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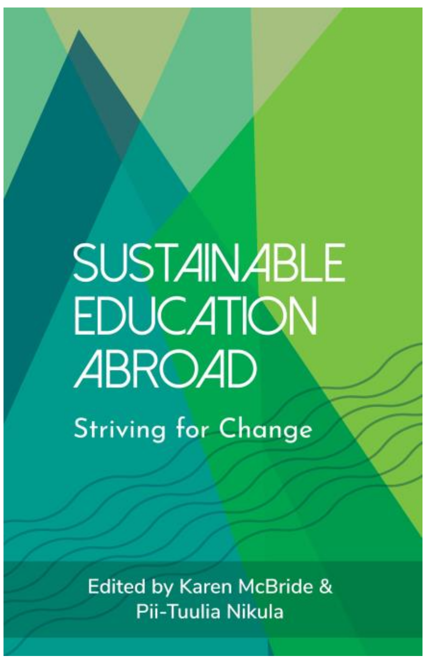

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The Age of Sustainable Education Abroad: Key Questions and Trends

Pii-Tuulia Nikula and Karen McBride

Objectives of the Book

Sustainable Education Abroad: Striving for Change is a timely and important book. Humanity is facing major global crises that require fast and decisive action. We have failed to adequately address a number of social issues (Raworth, 2017; Rockström et al., 2009). This is why all sectors need to rethink their modus operandi and introduce changes to better protect our human and ecological well-being. Education abroad is no exception. We need to reduce our sector's negative impacts while amplifying the positive local and global impacts of education abroad. This book will help toward that goal by improving key stakeholders' understanding of sustainability issues and available solutions. Hence, this edited collection is an essential reading for education abroad and sustainability professionals within educational institutions, researchers, and policymakers.

The key focus of this book is on education abroad, which The Forum on Education Abroad (2020) defines in clause 3.11 of the Terms and Definitions section of the *Standards of Good Practice for Education Abroad* as "enrollment in courses, experiential learning, internships, service learning, and other learning activities, which occurs outside the participant's home country, the country in which they are enrolled as a student, or the country in which they are employed as personnel."

A significant number of students participate in education abroad programs each year. Pre-COVID-19 (in the 2018–2019 academic year), 347,099 American students were enrolled in credit-bearing study abroad and around 38,000 students participated in non-credit-bearing programs (Open Doors, 2021). Due to the COVID-19 pandemic, these numbers declined significantly in 2019/2020, but 162,633 Americans were still able to study abroad for academic credit (Open Doors, 2021). In Europe, more than 300,000 students participated in the Erasmus+ mobility scheme (European Commission & Directorate-General for Education, 2021) and around 50,000 Australian university students were involved in study abroad in 2019 (Department of Education, Skills and Employment, 2021). The sheer number of students engaged in these and other education abroad opportunities globally means that sustainability questions associated with this mobility warrant careful investigation. Many of the issues and solutions are shared with other forms and modes of international education, such as degree-seeking mobility. Hence, many of the insights from this book are likely to be applicable to wider international education contexts.

This edited volume is an outcome of a collaborative effort made possible by the authors who are all passionate experts in the field of education abroad, sharing their knowledge, experiences, and research. By emphasizing and presenting solutions, the contributors offer a positive response to the sustainability issue. The findings are of interest to the global audience, with chapters exploring learnings from North and Central Americas, Europe, Africa, and Oceania. The chapters in this book present both new primary data and insightful evaluations of existing programs and practices, enhancing our awareness of the underlying complexities. Hence, the collection offers a multitude of ideas for practitioners and researchers across the globe.

Sustainability in Education Abroad

How much focus are academics placing on sustainability within the study abroad context? In the past couple of years, a number of academic journal articles have been published that have examined this intersection using both qualitative and quantitative study designs. For instance, Zhang and Gibson (2021) conducted qualitative interviews with 31 former short-term study abroad students (from the U.S. to the South Pacific) to explore whether participation in a sustainability-themed study abroad program resulted in changes in participants' long-term sustainability attitudes and behaviors.

Their findings indicated that a "sustainable mindset" was retained by many participants after the program, with specific changes in many participants' everyday lives, career paths, and travel styles. Other examples include the study by Hane and Korfmacher (2020) highlighting how the exposure to a new culture can have an impact on the way students think about environmental problems, and the contribution by Thomas (2020) discussing ways in which educators can deepen university students' sustainability understanding with examples from a semester-long study abroad program in Italy.

