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Report
GHG emissions reporting of air travel in academic institutions: Data collection, methods, results and communication

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Abstract

The urgency to reduce carbon emissions is growing. Academic institutions need to address the issue of air travel reduction, since air travel is a significant contributor to their overall greenhouse gas footprint. Universities in Germany are being requested to adopt strategies to reduce their carbon emissions. Some already have established processes to monitor their progress. The FlyingLess project aims to reduce academic air travel, recognising that international exchange is essential to the excellence of research institutions.

This report highlights the importance of a systematic approach to monitor flight-related emissions, aligning with federal policies and sustainability targets. While universities are creating frameworks to track emissions, challenges such as gaps in data collection and inconsistent reporting persist. The FlyingLess GHG monitoring tool uses a consistent monitoring system based on actual travel data and emission factors, advocating for clear system boundaries to ensure consistency across institutions. Tools like the FlyingLess GHG monitoring tool help define and track emissions and identify high-frequency travel patterns. Initial results showing a wide variability of emissions depending on the institution's size and international engagement. At present, a significant challenge is the collection of data, which is due to incomplete travel records, inconsistent data acquisition and a lack of stakeholder engagement. Standardisation across institutions is also problematic. The true challenge in overcoming these obstacles lies in defining reduction targets and developing instruments to achieve them.

The report offers recommendations to enhance GHG monitoring, emphasizing the need for accurate data, harmonised methods, policy alignment, and institutional commitment to achieve meaningful emission reductions.

FlyingLess Project

With the internationalization of science and research, the air travel of university members has increased – scientists are among the frequent flyers. The aim of the FlyingLess project is to support universities and research organizations in reducing air travel, which accounts for a significant proportion of their total greenhouse gas emissions.

FlyingLess developed approaches to reduce air travel in the academic sector, which are implemented at different levels (research, teaching and administration). The project was conducted in close collaboration with four pilot institutions - the EMBL (European Molecular Biology Laboratory) and the MPI Astronomy in Heidelberg as non-university research institutions, and the Universities of Konstanz and Potsdam. Further academic institutions were collaborating with the project as so called "Satellites".

The project was led by the ifeu institute Heidelberg in close cooperation with the TdLab Geography at the Institute of Geography of Heidelberg University. The project was funded over 3 years (October 2021– December 2024) within the framework of the National Climate Initiative (NKI) of the Federal Ministry for Economic Affairs and Climate Action.

Content

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1 Background and motivation

Climate change has a strong impact on the planet - air traffic increases and accounts for a large proportion of CO_2 emissions.

Recent reports of the Intergovernmental Panel on Climate Change (IPCC) send a clear message: the international community is not on track to achieving the 1.5 degrees Celsius goal, which is set out in the Paris Agreement from 2015 (IPCC 2021). Extreme weather events, such as heat waves or floods, and in particular trends regarding planetary boundaries or so-called climate tipping points, give an idea of the enormous challenge the international community is facing (Lenton et al. 2019; Rockström et al. 2009). Despite the fact that the international community has much more profound knowledge about the implications of climate change and about the mitigation measures required to address the root causes of climate change and other sustainability challenges, a large action gap remains (Knutti 2019).

Aviation plays a special role for the path to reduce GHG emissions. Flights have increased substantially over the last decades (IEA 2022; Loveday et al. 2022). COVID-19 has briefly interrupted this massive growth of overall flights and even led to a temporary decline in annual emissions (ICAO 2021; Le Quéré et al. 2020), but emissions are on the way back to pre-COVID-19 levels (Overton 2022; Sun et al. 2023).

Business air travel accounts for a large proportion of the GHG emissions of academic organizations. Despite major challenges, reductions are necessary to achieve the climate protection targets.

In academic institutions, flights contribute to a major share of total GHG emissions (Ahonen et al. 2021; ALLEA 2022; Ciers et al. 2019; Wynes et al. 2019), partly due to the increasing availability of cheap flights and the goal of internationalisation (Hopkins et al. 2019). Flying is often seen as normal (Glover et al. 2017) or even as a necessity for successful academic careers (Nursey-Bray et al. 2019).

For universities and research organisations, reducing flight emissions is of high importance for several reasons (Görlinger et al. 2023):

- Researchers fly more than the average person (Burian 2018; Jacobson 2022; Poggioli, Hoffman 2022), whereas various studies in recent years have shown that flying is very unevenly distributed among academic groups (Arsenault et al. 2019; Ciers et al. 2019; Wynes, Donner 2018)
- Researchers are (mostly) (co-)financed by public funds and are therefore subject to the social and political framework conditions (Poggioli, Hoffman 2022) (including net-zero targets)
- they risk losing credibility if they do not follow scientific consensus about GHG impact of air travel (Attari et al. 2016)
- Air travel has a significant share of an organisation's total GHG emissions (ALLEA 2022; Hoolohan et al. 2021; Medhaug 2021; Wynes, Donner 2018)

2 A solid monitoring process for flight GHG emissions is required

2.1 Federal targets and policies by universities

The relevant impact of flight emissions by academic air travel was recognized and taken up in climate protection laws and in reduction targets policies of universities. Since 2019, the goal of "climate-neutral administration by 2030" for the federal government has the status of law in Germany

(Bundes-Klimaschutzgesetz, §15 KSG), for which a program of measures with specific requirements for mobility has also been published (Bundesregierung 2021). Most of the federal states have adopted laws and initiatives for greenhouse gas-neutral state administration which covers also universities (Nußbaum et al. 2024).

Many academic organizations have set themselves ambitious general net zero targets (ALLEA 2022). Some academic institutions have set specific targets to reduce emissions from travel activities, including air travel. Examples from FlyingLess partners:

- University of Konstanz: Air Travel Policy 2021. Reduction in air travel GHG emissions by a third in 2023 compared to 2019[1]
- University of Potsdam: A measures in the Climate Protection Concept, is to reduce GHG emissions from business air travel by 40 % by 2025 (compared to 2019)[2]
- EMBL: Sustainability Strategy 2021[3]. In 2030, 50 % reduction in total of business travel emissions compared to 2019 baseline.

Several universities implemented compensation mechanisms for academic air travel. In some federal states a compensation payment is mandatory for all business-related flights in public institutions (e.g. Baden-Württemberg, Hamburg). In Baden-Württemberg the state's travel expense law introduced a mandatory compensation payment for all business-related flights in public institutions. This also applies to flights paid for by third-party funded projects, provided that this does not conflict with the requirements of the third-party funder (Landesreisekostengesetz - LRKG, §4 (4)[4]).

An example of an interesting university initiative is the Carbon Tax Model at the University of Konstanz. The university developed an incentive model to reduce academic air travel on a voluntary basis which came into effect on 1 January 2024[5]. The emissions from flights have also been calculated in detail for this purpose.

2.2 Activities to establish a monitoring system

The basis for assessing the relevance of air travel emissions, developing measures and verifying their effectiveness, as well as for monitoring the development of GHG emissions from business travel, is the proper recording of GHG emissions.

This report focuses on the first stage of the overall process: Establishing of a GHG emissions inventory for business flights and implementing of a monitoring system. Several activities are associated with this process:

1 https://www.uni-konstanz.de/universitaet/nachhaltige-entwicklung/institutionelle-verankerung/arbeitsgruppe-nachhaltige-entwicklung/mobilitaet/bewusster-fliegen-leitlinien-fuer-nachhaltiges-reisen/ (11.9.2024)
2 https://www.uni-potsdam.de/en/umweltportal/handlungsfelder/mobilitaet/dienstreisen (11.9.2024)
3 https://www.embl.org/documents/wp-content/uploads/2021/10/sustainability-strategy-embl-2021.pdf (11.9.2024)
4 https://www.landesrecht-bw.de/perma?d=jlr-RKGBW2021V1P4 (11.9.2024)
5 https://www.uni-konstanz.de/en/university/news-and-media/current-announcements/news-in-detail/ein-anreizmodell-zur-reduktion-von-flugreisen/ (11.9.2024)

