UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Greenhouse Gas Emissions Reduction Opportunities in Business Air Travel Project

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APSC 461

Themes: Climate, Community, Transportation

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Project Report

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CC: David Gill, Bud Fraser, Meryn Corkery
FROM: Atlas Kazemian, Erwin Sun, Ian Garvie
DATE: 25 June 2020
SUBJECT: SEEDS Aviation GHG Reduction Project Report

Please find attached the project report for the Greenhouse Gas Emissions Reduction Opportunities in Business Air travel. This project has been undertaken in response to the University of British Columbia's Social Ecological Economic Development Studies' (SEEDS) project request, which aims to reduce UBC related air travel emissions. Furthermore, this project wishes to address the changes that have been made in the wake of the COVID-19 Pandemic, with respect to travel emissions reductions and remote communication initiatives.

The report briefing includes background information regarding the impact of the COVID-19 pandemic on global aviation, as well as UBC. Explicitly presented and explained are the team's objectives, data collection methodology, data analysis procedures, and final recommendations for future actions to be taken.

More specifically, the report outlines which data types should be collected in the future, and from whom they will be collected. The selected team has gathered from UBC SEEDS a record of which flights were taken for UBC purposes from 2018 and 2019. This includes flight routes, departure and return dates, as well as the purchasing faculty department. Although some data is missing from the received sets, recommendations are made as to which data should be collected in the future when UBC Finances process flight reimbursements.

From the information given and processed, the team was able to develop an aviation necessity determination, as well as a framework for policies and guidelines that will help reduce future UBC business aviation trips as well as a prototype tool to assess such policies. From the COVID-19 pandemic, UBC will be able to recognize what travel is essential and which trips can be avoided in the future.

Please contact the team via email if there are any questions pertaining to the project.

Executive Summary

This report is in response to the University of British Columbia's Social Ecological Economic Development Studies' project (SEEDS), which aims to reduce business air travel greenhouse gas emissions (GHG). Due to the global impact of COVID-19 and the social distancing measures that have been implemented, business air travel nearly came to a stop, causing a drastic reduction in GHG emissions. The University of British Columbia (UBC) has taken this opportunity to introduce a new goal in their Climate Action Plan: the reduction of business air travel emissions, with policies informed by the COVID pandemic. The SEEDS program from UBC Campus and Community Planning is creating student-led projects to focus on this goal.

This project is for the SEEDS aviation emissions reduction initiative. It will focus on studying the university's business air travel data prior to the pandemic, while also observing the approaches used to mitigate and reduce physical interaction and thus in person events, during the pandemic. Thus, drawing lessons on how these approaches can be used to continue emission reductions after the pandemic.

The team conducting this project has collected pre-pandemic flight information from UBC faculties to inform the design of a framework of a tool that can be used to assess different future policy scenarios. The team also considered faculty members who are frequent business air travelers, as they may be directly affected by the outcomes of this project. However, the team was unable to consult with these travelers due to the short project timeline. With the flight data collected, the team has designed a data collection tool that will be able to analyze average GHG emissions prior to and during the pandemic, as well as a scenario analysis tool that will use the collected data to assess various policies for reducing emissions in the future. The team members are all equipped with background experience related to GHG emissions reduction and carbon life cycle assessment, which further ensures the successful completion of this project. It is expected that by 25 June 2020, the team will have finalized policy recommendations for SEEDS that will help the university in successfully reducing their air travel GHG emissions after the pandemic has ended.

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1 Introduction

Aviation is one of the fastest growing sources of Greenhouse Gas (GHG) emissions in the world. In 2018, the global GHG emissions resulting from air travel was 905 million tonnes CO_2e, making up 2.4 % of total global CO_2 emissions (Overton 2019). Given this growth trend, it is predicted that air travel emissions may triple by 2050 (Overton 2019). A significant portion of these emissions are the result of air travel for business purposes. Organizations with high international presence, such as universities, depend heavily upon air travel as the primary method of transportation for attending meetings and conferences, both domestically and abroad.

