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The Sustainability of Academic Air Mobility in Finnish Universities

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Abstract: With the simultaneous rise of concern about the climate crisis and the growing internationalization of research institutions, academic mobility poses an "academic paradox": knowledge of the environmental harm of aviation does not necessarily translate into action. Universities must make changes to their mobility habits if they wish to comply with governmental carbon neutrality targets and lead with example. This research looks at Finland's 14 universities and identifies the patterns and trends of academic mobility from a series of reports provided by the universities and their travel agencies. Moreover, we mapped the travel destinations to understand the scope of Finnish academic travel. The data revealed that Finnish universities are in different states of sustainability: some acting as clear trendsetters and others lagging. The results show that although the universities are performing well in some areas, as in preferring European destinations over intercontinental ones, there are still areas of improvement related to stopover reduction, the number of 1- and 2-day trips, and alternative transport forms to aviation. There is also a need for the standardization of targets and emission calculators. These key development areas are posed as recommendations through which the universities could easily reduce the carbon footprint of their mobility.

Keywords: corporate sustainability; aviation emissions; research organizations; researcher mobility; wicked problems; sustainable academia

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Citation: Ahonen, V.; Siljander, M.; Pellikka, P.; Johansson, T.; Rask, M. The Sustainability of Academic Air Mobility in Finnish Universities. *Sustainability* **2021**, *13*, 2948. https://doi.org/10.3390/su13052948

Academic Editor: Luis Delgado

Received: 15 February 2021
Accepted: 5 March 2021
Published: 9 March 2021

1. Introduction

Among all forms of transport, aviation generates the largest CO_2 emissions per capita: accounting for 2% of annual global CO_2 released [1], with a steady growth due to increased globalization and GDP [2]. Due to its swiftness, aviation is widely considered the most time-efficient way to travel, especially by organizations and businesses. Yet, simultaneously, organizations are driving toward socioecological sustainability due to changes in regulation and customer need, such as elevated concern about climate change [3,4]. Thus, tracking and reducing aviation-based greenhouse gas (GHG) emissions has become normal in organizations.

In a world that is both globalizing and warming, research organizations play a dual role. While they contribute to climate solutions through research, they also produce substantial CO_2 emissions through academic mobility—the average GHG emissions of a scientist often even exceed those of a typical citizen. This has been referred to as the "academic paradox" [5,6] and can be classified as a wicked problem, since the culprits themselves cause the problem that they are trying to solve [7]. Academic mobility studies have been carried out in several countries, including Canada [8], New Zealand [9], and Australia [10]. These studies identify the presence of a "knowledge-action gap", especially among green academics [11], highlighting that knowledge of the climatic effects of aviation does little to affect behavior. Previous research has also identified that alongside behavioral reasons, the disconnection between action and knowledge results from rigid organizational culture relying increasingly on internalization. In the academic world, traveling by air to conferences, fieldwork and foreign lectures are perceived as part of a successful career [10,12–14]. Although substitutes such as videoconferencing have existed for a while, they currently fail to replicate genuine human interactions essential to conference culture, such as informal gatherings [15]. There is also a call for more support for alternative forms of mobility (e.g., land traffic) and changes in travel habits.

Universities have three primary emission sources: energy and heating, mobility, and waste. Waste emissions are generally the smallest out of the three. Energy and heating are counted as Scope 1 and 2 emissions (caused directly by the organization or emissions deriving from the organization's energy inputs) and thus are directly or indirectly controlled by the organization. Waste and travel emissions (Scope 3 emissions) are more difficult to monitor and control since they are largely generated outside of the workplace [16]. Thus, lowering energy and heating emissions is easier through technical changes related to energy efficiency and building temperature control. Reducing Scope 3 emissions requires more difficult and complex changes involving a multitude of actors, and due to their broadness may lead to a conflict of responsibility and neglecting of the problem altogether [9].

One geographically interesting country that still lacks research on academic mobility is Finland. It is located in Northern Europe, approximately between 60° N and 70° N latitude, and 19° E and 31° E longitude. The largest proximate foreign cities are Tallinn in Estonia (at the air distance of 82 km from Helsinki), St. Petersburg in Russia (299 km), Riga in Latvia (362 km) and Stockholm in Sweden (397 km). In the south and west, Finland is bordered by the Baltic Sea, which makes direct rail transport impossible and isolates the country from most of mainland Europe and Scandinavia. The isolation and size (338,465 km^2), combined with large distances within the country, makes Finland an aviation-dependent nation: in fact, according to a recent finding by the International Council on Clean Transportation, Finns produce the second highest aviation CO_2 emissions per capita in the world [17]. Simultaneously, due to Finland's high latitude location, the northern parts of the country are expected to suffer from the fastest climate warming during the coming century [18]. This dilemma further highlights that a complete outlook on the issue in the region is long overdue.

The objective of this study was to find the extent to which GHG emissions from academic mobility affect the total GHG emissions of Finnish universities, and what mobility trends and patterns can be identified in them. Based on this, we have suggested a series of recommendations, aiming to set sustainable mobility guidelines that benefit universities in Finland and abroad. To move closer to this objective, we asked two research questions:

1. What is the current state of emissions from academic air mobility at Finnish universities?
2. What are the key areas of development in terms of GHG emissions by Finnish universities?

This study is based on data compiled from all Finnish universities in spring 2020 and presents a comprehensive review of their mobility habits and strategies at the time. There are 14 universities in Finland: five in the Greater Helsinki metropolitan region, seven within 400 km of the capital city of Helsinki, and two over 400 km away. The 400 km distance is deemed important in Finland because for distances under 400 km, other forms of traffic (such as train and bus) can compete with aircraft in terms of travel time. After 400 km, this trend is reversed [19]. The geographic locations of Finnish universities are presented in Figure 1.

Figure 1. The locations of the 14 universities in Finland and the largest proximate foreign cities from Helsinki.

2. Materials and Methods

The preliminary data consist of an overview of openly available documents about mobility strategy from university websites. In cases in which the website searches yielded few results, a Google search with the following keywords (university + carbon footprint/sustainability/aviation/mobility) was also carried out.

Next, each university was contacted through their sustainability director or strategy officer to fill in the information gaps. A set of questions was sent out via e-mail:

- What is the university's official stance on academic aviation?
- What is the total carbon footprint of the university (annual)?
- How much greenhouse gas emissions did academic aviation produce in the university?
- How many kilometers were flown?
- How long (time) were the flights?
- What were the flights' destinations?

The universities were then classified into groups based on the level of the adoption of ideas according to the innovation adoption lifecycle [20].

The raw data were obtained from the travel agencies or mobility personnel in the form of separate Excel spreadsheets or PDF files, the scope of which depended on the university. In the simplest case, the data consisted of a chart of the CO_2 emissions and flight kilometers for the year in question, sorted by flight length. In the largest datasets the data included a row for each individually purchased trip, organized into the following columns (excluded parameters in parentheses): traveler name, (fare paid), ticket routing, origin city/country/region name, main airline name, destination city/country/region name, CO_2 equivalent tonnes, (miles) and kilometers, (ticker number), ticket departure date, and ticket return date. In addition, we included the number of employees and percentage of flights booked outside the travel agency.

Carriers were deemed to be important, since previous research has identified that the CO_2 emissions of the same flight path can vary significantly depending on the airline, due to the choice of aircraft, the number of occupied and total seats on an aircraft, and the passenger to freight factor [21] or even geographic region, with European airlines performing better sustainability-wise than their Asian counterparts [22]. The number of landings was included because for flights of over 800 km, 25% of emissions are produced during the Landing Take-Off (LTO) cycle. For this reason, direct flights generally produce fewer emissions than flights with stopovers [23]. Departures and destinations are integrally linked to both flight kilometers and CO_2 emissions and were chosen to fully understand the scope and patterns of mobility at Finnish universities. Duration days were included, since studies have revealed that most academic travels are short stays such as conferences [8,10,24,25], and that short stays in faraway destinations produce the highest carbon footprint [26]. Finally, it was important to identify the number of employees to calculate emissions and kilometers per capita, and to find out the percentage of flights booked outside the official travel agency, since the universities cannot provide data on these flights.

After setting up the dataset, the data were ordered alphabetically and duplicates were removed and calculated to sum the number of cells that corresponded to each parameter. The data were then ordered numerically in descending order or converted to a percentage value (with parameters containing fewer than ten unique fields). The range of each data series was one year.

After this, the data series were converted into graphic form with Excel spreadsheets and analyzed for patterns and trends both within and in between universities.

Next, spreadsheet data with coordinate information of the destination cities were imported into ArcGIS software and they were spatially mapped in two different ways: the first map shows global distribution of destination flights for four organizations in 2019 (Figure 2); the second map is a graduated symbol map of the number of destination flights for the main European cities (Figure 3). In addition, we created a map showing global distribution of destination flights for the University of Helsinki in 2019 and 2020 to demonstrate how the COVID-19 pandemic drastically changed the pattern of destination flight locations (Figure 4).