The impact of studying abroad has also been explored using quasi-experimental designs. Tarrant et al. (2021) evaluated the influence of different pedagogical models, including study abroad and sustainability topics, on student engagement using quantitative pre- and post-survey results. The self-reported data from 3096 undergraduate students in the United States demonstrated that the positive impact on deep learning was associated with both sustainability courses and study abroad participation. However, the study could not confirm whether learning about sustainability while studying abroad enhanced deep learning more compared to studying non-sustainability-related subjects abroad. In another paper employing a similar design with a dataset including 1703 undergraduate students from the United States, the authors argue that studying abroad, regardless of the topic, can be an effective way to improve sustainability literacy (Ling et al., 2021).

Researchers have also provided estimates/calculations of greenhouse gas emissions related to education abroad-related travel (c.f., Arsenault et al., 2019; Hale, 2019; Shield, 2019). These insights are important so that we can better understand the environmental costs related to student mobility. Furthermore, considering the travel disruption caused by the COVID-19 pandemic, institutions and educators have been prompted to consider alternative ways to provide international experiences, including virtual exchanges/collaborative international learning (COIL) opportunities. For instance, a survey of 216 members of The Forum on Education Abroad reported 60% growth in virtual offerings in 2021 (The Forum on Education Abroad, 2021a). This highlights the importance of further exploring the intersection of virtual exchanges/COIL and sustainability (e.g., Bowen et al., 2021; King et al., 2021). Moreover, the topic of reciprocity, including equitable and sustainable partnerships between low-, medium-, and high-income countries, has attracted scholarly attention. For instance, Jotia, Biraimah, and Kurtz (2020) discuss the way in which short-term study abroad programs organized in the Global South could be made more beneficial to host institutions/communities, while also simultaneously improving student experiences. There seems to be less research focusing on the study abroad experiences of students from low-income countries.

Bell et al. (2021) highlight this issue and discuss the experiences of Indian short-term study abroad students in Australia as well as the ways in which Higher Education Institutions (HEIs) could further increase the level of reciprocity in study abroad programming.

Besides academic research, a number of industry presentations and initiatives have highlighted the importance of sustainability within the education abroad and wider international education community. The Forum on Education Abroad has developed guidelines aiming to enhance sustainability awareness and action within the sector. These guidelines align with U.N. Sustainable Development Goals (hereafter SDGs) with specific education abroad activities (The Forum on Education Abroad, 2021b). SDGs are also the starting point for many chapters in this book, providing a useful framework when addressing a variety of social and ecological concerns. Other examples of recent North American initiatives include NAFSA's decision to use sustainability expertise to appoint its 2020–2021 Senior Fellows leading to a special edition issue highlighting trends and insights (NAFSA, 2021).

A number of initiatives focused on sector-wide sustainability engagements outside North America are also available. Examples of these include, for instance, the European Green Erasmus project (https://greenerasmus.org/) aiming to enhance awareness about the importance of sustainable internationalization, the European Association for International Education (EAIE) forest initiative offsetting emissions related to their annual conference (https://www.eaie.org/blog/eaie-starts-education-forest-offset-co2.html), and sustainability articles/contributions featured in industry magazines/other industry platforms (see for instance; EAIE, 2022; McDonald, 2015; Nikula, 2019). Many international education conferences across the globe have also increasingly included presentations related to environmental and social sustainability issues. At the same time, sustainability-related bottom-up initiatives around specific sub-topics have emerged. For instance, the Climate Action Network for International Educators (www.canie.org) advocates for climate action (CANIE, 2022). A number of other networks/associations contribute to sustainability work alongside individual higher education institutions and other education abroad providers, who have acted to align their institutional objectives and strategies with the U.N. SDGs or taken other action to address some of the existing issues. For instance, a growing number of institutions have started to measure their greenhouse gas emissions, while some have also made a commitment to reduce and offset their education abroad-related emissions (Redden, 2019).