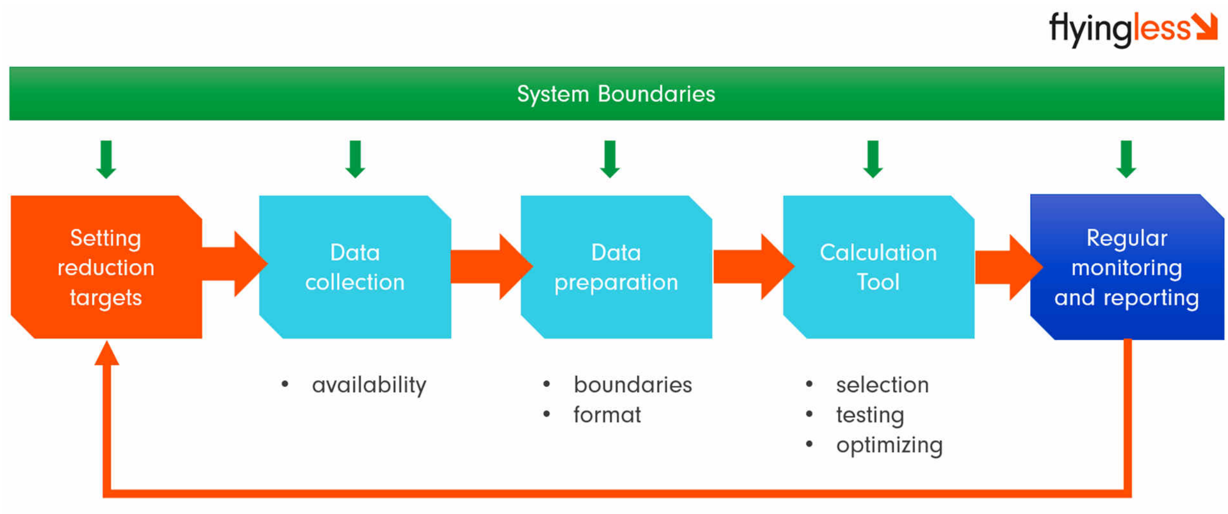


Figure 1: Activities to be considered for GHG reporting of academic business air travel

A) Defining the system boundary

The first step is to define which travel activities should be included. For example, only flights which the university funded or all flights related to university activities, including guests, students, scholarship researchers which receive external or private funding.

In addition, it should be determined which greenhouse gases should be considered and which scope. For air travel, the non-CO_2 GHG-emissions in particular must be taken into account. The transparent documentation of used emission factors is important.

B) Data collection: Analysis of available data and preparation

It needs to be checked which data sources are available and in which format (e.g. digital or analogue). The most robust results are achieved if GHG emissions are calculated on the basis of single flights, providing the origin and destination airports. Other information, such as the purpose of the trip, is helpful to analyse the data and take specific measures. In many cases data is not available in this format (also see chapter 6). Organisational steps to further improve the dataset should be considered within the limits of available resources. For example, the conversion of the travel expense accounting system (e.g. due to a digitalization process) could be a good opportunity to make improvements with regard to the data requirements for a more accurate GHG accounting of air travel.

C) Calculation Tool: Development/Selection of Calculation Tool

A variety of tools are available which allow calculating the GHG emissions of business air travel in general and therefore can be used to evaluate flights of academic organizations. But these tools have been developed with different objectives and at varying levels of detail. This paper presents an overview of selected tools, including their respective names and a comparative analysis for the use case of business air travel.

D) Scheduled monitoring and reporting

First, a base year must be selected in order to analyse target achievement. Then the timeline of monitoring (e.g. monthly or annual) and official reporting must be selected. The report also covers the analysis of the results and discusses adapted measures.

3 Methods

3.1 Framework

The above-mentioned laws, regulations and targets often do not specify how emissions from aviation are to be calculated. This raises the issue of comparability and the validity of emission allowances. In order to report the corporate-level GHG emissions universities primarily use the "Greenhouse Gas Protocol Corporate Standard", developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), which is the most widely used international standard for the corporate accounting and reporting of GHG emissions (GHG Protocol Initiative 2004). It provides a guidance for the preparation and reporting of a systematic GHG-inventory. Compliance with this globally recognized standard enables external verification and comparability.

The standard can to be adopted for different use and organisations. In Germany, the Federal Environment Agency (UBA) published a guideline for administrations (including universities) on how to develop a climate neutral strategy and conduct a GHG inventory (Huckestein 2020).

In the EU, the European Sustainability Reporting Standard (ESRS[6]) is likely to have a greater impact in the future. The ESRS provides the framework and methodology for reporting set out in the Corporate Sustainability Reporting Directive (CSRD[7]). The directive only applies to companies but the ESRS may serve as a general orientation to report GHG emissions.

3.2 System Boundaries

Greenhouse gases considered

In addition to CO_2 all other greenhouse gases defined in the Kyoto Protocol should be considered (methane (CH_4), nitrous oxide (N_2O), hydrocarbons (HFCs, PFCs), nitrogen trifluoride (NF_3) and sulphur hexafluoride (SF_6)). The greenhouse gases are converted to CO_2 equivalents (CO_2eq) according to their global warming potential (GWP) in relation to CO_2. The GWP conversion factors should be based on the latest Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). In the case of flight emissions, other non-CO_2 greenhouse effects should be taken into account.

There are significant aviation's non-CO_2 impacts on climate. They are considered to be at least as important in total as those of CO_2 alone (EU Commission 2020).The non-CO_2 impacts arise from emissions of nitrogen oxide (NOx), soot particles, oxidised sulphur species, and water vapour. These emissions result in changes in the chemical composition of the global atmosphere and cloudiness, perturbing the earth-atmosphere radiation budget. The net impact of aviation non-CO_2 emissions is a positive radiative forcing (warming). It is important to consider these effects when drawing up a GHG inventory of flight emissions. They can be taken into account on the basis of their relative contribution compared to the GHG emissions in the corresponding flight phases in the form of RFI or EWF factors[8]. The RFI 3 or EWF are recommended by FlyingLess. Further description on the different metrics to assess non-CO_2 effects is summarized in the documentation of the FlyingLess GHG monitoring tool (Kräck, Kämper 2024).

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R2772&qid=1729853954227 (25.10.2024)
[7] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022L2464 (25.10.2024)
[8] RFI: Radiative Forcing Index; EWF: Emission Weighting Factor.

Scope of emissions and activities considered

After identifying the emission sources, a distinction is made between direct and indirect emissions and categorized into scopes 1, 2 or 3.

- **Scope 1**: Direct GHG emissions that originate from sources that a company controls or is responsible for. They are closely linked to internal activities and include various processes in which greenhouse gases are released.
- **Scope 2**: Are indirect emissions caused by the purchase of energy, such as electricity, steam, heating and cooling. These emissions are not generated directly on site, but are the result of activities outside the company's boundaries.
- **Scope 3**: Include all indirect GHG emissions, that are not generated in the company, but in its supply/value chain (e.g. purchased goods, employee mobility, etc.).

In the case of academic organisations business air travel is covered in scope 3 as indirect emissions caused by mobility. According to the GHG Protocol, accounting for scope 1 and scope 2 emissions is mandatory and accounting for scope 3 emissions is recommended. In the ESRS, business travel plays a more dominant role as scope 3 emissions and is specified for reporting more directly.

The Baden-Württemberg state specifies in its concept for a climate-neutral state administration that, business travel has to be included (Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg 2014). It depends on the institution how far they extend their reporting in scope 3 beyond this.

Mobility in scope 3 covers both commuter traffic and business travel but it is not clearly defined by the federal policies how extensive mobility of students and guests are considered. Universities report mobility very differently (Helmers et al. 2021). There is no standardized methodology for GHG reporting at universities in Germany. Some balancing rules can be found in the legal requirements of climate-neutral administrations together with the recommended tools of the states. This accounts especially for Baden-Württemberg and Bayern:

- Klimaschutz- und Klimawandelanpassungsgesetz Baden-Württemberg §11: Net GHG neutrality by 2040. Progress is to be reported in a two-year monitoring process. Specifications for the climate-neutral state administration for the CO_2 balance are described in the monitoring reports and recorded in the recommended Excel- tool "BICO2BWLand". Student mobility is not taken into account.
- Bayerische Klimaschutzgesetz (BayKlimaG): Guidelines for GHG accounting at universities in Bavaria (Zentrum für Hochschule und Nachhaltigkeit Bayern). Mobility of employees and students is recorded under Scope 3. This also applies to trips by outgoing students, excursions and guest trips financed by the university.

University staff, students and guests

As mentioned above, there are significant differences in the reporting of GHG emissions from student and guest mobility between universities. FlyingLess recommends the Bavarian requirements outlined by the *Zentrum Hochschule und Nachhaltigkeit Bayern*[9], which take into account business trips by

[9] https://www.bayzen.de/materialien/baycalc/ (12.12.2024)

staff, excursions of staff and students, trips for outgoing students (for semester abroad) and trips by guests if their expenses are covered by the institution.