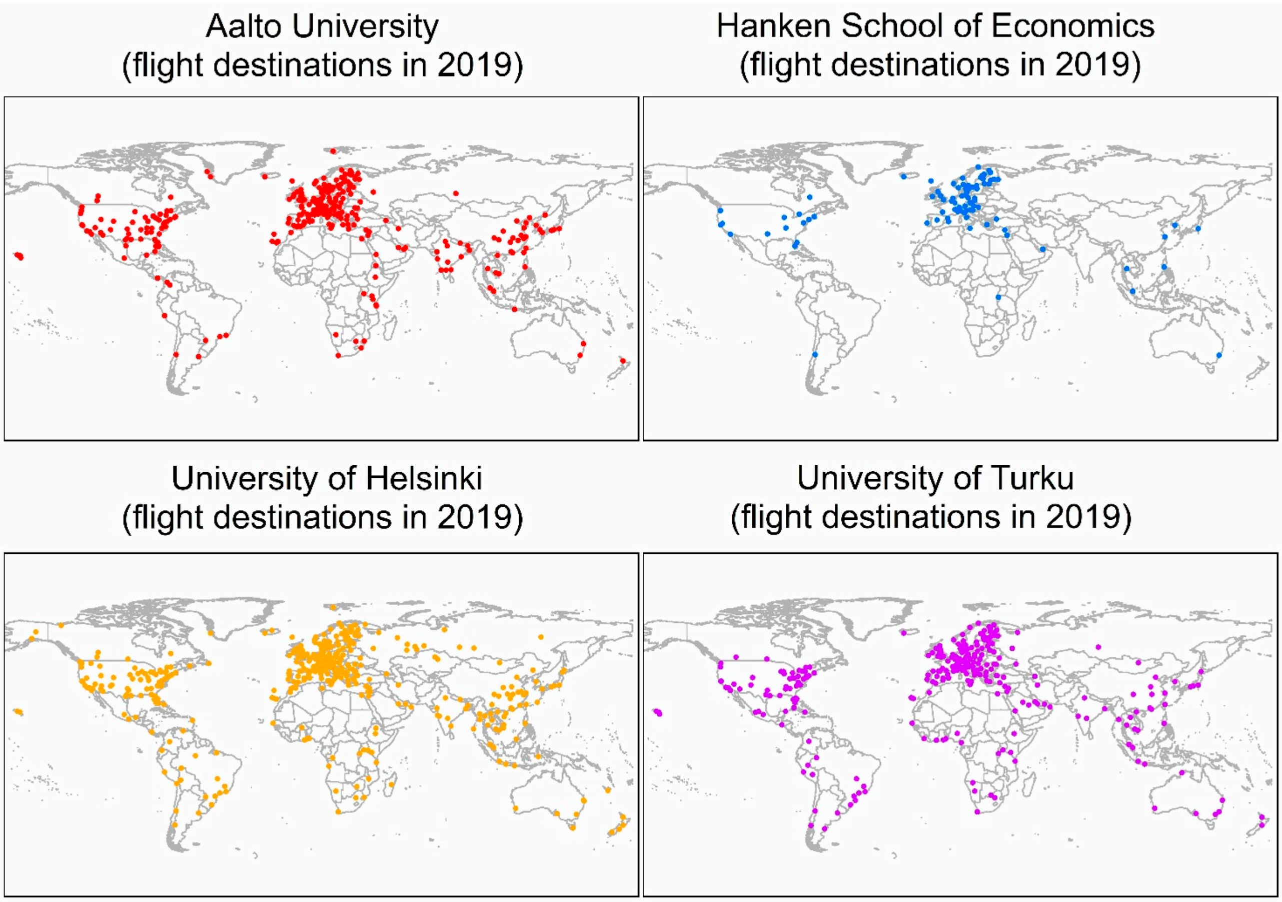

Figure 2. Flight destinations in 2019 for four selected universities.

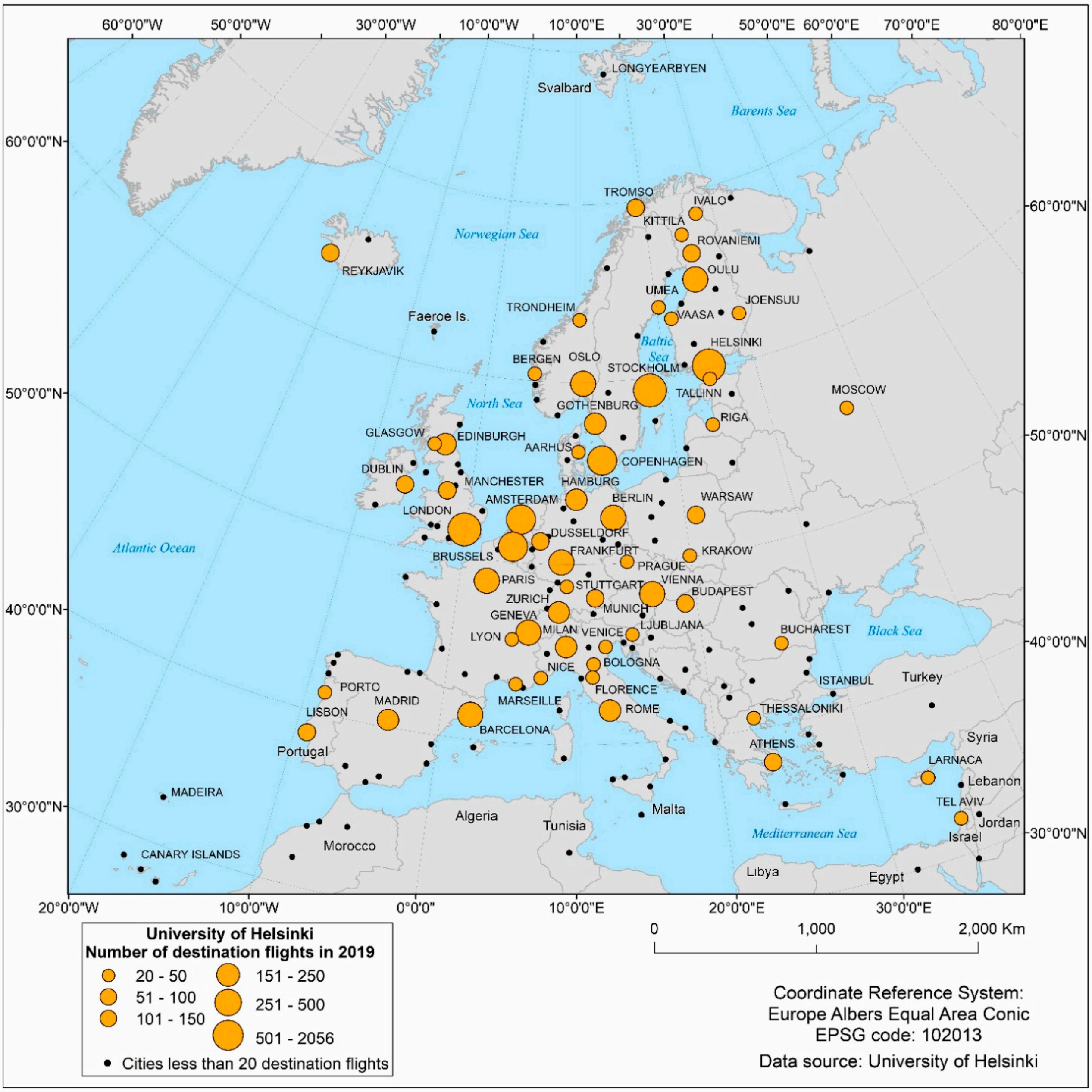

Figure 3. University of Helsinki, European flight destinations in 2019.

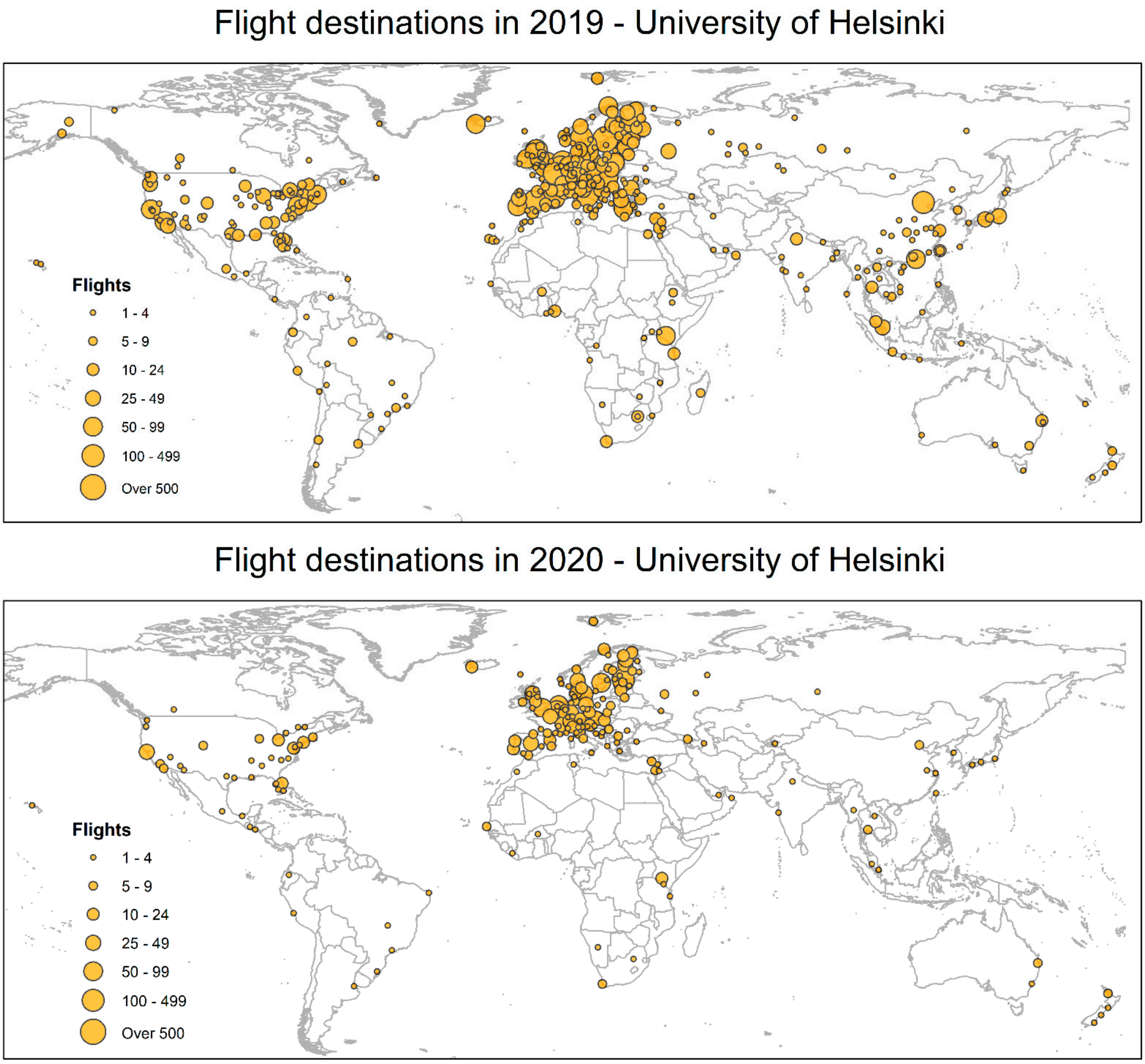

Figure 4. The effects of COVID-19 on the flights of the University of Helsinki in spring 2020 compared to the year 2019.