Despite all these laudable initiatives, the implementation of sustainability principles is still in its infancy. For instance, a sector-wide sustainability awareness and performance survey conducted by Bound International and

Earth Deeds which captured 77 higher education institutions and study abroad provider organizations from 13 countries, showed that sustainability performance is neither consistent nor particularly high within the field (Bound International, 2021). While not a representative sample of the more than the estimated 20,000 HEIs in the world, the data were retrieved from a good cross-section of institutional and organizational types, including public universities, private universities, private study abroad organizations, and community colleges. Some notable statistics from the survey included the fact that only 22% of survey respondents indicated that environmental sustainability was explicitly embedded into organizational mission, goals, and objectives and only 17% explicitly embedded it into their organizational policies. Furthermore, 68% of respondents do not track Scope 3 emissions from student, faculty, or staff travel abroad and most institutions and organizations do not include the terms "Sustainable Development Goals," "Climate Change," "Environmental Sustainability," or "Social Sustainability" into any education abroad program titles or descriptions. The drivers for action are clear, but we need a radical change in the way we think about and design education abroad opportunities. At the same time, the complexities and tradeoffs need to be considered carefully before implementation (Nikula and van Gaalen, 2022). Examples from programs/courses, such as those shared in this book, are valuable resources for institutions considering similar initiatives.

In this book, we do not rely on a single sustainability definition. Rather, each author details their own sustainability lens whether they are referencing environmental and/or social sustainability questions. This is done, in part, due to a lack of formalization and consistency regarding sustainability within the international higher education context to date. However, formalization and consistency should be considered important endeavors with strategic planning within higher education institutions and other study abroad organizations henceforth. In particular, HEIs and affiliated partners should likely consider how they are positioned to make an impact on the climate crisis and what they want student learning and research-oriented outcomes to be before creating a working definition.

Two main approaches are used throughout this book. First, some of the chapters are exploring the ways in which the negative impacts (i.e., the "footprint") related to education abroad could be minimized. Second, a number of chapters are exploring the ways in which education abroad can have a positive influence (i.e., the "handprint"). The former approach includes different ways of reducing education abroad sector's negative impact on the planet and/or on our communities. For instance, the carbon emissions related to international education mobility are considerable, and hence highly problematic, when considering the urgent need to decarbonize our economies (Shields, 2019). The latter approach focuses on how to maximize the positive handprint of the education abroad sector by influencing stakeholders, such as students and local partners involved in education abroad programs. These two approaches are not exclusive, but, on the contrary, the successful transitions toward a sustainable education abroad era requires that both are addressed simultaneously.

Chapters

The chapters in this book were written by a group of international education professionals and researchers from a number of organizations and countries. All authors contribute by providing their unique knowledge about their chosen topic discussing different intersections of sustainability and education abroad. This book is structured as follows: Sustainability in the Curriculum; Sustainability and the Student Perspective; Sustainability in Administration; Sustainability and Program Design; and Travel and Greenhouse Gas Emissions. Many of the authors discuss and explore issues, solutions, and perspectives that cover more than just one of the themes mentioned above.

Sustainability in the Curriculum

Chapter 2 by Tammy Shannon, Ketja Lingenfelter, and Robert Shannon explains how sustainable practices have been built into the Penn State university's study abroad curriculum in Costa Rica. The authors present feedback from alumni, students, and faculty to discuss best practices and how the education abroad experience has impacted students and graduates. In Chapter 3, Linda Beck and Mark Pires examine a faculty-led travel course in Tanzania focused on responsible tourism. This chapter provides an overview of the 2-week experiential learning excursion encouraging students to develop informed understanding of the impact tourism has on the natural environment, livelihoods, and economic development. Chapter 4 by Derek Martin and Molly Roe discusses how institutions can incorporate the U.N. SDGs to short-term faculty-led education abroad programs. The authors provide examples from a faculty-led program "Greek Culture: Ancient and Modern" offered by Susquehanna University.

Sustainability and the Student Perspective

In Chapter 5, Shayle Havemann and Cynthia Arochi-Zendejas share their insights into how virtual programs, when carefully planned, can be used to promote equality in North–South partnerships. Their chapter includes small scale survey and test data from students who have completed a Global Sustainable Development virtual exchange program and the students themselves were based in the Southern and Northern Hemispheres. Chapter 6 is co-authored by Rebecca L Farnum and her students Kahsenniiostha Jacobs, Courtney Jiggetts, Annabel Lassally, and Elias Mittelstadt. This chapter provides an insightful reflection on the value and potential pitfalls of experiential sustainability-focused learning abroad, based on the example of a 10-day field seminar organized in Northern Europe.