The current COVID-19 pandemic and the social distancing measures have had a significant impact on the amount of global emissions from aviation. The average change in GHG emissions from January to April 2020 has been around 2 Mt CO_2e per day (Le Quéré et al. 2020). Figure 1 shows a graph from a report published by Nature that looks at the impact of COVID-19 confinement on various industries, including aviation. Based on the graph, there is a sharp decrease in GHG emissions from aviation from January to May 2020. The positive environmental impact caused by the pandemic is driving organizations and institutions towards developing greener alternatives based on lessons learned during the pandemic. One of these institutions is the University of British Columbia (UBC).

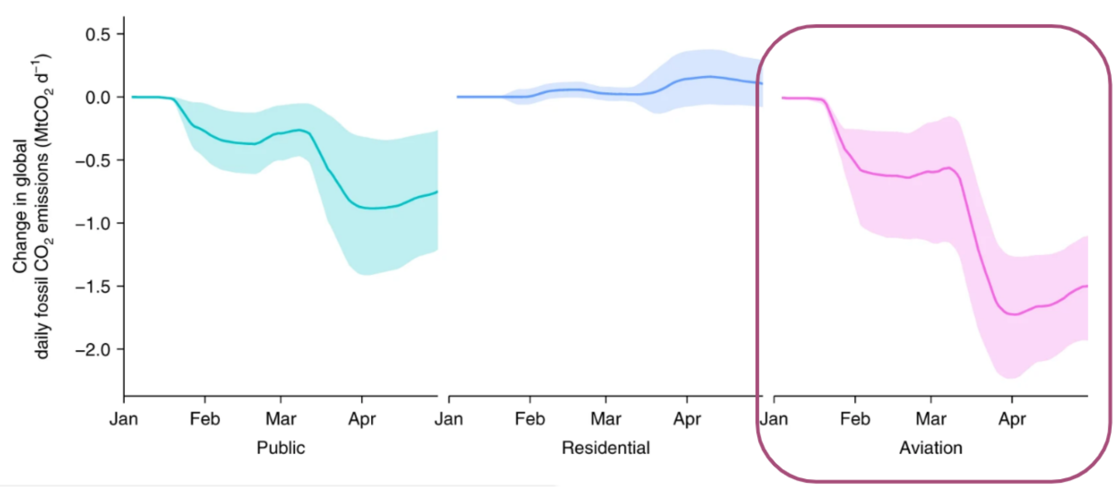

Figure 1: Change in Aviation GHG Emissions from January to May 2020 (Le Quéré et al. 2020).

UBC has reported that in 2018, 15% of the university's total measured emissions came from business air travel. To mitigate this, UBC is exploring air travel emissions in their Climate Action Plan (UBC Sustainability 2020a). The Social Ecological Economic Development Studies (SEEDS), is a campus program that designs student-led projects focused on sustainability ideas and best practices. Their current focus is on developing policies and methods to mitigate air travel emissions, as per UBC's Climate Action Plan. This report focuses on the SEEDS business air travel project, as such, they will be addressed as the partner organization throughout this reading.

The project was focused on creating a scenario analysis tool to help SEEDS compare the effect of various policies at once. In doing so, the team performed independent research, stakeholder consultation, and a review of similar policies that have been implemented in other institutions. The project team consists of three engineering students with backgrounds in GHG emissions reduction and life cycle impact assessments. It should also be noted that the development of specific policies, reanalysis of previous data and reports, and final software development were outside of the scope of this APSC 461 project.

2 Purpose

During the COVID-19 pandemic, business travel has almost completely shut down, resulting in GHG emissions reductions globally. Once the COVID-19 pandemic has passed the UBC campus, much like other institutions globally, may return to normal operations, and business air travel emissions are expected to increase again. The project aims to develop a tool that can assist in assessing the impacts of different policy options that address UBC's business air travel GHG emissions in order to reduce emission levels below pre-pandemic level. The team also hopes that the policies developed during this project will contribute to the adoption of similar policies by other institutions.

