possibilities for promoting electric regional aviation

This question only appeared if the respondents mentioned that they were aware of the new Kvarken EGTC and sought ideas on how the new EGTC may help in future collaboration concerning EA and its implementation. The question was only answered by 15

respondents. EGTC was expected to have positive impacts on the promotion of the region towards the EU level. The responses acknowledged that EGTC may offer better visibility in the region and the FAIR project and could help to promote new innovations on the European level. EGTC may also have a positive impact on obtaining funding from the European Union (EU). It was also suggested that the region will appear to be larger than it actually is, as it has the following status:

> *"EGTC will increase the possibility for promoting e-aviation and receiving EU funds, as EGTC is a known legal entity within the EU."*
>
> *"Better visibility in Europe."*
>
> *"Somewhat more impact on the European level; otherwise, not so much."*

4.3 Opinions regarding business models and new routes

4.3.1 Business models to support the early implementation of electric regional aviation

Table 4. Suitable business models for EA

Business model	n	Percent
regional airlines with several small planes	37	78.7%
low-cost carrier (mainly point to point service)	22	46.8%
charter carrier (with a focus on a particular air service & travel packages)	11	23.4%
other, what (specify any concrete ideas about business models & business model innovation here):	9	19.2%
full-service carrier	7	14.9%
cargo as a core activity	6	12.8%
regional airlines with few large planes	5	10.6%
I do not know	5	10.6%

This question was employed to gather ideas for future business models concerning EA (Table 4). The majority of the respondents (79%) thought that regional airlines with several small planes would be a fitting business and operational model for the early implementation. The potential of a low-cost carrier (mainly point-to-point service) was seen among the respondents (47%).

Other interesting business model ideas were proposed via an open question. These models included hybrid models with scheduled flights and charter options. Flights could also be connected to other public transportation via travel chains or be structured similar to an air taxi type of service. User friendliness was highlighted in the answers. It should be easy and fast to purchase tickets for flights, and airport services should be accessible. The benefits of EA were considered reduced if the time saved during travel is lost in an airport.

Views on the financial support needed by electric airplane manufacturers and regional airlines were also presented. The electric airplane producer field may need new actors to provide aircrafts for different purposes, e.g. smaller planes than the Heart Aerospace's 19-seat model may also be needed. The airlines may also need financial aid to operate in the Kvarken region. The operation may not be profitable in the early stages, which explains why new business models should be created.

4.3.2 Potential routes/areas for implementing electric aviation

This question was searching for potential routes for EA. Among the 47 responses, regarding business travel, the line between Vaasa and Umeå was mentioned 18 times, Skellefteå was mentioned 36 times and Kokkola was mentioned 30 times as a possible point of origin or destination. A detailed list of suggested travel routes has been added as Attachment 1. There were also several mentions of Örnsköldsvik, Mo i rana, Bodö and Seinäjoki, as well as Jakobstad. Some respondents also envisioned direct lines to capital cities, such as Helsinki, Stockholm, Copenhagen, London and Berlin. There was a lot of disparity in the responses, as some respondents mentioned better connections to Lapland or southern European tourist destinations. Umeå and especially Vaasa were considered important nodes for EA, as both were mentioned several times and included in numerous combinations of routes.

This question also allowed other remarks, for example, the hope that all airports within a certain range (especially smaller airports) would be able to offer EA activities as well as connections to capital regions etc. One respondent mentioned that both business travel and leisure travel are necessary, so both should be encouraged. One respondent also mentioned EA as a possibility for tourism in the Kvarken archipelago as well as the possibility of hospital flight services:

> *"Connecting the whole Kvarken region must improve business."*
>
> *"Develop a system that includes all major nodes in the region with existing airports."*
>
> *"Increase potential for tourism."*

"Easier connection to domestic and international flights and services for hospital related transport."

4.4 Opinions regarding next steps

4.4.1 Concrete measures and steps to support early implementation

This question sought concrete measures that could support early implementation. Suggestions for possible first steps varied among the 36 responses. To summarise the concrete measures, it was seen that establishing infrastructure to provide connections to a couple of airports would be a good way to indicate valid interest and create excitement. Networking and regulations were also mentioned as ways to explore future development. More networking among energy and EA institutions and a better understanding of possible regulations were also mentioned.

Some of the responses suggest a more practical approach:

"Choose destinations with the highest priority and start implementation from these destinations."