Sustainability in Administration

Chapter 7 is based on a case study of University of Auckland in New Zealand. The authors, Ainslie Moore and Brett Berquist, examine how a university's international education office can collaborate to influence and develop a sustainability agenda. They present a number of ways international offices can take sustainability action both within and beyond the university. In Chapter 8, Anne C. Campbell and Thi Nguyen investigate the topic of climate change by analyzing the practices and aspirations of those working in the field of international education. The authors discuss the different types of action international education professionals engage in both their professional and personal lives, and the type of organizational and sector-wide leadership that is called for. In Chapter 9, Julie Ficarra and Melissa Topacio Long challenge some common education abroad practices. The authors discuss the value of using a decolonial lens to analyze education abroad programs based on their learnings from case studies in Costa Rica and in Morocco.

Sustainability and Program Design

Chapter 10 by James M. Lucas, Amy Butler Kennaugh, and Opal Bartiz presents the case study of Michigan State University. The authors discuss the university-level approach to sustainability as well as unit-level structures and the delivery of a specific program. The authors use SDGs to explore these different levels, highlighting the ways in which carefully designed education abroad programs can be valuable learning activities with potential long-term benefits. In Chapter 11, Miguel Karian presents a Sustainable Global Stewardship framework to guide the design and implementation of transformative education abroad. The author presents primary data from education abroad participants in Costa Rica to indicate how the offered learning opportunities can improve student learning and encourage sustainable behaviors.

Travel and Greenhouse Gas Emissions

In Chapter 12, Stephen Robinson, Christina Erickson, and Tony Langan discuss the climate impact of U.S. education abroad. The authors calculate the carbon footprint associated with education abroad-related overseas travel before discussing potential solutions. Chapter 13 further explores education abroad-related emissions. Daniel Greenberg discusses the ways in which these emissions ought to be measured, reduced, and priced. Then, a new carbon tax scheme is discussed, including how it would eliminate some of the challenges related to more commonly used offsetting practices.

Finally, Chapter 14 by the editors explores how, collectively, the chapters in this book fill a clear void by exploring a diversity of issues and solutions pertinent to the intersection of study abroad and sustainability.

Final Thoughts

This volume compiles in-depth knowledge about the intersection of sustainability and education abroad in a book format. Readers are offered valuable insights into different levels, including sector-wide, institutional, program, and curriculum, that they can use to reflect on practices in their own international education contexts. We believe this book will become an important resource for practitioners, researchers, and policymakers and helps the field to transform the way in which we design and conduct our education abroad activities across the globe.

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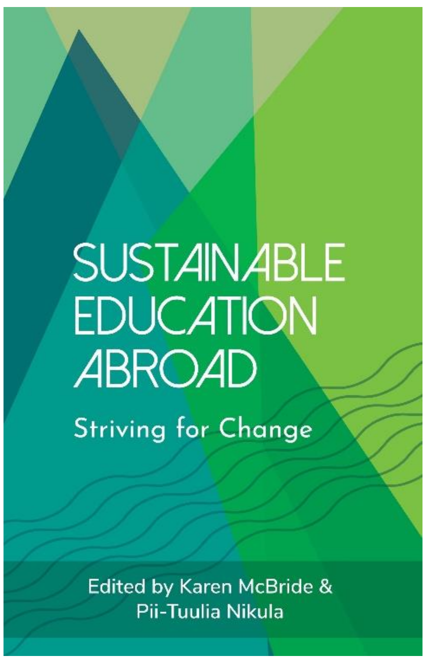

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Carbon Footprints and Carbon Offsetting of U.S. Education Abroad Air Travel

Stephen Robinson, Christina Erickson and Tony Langan

Education Abroad's Climate Impact

US students participated in more than 347,000 study abroad experiences in the 2018–2019 academic year to destinations on all continents, according to the Institute of International Education's Open Doors report (2020). Study abroad is well recognized as a high-impact practice for developing global and intercultural awareness, expanding horizons academically, and, especially in recent years, gaining international professional experience. However, the majority of these experiences require students to fly internationally, a practice known to emit large quantities of carbon dioxide (CO_2) into our atmosphere (Lee *et al.*, 2021) and contribute to anthropogenic climate change. The environmental and climate impacts of study abroad have only relatively recently started to receive significant attention within the education abroad sector (Hale, 2019; Redden, 2019; de Wit and Altbach, 2020). The Forum on Education Abroad recently released a set of guidelines for advancing the United Nations Sustainable Development Goals, including climate action, in an education abroad context (Forum on Education Abroad, 2021).