3 Partner Organization, Participants and Community

The team has identified UBC as an institutional stakeholder, with two additional stakeholder entities under the UBC umbrella. The first being the partner organization, SEEDS, and the second being the faculty and staff members, from all departments, that are frequent business air travelers. As stated in the report published by the Pacific Institute for Climate Solutions, 36% of UBC staff and faculty fliers are responsible for 80% of all aviation emissions (Wynes and Donner 2018). As such, these staff and faculty members were at the forefront of the team's consideration. Furthermore, these same staff and faculty should be thoroughly consulted while the policies are in development and again before any policy changes are enacted.

The SEEDS Sustainability program is composed of UBC staff, faculty members, and students working with community partners on sustainability strategies. SEEDS aims to provide an applied learning experience for students through collaboration with staff members and community partners while advancing ideas, policies and practices surrounding sustainable operations and development. As the partner organization, they are a significant stakeholder for this project. Moreover, UBC Campus and Community Planning, the institutional administrator of SEEDS, is directly involved in implementing UBC's Climate Action Plan and mitigating GHG emissions. UBC Sustainability conducts an annual GHG inventory to record and demonstrate the university's progress towards emissions reduction, as well as to fulfill the requirements of BC's GHG reduction Targets Act (UBC Sustainability 2020b). UBC Sustainability access to GHG data and their role as the campus sustainability office is valuable in completing this project.

Since UBC faculty and staff members are the people who will be directly affected by the outcome of this project, their input is valuable in the team's decision-making process. This stakeholder group includes any member that has travelled by air for UBC business purposes in the past few years.

4 Goals and Objectives of the Project

The main goals of the project are to:

- Summarize available UBC air travel data into a concise document
- Analyze the effects of different policies enacted with respect to aviation GHG emissions

The team aimed to use the previously available travel data from the partner organization, and restructure it into a single document, which could then be used to assess the impact of different policies to identify the scenario that results in the lowest GHG emissions level.

5 Approach and Methods

The team decided to split their effort into two different sub-projects in order to address both goals:

1. Creating a new database that takes all previously available and newly collected travel data and summarizes it in a single spreadsheet in a way that allows for future analysis.
2. Creating a scenario analysis tool that uses the data collection model from Part 1 to compare the outcome of different scenarios in terms of emissions reduction using various policies.

Each subproject is explained in more detail below:

5.1 Data Collection Model

The partner Organization provided the project team with travel data from 2018 and 2019, provided by UBC's current and previous travel management companies, Direct Travel and North South Travel. The team also had access to the previous SEEDS reports to examine what work in this area had already been done. The team decided on including the following data types in the new database. These data types were chosen to result in accurate calculation of past and current emissions as well as to be used in creating the scenario analysis tool.

Table 1: Data Types for the New Database

1. UBC Internal Trip Number
2. Departure and Return Dates
3. Direct or Indirect Flights
4. Faculty
5. Purpose
6. City Pair
7. Ticket Class
8. Emission Factor
9. One way or round trip
10. Emissions per Flight

5.2 Scenario Analysis Tool

After the new database was developed, the team used it to create a tool that allows the user to analyze the impact of adjusting the intensity of various policies to obtain GHG emissions of different scenarios. Below is a list of the policies that have been considered for this tool. These policies were taken from a list of possible policies provided by SEEDS.