"Prepare two airports with supporting basic infrastructure to pilot point-to-point service. Charging infrastructure is important."

However, other respondents highlight a slower, more research-focused approach:

"Action plan; infrastructure and services"

"Have competitions (hackathons) at universities for developing business models."

Financing and procurement, as well as development projects, are also considered viable points. However, there are different views regarding the level of implementation and who should act, as many respondents indicate the hope for resource contributions from the EU, some respondents aim for a national focus and two respondents consider it a regional opportunity:

"Ensure that national and regional procurement of public transport considers these opportunities."

"Engage in 'innovative procurement' to spur development."

"Start an EU-funded airline for the first 5 years until the airline becomes established."

4.4.2 Education and/or research needs

This question was employed to examine how prepared the Kvarken region is to utilise EA in its education and research activities; it received 36 responses. Although education and research needs were related to the practical aspects of EA (batteries, security issues, etc.), some respondents stated that action instead of research is needed. The findings conclude that more knowledge is needed but it is also important to connect experts of varying fields to gather global knowledge and implement it in the Kvarken region:

> *"None. Just do it."*

> *"Battery research for use, reuse, and recycling to make the whole value chain more sustainable."*

> *"Electric aviation-related training could be offered in the region to profile the area as a leading centre of e-aviation in the Nordics."*

4.4.3 Key challenges

This question addressed potential key challenges for EA implementation. Interestingly, the 33 responses highlight speed and caution, as several respondents see the need to rapidly design and construct infrastructure, whereas some respondents request more preparation regarding funding and regulations, as well as a better understanding of possible charging or battery standards. The respondents expressed the hope for concrete measures with extensive preparation so that early investments would not be wasted, as haste can potentially harm the general interest around EA:

> *"Investigate the need for future implementation without subsidies."*

> *"Examination of risks/costs with new technology for airlines and how to handle them."*

> *"It is a new technology that is currently being developed. Important to not rush the implementation of electric air travel, as potential disruptions could affect consumer confidence in it."*

> *"Rapidly construct electric infrastructure, as it directs the electric airplane manufacturers."*

> *"Build electric infrastructure so that limited e-plane traffic can begin as soon as possible."*

4.4.4 Other feedback

Other feedback included 18 responses, some of which entailed providing contact details and requests for more cooperation (these responses were omitted to ensure anonymity among the respondents), as well as suggestions on how to continue with the project, spark general excitement and ensure stakeholders that the region is actively addressed EA-related issues. The potential for further testing of technologies and the inclusion of hydrogen powered planes were suggested:

> *"Invite the incumbent manufacturers of electric aviation (small and large) to an e-flight conference in 2021 to put you on the map!"*

> *"The concept of Kvarken as an EA test area because of variable weather conditions and reliability of the complex system should be investigated in the development of aircraft and airport systems. Is it legally possible for air traffic control to prioritise electric aircraft in comparison to traditional jet aircraft? What changes are needed to aviation law because of e-aviation?"*

> *"I would consider a side track using hydrogen aircraft and the associated infrastructure to safeguard the initiative and ultimate target of environmentally friendly aviation in the area. Hydrogen has, in my view, far more realistic potential that battery-driven flights right now."*

> *"Keep up the good work!"*

5 CONCLUSIONS

Based on the survey data, EA is still a new phenomenon, and thus, views regarding it differ among stakeholders. EA is generally viewed as a new, exciting opportunity for increasing collaboration in the Kvarken region. It should be noted, however, that the opinions of this group of respondents about EA are probably quite positive compared to the general public. However, the respondents are perhaps also more likely to see the potential for future opportunities as they are knowledgeable about the current state of EA. Stakeholders definitely considered EA as a positive opportunity but understood that regulations and financing set important preconditions for early implementation that need to be considered carefully. The search for innovative and new business models, as well as new ways to approach aviation as a service industry, was also highlighted by the respondents. The Kvarken region can act as a beacon for others to follow, but on the other hand, risk-taking may also mean that implementation of EA will take longer, especially if there are early failures.