Input data for the calculation

The most accurate calculation is based on individual travel data with the place of departure and place of arrival. If the flight is not direct, any stopovers must be taken into account. It is also important to specify the booking class, as there are significant differences in emissions per seat kilometre depending on the category selected. Other derived parameters are part of the emission calculation such as information on aircraft category, utilisation rate, distribution of flight phase, etc. These parameters are defined in the selected calculation method (e.g. ISO 14083:2023[10]).

Information about flight (departure, arrival and stopovers) is not available in many academic institutions. During a transition period less precise calculation methods are commonly used such as aggregated assessment of short-distance and long-distance flights and benchmarks on average distances within these categories. Some institutions only have data on travel expenses. The GHG Protocol Standard gives the opportunity to use a spend-based method but it is not recommended. It is the least precise method, as the price for flights is influenced by numerous factors. FlyingLess recommends that organisations improve their data collection processes so that they can report on single flight distances.

[10] Greenhouse gases – Quantification and reporting of greenhouse gas emissions arising from transport chain operations

4 Tools for GHG emissions reporting of air travel

In order to compile the GHG inventory of the academic institutions, different tools are available and used in Germany[11]. Concerning business air travel, some of the tools only allow a highly aggregated input of data because they are not optimised for the purposes of academic institutions. In a lot of cases flights are aggregated by distance class. It is also not intended to differentiate between scientists and students or flight purpose. For an in-depth analysis and target monitoring in business flights more detailed data on single flights is needed.

Table 1: Selected (free of charge) tools to calculate GHG emissions in universities

Tool	Single flight recording	Student recording	Emission factors distance classes Non-CO2 metric Data-Source
		Developed for administration in general	
BICO2LandBW[12]	Aggregated recording or single flight recording	No students defined.	Differentiated: • short-distance (<1,000km) • middle-distance (1,000-2,000km) • long-distance (>2,000km) Non-CO_2 metric: EWF Source: TREMOD 6.41
		Developed for universities	
BayCalc[13]	Aggregated recording by distance class	Students defined.	Differentiated: • short-distance (<1,000km) middle-distance (1,000-10,000km) • long-distance (>10,000km) Non-CO_2 metric not defined Source: UBA, unpublished request.
KliMax[14]	Aggregated recording for different years	Students defined.	Differentiated: • average flight emissions by year: 2015-2022 • scenario until 2050 Non-CO_2 metric: TREMOD Source: UBA reported by TREMOD 5.72, 5.82, 6.03, 6.21, 6.51
ClimCalc[15]	Aggregated recording by distance class	Students defined.	Differentiated: • short-distance (<750km) • long-distance (>750km) Non-CO_2 metric not defined Source: Umweltbundesamt (Austria) Gemis

Calculation methods as of September 2024.

[11] https://wiki.dg-hochn.de/wiki/Treibhausgasbilanzierung (01.08.2024)
[12] https://www.kea-bw.de/kommunaler-klimaschutz/angebote/co2-bilanzierung (20.09.2024)
[13] https://www.nachhaltigehochschule.de/arbeitsgruppen/ag-thg-bilanzierung/ (20.09.2024)
[14] https://www.h2.de/hochschule/portrait/nachhaltigkeit-und-klimaschutz/klimax-tool.html (20.09.2024)
[15] https://nachhaltigeuniversitaeten.at/arbeitsgruppen/co2-neutrale-universitaeten/ (20.09.2024)

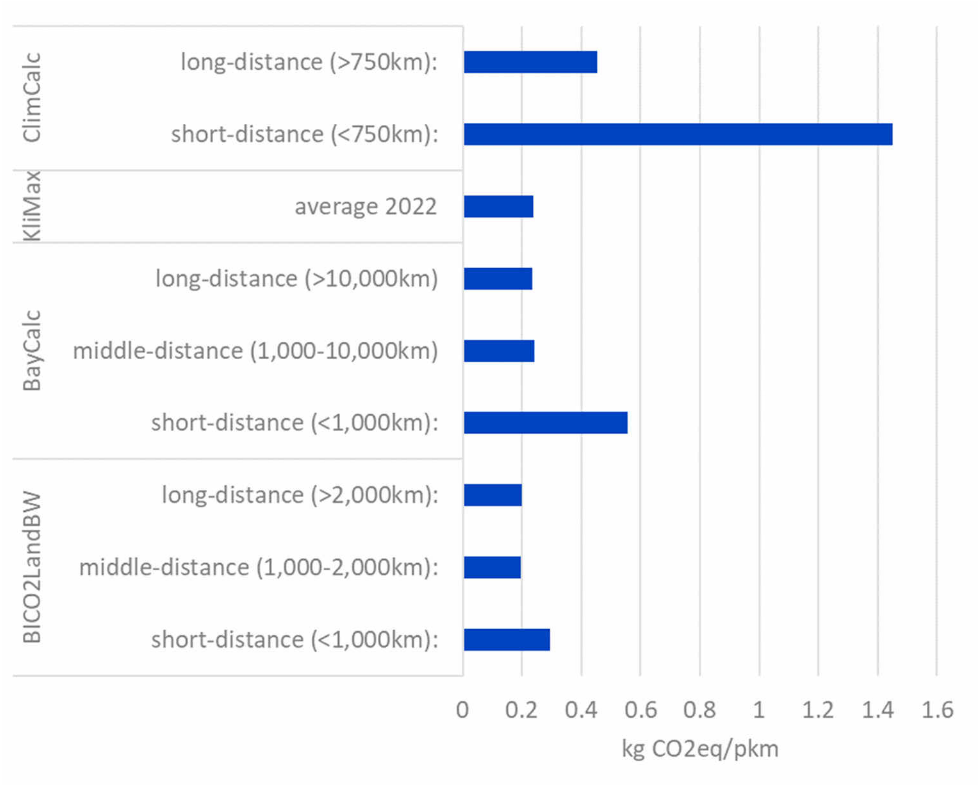


Figure 2: Emission Factors used in considered tools

Table 1 summarizes selected free of charge tools to calculate GHG emissions for universities. These tools often use emission factors for distance classes such as short-and long-distance. Figure 4 shows the underlying emission factors used by the different tools. Especially the emission factor for short-distance shows a significant range of about 1,2 kg CO2eq per passenger kilometre.

If the results are calculated on the basis of specific single flights online tools for flight emission calculations are used. Besides others, the most widely used tool is atmosfair. The atmosfair gGmbH is a non-profit private limited company which contributes to CO_2 mitigation by promoting, developing and financing renewable energies worldwide. They offer solutions for offsetting GHG emissions with renewable energy projects. In this context they offer a tool on their website to calculate emissions from single flights[16]. They also offer the whole GHG emissions calculation of business travel for entire organisations as a payable service.

The tools in Table 1 focus on the general GHG balance for the whole institutions. In order to monitor GHG emissions and analyse the development of reduction measures from business travel by academic organisations, it is necessary to consider further parameters (see Figure 4). Some of the parameters are relevant for a robust emission calculation (e.g. date, location data of departure and arrival, seat class) other parameters are interesting for further analysis (e.g. status group, organizational unit, travel purpose).

[16] https://www.atmosfair.de/en/offset/flight/ (27.06.2024)

FlyingLess GHG monitoring tool

The FlyingLess GHG monitoring tool is developed to help academic institutions to gather flight data with a lot of input opportunities and calculate a whole dataset of GHG emissions on a single flight basis free of charge. The tool was developed in consultation with the project partners and offers a range of options, taking into account the availability of information at the respective institution. The tool is designed to record all air travellers at a university separately for the GHG inventory. Students can be recorded in the tool as Master, Bachelor or guest students, depending on the reports system boundaries of the institution. Different calculation metrics for non-CO_2 GHG emissions can be selected, time series adapted and targets assessed.

On the basis of this data it is possible to analyse, which groups cause particularly high CO_2 emissions or monitor and analyse in detail the success of a flight reduction policy. The aggregated results of the tool can be transferred in other GHG tools for the general CO_2 monitoring report of the whole institution (e.g. tools in Table 1). Figure 4 summarises all variables possible for recordings flights. The mandatory variables to fill out are highlighted in orange.

Additional to the FlyingLess GHG monitoring tool for whole datasets a webtool for calculation of GHG emissions for single flights is also available on the FlyingLess webpage[17]. It should help the administration and other interested parties to generate quick results (e.g. for assessing climate levies per flight).