Table 2: Emissions Reduction Proposed Policies

1. X% of **One day trips** are replaced by **Information and Communication Technology (ICT)**
2. X% of total trips are **direct**
3. X% of Total Trips are **Economy Class**
4. There is a **Carbon Budget** of X kg CO2 per faculty in a year

Using these 'policies', the team focused on determining the resulting emissions for any combination of the above policies. In other words, the resulting emissions when X is varied for each of the above policies. To do so, the team categorized all trips based on their departure and final destinations. For instance, all trips from Vancouver to Toronto fall under Trip A, regardless of whether they are direct or indirect. This allows the team to calculate emissions for each trip type based on the frequency, the distance and the emission factor for that trip.

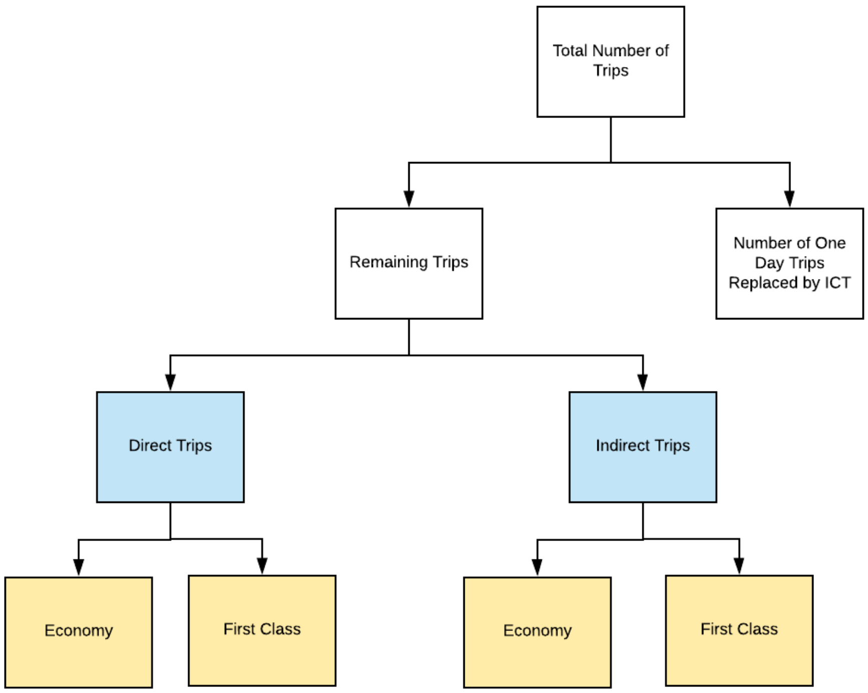

Figure 2: Flowchart of methodology for applying policies

Figure 2 represents the flowchart explaining the methodology for calculating emissions for a trip based on policies 1-3. Starting from the top, after applying Policy 1, the number of trips that are not replaced by ICT are categorized into direct and indirect flights (Policy 2). In the next step, the total number of direct flights are categorized into Economy and First Class Flights (Policy 3). Similarly, the total number of indirect flights are also categorized into Economy and First Class. This gives four different types of flights for which emissions should be calculated for each trip, as shown in Table 3.

Table 3: Flight Types Used for Calculating Emissions

	Flight Path	
Flight Class	Direct Economy	Direct First Class
	Indirect Economy	Indirect First Class

The resulting emissions for a trip type will be the sum of the emissions of the above four flight types. It should be noted that Policy 4 is not shown in the above flowchart and is not considered in the scenario analysis tool. This is further discussed in the Results section.

6 Results

6.1 Data Collection

Since most of the data has been extracted from existing reports or provided by travel management agencies, the team first investigated the reliability of the sources. The majority of the data are from the flight summary provided by two travel management companies, and the data is directly from their database, so the data presented should be accurate and reliable. However, the team realized that the limited amount of data may not represent the actual holistic situation of UBC's aviation. For reasons such as faculty and staff buying tickets through external agencies or websites, rather than through the UBC booking system, there were flights that were not accounted for. As a result, the team noted that the prediction of GHG emissions may be underestimated, and the resulting policy making process should take this uncertainty into consideration. Other than the dataset directly from the two companies, the team also viewed various reports. In these reports, raw data are not available, but some analyzing methods and results are applicable to this project.