The objective of the study was to analyse the potential regional effects of EA in the Kvarken region. According to the results, the effects are manifold and also challenging to foresee. The inclusion and utilisation of new networks, ideas and skills related, for example, in new technologies will certainly affect existing networks and ways of working. New collaboration opportunities are likely to emerge, and there will probably be new opportunities for the existing industries in the Kvarken region, such as energy technology companies, as some of their products may become important in the EA industry. The Kvarken region may also benefit from interest from the general public, which arises with EA and an increase in accessibility. Overall, EA seems to ”make sense” in relation to existing activities in the Kvarken region, such as the development of battery industries, energy cluster and existing sustainable energy activities, such as the Aurora Botnia ferry and the joint harbour company between Vaasa and Umeå. It has been envisioned in the FAIR project activities that this approach could even act as first step for a mutual airline, which would coexist alongside ferry activities, potentially benefitting ticket sales and other administration activities.

The need for better accessibility is recognised widely in the Kvarken region, and improvements in this regard are seen to improve future collaboration. The newly established Kvarken EGTC will help communication with the EU and make the region more known for European-level cooperation. However, more collaboration between local stakeholders and national stakeholders is still needed as regulations and preparations are especially needed to make EA a reality in the Kvarken region.

How should EA be implemented? This question received very different answers as some stakeholders emphasised the urgency to act fast and other stakeholder indicated the need

for more preparations. Risk-taking is considered mandatory, yet early failure may be a serious setback for a new industry. Most of the respondents were still slightly cautious and suggested that the Kvarken region is in a good position and needs to continue working towards understanding the practical significance of the implementation of EA. The survey findings indicate that further understanding is needed with ongoing discussions concerning the implementation of EA.

There were also some comments concerning funding and who should act. Some stakeholders view EU support, e.g. via the importance of project funding, whereas other stakeholders hope for more national support, e.g. via procurements. There are also stakeholders who ask how the Kvarken region could take charge of EA pilot projects on its own and commence with the implementation of EA. These questions will be considered within the FAIR network.

Despite the future challenges, the FAIR project seems to be on the right track and entails important work, as it tries to unravel the challenges regarding the implementation of EA. This optimism can be seen from the stakeholders' keen participation in project events and is expressed in the survey responses. It is therefore important to keep sharing our knowledge with others and form a larger network to collaborate with more people who are interested to make EA a reality in the Kvarken region.

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Appendices

Appendix 1. Suggested routes

ROUTE	Business travel	Leisure travel	Overall
Umeå - Vaasa	18	9	27
Umeå - Kokkola	7	4	11
Skellefteå - Kokkola	8	2	10
Umeå - Skellefteå	5	2	7
Vaasa - Hemavan	0	6	6
Umeå - Hemavan	0	5	5
Skellefteå - Örnsköldsvik	2	2	4
Vaasa - Örnsköldsvik	2	2	4
Vaasa - Skellefteå	3	1	4
Umeå - Örnsköldsvik	2	1	3
Umeå - Pietarsaari	2	1	3
Kokkola - Pietarsaari	2	1	3
Örnsköldsvik - Kokkola	2	1	3
Umeå - Mo i Rana	1	1	2
Vaasa - Pietarsaari	1	1	2
Vaasa - Kokkola	1	1	2
Umeå - Kruunupyy	1	1	2
Umeå - Seinäjoki	2	0	2
Skellefteå - Pietarsaari	2	0	2
Skellefteå - Seinäjoki	2	0	2
Skellefteå - Hemavan	0	2	2
Umeå - Bodö (NOR)	1	0	1
Umeå - Vilhelmina	1	0	1
Umeå - Höga kusten	1	0	1
Umeå - Trondheim	0	1	1
Umeå - Lyckelse	0	1	1
Umeå - Helsinki	0	1	1
Tärnaby - Höga kusten	0	1	1
Vaasa - Bodö (NOR)	1	0	1
Vaasa - Seinäjoki	1	0	1
Vaasa - Tärnaby	0	1	1
Vaasa - Mo i Rana	0	1	1
Vaasa - Lycksele	0	1	1
Vaasa - Gällivare	1	0	1
Vaasa - Stockholm	1	0	1

Vaasa - Helsinki	1	0	1
Vaasa - Copenhagen	1	0	1
Vaasa - London	1	0	1
Vaasa - Berlin	1	0	1
Vaasa - Höga kusten	0	1	1
Kokkola - Seinäjoki	1	0	1
Luleå - Arvidsjaur	1	0	1
Skellefteå - Bodö (NOR)	1	0	1
Skellefteå - Gällivare	1	0	1
Skellefteå - Sundsvall	0	1	1
Skellefteå - Kiruna	0	1	1
Skellefteå - Höga kusten	0	1	1
Örnsköldsvik - Pietarsaari	1	0	1
Örnsköldsvik - Seinäjoki	1	0	1
Örnsköldsvik - Gällivare	1	0	1
Örnsköldsvik - Hemavan	0	1	1
Örnsköldsvik - Höga Kusten	0	1	1

Please note: Some countries, like Greece and Thailand as well as regions like Lapland/mountain areas were also mentioned, but since they were more of a description rather than direct suggestion for concrete airports or routes, these have been left out from the attachment.