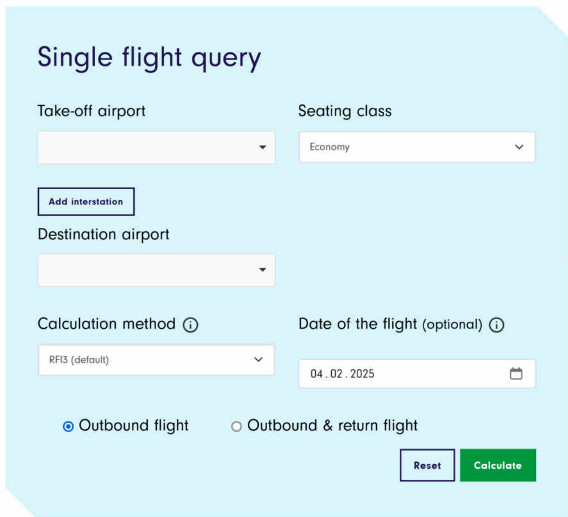
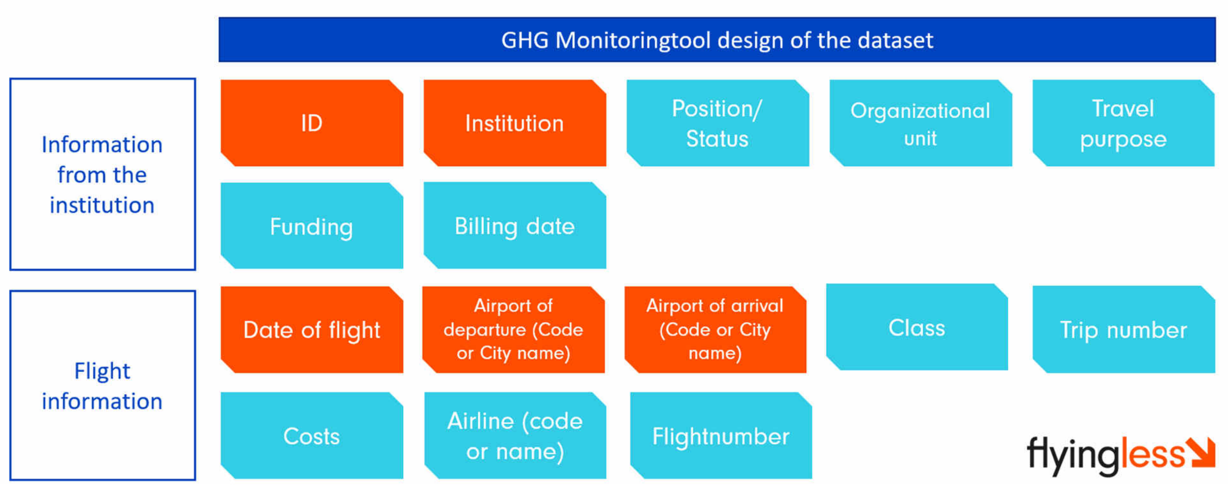


Figure 3: FlyingLess single flight query on

The data basis of the tool uses emissions factors developed with the Transportation Emission Model Aviation-TREMOD AV by the ifeu institute to calculate German flight emissions for the German Federal Environmental Agency (Knörr et al. 2012). The emission factors are in accordance with requirements from the GHG Protocol Standard and the European Sustainability Recording Standard (ESRS). The detailed calculation method complies with the latest ISO 14083:2023 as far as possible. Due to data availability restrictions on distinct parameters average values might have been taken into account. (Greenhouse gases — Quantification and reporting of greenhouse gas emissions arising from transport chain operations).

[17] https://flyingless.de/thg-rechner (17.10.2024)

The largest differences concerning the emission factor results from the applied method of non-CO_2 GHG emissions. The GHG Protocol Standard and the ESRS do not specify a fixed metric it is only defined to report the selected metric. The FlyingLess GHG monitoring tool presents in the results sheet different metrics where the institutions can choose from. However, FlyingLess recommends the RFI3 or the EWF metric as the most scientific advanced. Further description on the different metrics to assess non-CO_2 effects is summarized in the documentation of the FlyingLess GHG monitoring tool (Kräck, Kämper 2024). The FlyingLess GHG monitoring tool thus allows academic institutions to record their emissions on the basis of a transparent and flexible scientific based methodology and report their GHG emissions which follow the mentioned standards.



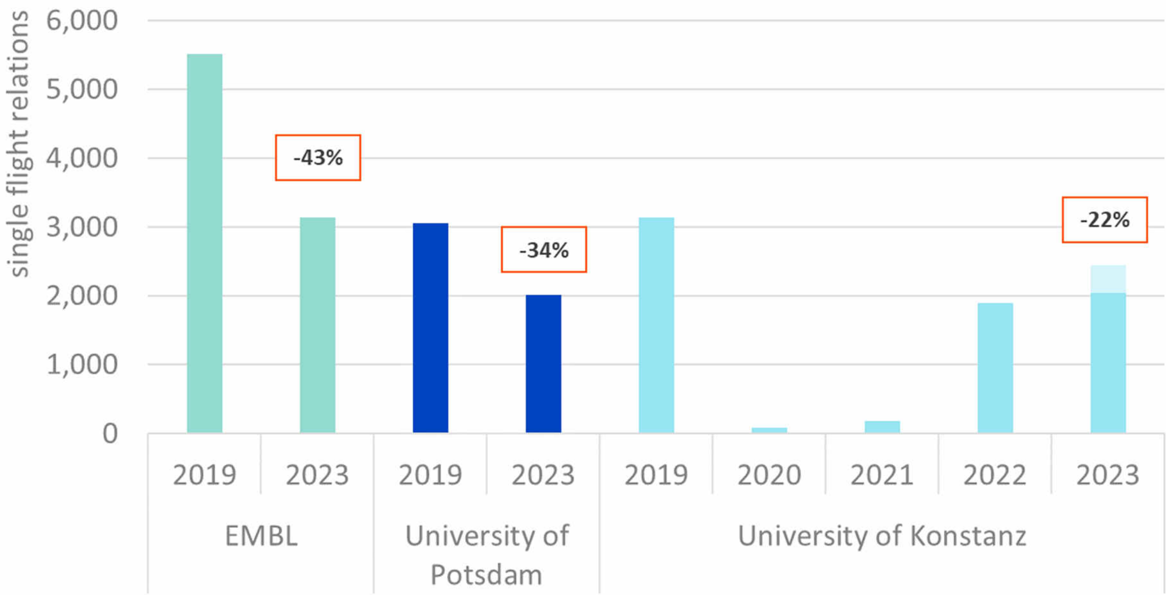
Note: Orange: mandatory variables, blue: optional variables for further analysis.

Figure 4: Summary of the variables of FlyingLess GHG monitoring tool

5 Selected results FlyingLess GHG monitoring tool

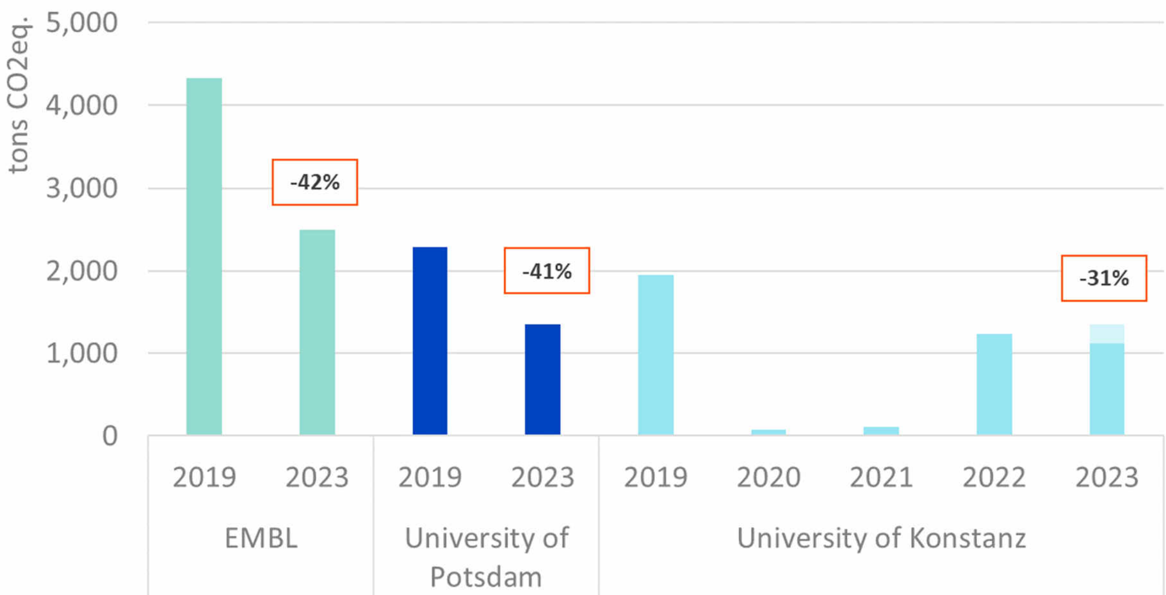
In this chapter some exemplary results from the GHG monitoring tool are summarized in order to demonstrate the potential for monitoring and further analysis. The FlyingLess project has shown that only a few academic institutions in Germany systematically record air travel and digitize the information. Despite the early progress of the GHG monitoring tool in the project, data collection by the partners was challenging. By the end of the project data was available for 2019 and 2023 for three partner institutions. 2019 is considered a baseline, the year before the project start and corona pandemic. 2023 is the latest recorded dataset during the project time. It should be noted that our data on annual GHG emissions from business flights may differ from the data reported in the institutions' sustainability reports due to different system boundaries and the selection of preliminary data. The partner institutions are still improving the process of adjusting the method and data to create a good basis for calculation.