The rest of this section focuses on the two tools the team has developed during the course of this project: The New Database and the Scenario Analysis Tool.

6.2 New Database

As shown by the data collection process, UBC has a wide range of data about business air travel. However, they are very scattered, either collected by different agencies or reported through different channels. As a result, it is hard to perform a comprehensive evaluation, such as estimating emission reduction, especially when collecting and calculating GHG information is not an inherent function of the existing systems. To remedy this, the types of data collected and consolidated must be standardized. According to the SEEDS project sponsors, UBC may be getting a new unified finances system with options for customization. By modifying this new system to automatically include GHG calculations, there will no longer be a need to try and stitch together several different datasets to determine UBC's aviation emissions. As stated before, most, if not all, of the required types of data are already collected in some fashion; be it from the current booking system, reason for reimbursement requests, or financing and budgeting information. With the unification of these systems, not only can UBC flight GHG emissions be more accurately calculated, but different policies and scenarios can then be modeled based on this information. A tabular summary of these data types and resultant calculations is presented in Table 4, below.

Table 4: Sample of a spreadsheet with all necessary data types and preliminary calculations

UBC internal trip number	Departure date	Same day return?	Direct or indirect?	Faculty	Purpose, general	Purpose, specific	City Pair	Ticket Class	GCD (km)	Emission Factor with Rad Force	Flight Path one way or round trip?	Emssions per flight (kg CO2e)
UBC-1	17-Jun-20	yes	Direct	SCIE	Research	fieldwork	Kelowna (YLW)-Vancouver(YVR)	Economy	288	0.27867	Round	173.4
UBC-2	17-Jun-20	no	Indirect	APSC	Conference	Conference on Diversity in Eng	Vancouver(YVR)-Toronto(YYZ)	Economy	3355	0.14678	One way	531.8
							Vancouver(YVR)-Calgary(YYC)	Economy	688	0.16508	Round	245.3
UBC-3	18-Jun-20	yes	Indirect	APSC	Lecture	Lecture at UWO	Vancouver(YVR)-Toronto(YYZ)	Economy	3355	0.14678	Round	1063.7
							Toronto(YYZ)-London(YXU)	Economy	143	0.27867	Round	86.1
UBC-4	18-Jun-20	no	Direct	ARTS	Conference	Conference on Anthropology	Vancouver(YVR)-Prince George (YXS)	Economy	524	0.16508	Round	93.4
UBC-5	20-Sep-20	no	Direct	APSC	Conference	Conference on Sustainability in Eng	Montreal(YUL)-Vancouver(YVR)	First Class	3693	0.58711	Round	4683.3

Note: Sample of what a spreadsheet containing the necessary information for GHG calculations and what a business flight itinerary may look like. Note, certain intermediate variables, such as return date, calculated flight distance, and radiative forcing factor calculations have been hidden for ease of presentation in this report.

In determining the emissions from individual flights, the team first used a Greater Circle Distance (GCD) calculator (Meco Media and Communication n.d.), and added an 8% distance increase per the recommendations of the UK Department for Business, Energy, and Industrial Strategy (UK BEIS) (Wynes and Donner 2018), to determine the approximate flight path distance. With the flight path found, the distance was multiplied by the emissions factors given in the 2018 BC Methodological Guidance for Quantifying GHG Emissions (BC Ministry of Environment and Climate Change Strategy 2017). These are the same emissions factors that were used in generating the UBC 2018 Business Air Travel GHG Emissions dataset/report. The use of the same factors will allow the team and any future user of this tool to remain consistent with provincial standards and the methods employed in previous reports. Lastly, per the recommendation of the UK BEIS (Wynes and Donner 2018), the total emissions, per unit mass, are multiplied by a radiative forcing factor of 1.9 to account for the high altitude at which the emissions are released. Although this does not mean that more emissions are released, but that these emissions are much more potent and thus have the same effect as if 1.9 times more emissions were released on the ground surface. Furthermore, by verifying the steps of calculations within and between reports, the team's adapted method of calculating emission factors, which made the comparison between different flights easier.