3. Results

The pregathered results from the university websites and e-mail discussions revealed nine out of 14 universities were aiming at carbon neutrality by years ranging from 2024 to 2035. These were then compared with the categories of Rogers (2010) and listed in Table 1.

The results show that especially the middle categories of early adopters and early majority correspond to the numbers in the dataset of the Finnish universities. However, a higher proportion than usual fall into innovators and laggards. Innovators are traditionally risk-takers; those using judicious choices of adoption do so to maintain their positions in the community. The late majority and laggards prefer traditions and adopt choices only after majority of society has adopted them [20]. Compared to the classic model, this dataset shows three distinct categories due to the gaps between the years 2024 and 2025 forming a joint "innovator-early adopter" category, with the 2030–2035 cohort representing the "majority", and those with no aims representing the "laggards". Out of the 14 universities, 10 were able to supply additional data on their travel habits. These were listed in Table 2.

Table 1. Finnish University carbon neutrality targets compared to the categories of adopters introduced by Rogers (2010).

Year of Carbon Neutrality (Finnish Universities)	Universities	Percentage	Category (Diffuse of Innovations Theory)	Percentage
2024	Lappeenranta-Lahti University of Technology	7%	Innovators	2.5%
2025	University of Eastern Finland, University of Turku	14%	Early adopters	13.5%
2030	Aalto University, Åbo Akademi, Hanken School of Economics, University of Jyväskylä, Tampere University	36%	Early majority	34%
2035	University of Helsinki	7%	Late majority	34%
No aims	University of the Arts, Finnish Defense University, University of Lapland, University of Oulu, University of Vaasa	36%	Laggards	16%

The data gathering phase also revealed that half of the Finnish universities had either considered or chosen to offset their aviation emissions as a way to reach carbon neutrality. However, the reasons for their decisions and the comparisons between their chosen carbon offset schemes are complex and out of the scope of this article, which is why they were omitted from further analysis.

Carrier data exist for Aalto University 2018–2019 and the University of Helsinki 2017–2019. Out of the 193 identified airlines, Finnair, the flag carrier and largest airline in Finland, was the most commonly used airline. Other large airlines were Lufthansa (Germany), Scandinavian Airlines (Sweden, Norway and Denmark), Norwegian (Norway), KLM Royal Dutch Airlines (Netherlands) and British Airways (Great Britain), which suggests that European and especially North European airlines are preferred over non-European ones. The largest airlines also reflect the most common flight destinations.

Data on departures and destinations spanned regional, country and city levels. Regional-level data were acquired for Aalto University (2018–2019) and the University of Helsinki (2018–2020), and were divided into eight regions (South America, Oceania, North America, Middle East, Europe, Central America, Asia and Africa). Country-level data existed for the same years and universities. At the city level, Hanken School of Economics (2019), University of Helsinki (2015–2017), and University of Turku (2019) were also included.

Most of the departures were from Finland, which made Europe the largest departure region (93–94% of departures). The second largest departure region was North America (3%), with the United States being in the top 10 in all datasets, followed closely by Asia (1–2%), and in descending order Africa, South America, Oceania, Middle East and Central America, each representing less than 1% of departures. The top ten departure countries in descending order were: Finland, United Kingdom, Sweden, United States, Germany, Denmark, Norway, Spain, Netherlands, and France. At the city level, in nine of the ten datasets, Helsinki was the number one departure city. This was followed in descending order by the cities of Stockholm, Copenhagen, Amsterdam, London, Frankfurt, Paris, Brussels, New York, and Barcelona, showing a preference for nearby locations.

Table 2. The data obtained from the 14 universities of Finland.

University	Key Notes on Actions	Mobility Data Collected
Aalto University	Encouraging less travel through providing information on travel emissions, building sustainable culture. New travel booking system that displays emissions. Internal carbon offsetting considered.	2014–2019: Kilometers, tCO_2 eq; 2018–2019: carrier, departures and destinations (city, country and region), duration days, landings, flight length, traveler name.
Åbo Akademi	Oral instructions on reducing air travel in Finland. Carbon footprint calculated from 2019 onwards.	2019: kilometers, tCO_2 eq.
University of the Arts	Sustainable future-program with environmental planning and monitoring system drafted for 2021–2024. Considering investing into sustainable infrastructure, new technologies and integrating sustainability into studies.	2019: flight length, tCO_2 eq.
Finnish defense University	Sustainability program in early stage. Carbon footprint calculations in development—following example of Turku University.	No data available
University of Eastern Finland	Strategy endorses alternative ways of travel and virtual meetings. Offsetting aviation emissions.	No data available
Hanken School of Economics	Looking into science-based targets for Scope 3 emission reductions. Offsetting of aviation emissions considered.	2019: departures & destinations (city), flight length, kilometers, tCO_2 eq.
University of Helsinki	Use of ABC principle when identifying of the need for travel (Avoid, Book an Alternative, Compensate). Offsetting aviation emissions.	2015–2020: departures & destinations (city), kilometers and tCO_2 eq; 2016–2020: flight length; 2017–2020: carrier, traveler name; 2018: duration days; 2018–2020: departures and destinations (country and region), landings.
University of Jyväskylä	Committed to UN Sustainable Development Goals. Considered: regional, national and international targets. Carbon footprint calculations in development. Offsetting of aviation emissions considered.	2017–2019: flight length, kilometers, tCO_2 eq.
University of Lapland	Sustainability program in early stage. Strategy from 2021 onwards aims to emphasize necessity of travel.	No data available
Lappeenranta-Lahti University of Technology	SDG goals clearly stated in strategy, via climate action first hand (e.g., digitalization). Personal carbon trading scheme for mobility considered. Offsetting of aviation emissions considered.	2018–2019: kilometers, tCO_2 eq.
Tampere University	Emphasis on the importance of videoconferencing and combining work & pleasure travel. Offsetting of aviation emissions considered.	2019: flight length, kilometers, tCO_2 eq, % of flights outside travel agency.
University of Oulu	Sustainability program in early stage. Carbon footprint calculations start in 2020.	2018–2019: flight length, kilometers, tCO_2 eq.
University of Turku	Carbon footprint calculated from 2019 onwards. Alternative means such as preferring direct routes and alternative traffic options endorsed.	2019: departures and destinations (city), kilometers, tCO_2 eq.
University of Vaasa	Sustainability program in early stage. Sustainable development as 1/3 key goals of the university. Strategy endorses light mobility and virtual conferencing as a substitute to mobility.	No data available

Of destinations, Europe represented 78–85%, and North America (8–11%) and Asia (2–8%) rose in importance. The role of Asia was especially important in Aalto University mobility, whereas the University of Helsinki traveled more to Europe, Africa and Oceania. During the COVID-19 pandemic in the University of Helsinki, the role of mobility within Europe was emphasized by the expense of Asia, as there were travel bans to distant destinations (see Figure 4). Africa represented 1–2% of destinations, followed in descending order by Oceania, South America, Middle East and Central America at <1%. The top ten destination countries in descending order were: Finland, the United States, Germany, the United Kingdom, Sweden, Denmark, Italy, Netherlands, France and Spain, with Finland dominating less strongly than with the departures. The top countries are also reflected in the destination cities in Figures 2 and 3. Cities in Northern Finland, such as Oulu, were also prominent.

Travel duration data ranged from 1 to 323 days and covered a two-year period at Aalto University (2018–2019) and a one-year period at the University of Helsinki (2018). Most of the trips lasted for fewer than 10 days. In both universities, there was a steep decline, especially between 1- and 2-day trips, after which the frequency of trips linearly decreased with the trip length. Roughly at 50 days, the dataset reached a point where the trip length frequencies were, with a few exceptions, standardly 0–2, which is why the data were excluded from the figures. Single peaks in the frequencies (such as 13 trips of 92 days at the University of Helsinki 2018 dataset) might be the result of either random distribution, research or course visits with several participants, or grant processes offering pay exclusively for this length of trip. In this case, 80% of these trips were single visits to the same destination. The results are presented in Figures 5 and 6.

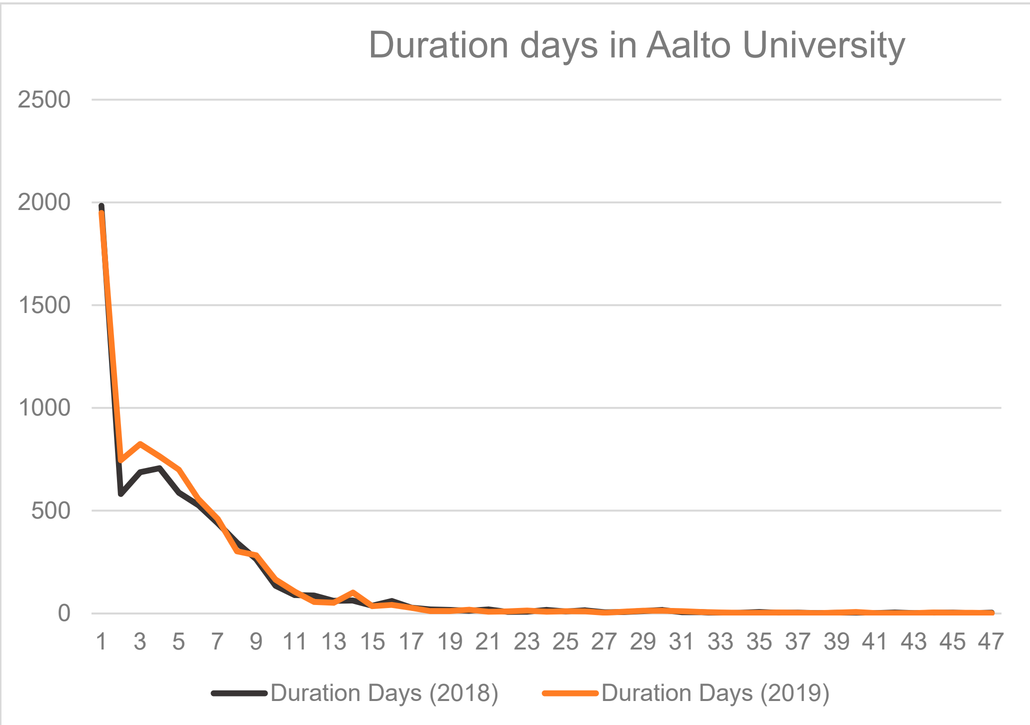

Figure 5. Trip duration at Aalto University (2018–2019). Y-axis: number of trips; X-axis: trip length in days.