Figure 5 shows the development of the absolute number of single business flights by three of FlyingLess partner institutions. A single flight is defined as a flight relation between the point of departure and the point of arrival of an aircraft. Stopovers and round trips are therefore counted separately. At all institutions number of single flights are lower in 2023 compared to baseline 2019 (before COVID-19). The reduction for EMBL is about -43 %, for University of Potsdam -34 % and University of Konstanz -22 %. The University of Konstanz was able to gather data for a complete time series. Thus, the complete breakdown in the COVID-19 years 2020 and 2021 is clearly visible. In 2022, the flight numbers rose quickly up to 60 % of baseline (pre-COVID19 conditions) in 2022. According to the other partners this pattern can be observed in their respective data. In 2023 the University of Konstanz has already reached 78 % of baseline.



Note: EMBL: European Molecular Biology Laboratory. Lighter colour in 2023 for University of Konstanz indicates expected data reporting in 2024. Results are considered preliminary due to adjustments to method and data by partner institutions.

Figure 5: Absolute number of single flights from business air travel in 2019 and 2023 for FlyingLess partners.



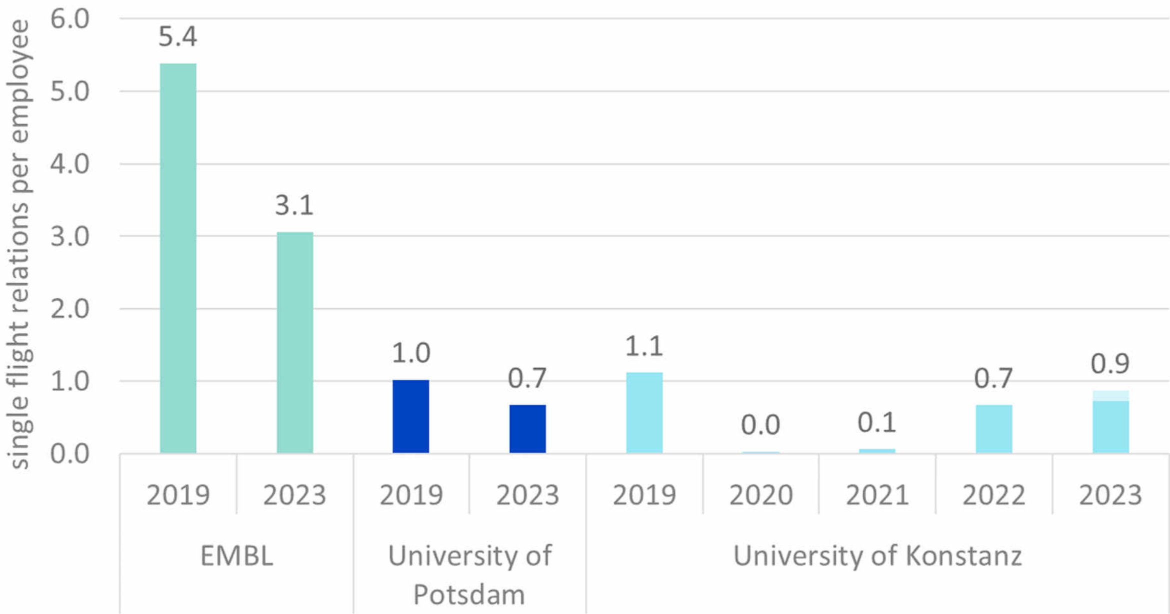
Note: EMBL: European Molecular Biology Laboratory. Lighter colour in 2023 for University of Konstanz indicates expected data reporting in 2024. Results are considered preliminary due to adjustments to method and data by partner institutions.

Figure 6: Absolute GHG emissions from business air travel in 2019 and 2023 for FlyingLess partners.

Figure 6 shows the absolute GHG emissions (RFI3 metric is applied) from business flights by three FlyingLess partners. In general, it has the same pattern as the number of flights. However, reduction between 2019 and 2023 for the universities of Potsdam and Konstanz is higher compared to the number of flights. This is due to the fact that the average emission factor per kilometre of their flights is reduced in 2023 compared to 2019 (- 11 %). The main reasons for the changes in emission factors were the tendency towards higher occupancy rates on flights and the increased use of aircraft with lower fuel consumption per seat offered. The average kilometres per flight do not change significantly for the universities in 2019 and 2023.

The reduction between 2019 and 2023 for EMBL is nearly the same value if number of flights and GHG emissions. This is due to two opposing effects. On the one side reduction of emission per flight kilometre is lower at EMBL (- 2 %). The opposing effect is, that the distance per flight for EMBL increases between 2019 and 2023 by 240 km. This effect can be explained by the change in travel behaviour between the two EMBL sites in Heidelberg and London. Monthly in-person meetings have been switched to virtual format and train journeys between the two locations are becoming more frequent.

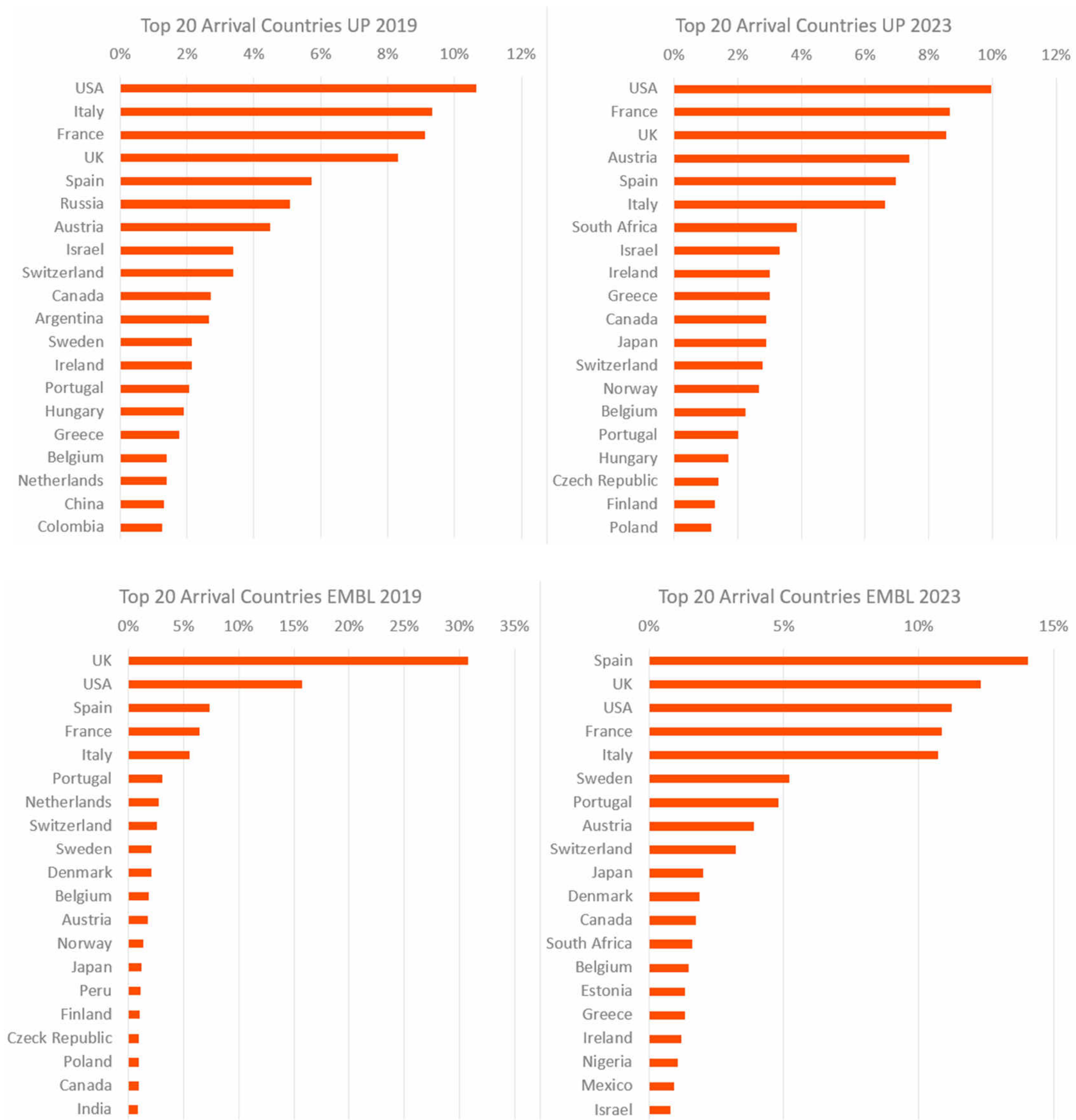
Figure 7 shows the development of the number of single flights in relation to the employees. Both universities show a similar pattern with about one flight per employee in 2019 and less than one flight per employee in 2023. EMBL as an intergovernmental research organization with six sites in Europe shows considerable higher flights per employees (2019: 5,4; 2023: 3.1). However, from EMBL a strong decrease in flights can be observed in the absolute results as well as in relative results. Instead of the absolute number of employees also full-time equivalents can be put into relation which is a more accurate unit in order to compare universities internationally. As long as the data for e.g. status group and organisational level is filled out, the results can be further filtered and analysed.