6.3 Scenario Analysis

In creating the scenario analysis tool, the team used an Excel spreadsheet that takes inputs from the new database and calculates emissions for different scenarios as per the flowchart in Figure 2. As mentioned earlier, trips will be categorized based on their initial and final destination in this tool. Using this methodology, the results for an example scenario are shown in Table 5.

Table 5: Scenario Analysis Tool prototype output within an Excel sheet

Input % One Day Trips Replaced by ICT		10%
Input % Direct Trips		60%
Input % economy Trips		90%
Resulting Emissions	**63865.00**	**Kg CO2**

Table 6 shows the method used for calculating emissions. This methodology was explained earlier in the flowchart in Figure 2. Considering trip B (Vancouver to Kelowna) in this example, the total number of trips is 22 in a year, including 10 single day trips. From the 10 single day trips, 9 will happen, resulting in a total of 21 trips that happen. From these 21 trips, 13 trips are direct and 8 are indirect. From the 13 direct flights, 12 are economy class and 1 is first class. From the 8 indirect flights, 7 are economy class and 1 is first class. Using emissions factors for each of the four columns in yellow, emissions levels were then calculated, which are shown in pink columns of Table 6. The last column shows the total emissions as a sum of the four pink columns. The total emissions is then the sum of emissions from each trip type. It should be noted that even though the correct distances and emission factors were used in this calculation, the number of flights chosen were arbitrary and are for the purpose of this example only.

The rest of this section covers the methodology used in obtaining flight distances as well as emission factors used in the tool.

Table 6: Data and inputs used for testing the Scenario Analysis Tool

UBC internal trip number	Total Number of Trips	Total Number of One Day Trips	Number of Trips That Happen	Number of Direct Trips	Number of Indirect Trips	Direct, Economy	Direct, First Class	Indirect, Economy	Indirect, First Class	Emissions (Direct, Economy)	Emissions (Direct, First Class)	Emissions (Indirect, Economy)	Emissions (Indirect, First Class)	Total Emissions
Trip A (Vancouver - Troronto)	34	0	34	20	14	18	2	13	1	20456.76	3409.32	15928.09	1837.78	41631.95
Trip B (Vancouver - Kelowna)	22	10	21	13	8	12	1	7	1	2134.07	177.84	0.00	0.00	2311.91
Trip C (Vancouver - Montreal)	12	0	12	7	5	6	1	5	0	8675.79	3837.37	7407.98	0.00	19921.13

6.4 Direct and Indirect Flight Distances

For determining the direct distance of each trip, a GCD calculator was used (Meco Media and Communication n.d.). To determine the indirect distance for a trip, the GCD of the most common indirect flights was calculated and averaged to give an estimate of the indirect flight distance. As previously mentioned, both direct and indirect distances were multiplied by a factor of 1.08 to determine the actual distance (Wynes and Donner 2018).

6.5 Emission Factors

The emission factors used for different flight path lengths and different flight classes were obtained from the PICS 2018 report and are shown in Table 7, below.

Table 7: emission factors used in the 2018 PICS report on UBC air travel emissions (Wynes and Donner 2018).

PICS Emission Factors (kg CO2/passenger km)			
Class	Long Haul	Medium Haul	Short Haul
Economy	0.14678	0.16508	0.27867
Economy Plus	0.23484	0.24761	0.27867
Business	0.42565	0.24761	0.27867
First Class	0.58711	0.24761	0.27867

Since Policy 3 categorizes flights into economy and first class, the economy and economy plus factors in Table 8 were averaged to create a single economy emissions factor. Similarly, the business and first class factors were combined to create a business/first class emissions factor. The resulting emission factors that are used by the team are shown in Table 8.