Cities mentioned as part of different EA routes (based on the previously presented routes)

City / Region	Mentions
Umeå	68
Vaasa	52
Skellefteå	36
Kokkola	30
Örnsköldsvik	19
Hemavan	14
Pietarsaari	11
Seinäjoki	7
Höga Kusten	5
Gällivare	3
Mo i Rana	3
Bodö	3
Tärnaby	2
Kruunupyy	2
Helsinki	2
Kiruna	1
Luleå	1
Sundsvall	1
Vilhelmina	1
Lycksele	1
Arvidsjaur	1
Stockholm	1
Copenhagen	1
Berlin	1
London	1

Appendix 2. The Questionnaire

FAIR Survey
FAIR - ELECTRIC AVIATION IN THE KVARKEN REGION

Welcome to share your views on electric aviation in the Kvarken region! Answering will take about 20 minutes. At the end of the survey, you may also give comments and feedback.

This survey is part of the FAIR-project (Finding Innovations to Accelerate Implementation of electric Regional aviation), which analyses possible flight routes and social-economic impacts of electric aviation in the Kvarken region. The objective is to develop models for possible commercialization through private and public innovations in the region. FAIR is an Interreg Botnia-Atlantica project, coordinated by The Kvarken Council:

https://www.kvarken.org/projekt/fair/

The aim of the survey is to investigate how electric aviation and its effects are perceived generally and especially as part of the regional transportation system in the Kvarken region. We are interested in your personal views, which will be handled anonymously.

By “the Kvarken region” we mean the area consisting of Ostrobothnia, Southern-Ostrobothnia, Middle-Ostrobothnia, Västerbotten and Örnsköldsvik municipality. The term "electric aviation" is used at a general level to refer to different plane types from drone-type planes and eVtols to different sized “regular” planes.

All questions are in english, but: Du kan också svara på svenska på öppna frågor/Voit halutessasi vastata avoimiin kysymyksiin myös suomeksi.

We thank you already in advance for your time and input! The results will be published in the reports of the FAIR project in between 2020-2022.

For more information concerning the survey, please do not hesitate to contact us!

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ANONYMITY AND GDPR
We assure you that your answers are completely anonymous and cannot be traced back to you. Your answers are combined with many others and only used in a summarized form. The results will be used in scientific and project publications or presentations at conferences. Data will be stored without identification details by the University of Vaasa, according to the European General Data Protection Regulation (GDPR). This regulation gives the respondent rights to, for example, look at the collected personal data as well as right to remove answers from the database.

For more information on GDPR, please contact: antti.maenpaa@univaasa.fi

1. Regional effects of electric aviation

1. The implementation of electric regional aviation will…

- improve the quality of the environment in the Kvarken region
- transform the regional transportation system in the Kvarken region
- balance regional development within countries by improving accessibility of smaller cities and rural areas
- balance regional development within the Kvarken region by improving accessibility of small cities and rural areas
- bring positive international visibility to the Kvarken region
- add to the international competitiveness of the Kvarken region
- make the Kvarken region a pioneer in the field of electric aviation

(The respondents were able to choose between the following alternatives: Strongly disagree, disagree, neither agree nor disagree, agree, strongly agree, don't know)

2. What sort of specific impacts do you think that an early implementation of electric regional aviation will have on the Kvarken region?