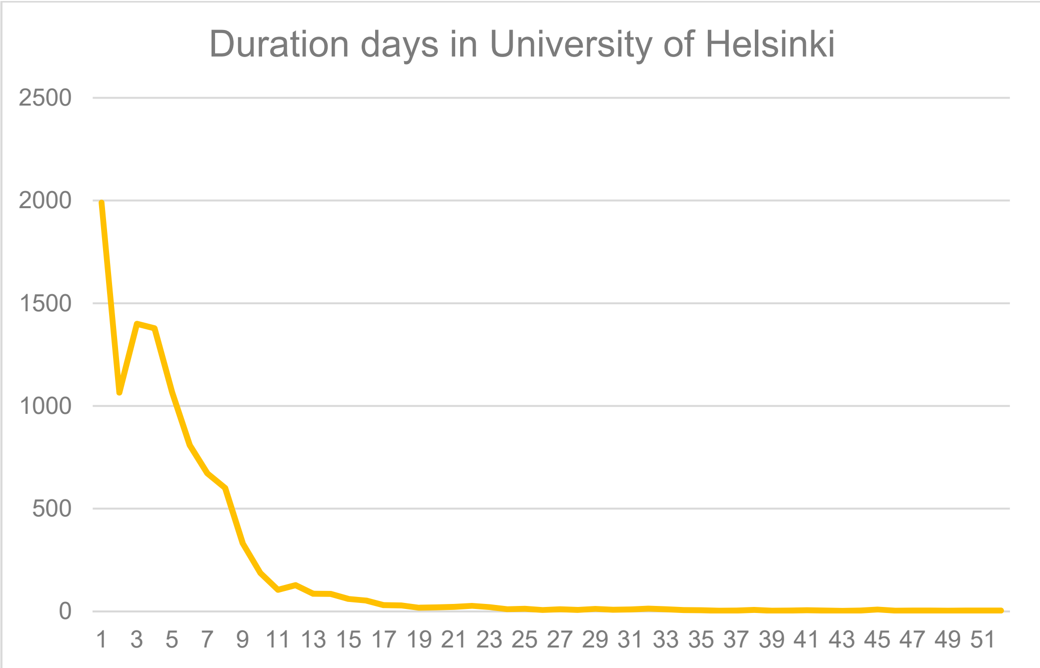

Figure 6. Trip duration at University of Helsinki (2018). Y-axis: number of trips; X-axis: trip length in days.

Landing data exist for Aalto University during 2018–2019 and University of Helsinki during 2018–2020 and were calculated manually from flight routing strings by identifying the number of landings on a flight path (e.g., Helsinki–Stockholm–Helsinki = two landings).

The number of landings ranged from 1–9, and in the case of Aalto University (2019), a 12-landing flight path also existed. The most common flight path included two landings (54–60%), followed with four-landing (17–20%) and one-landing (13–19%) flights. One-landing trips likely also included a return flight, which is shown as a separate flight string due to different purchase times from the departure flight, or do not appear in the dataset due to the purchase being made outside the official travel booking system. Flight paths with over four landings were rare (<3%). Flights with over six landings were excluded from the figure due to low frequency (<1%). There were no marked differences between the universities or years. See Figure 7 for details.

Flight lengths were analyzed for Aalto University (2018–2019), University of Arts (2019), Hanken School of Economics (2019), University of Helsinki (2016–2020), University of Jyväskylä (2017–2019), Tampere University (2019), University of Turku (2019), and University of Oulu (2018–2019). They were divided by the travel agencies into short-haul (<463 km), medium-haul (463–3700 km) and long-haul trips (>3700 km) in all cases except for Aalto University (2018–2019) and University of Helsinki (2017), in which they were divided into domestic, continental and intercontinental trips. This difference in classification is visible especially in the case of long domestic trips in Finland (such as Oulu at the distance of 539 km). In the first category, these are divided into medium haul, but in the second category, into domestic, which causes a small overdistribution of domestic trips compared to short-haul trips. It also affects longer continental trips, which in the first category are long haul, but in the second category are continental, leading to an overdistribution of continental flights compared to medium-haul flights.

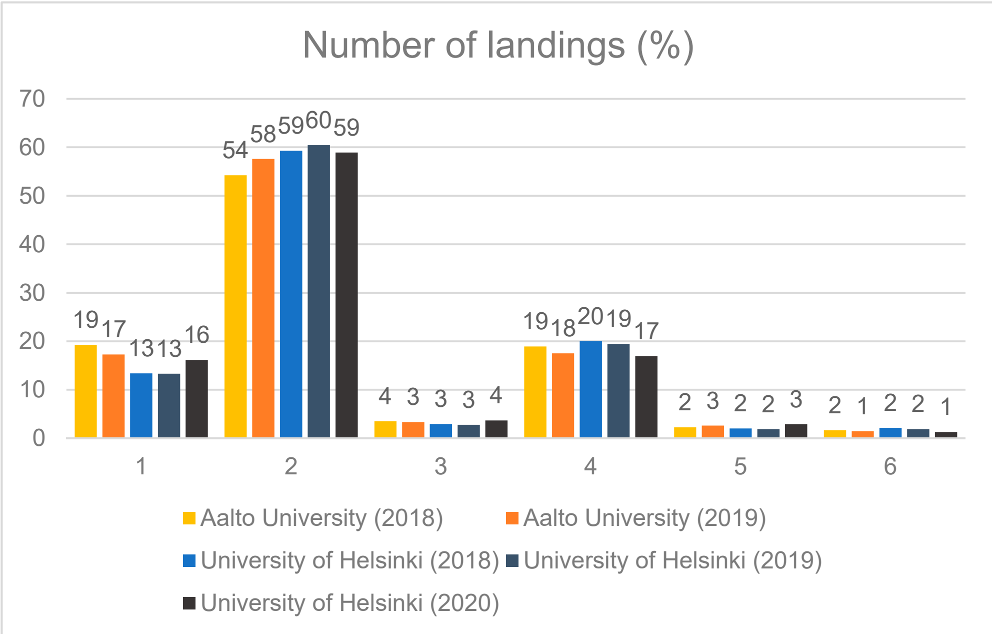

Figure 7. The number and distribution of the number landings per flight path for five individual years. Y-axis: distribution (percentages) of landings for the year in focus; X-axis: number of landings.

The most flight kilometers came from long-haul trips, followed by medium- and short-haul trips, as they are shorter in length. At Tampere University, University of Turku and University of Helsinki, these were roughly distributed at 50% long-haul, 45% medium-haul, and 5% short-haul trips, with the exception of the year 2020 in the University of Helsinki, which was affected by COVID-19 and thus long-distance travel was reduced on the expense of shorter-distance travel; at University of Oulu there was an almost equal number of short-haul (30%), medium-haul (35%) and long-haul kilometers (35%). Oulu is located further north and thus the number of short, within-Finland trips is higher. In Hanken School of Economics, short-haul flights provided only <1% of kilometers, followed by medium-haul with 29%, and finally 70% of kilometers coming from long-haul flights, suggesting more long-distance travel. The detailed numbers are presented in Figure 8.

In the second classification, continental trips were the most common type, followed by intercontinental and domestic ones. The number of domestic flights roughly corresponds to the number of short-haul flights in the first classification. There is a major difference, with continental trips taking up to ~70% of space and intercontinental only 22%. The difference in classification is the most likely driver here. See Figure 9 for details.

Flight kilometers were analyzed from Aalto University (2018–2019), Hanken School of Economics (2019), University of Helsinki (2015–2020), University of Jyväskylä (2017–2019), Lappeenranta-Lahti University of Technology (2018–2019), University of Oulu (2018), Tampere University (2019) and University of Turku (2019). Note the anomaly with the University of Helsinki—2020 km, which is caused by the COVID-19 situation (and shorter comparison period of 6 versus 12 months). During this period, flights were reduced by 87%, and the CO_2 emissions by 88% compared to the previous year. The drop in emissions between 2016 and 2017 was the result of the change of travel agency and calculation methods. The results are presented in Figure 10.