Table 8: Emission Factors used in testing the prototype Scenario Analysis tool, based on the UK BEIS/PICS and BC recommendations.

Emission Factors Used			
Class	Long Haul	Medium Haul	Short Haul
Economy	0.19081	0.16508	0.27867
Business/First Class	0.50638	0.24761	0.27867

As mentioned earlier, Policy 4, which allocates a carbon budget for each faculty member and department, is not included in this tool. The main reason for this is that the team did not have access to enough data entries from all faculties in order to analyze the result of defining a carbon budget per faculty. However, since this information will be collected as per the new dataset, analyzing the impact of this policy will not be challenging.

7 Discussion

7.1 Data Collection

As seen in Table 4, the team has determined that the following data types are necessary in both accurately calculating emissions as well as testing the efficacy of the aforementioned policy scenarios. The data types and collection rationales are as follows:

1. **UBC Internal Trip Number:** Each itinerary and travel purpose should be kept under one specific internal travel number. This will allow any and all flights taken, as well as their associated emissions, to be accounted for under a single journey and reason.

2. **Departure and Return Dates:** Listing both the departure and return dates will help catalog which flights are same day return, and which are longer term. This will allow for the analysis of the impact of reducing same day return trips and will also show why same day return trips

were taken in the first place. Since not all same day return trips are likely to be eliminated, nor should they, this will allow UBC to determine which same day returns are more essential.

3. **Direct or Indirect Flights:** By recording which itineraries are direct or indirect, the number of flights taken can be reduced by finding a more direct path. While some flight paths do not actually exist, such as Vancouver YVR to London YXU, this will still help in reducing the number of unnecessary indirect flights.

4. **Faculty:** Either department and/or faculty member. This will allow for the accounting of a carbon budget across different departments.

5. **Purpose:** The purpose of a business trip is already recorded for the UBC finances office in order to approve reimbursement. However, this information has not been included in any of the reports or datasets related to air travel emissions. As such, the primary purpose for the travel should be taken into account when conducting a GHG inventory, to monitor why flights are happening and which flights can be mitigated. Furthermore, there should also be a more specific flight purpose to document patterns such as year over year changes in conference attendance or allocating flight GHGs to a specific study. Without knowing why flights are taking place, it will be extremely difficult to reduce the number of flights.

6. **City Pair:** This gives the distance between the two airports, and thus the total flight distance of the flight which is used in emissions calculations. It can also show where UBC staff and faculty are flying and help give insight as to which of these flights can be reduced.

7. **Ticket Class:** As stated before, higher classes of tickets will take up more space on a plane that could have flown more people, and thus has a higher emissions factor. Although most UBC flights were already economy class, it will be beneficial to calculate the impacts of reducing what few non economy flights were taken.

8. **Emission Factor:** This is the factor by which the flight distance is multiplied by to calculate the total GHG emissions. There are different factors for both ticket class as well as flight range, due to differences in aircraft type. These values have been taken from the 2018 BC Methodological Guidance for Quantifying GHG Emissions and the BEIS values given in the

SEEDS PICS report (BC Ministry of Environment and Climate Change Strategy 2017) (Wynes and Donner 2018).

9. **One way or round trip:** knowing which flights were taken round trip and which indirect flights were taken one way will help in better planning and reducing extraneous indirect flights.

10. **Emissions per Flight:** This is the main concern of the tool, this project, and of the policies that will hopefully be implemented in the future

A framework like the one discussed in this report could greatly help with organizing data and present a clear view of the issues, so policies could be more easily targeted and potentially more effective. Although the model presented in this project is preliminary, with more resources, it could be expanded into a universal system-wide tool for UBC, and contribute to UBC's climate action plan.