3. What sort of concrete innovation potentials do you think that the implementation of electric aviation brings to the region…

- in service innovation:
- in product innovation:
- in business model innovations:
- I don´t know (mark with an "x")

In the next questions we would like you to evaluate first the current state of the cross-border region and then how electric regional aviation might affect it in the future

4. Please evaluate the state of the cross-border activities in the followin domains – as you consider the situation today:

- Accessibility in terms of transportation (road, air, rail, sea)
- Sociocultural coherence (e.g. education, language)
- State of economy & technological development (e.g. income, job creation, firms creation, innovation, knowledge production)
- State of environment (collaboration in environmental issues, environment and heritage protection, natural tourism)
- Institutional/legal coherence (cross-border entities, governance, laws, regulations)

(The respondents were able to choose between the following alternatives: very poor, poor, fair, good, excellent, no opinion)

5. Now, imagine the state of the Kvarken region in 2050: how would an early implementation of electric aviation change this?

- Accessibility in terms of transportation (road, air, rail, sea)
- Sociocultural coherence (e.g. education, language)
- State of economy & technological development (e.g. income, job creation, firms creation, innovation, knowledge production)
- State of environment (collaboration in environmental issues, environment and heritage protection, natural tourism)
- Institutional/legal coherence (cross-border entities, governance, laws, regulations)

(The respondents were able to choose between the following alternatives: very poor, poor, fair, good, excellent, no opinion)

Cross-border cooperation

6. How do you think that an implementation of electric regional aviation would affect cooperation?

- Inside the Kvarken region
- Between the Kvarken region and national levels (Sweden/Finland)
- Between the Kvarken region and international level (EU/rest of the world)

(The respondents were able to choose between the following alternatives: brings strong negative effects, brings some negative effects, neither negative nor positive effects, brings some positive effects, brings strong positive effects, don't know)

7. How do you think that an implementation of electric regional aviation will change cooperation within the Kvarken region, concretely?

8. The Kvarken region will soon become the first Nordic EGTC (European Grouping of Territorial Cooperation), which is a European legal instrument designed to facilitate and promote cross-border cooperation. Did you know about this?

- Yes/No

9. How do you think that the new EGTC affects the region's possibilities to promote electric regional aviation?

Business models and new routes

Please note, you can have multiple choices on question 10

10. What sort of business models should be developed to support the early implementation of electric regional aviation in the Kvarken region?

- full-service carrier
- low-cost carrier (mainly point to point service)
- charter carrier (with a focus on a particular air service & travel packages)
- regional airlines with several small planes
- regional airlines with few large planes
- cargo as a core activity
- other, what (In case you have some concrete ideas on business models & business model innovation, please specify your answer here):
- I don´t know

11. In your opinion, within which routes/areas may an implementation of electric aviation add most value for the Kvarken region? You can either name concrete routes or answer more generally concerning your opinions on added value of implementing electric aviation for both business and leisure travel

- business travel:
- leisure travel:
- No opinion (mark with an "x")

Next steps

12. In your opinion, what concrete measures and steps should be taken to support an early implementation of electric regional aviation, and make it a reality in the Kvarken region?

13. What kind of education and/or research is needed to support the implementation of electric aviation in the Kvarken region?

14. What key challenges should be addressed to support an early implementation of electric aviation in the Kvarken region?

15. Any other feedback to the FAIR team? (e.g. other thoughts, comments or worries concerning the topic of the survey, possible development ideas)

Background information

We will lastly ask some background information in order to form statistics of the respondents

16. Which type of organisation are you working in? *

- Company (50+ personnel)
- SME (less than 50 personnel)
- Higher education institute or research organisation
- Regional development organisation (Vasek, INTO Seinäjoki etc.)

- Public organisation (airports, cities, regions, municipalities etc.)
- NGO (chambers of commerce etc.)
- Other, What?

17. If you are working in a company or SME, please describe the industry

- Energy
- Materials (construction materials, metals & mining, paper & forest products, chemicals)
- Industrials (capital goods, commercial services, transportation)
- Consumer discretionary (automobile, media, consumer durables and apparel, retailing)
- Consumer staples (food, beverage and tobacco, household & personal products)
- Healthcare (pharmaseuticals, biotech and life sciences)
- Financials (banks & insurance)
- Information technology (software, technology hardware, semiconductors)
- Telecommunication services
- Utilities (electric, water, gas, power & renewables)
- Real estate
- Other; what:

18. Which region/country are you working in? *

- Finland, Kvarken region
- Finland, rest of Finland
- Sweden, Kvarken region
- Sweden, rest of Sweden
- Norway
- Other, what:

19. Gender (for statistical purposes only) *

- Female
- Male
- Other
- Don´t wish to share

20. Year of birth (for statistical purposes only) *