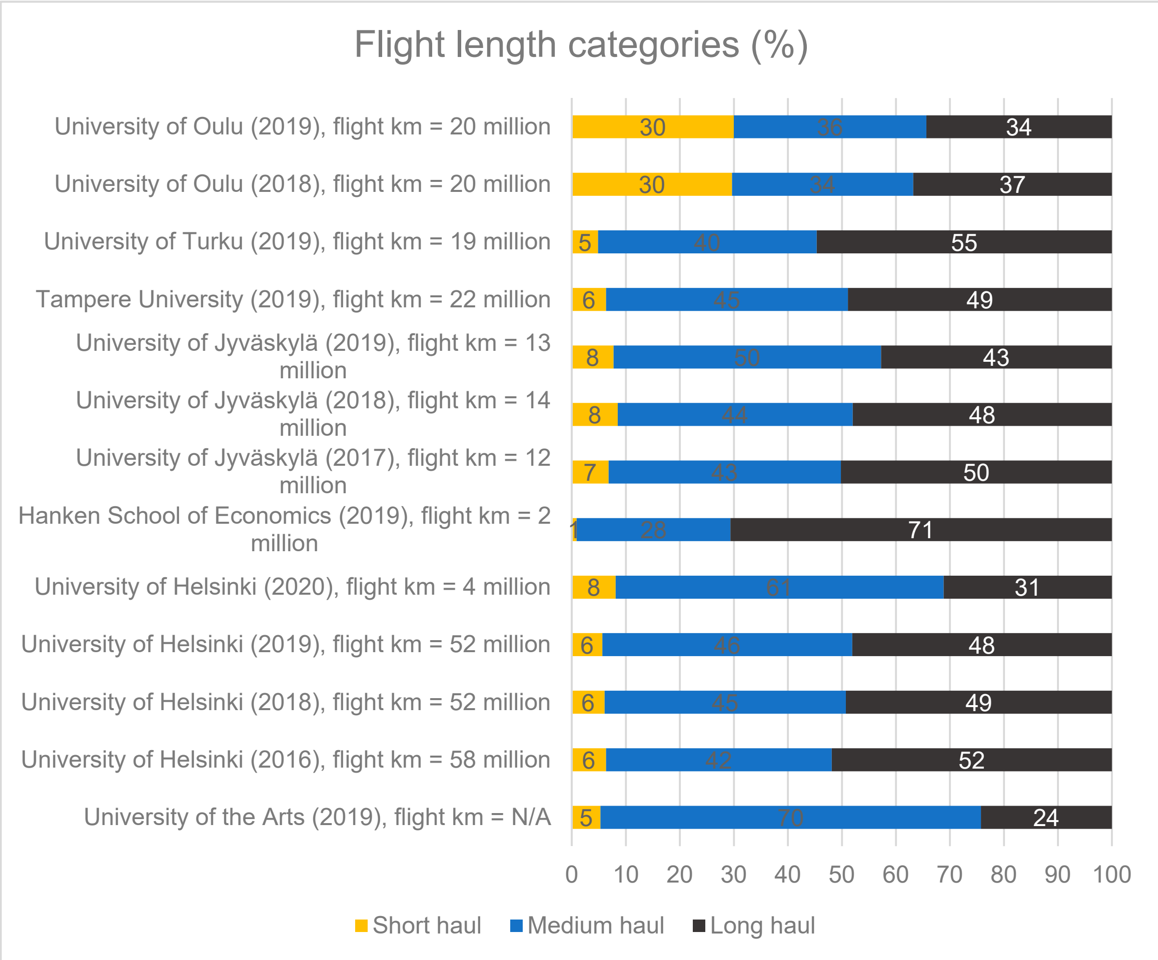

Figure 8. Distribution of flights by length (percentages of total flights). Flight kilometers stated for easier comparisons.

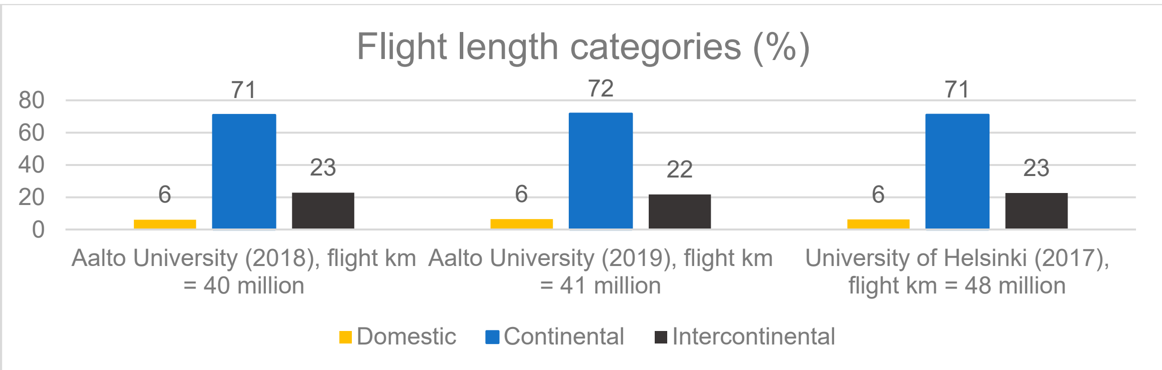

Figure 9. Distribution of flights by length (percentages of total flights).

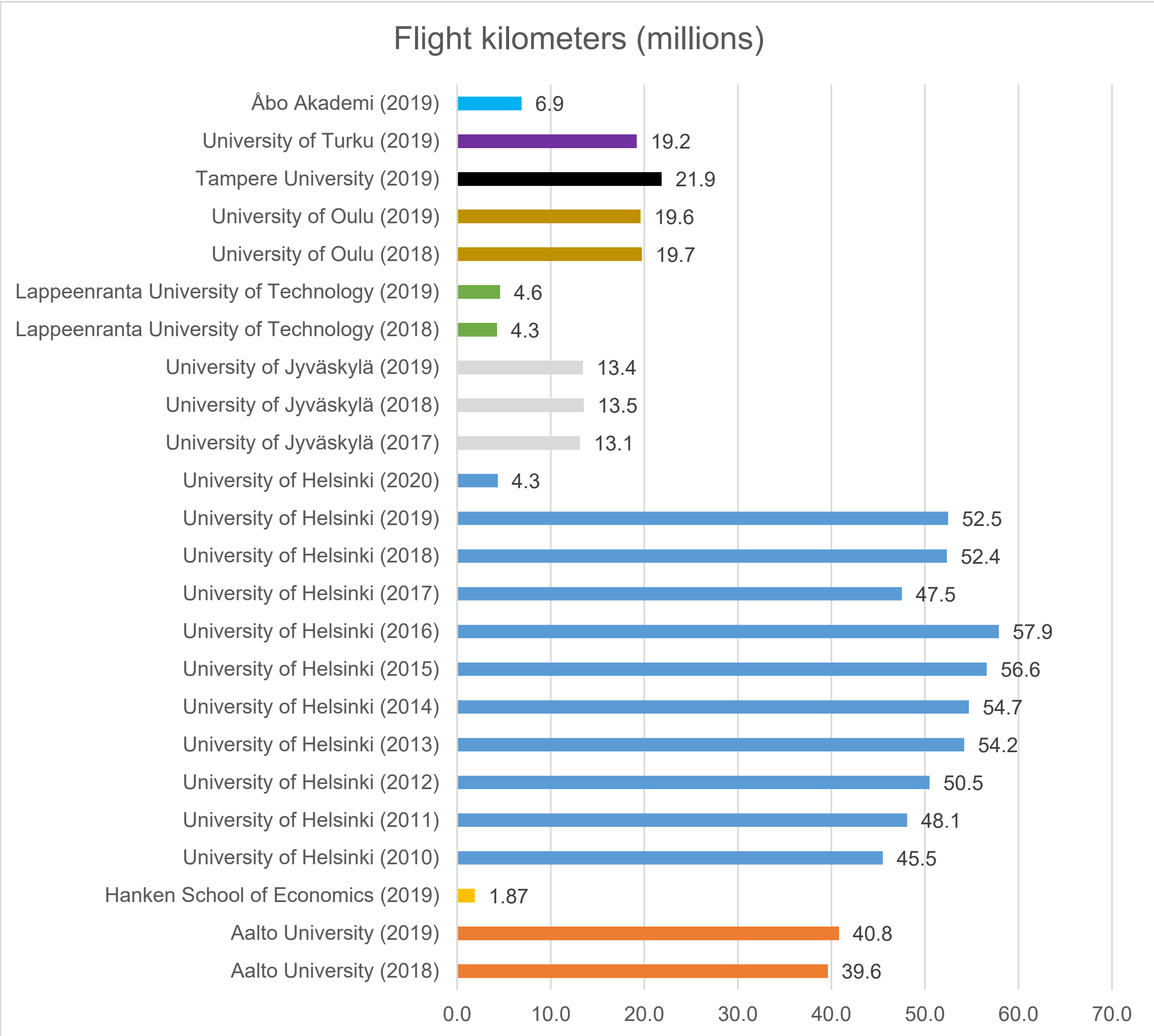

Figure 10. Flight kilometers (millions) for eight Finnish universities per annum 2010–2020.

Aalto University personnel flew the most per employee, followed by Hanken School of Economics and University of Oulu. The two latter cases these could be explained by the large amount of long-distance travel, or high number of flights in general due to distant locations. See Figure 11 for details.

CO_2 equivalent tonnes were analyzed for Aalto University 2014–2019, University of Arts 2019, Hanken School of Economics 2018–2019, University of Helsinki 2010–2020, University of Jyväskylä 2017–2019, Lappeenranta University of Technology 2016–2019, University of Oulu 2018–2019, Tampere University 2019, University of Turku 2019 and Åbo Akademi 2019. The flight kilometers and emissions do not exactly correspond with each other due to differences in emission counting, in distribution of flights of different length, and in the number of landings. See Figure 12 for detailed numbers.