Note: EMBL: European Molecular Biology Laboratory. Lighter colour in 2023 for University of Konstanz indicates expected data reporting in 2024. Results are considered preliminary due to adjustments to method and data by partner institutions.

Figure 7: Relative number of trips from business air travel per employee in 2019 and 2023 for FlyingLess partners.

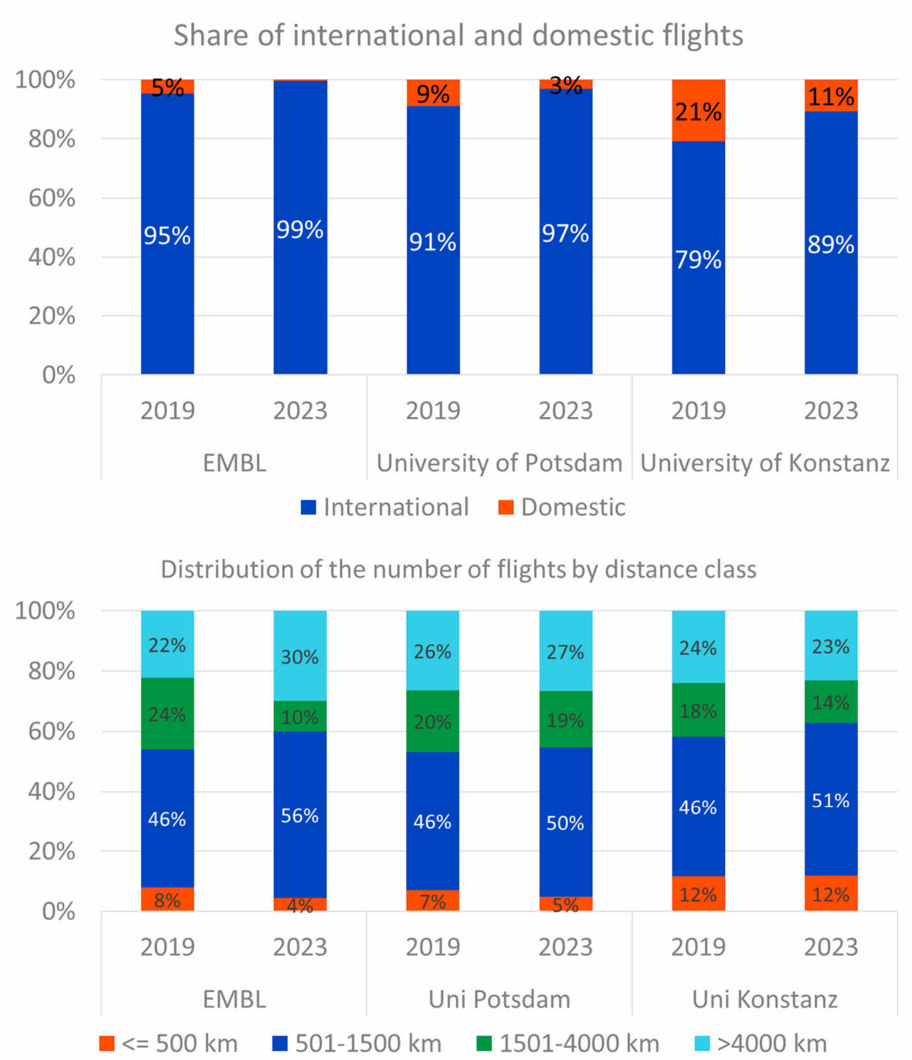
Figure 8 shows the development of the top destinations of business air travel for the University of Potsdam and EMBL. The results for the University of Potsdam shows a similar picture for both years indicating, that the distribution of destination countries has not changed much. The United States are still the most relevant destination followed by the European Countries: France, UK, Australia, Spain, Italy. Destinations outside Europe and North America play a minor role. The results for EMBL show a clear shift in the distribution of destination countries. In 2019, over 30 % of flights were headed to the UK. In 2023, the UK has the second rank (12 %) after Spain as a destination country. This is due to the already described effect that EMBL changed (after COVID-19) internal meeting format between German and British EMBL location from in-person to virtual meeting. Additionally, South Africa and Japan moved up the in the ranking of main destinations at EMBL in 2023.



Note: EMBL: European Molecular Biology Laboratory. Germany as a destination is excluded because not all returning flights could be identified. Results are considered preliminary due to adjustments to method and data by partner institutions.

Figure 8: Top 20 destinations of business air travel in in 2019 and 2023 for University of Potsdam (top) and EMBL (bottom).

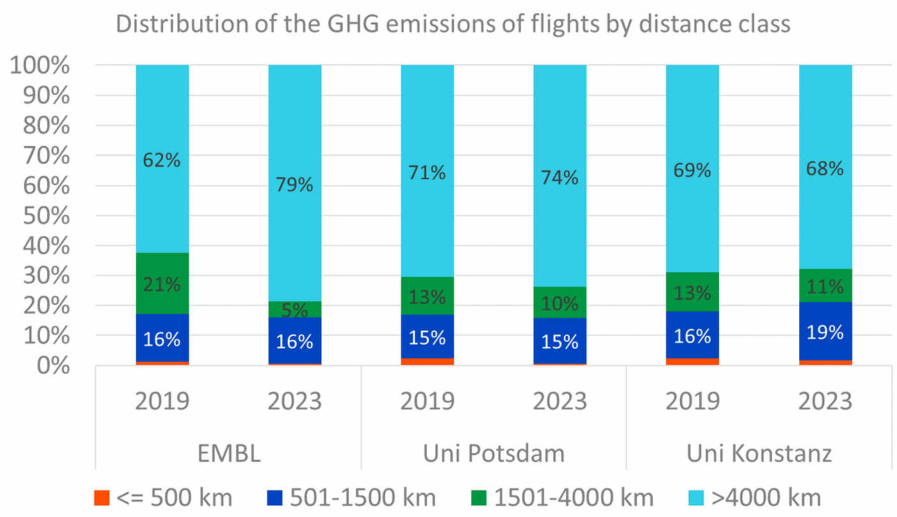
Figure 9 shows the share of domestic and international flights (top) and share of different distance classes (bottom) over time. The flights for EMBL and the University of Potsdam account over 90 % for international flights. The share of domestic flights even decreased further between 2019 and 2023 to 1 % (EMBL) and 3 % (University of Potsdam). The peripheral location of the University of Konstanz and its poor connection to fast intercity rail connections causes the higher share of domestic flights (2019: 21 % and 2023: 11 %). A more detailed analysis is provided by categorisation according to defined distances (Figure 9, bottom). It shows a down-shift in EMBLs middle-distances flights (1,501 km to 4,000 km) from 24 % to 10 % in 2023 and in ultra-short-distance flights (up to 500 km) from 8 % to 4 % in 2023. Accordingly, the distance categories "501 km to 1,500 km" and ">4,000 km" show higher shares in 2023. The University of Potsdam shows small changes in the category "up to 500 km" (- 2 %) and in the category "up to 1,500 km" (+ 4 %). The university of Konstanz remained stable in the category "up to 500 km" and show changes in the category "up to 1,500 km" (+ 5 %) and in the category "up to 4,000 km" (- 4 %).