However, the team also realized one major drawback of this model. Currently, all inputs are empirical data, with no human factors included, so it cannot represent the reality of the situation around air travel and non-quantitative measures. Although measures like this could greatly reduce the amount of business air travel, it also eliminates the opportunity for face to face interaction, which may hinder academic experiences and networking opportunities. Due to scarce time and impact of the COVID-19 pandemic, although realizing this drawback, the team was not able to incorporate human factors. Although the tool that has been described in this report will be integral in assisting in determining which policies will be most effective in reducing emissions, there must still be thorough consultation with frequent UBC travelers for any kind of equitable policy to be developed.

7.2 The Existing Datasets

There were also some discrepancies in the aviation emission reports conducted by SEEDS. Most of the errors had to do with the travel distance between two airports. For example, the 2018 and 2019 GHG emissions reports from both North South Travel and Vision Travel have incorrect values for the travel distance from Vancouver YVR to Kelowna YLW, which is by far the most common flight taken by UBC personnel. The values given were 284 and 355 km of flight, a very large gap between the two reports. When the team used a GCD calculator, and added an 8% distance increase per the recommendations of the UK BEIS, it was determined that the approximate average flight distance between YVR and YLW was actually 311 km (Meco Media and Communication n.d.). This means that both reports were incorrect in their emissions calculations, with one over and one under estimation. Furthermore, in the 2018 report, it is listed that there were 2232 long haul flights taken, accounting for 41% of the North South flight emissions, and 23% of all UBC aviation emissions in 2018. Without the specific flight paths and numbers of those flights as well as the aforementioned discrepancies, it is not possible to verify the accuracy of this data. Lastly, without the itineraries and specific booking information for these flights, it would not be possible to test the effect of different policies on the 2018 data.

However, the 2019 data was given to the team in the form of comprehensive quarterly reports from North South Travel. In these data sets, specific information is given for booked flights, such as departure date, airline, complete flight itinerary, and fares. Although there is some helpful information missing, such as faculty/department, purpose of flight, and return date, the overall structure of these reports is quite useful. While the primary purpose of these reports is to track finances from plane flights, they could easily be modified to track GHG emissions as well. Also from 2019, the team was given another dataset that contained the number of flights purchased for each city/airport pair throughout the year. This list of over 1300 airport and airline combinations can provide the basis for a database of internal flight routes and their distances, and thus the GHGs emitted along that route.

8 Conclusions and Recommendations

In this project, the team aimed to summarize UBC's available air travel data, then using them to construct a framework which could be used for analyzing effects of policies under different scenarios. With the goals clearly identified, the team referred to various sources of data, and was able to construct a preliminary version model, which summarizes air travel information and has factors from different scenarios built in. Furthermore, the team utilized the unique environment created by the pandemic, and investigated air travel emission reduction in a context that was normally inaccessible. With the methods and results presented, this report can raise awareness of the great potential of reducing emission in business air travel, and could be used as a reference for more in-depth research in the future. The framework created by the team can be used by SEEDS research team as a baseline for building more sophisticated models.

However, due to limited time and resources, there are certain drawbacks within the preliminary framework. The team has clearly identified those flaws, and will present recommended actions to address the issues:

- The inputs used in the model are not comprehensive. Instead of just using data from the companies' database, information directly from faculty members are preferred, such as through questionnaires. As a result, the outputs are less likely to be biased. Using a new and universal UBC-wide software for data collection from flight bookings would greatly alleviate this problem.
- When using the framework for creating policies or doing further research, frequent traveler input must be included in policy development. The tool framework developed only considers numbers from the data, so it cannot consider human factors. Without this consultation and sole reliance on only reducing emissions, the resulting policies may do more harm than good to the UBC community.
- Most of the factors used in the Scenario analysis tool were obtained from the PICS report, if more accurate numbers are obtained in future reports, these factors can be changed accordingly to reflect more recent findings.

With the above recommendations, the framework could be used for future investigation of business air travel emission and the testing of different projections.

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