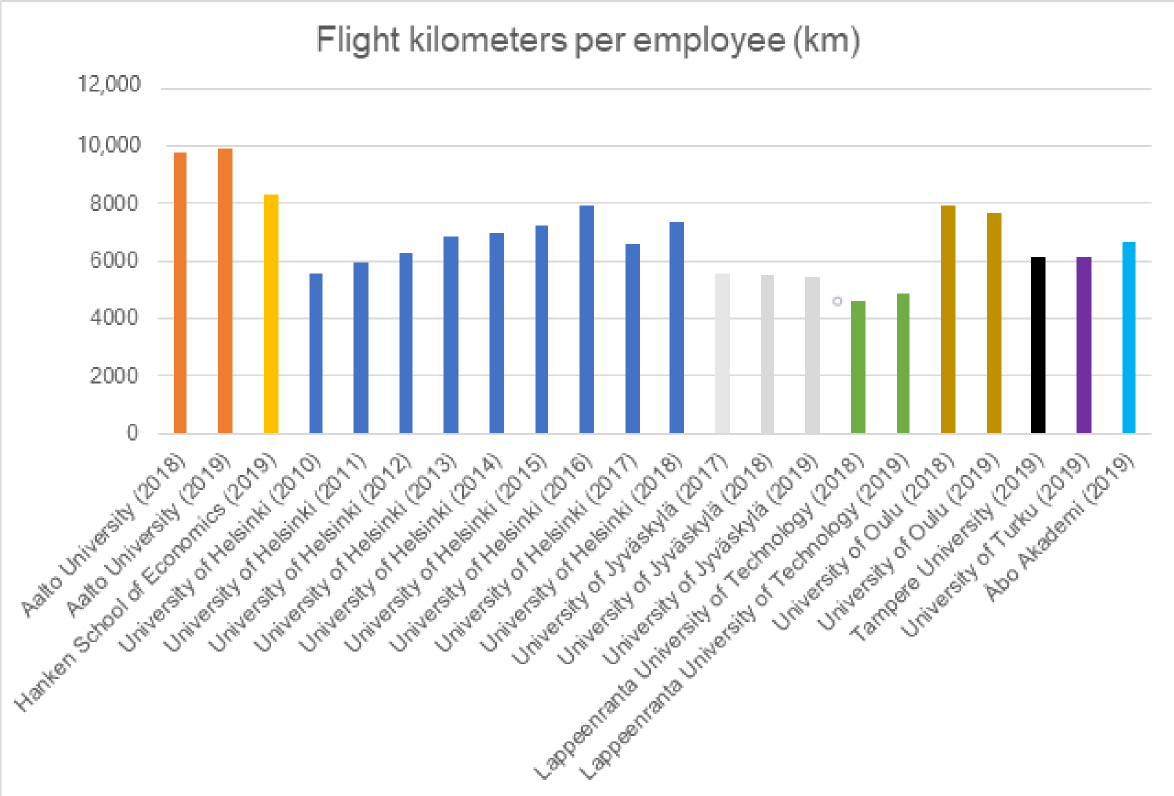

Figure 11. Flight kilometers for the years in Figure 10, divided by the number of personnel working in the university during the corresponding years. The number of personnel was obtained from Vipunen-Education Statistics Finland.

The per-employee CO_2 emissions were lowest at the University of Helsinki and highest at Hanken School of Economics and University of the Arts, possibly due to changes in flight distance, number of direct flights over ones with stopovers, and differences in counting methods. Especially in Hanken School of Economics, the large proportion of long-haul flights resulted in high emissions although the actual kilometers flown were few. The case of the University of Arts may indicate that sustainability is not traditionally linked to art and their sustainability program is still at an early stage. University of Turku's emissions appeared to be exceptionally high (compared to flight kilometers) since they used a different emissions calculator (Hiilifiksu calculator), whereas the others provided data directly from the travel provider. Figure 13 presents the results.

The travel emissions of the universities were then compared to the total CO_2 eq emissions for the years in question. The lowest level of aviation CO_2 emissions compared to total emissions came from the University of Helsinki (10%) and Tampere University (12%), whereas the universities with high aviation "footprints" compared to total carbon footprint were Hanken School of Economics (78% in 2018) and Lappeenranta University of Technology (68% in 2018). Yet, a high aviation footprint itself does not explain the university's total carbon performance, as the carbon footprint of a university consists mainly of infrastructure, travel, and research equipment and waste. Thus, the flight footprint is affected by the relative emissions from the other main sources. Especially at universities with a high share of renewable energy, or energy-efficient buildings (Aalto University, Lappeenranta University of Technology), the relative share of aviation emissions will be higher. The contradiction is in effect in universities using a high proportion of fossil fuels, or owning a large number of separate buildings, such as the University of Helsinki. See Figure 14 for details.

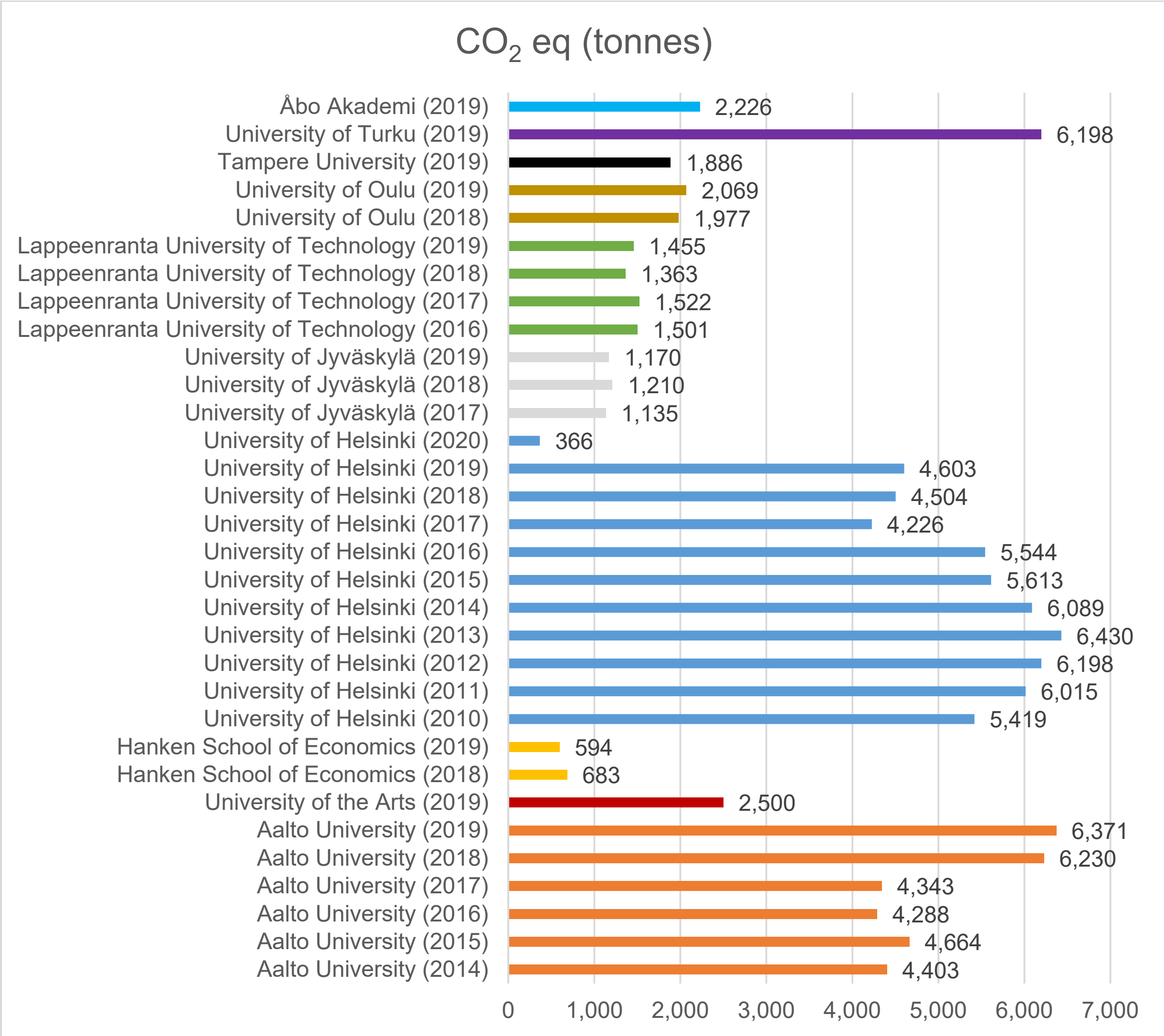

Figure 12. Flight emissions (CO_2 equivalent tonnes) for ten Finnish universities.

The traveler name parameter was only used to calculate the percentage of flying staff in a university by dividing the number of individual travelers by the total number of staff working in a university during the study year. Other traveler-specific data, such as academic position, were not included in the dataset, but it can be assumed that this dataset included researchers of all levels and support, such as HR staff, as all the flights in both studied universities (University of Helsinki and Aalto University) were bought centrally through the same travel agency. The percentages of flying staff were divided thusly: 75 and 74% (Aalto University 2018 and 2019), and 45, 69, 72 and 20% (University of Helsinki 2017–2020). There is little variation among the numbers, and only the years 2017 and 2020 show anomalous results. In the case of 2017, this is most likely due to the change of travel agency, and in 2020 due to the reduction in travel caused by the COVID-19 pandemic and the shorter comparison period.

Finally, only Tampere University was able to provide the percentage of outside-booked flights, which was 26%, meaning that out of 100 flights taken, 26 were booked outside of the travel agency.