Note: EMBL: European Molecular Biology Laboratory. Results are considered preliminary due to adjustments to method and data by partner institutions.

Figure 9: Share of distance classes for flights by category international/domestic (top) and Eurocontrol categories (bottom) in relation to the number of flights.

Flights longer than 1.500 km contribute about 80 % to the total GHG emissions over all considered institutions. The highest distance class 'over 4,000 km' accounts for only 20 % to 30 % of the number of flights (Figure 9), but around 70 % to 80 % of GHG emissions (Figure 10). Reducing long-haul flights therefore has the greatest leverage in terms of absolute GHG emissions. Thus, a ban of short distance flights (equal to 8-10 hours train travel) would only reduce emissions by around 10 %. Reducing or banning of short-haul flights alone is therefore not sufficient to reach achieve reduction targets.



Note: EMBL: European Molecular Biology Laboratory. Results are considered preliminary due to adjustments to method and data by partner institutions.

Figure 10: Share of distance classes for flights by Eurocontrol categories in relation to the GHG emissions of flights.

Besides the exemplary results shown in this chapter further analysis can be made depending on the quality and depth of the input data. For instance, results can be generated by organisational unit, travel purpose or costs. The differentiated analysis of the results allows a target-orientated monitoring.

6 Lessons Learned: Data collection is the biggest obstacle

A comprehensive GHG inventory of the status quo and an annual monitoring of the results was considered to be crucial to establish a strategy to reduce business air travel and monitor the progress. Thus, the development of the GHG monitoring tool has started very early in the project timeline. The first version of the tool was available in summer 2022.

In order to use the tool, the partners had to collect the relevant flight data and adjust them to the requirements of the tool. While it was to be expected that this would be the biggest challenge for academic institutions, the full extent was surprising. The lack of centralized and digital business travel data collection is a well-known issue in administration. This affects state universities and private research institutes alike. The administration units of these institutions are very large and changes in procedures or adaptation of processes and software products have very long lead times and decision-making chains. The processing of business trips has always focused primarily on the allocation of cost centres and travel expense reimbursements. The inclusion of further processes and data points (like departure and arrival locations) for individual business trips has not yet been part of the data collection process.

In order to calculate single flight-based emissions further information is required. This includes at least information on location of departure and arrival of the flight (compare Figure 4). However, this presumably small amount of information requires a major coordination process for the entire institution to adapt the data collection or evaluate existing data. In addition, this information may have to be researched and entered by the administration staff manually. This is often a major challenge for understaffed administrations. Furthermore, common administration software for travel expense management do not have adequate fields for recording. It is not uncommon for the entire business travel application and travel expense reimbursement process to be predominantly analogue. Some institutions do have digitalized data for travel application but not reimbursement. Thus, the institutions report the GHG emissions for business travel on the basis for application. This approach leads to a certain overestimation of GHG emissions.

One option for standardized digital data entry of business trips is the outsourcing of the travel planning and booking process to an external travel agency. These platforms collect travel data in a standardized manner and in some cases already offer services for further data analysis. However, the use of these booking platforms is often more expensive. Some institutions have contracts with travel agencies but in general only a certain share of business trips is recorded via these providers.

Another strategy to reduce the workload from administration is the direct data input (including GHG emissions) by the traveller itself. An approved calculation tool or travel decision tool has to be provided. In order to receive travel approval or reimbursement of expenses the traveller has to provide certain data of the flight in digital format. But this may also require digital post processing by administration into the travel expense management system. The advantage of this procedure is that the traveller itself is directly confronted with the emission he/she causes to the environment and is thus sensitized to the issue.

Universities in Baden-Württemberg are a little further ahead in terms of data collection, as there is a legal requirement for a CO_2 levy on flights[18] and a documentation obligation. In practice, however, travel expense reports are also digitized individually at great expense. There is still a lack of detailed guidelines on the calculation method and system boundary (see chapter 3).

Due to the unsatisfied process and lack of official guidelines, several activities are taking place to enhance data collection and calculation. These activities are initiated by different actors on university level (scientists or admin staff), on state level (legal requirements and recommended tools) or on national/international network level (e.g. DG-HochN, Sustainable European Laboratories Network). These activities are currently taking place in parallel and there is a lack of efficient consolidation and coordination of the knowledge transfer and outcomes.

[18] University financing agreement II from the 31st of March 2020

7 Recommendations

As this report describes, the whole process of calculating flight emissions in universities as part of Scope3 GHG reporting, still has a lot of room for improvement. From our experience based on personal communication, workshops and tool development; several recommendations can be summarized:

- *For academic institutions*
    - Consider the integration of travel activity data in the digitalisation process of travel management
    - Develop a flight travel policy and consider a strategy for collecting and monitoring GHG data
    - Select a suitable GHG calculation tool that takes into account data based on individual flights
    - Targeted monitoring to determine progress towards achieving the defined goal
- *For funding institutions*
    - Linking funding to a minimum use of air travel
    - Mandatory reporting of greenhouse gas emissions from travel
    - Funding of additional expenses for train travel
    - Funding of additional expenses for online formats
- *For politics*
    - Provision/selection of a solid methodological background for calculating flight emissions (standardization)
    - Provide guidelines on the calculation method and system boundary
    - Financing of harmonised calculation tools and integration into digital administration processes of travel management
    - GHG reduction targets for state institutions/climate levy

8 References

Ahonen, V.; Siljander, M.; Pellikka, P.; Johansson, T.; Rask, M. (2021): The Sustainability of Academic Air Mobility in Finnish Universities. In: *Sustainability*. Vol. 13, No. 2948, p. 1–23. DOI: *10.3390/su13052948*.

ALLEA (2022): Towards Climate Sustainability of the Academic System in Europe and Beyond. Berlin. S. 1–112. DOI: *10.26356/climate-sust-acad https://allea.org/portfolio-item/towards-climate-sustainability-of-the-academic-system-in-europe-and-beyond/*.

Arsenault, J.; Talbot, J.; Boustani, L.; Gonzalès, R.; Manaugh, K. (2019): The environmental footprint of academic and student mobility in a large research-oriented university. In: *Environmental Research Letters*. Vol. 14, No. 095001, p. 1–9. DOI: *10.1088/1748-9326/ab33e6*.

Attari, S. Z.; Krantz, D. H.; Weber, E. U. (2016): Statements about climate researchers’ carbon footprints affect their credibility and the impact of their advice. In: *Climatic Change*. Vol. 138, No. 1, p. 325–338. DOI: *10.1007/s10584-016-1713-2*.

Bundesregierung (2021): Maßnahmenprogramm Nachhaltigkeit – Weiterentwicklung 2021 „Nachhaltigkeit konkret im Verwaltungshandeln umsetzen“. *https://www.bundesregierung.de/resource/blob/975226/1953740/d54a3a3d36e719c23f76bbd5d1edac5c/2021-08-25-massnahmenprogramm-nachhaltigkeit-2021-data.pdf?download=1* (23.08.2024).

Burian, I. (2018): It is up in the air: academic flying of Swedish sustainability academics and a pathway to organisational change. *Master Thesis Series in Environmental Studies and Sustainability Science*, LUCSUS (Lund University Centre for Sustainability Studies).

Ciers, J.; Mandic, A.; Toth, L.; Op ’t Veld, G. (2019): Carbon Footprint of Academic Air Travel: A Case Study in Switzerland. In: *Sustainability*. Vol. 11, No. 80, p. 1–8. DOI: *10.3390/su11010080*.

EU Commission (2020): REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL Updated analysis of the non-CO2 climate impacts of aviation and potential policy measures pursuant to EU Emissions Trading System Directive Article 30(4). *https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0747* (12.09.2024).

GHG Protocol Initiative (2004): The Greenhouse Gas Protocol. A Corporate Accounting and Reporting Standard. p. 116.