This chapter presents some estimates of the carbon emissions from U S study abroad air travel in an effort to understand how much carbon is generated by education abroad so that we can establish a baseline against which the field can benchmark itself and to then properly target reduction efforts. It also outlines some strategies that U S students, colleges, and study abroad programs can implement to offset this carbon contribution in an effort to become more sustainable.

Carbon Footprints and Carbon Calculators

A carbon footprint is the measure of the carbon emissions relating to an activity, expressed as a mass of carbon dioxide (CO_2) emitted or as carbon dioxide equivalent (CO_2-eq) if the climate impacts of other greenhouse gas emissions are also included. The activity under consideration could be on various scales, so we can estimate carbon footprints for countries, industries, houses, campuses, events, and even personal carbon footprints based upon our lifestyles and activities. The average person on Earth has a carbon footprint of slightly less than 5 metric tonnes of CO_2 (World Bank, 2019), while the average per capita carbon footprint for the United States is significantly higher than the global average, at approximately 15.5 metric tonnes (Crippa *et al.*, 2020). Air travel is a significant contributor to global CO_2 emissions, accounting for about 2.4% of human-induced global emissions (Graver *et al.*, 2019). According to Shields (2019), global student mobility contributes between 14.0 and 38.5 megatonnes of CO_2-eq per year, depending on model assumptions. Hale (2019) estimated that student exchange travel involving the United States (outbound US students and inbound international students) results in a carbon footprint of 2.5 megatonnes of CO_2 per year.

The estimation of the carbon footprint of study abroad flights can be generally conducted in one of two ways, depending on whether bulk data in passenger kilometers (or miles) or individual flight data using origin, destination, and routing are to be used. Most international education offices would have information on the number of students sent to various destinations, but they often would not know the class of service, route, or connections the student took to get there. In this 'bulk data' situation, the best approximation is often to calculate a sum of passenger distance flown, often assuming a direct flight, and then multiply by a published conversion factor (Table 12.1) to arrive at the total CO_2 emitted as that passenger's share of the flight. These conversion factors are averages taking into account influences such as aircraft types, fuel consumption, average passenger loads, passenger-to-cargo ratios, and average time spent in non-direct flights for situations such as avoiding storms or circling airports (termed 'distance uplift', usually adding 8–10% to flight carbon footprint), but are not specific to any routing, flight distance, or region. However, this type of calculation likely underestimates

Table 12.1 Conversion of passenger distance flown to CO_2 emissions for bulk data air travel calculations. Values used for calculations in this chapter are noted with *

Source	kg CO_2 per passenger kilometer (mile)	Emissions weighting factor owing to high-altitude emissions
United States Environmental Protection Agency	0.099 (0.16)*	–
DEFRA (UK) – short haul – flights UK to Europe	0.083 (0.133)	1.89
DEFRA (UK) – long haul to/from UK	0.102 (0.164)	1.89
DEFRA (UK) – International to/from non-UK	0.095 (0.153)	1.89
Cox and Althaus (2019)	–	1.83 (flights of 2,000 km)
IPCC (2007)	–	2.7
Jungbluth and Meili (2019)	–	2.0 *
Atmosfair (2016)	–	3.0 for a portion of flight >9,000 m altitude

the true carbon footprint as it often assumes direct flights to the end destination. Calculations in this chapter use the US EPA's recommendation of 0.099 kg CO_2 per passenger kilometer (0.16 kg CO_2 per passenger mile) when bulk distance data is used. Other commonly used conversion factors are summarized in Table 12.1.

The carbon footprint for individual flights can easily be estimated using the above method or one of the many calculators available on the internet using origin, destination, connecting airports, and a class of service as inputs. An estimated carbon footprint per passenger for the flight is returned as a result. In contrast to the bulk processing noted above, these carbon calculators most often use data specific to each route, including aircraft types, fuel consumption, cargo-to-passenger ratios, average passenger loads, and average time spent in non-direct flights for situations such as avoiding storms or circling airports. It should also be noted that not all carbon calculators will return the same result owing to a significant number of assumptions that need to be included (Padgett *et al.*, 2008; Guardian, 2008), and all results returned from a calculator should be considered an estimate. It is best to look for a calculator from a well-established organization with robust documentation. Examples of these calculators include those from the International Civil Aviation Organization (ICAO, 2021), myclimate (2019), or Atmosfair (2016). The ICAO calculator does not include radiative forcing factors in its result (see below), while both myclimate and Atmosfair do but use different values and assumptions and thus will give different overall results for the same flight. It should also be noted that many calculators, including myclimate and Atmosfair, tend to return higher carbon footprint results for individual flights than either the bulk processing method or the ICAO calculator, even with radiative forcing factors included. This chapter uses the ICAO calculator and multiplies each flight separately by a radiative forcing factor of 2.0 (see below) when estimating the carbon footprint of individual flights.