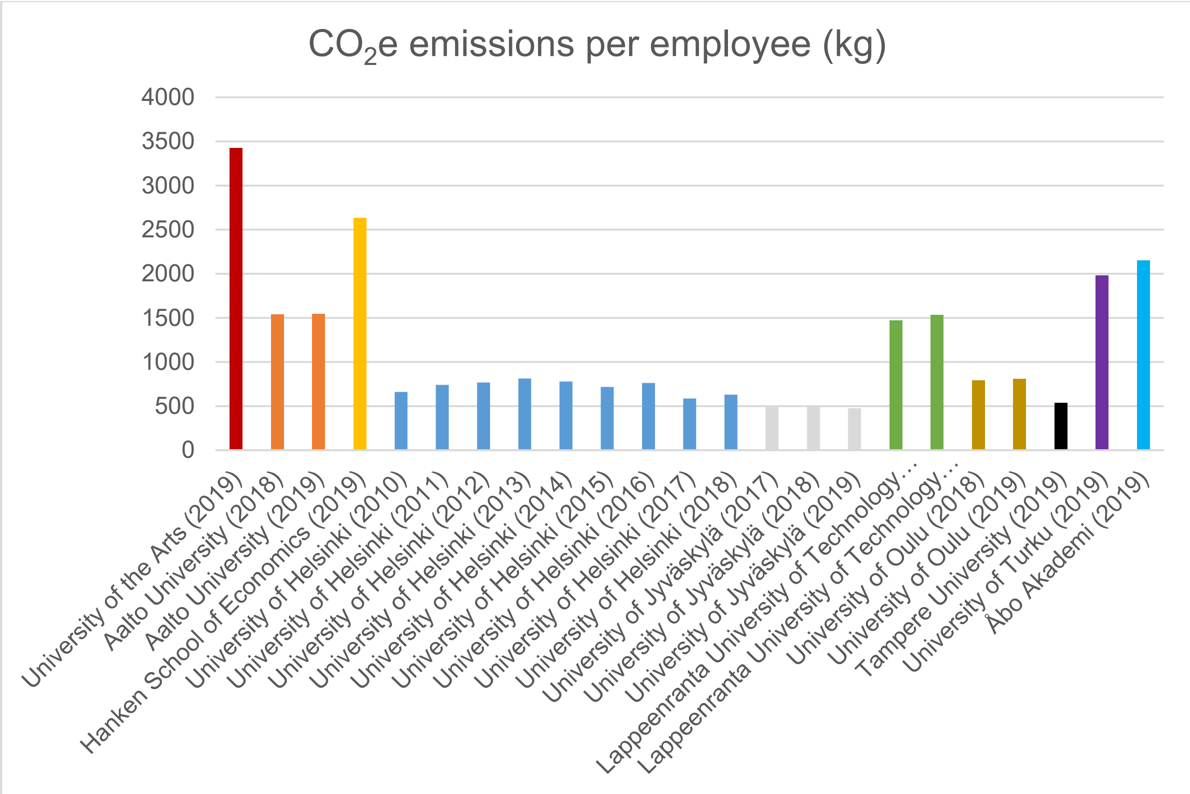

Figure 13. Flight emissions (CO_2 equivalent tonnes) divided by the number of personnel working in the university during the corresponding years. The number of personnel was obtained from Vipunen-Education Statistics Finland.

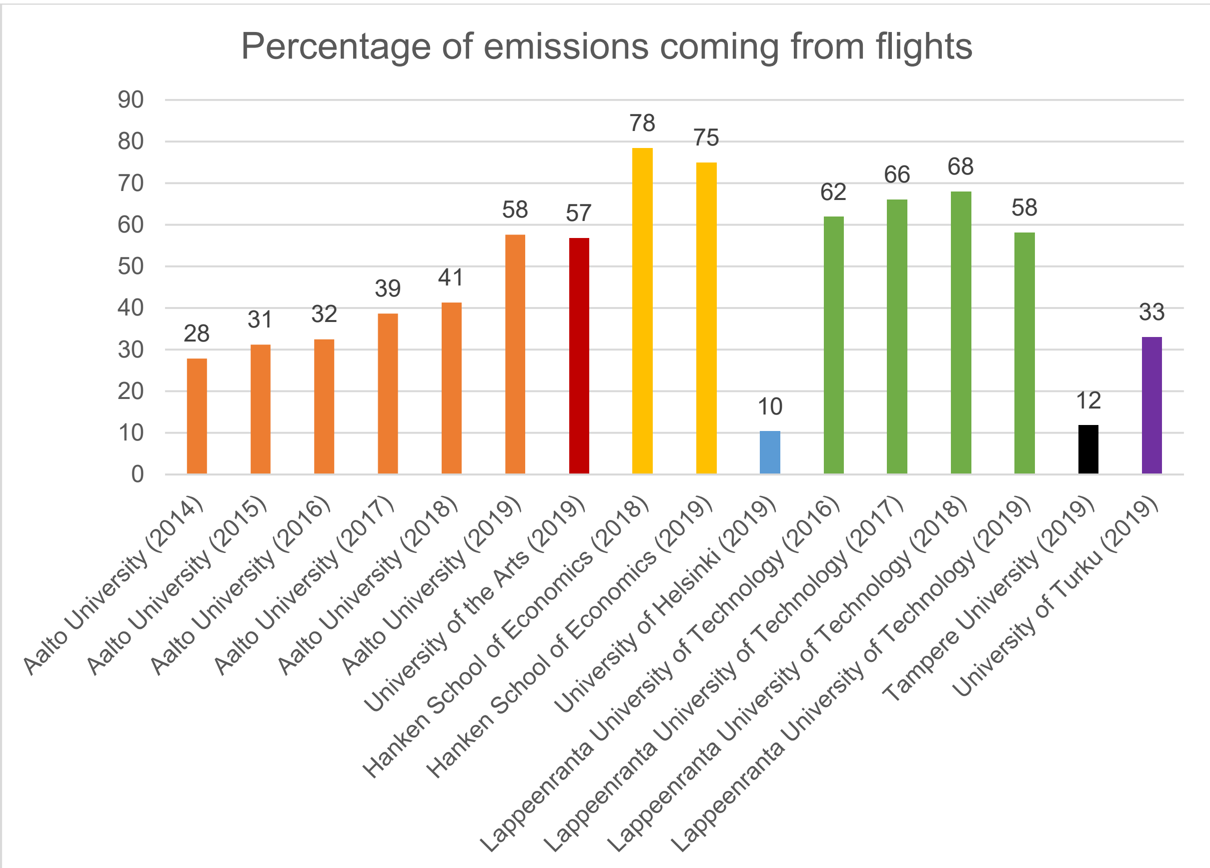

Figure 14. Flight emissions divided by the total amount of emissions of a university for a given year.

4. Discussion

As knowledge of the climate crisis intensifies, aviating academics have an extra responsibility. Past research such as that by [27] has pointed out that a large carbon footprint can negatively affect researcher credibility, and that scientists have an important role in leading by example [28]. Yet, an academic majority still flies, mainly to short-duration events such as conferences, workshops and meetings [24]. This discrepancy between knowledge and action proves that climate knowledge is not enough to induce behavioral change—researcher mobility is intertwined with academic expectations and behavioral norms, and lack of better alternatives and support [11,14,29]. Thus, the responsibility for emission reductions should lie on organizations rather than individuals.

In this study, we analyzed the mobility habits and strategies of all Finnish universities, and is the first known study on this topic in Finland. The amount of flight traffic varied considerably between organizations, with the largest player's—the University of Helsinki—employees flying a distance that is equivalent of circling the globe 1.1 to 1.5 times annually (between 2010 and 2018). The results revealed no clear trend, either decreasing or increasing, although annual comparisons were somewhat limited by the resolution of the datasets that could be acquired. However, the data revealed clear patterns in the mobility of Finnish universities.

The results show that, as of spring 2020, there is no single fixed state of academic air mobility among Finnish universities—rather, they are at separate stages of sustainability in their mobility and emission reduction strategies. With 7 out of 14 of Finnish universities having considered offsetting, and nine aiming for carbon neutrality, it can be stated that most Finnish universities follow the targets set by the Finnish Government Program 2019 of the country being carbon neutral by 2035 [30]. While some are taking an ambitious role as early pioneers and trendsetters, a few universities are still in the early stages, with no clear plan for the reduction in academic air mobility emissions and a lack of data from that source. Compared to [20], this study revealed a slightly larger number of innovators and laggards than in the original classification. It is notable that this study was carried out within the organizational context instead of the general public of the original study. In the organizational context, innovations that spread through political mandates or directives are especially likely to spread quickly [31]. Carbon neutrality is the goal of the Finnish Government for 2035, and universities may be driven to accomplish these goals as they act as public law bodies relying partly on governmental funding. It is likely that, as several universities are currently in the process of developing their sustainability strategy, within a few years from now almost all if not all of the universities have some kind of carbon neutrality target. The further aims towards this, such as carbon offsetting, are an interesting topic for future research.

The results revealed a preference towards local airline carriers. This could be regarded as positive, as some studies [21,32–34] show that European airlines outperform their foreign counterparts in sustainability reporting. However, the studies also pointed out that this discrepancy may result from corporate social responsibility (CSR) reporting originating in Western countries, and that other regions are just beginning to catch up. During recent years, Asian airlines have made particularly great efforts to catch up. The challenge of picking the correct airline, however, arises from the limited freedom individual academics have in their choice of airline due to travel agencies doing much of the work during the travel booking process. The decision for the choice of a certain airline may depend on pre-existing agreements of a travel agency and an airline, which may also affect the number of stopovers during the flight. Budget constraints and guidelines set by donor agencies of research projects may also have led to a situation where the academic picks cheaper flights over more sustainable ones. For instance, the University of Helsinki travel guidelines state the following: "Work-related travel must take as little time and be as inexpensive as possible or as is practical considering the duties to be completed during the trip. Travel using public transport usually meets the above criteria. Other means of transport must be justified on the travel expense report. If you have used a more expensive means of transport for no valid reason, the expenses will be reimbursed according to the least expensive public transport option available. When booking air travel and accommodation services, you must always choose the least expensive appropriate option" (University of Helsinki internal travel guidelines, located in the Flamma intranet, quoted 19.11.20).

Change is slowly taking place, with the improvement of design in new travel-booking systems, which allow classifying flight paths by CO_2 emissions and airline instead of price and flight length only. In addition, innovations such as internal flight levies placed on the price of each individual flight are steering consumer choice towards picking direct flight paths over those with stopovers (data acquired from Aalto University). Currently, extremely long flight paths were rare, but flights with one or two stopovers were still relatively common. With each stopover adding 25% to the emissions of a flight [23], changing these to direct flights could produce major emission reductions. However, it is notable that some studies, such as [21], reveal that flights with two stopovers might, in some cases, be more environmentally friendly than direct flights, due to changes in load and seat factor per flight. Providing more accurate information on the details of individual flights and the aircrafts used could help in picking the best possible option climate-wise. Overall, more knowledge on the sustainability of different mobility options is required.