Glover, A.; Strengers, Y.; Lewis, T. (2017): The unsustainability of academic aeromobility in Australian universities. In: *Sustainability: Science, Practice and Policy*. Vol. 13, No. 1, p. 1–12. DOI: *10.1080/15487733.2017.1388620*.

Görlinger, S.; Merrem, C.; Jungmann, M.; Aeschbach, N. (2023): An evidence-based approach to accelerate flight reduction in academia. In: *npj Climate Action*. Nature Publishing Group. Vol. 2, No. 1, p. 1–12. DOI: *10.1038/s44168-023-00069-y*.

Helmers, E.; Chang, C. C.; Dauwels, J. (2021): Carbon footprinting of universities worldwide: Part I—objective comparison by standardized metrics. In: *Environmental Sciences Europe*. Vol. 33, No. 1, p. 30. DOI: *10.1186/s12302-021-00454-6*.

Hoolohan, C.; McLachlan, C.; Jones, C.; Larkin, A.; Birch, C.; Mander, S.; Broderick, J. (2021): Responding to the climate emergency: how are UK universities establishing sustainable workplace routines for flying and food? In: *Climate Policy*. Vol. 21, No. 7, p. 853–867. DOI: *10.1080/14693062.2021.1881426*.

Hopkins, D.; Higham, J.; Orchiston, C.; Duncan, T. (2019): Practising academic mobilities: Bodies, networks and institutional rhythms. In: *The Geographical Journal*. Vol. 00, p. 1–13. DOI: *10.1111/geoj.12301*.

Huckestein, B. (2020): Der Weg zur treibhausgasneutralen Verwaltung: Hilfestellung und Etappen. Umweltbundesamt (UBA), Dessau-Roßlau. *https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2021_fb_weg_zur_treibhausgasneutralen_verwaltung_bf.pdf* (01.08.2024).

ICAO (2021): Effects of Novel Coronavirus (COVID-19) on Civil Aviation: Economic Impact Analysis. ICAO, Montréal, Canada. S. 1–110. *https://www.icao.int/sustainability/Documents/COVID-19/ICAO_Coronavirus_Econ_Impact.pdf* (11.04.2023).

IEA (2022): Aviation. In: *IEA (International Energy Agency)*. https://www.iea.org/reports/aviation. (06.04.2023).

IPCC (2021): Summary for Policymakers. In: *[Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]*. p. 32.

Jacobson, L. (2022): The Virus and the Elephant in the Room: Knowledge, Emotions and a Pandemic—Drivers to Reducing Flying in Academia. In: K. Bjørkdahl: / A. S. Franco Duharte: *Academic Flying and the Means of Communication*. Springer Nature, Singapore. S. 209–235. DOI: *10.1007/978-981-16-4911-0_9*.

Knörr, W.; Schacht, A.; Gores, S. (2012): Entwicklung eines Modells zur Berechnung der Energieeinsätze und Emissionen des zivilen Flugverkehrs - TREMOD AV. ifeu - Institut für Energie- und Umweltforschung Heidelberg GmbH, Berlin.

Knutti, R. (2019): Closing the Knowledge-Action Gap in Climate Change. In: *One Earth*. Vol. 1, No. 1, p. 21–23. DOI: *10.1016/j.oneear.2019.09.001*.

Kräck, J.; Kämper, C. (2024): Dokumentation: FlyingLess Bilanzierungs- und Monitoringtool der Treibhausgasemissionen für Flugreisen (THG-Monitoringtool). ifeu - Institut für Energie- und Umweltforschung Heidelberg GmbH, Heidelberg. *https://flyingless.de/fileadmin/user_upload/FlyingLess/THG-Calculator/Documents/Dokumentation_FlyingLess_THG_Monitoringtool.pdf* (12.09.2024).

Le Quéré, C.; Jackson, R. B.; Jones, M. W.; Smith, A. J. P.; Abernethy, S.; Andrew, R. M.; De-Gol, A. J.; Willis, D. R.; Shan, Y.; Canadell, J. G.; Friedlingstein, P.; Creutzig, F.; Peters, G. P. (2020): Temporary reduction in daily global CO2 emissions during the COVID-19 forced confinement. In: *Nature Climate Change*. Vol. 10, No. 7, p. 647–653. DOI: *10.1038/s41558-020-0797-x*.

Lenton, T. M.; Rockström, J.; Gaffney, O.; Rahmstorf, S.; Richardson, K.; Steffen, W.; Schellnhuber, H. J. (2019): Climate tipping points — too risky to bet against. In: *Nature*. Vol. 575, No. 7784, p. 592–595. DOI: *10.1038/d41586-019-03595-0*.

Loveday, J.; Morrison, G. M.; Martin, D. A. (2022): Identifying Knowledge and Process Gaps from a Systematic Literature Review of Net-Zero Definitions. In: *Sustainability*. Multidisciplinary Digital Publishing Institute. Vol. 14, No. 3057, p. 1–37. DOI: *10.3390/su14053057*.

Medhaug, I. (2021): The ETH Zurich flight emission project: Emissions 2016-2019. ETH Zurich. S. 1–32. DOI: *10.3929/ETHZ-B-000498721 http://hdl.handle.net/20.500.11850/498721* (08.10.2022).

Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg (2014): Konzept einer klimaneutralen Landesverwaltung Baden-Württemberg. Stuttgart.

https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/Dokumente/1_Ministerium/Aufgaben_und_Organisation/Konzept_einer_klimaneutralen_Landesverwaltung_BW.pdf (12.12.2024).

Nursey-Bray, M.; Palmer, R.; Meyer-Mclean, B.; Wanner, T.; Birzer, C. (2019): The Fear of Not Flying: Achieving Sustainable Academic Plane Travel in Higher Education Based on Insights from South Australia. In: *Sustainability*. Vol. 11, No. 2694, p. 1–22. DOI: *10.3390/su11092694*.

Nußbaum, P.; Ruiz, M.; Stibbe, J.; Wöhning, C.; Dietrich, C. (2024): Bilanzierung, Reduktion und Kompensation von Treibhausgasemissionen an Hochschulen: vom Footprint zum Handprint. HIS-HE:Forum HIS-Institut für Hochschulentwicklung e. V, Hannover.

Overton, J. (2022): Issue Brief - The Growth in Greenhouse Gas Emissions from Commercial Aviation. EESI - Environmental and Energy Study Institute. S. 1–10. *https://www.eesi.org/files/IssueBrief_Climate_Impacts_Aviation_2019rev2022.pdf* (15.03.2023).

Poggioli, N. A.; Hoffman, A. J. (2022): Decarbonising Academia's Flyout Culture. In: K. BJØRKDAHL: / A. S. FRANCO DUHARTE: *Academic Flying and the Means of Communication*. Springer Nature, Singapore. S. 237–267. DOI: *10.1007/978-981-16-4911-0_10*.

Rockström, J.; Steffen, W.; Noone, K.; Persson, Å.; Chapin, F. S. I.; Lambin, E.; Lenton, T. M.; Scheffer, M.; Folke, C.; Schellnhuber, H. J.; Nykvist, B.; de Wit, C. A.; Hughes, T.; van der Leeuw, S.; Rodhe, H.; Sörlin, S.; Snyder, P. K.; Costanza, R.; Svedin, U.; Falkenmark, M.; Karlberg, L.; Corell, R. W.; Fabry, V. J.; Hansen, J.; Walker, B.; Liverman, D.; Richardson, K.; Crutzen, P.; Foley, J. (2009): Planetary Boundaries: Exploring the Safe Operating Space for Humanity. In: *Ecology and Society*. Vol. 14, No. 2, p. 32. DOI: *10.5751/ES-03180-140232*.

Sun, X.; Wandelt, S.; Zhang, A. (2023): A data-driven analysis of the aviation recovery from the COVID-19 pandemic. In: *Journal of Air Transport Management*. Vol. 109, p. 102401. DOI: *10.1016/j.jairtraman.2023.102401*.

Wynes, S.; Donner, S., D. (2018): Addressing Greenhouse Gas Emissions from Business-Related Air Travel at Public Institutions: A Case Study of the University of British Columbia. Pacific Institute for Climate Solutions. *https://pics.uvic.ca/sites/default/files/AirTravelWP_FINAL.pdf* (01.09.2022).

Wynes, S.; Donner, S. D.; Tannason, S.; Nabors, N. (2019): Academic air travel has a limited influence on professional success. In: *Journal of Cleaner Production*. Vol. 226, p. 959–967. DOI: *10.1016/j.jclepro.2019.04.109*.

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