Great variation exists within the rarer travel locations among the universities, with larger universities having the greatest diversity and reach of destinations; this highlights their outreach and number of global partnerships. Despite this, the top destinations were largely the same with there being little variation among years or universities. This reflects various factors, such as the cooperation with nearby universities, and the fact that conferences and work trips tend to take place in larger cities with renowned universities. Some cities also act as important nodes with major airports, such as Stockholm, Copenhagen and Frankfurt, due to which a large number of flights take place there although the final destination would be elsewhere.

An important finding was that domestic aviation, e.g., to Northern Finland (Ivalo, Kittilä, Rovaniemi and Oulu), is still rather common, with Oulu holding the 11th spot in terms of destination cities. This is most likely due to the distance of the trip (from Helsinki) being 539 km—at this distance, traveling by aircraft clearly outperforms train travel [19], due to trains in general being seen as less convenient or more costly [11]. A flight to Oulu now takes roughly 1 h 5 min, compared to the fastest train trip of 5 h and 25 min. Previous studies such as [14] have identified that researchers are willing to use nonaviation alternatives for trips up to four times the length of the flight. Currently, trains to Oulu take too long for this to apply but adding within-airport transitions and security checks to air travel time increases the viability of trains as a travel form. Trains (especially in business class) also offer better facilities for distance working, with larger working space and constant access to Wi-Fi, and the lost time caused by the change of the form of mobility could be accounted for by sharing travel and using it productively together with a colleague [35]. Currently train travel plays a small role in Finnish university mobility—e.g., in the University of Helsinki in 2019, only 8% of all trips were taken by train. There is still room for development in this sector.

One of the most significant findings of this study was related to the short duration of travel. The shortcoming of this is that the result represents only three individual years collected from two universities, but as there is little variation in the other parameters among universities or years, it can be assumed that these data represent the wider trend of travel. With one-third of the trips by personnel at the University of Helsinki and Aalto University being short trips, ceasing these one- and two-day trips and replacing them with virtual attendance could reduce air mobility by as much as 36% (Aalto University), and 29% (University of Helsinki), making this a key development target. This is a daunting task, and as previous research has found, not all short-duration mobility can be replaced virtually without compromising key elements of social interaction, such as informality [15] and random meetings [24]. Corporeal presence is central, especially in networking situations [29]. Yet, in situations with already-established networks, such as supervision, committee and research group meetings, virtual attendance plays an important role. Even at events without previous commitments, such as conferences, virtual networking is possible, and the drastic increase in virtual conferences brought by the COVID-19 era offers a plethora of cases of well and poorly executed virtual events, which can be used as examples when planning future occasions. It is also notable that not all short-term meetings happen due to free choice, but may be required by legislation or a third party, such as a funding organization or steering committee [12]. Thus, change of expectations and requirements from the short-term event organizers is also pivotal.

The results from this study, especially with the prevalence of short-distance travel from and to Northern Finland, support past research on remoteness: those academics who live further away from capital cities and academic hubs have an increased need to travel to nearby locations by air since there are no realistic alternatives to their mobility, and events are rarely held at their locations [24]. The opposite phenomenon seemed to be in effect in Hanken School of Economics located in Helsinki, from which two-thirds of all trips were over 3700 km in length. The nature of the school being a business university may cause the over-representation of long-distance locations with major economic hubs—in the case of narrowing down the potential locations to Europe only, this could negatively affect the performance of the university. Thus, care must be taken when choosing to exclude or include potential destinations according to the length of the flight.

In the case of flight kilometers, the large number of long-distance flights occasioned by international collaboration have a visible effect on the kilometers flown by a university, as seen with Hanken School of Economics. A similar effect seems to be in play at Aalto, although their destinations are shorter on average. However, both universities focus on business and technology, which have traditionally been fields relying on international collaboration. Thus, when considering mobility reductions, it would be useful to gather more information on the different operations carried out by universities internationally, and how necessary these are. Identifying the need for corporeal presence is an in-process effort at the University of Helsinki, which is planning a questionnaire for their personnel on mobility habits and the key reasons for mobility, which will help target the right trips without sacrificing the need for the university to function as a global player.

Universities focusing on economics and technology, such as Hanken School of Economics and Aalto University, seemed to travel less to developing continents, such as Africa, South-East Asia and South America, while two multidisciplinary universities, University of Helsinki and University of Turku, had traveled much more frequently to these areas of the world. These areas are evidently less interesting for economists and developers of technology or lack partner universities in these fields but are interesting for natural scientists or researchers on social or cultural affairs.

There were differences between universities in the proportion of aviation emissions and their total carbon footprints—different emission calculators may lead to drastically different values. As seen for the University of Helsinki between 2016 and 2017, the change of travel agency and resulting differences in reporting and counting led to an over 1000 tonne decrease in CO_2 equivalents (although other factors may have also been at play). The most prominent difference can be seen with the case of the University of Turku, at which the emissions appeared abnormally large due to the use of a different emission calculator. Tampere University provided data both obtained directly from the travel provider and data on those same emissions calculated by using the Hiilifiksu calculator, which provided emissions that were four times higher than the travel agency. There is a need for the standardization of emission calculators to increase the reliability of future studies. If standardization is not possible, it would be important to release open information on the modifiers and values used in the calculators to ensure the reliable replication of results.

The results also highlight that the number of flying staff in the two universities that were able to provide data on traveler names was rather high, ranging from 69 to 75% of all staff, with a few anomalous exceptions caused due to external factors. This indeed proves that Finnish academics are highly mobile and that the reduction in academic aviation emissions is a group effort of the entire university.

Finally, the study showed that COVID-19 had various effects on travel in the University of Helsinki, causing long-distance travel to be largely cancelled or replaced by short-distance trips due to travel bans, and a drastic overall increase of 87% in travel during the time, with only 20% of academics travelling compared to the usual −70%. The full effects of COVID-19 on university travel are outside of the scope of this study, but the resulting anomalies caused by the pandemic on the travel offered an intriguing reflection and point of pause for universities to consider when planning their future travel after the pandemic.

Some shortcomings were identified during the research. In this article, we studied organizational emissions only as whole, and thus did not observe the individual behavior of academics. As we chose to focus only on aviation emissions, we also ignored an important part of academic emissions arising from daily commuting (e.g., via automobiles). While these emissions are clearly outside of the scope of this article, they should not be ignored, and universities should take them into account when planning travel reduction strategies. In addition, this study can act only as a snapshot at a single point of time, providing an overview of the state of mobility in Finnish universities in the early half of 2020. As carbon neutrality is an ongoing subject, rapid changes may occur, e.g., with the University of Helsinki, which, by spring 2021, has pushed their carbon neutrality target onward from 2035 to 2030. It is also notable that although all universities provided mobility data in written form, four of them were unable to provide any numeric data. The datasets were also of different sizes; in the case of some universities, the resolution of the data was too small to paint a comprehensive picture, and in the case of universities with larger amounts of data, the problem of lack of standardization emerged, leading to a situation in which making reliable comparisons between the players became difficult. This suggests that universities should work together to standardize their emission counting and travel targets. One final shortcoming is that only one university was able to state the number of flights booked outside the travel agency. However, if other universities follow this trend, it might be that even a quarter of all flights are acquired outside travel agencies, making their monitoring and reduction even more difficult.

5. Conclusions

At the time of writing, this study was the first on this topic and scope in Finland. Based on the results, the key recommendations that would lead to the highest emission reductions in Finnish universities are:

1. Updating preset travel guidelines to ensure that academics have freedom to pick a sustainable airline instead of the most economic option.
2. Preferring short- to long-distance travel and shifting to train for all distances where the train is faster than a flight. Supporting and encouraging alternative travel forms more actively, even in cases when the alternative would take longer than taking a flight. Caution must be applied so that the alternatives are indeed more sustainable and do not simply displace the emissions elsewhere.
3. Reducing stopovers in the case in which it is proven that the direct flight is less emission-intensive than one with a stopover. An individual flight tax or levy could help incentivize academics.
4. Recommending virtual over corporeal presence in the case of one- or two-day trips. Each trip must be assessed individually to be certain of whether corporeal presence is necessary, preferring corporeality in networking occasions to those with already existing networks.
5. Standardizing the emission calculators used by travel agencies or providing more accurate information on the exact modifiers used to help replicate the calculations and to increase comparability of data.
6. More data on both individual mobility habits and larger patterns of the issue are required. Universities should conduct organization-wide surveys studying the reasons

for academic mobility to increase the applicability of this research. It would also be important for universities to calculate the magnitude of flights booked outside of their official travel agencies to understand the full scope of their mobility.

Author Contributions: Conceptualization, V.A. and M.R.; Formal analysis, V.A. and M.S.; Funding acquisition, V.A.; Investigation, V.A.; Methodology, V.A.; Supervision, P.P., T.J. and M.R.; Visualization, V.A. and M.S.; Writing—original draft, V.A.; Writing—review and editing, P.P., T.J. and M.R. All authors have read and agreed to the published version of the manuscript.

Funding: This work was funded by the University of Helsinki Doctoral Program of Interdisciplinary Environmental Sciences. Open access funding provided by University of Helsinki.

Institutional Review Board Statement: Ethical review and approval were waived for this study, due to the data being collected and analyzed on an institutional level. Any personal data (e.g., traveler names) were excluded from the research.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Restrictions apply to the availability of these data. Data were obtained from a third party (the Universities of Finland) and are available from the authors with the permission of the universities.

Acknowledgments: We wish to thank Vice Rector Tom Böhling from the University of Helsinki and research professor Jari Liski from the Finnish Meteorological Institute for their insights on the scope of this research, and the 14 Finnish universities that provided their data. The authors would also like to acknowledge the funding from the Academy of Finland for the VECLIMIT project (decision No #329323) and SARS-coronavirus-2 in space and time: Molecular epidemiology and phylogeography for disease prevention and mitigation sub-project.

Conflicts of Interest: The authors declare no conflict of interest.

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