Studies (Fromming *et al.*, 2012; Lee *et al.*, 2021) have shown that the combustion of fuel at high altitudes, such as those during international flights, has a greater climate impact than combustion at ground level. This is due to non-CO_2 warming pollutants, such as water vapor, aerosols, and nitrogen oxides, being produced, along with the development of contrails. A multiplying radiative forcing (RF) factor needs to be included in the calculations (Jungbluth and Meili, 2019), which thus results in a measure expressed in CO_2-eq. This multiplying factor is commonly either 1.89 as suggested by DEFRA (UK), 2.7 as suggested by SIMAP based on IPCC (2007), or 3.0 for all flight time at greater than 9,000 m suggested by Atmosfair (2021). Cox and Althaus (2019) showed that the emissions weighting factor varies with flight length, with longer flights with a greater proportion of time spent at cruising altitude having larger factors. They suggest an emissions weighting factor of 1.83 for flights of 2000 km. Jungbluth and Meili (2019), in an analysis of radiative forcing factors in the literature, note that there is currently no scientific consensus but recommend a factor of 2.0. The calculations in this chapter follow Jungbluth and Meili's (2019) recommendation of an RF factor of 2.0.

As mentioned above, there are several methods for estimating the carbon footprint of flights, and each will give a different result. Flight carbon calculators such as myclimate or Atmosfair tend to return higher carbon emission estimates than the bulk data method used extensively in this paper and in Shields (2019) and Hale (2019). Bulk data estimations are used widely in this chapter primarily owing to the type of available data, that is, numbers of students and destinations, without any indication as to the exact routing to the destination, aircraft type, class of service, or typical passenger or cargo loading on the route as incorporated into the calculations of the individual flight calculators. With this in mind, it is believed that the calculations presented in this chapter represent an estimate of the low end of the true carbon footprint of US education abroad flight carbon footprint as a sector. A carbon calculator developed specifically for individual flights, such as myclimate, Atmosfair, or the ICAO calculator, should be used in those cases and will likely return a greater estimated carbon footprint.

Estimating US Study Abroad's Global Flight Carbon Footprint

It is possible to estimate the total carbon footprint of flights owing to US study abroad globally through the use of data from the Institute of International Education's Open Doors report (2020) and the carbon calculations listed above. IIE (2020) data consists simply of the number of US students who studied abroad in a foreign country in a given year and does not include the US departure or destination airports. For the purposes of this carbon footprint estimation, flight distances are calculated based on assuming students departed from St. Louis, the closest international airport to the population center of the United States, and flew on a direct flight to the capital city of the country in which they were studying abroad. The assumption of all students originating from the population center of the United States as a departure city averaging effect does not capture any regional differences in US education abroad that may exist (i.e., students from one US region preferentially studying abroad in a certain destination or region, or study abroad participation rates being higher in particular US regions), or if the students flew out of the location of their institution or of their usual home. Additionally, the assumption that direct flights were available and taken very likely results in an underestimate of the total passenger distance flown.

While more than 347,000 students studied abroad in 2018/19, slightly more than 26,000 of those traveled to multiple countries on the same overseas trip, the location of which is not included in the Open Doors data. Thus, we calculate the total study abroad passenger miles as the known country destination of 321,025 students using the methodology above and consider the remaining 26,074 students as having traveled the weighted average distance of those with known destinations.

Using this approach, it is estimated that the 347,099 U.S. study abroad students flew a combined 5.57 billion kilometers, round trip, for their study abroad experience, or an average of 16,043 kilometers per student (Table 12.2). Using conversions of 0.099 kg CO_2 per passenger kilometer and a high-altitude combustion radiative forcing factor of 2.0, this results in an estimated total of 1,102,535 metric tonnes of CO_2-eq (or 1.103 megatonnes) emissions for U.S. study abroad traveling to and from their abroad destination for the 2018–19 academic year. The estimated carbon footprint per student is 3.176 metric tonnes of CO_2-eq. Again, based on the bulk data calculation method being used, it is believed that these values represent an estimate on the low end of the true estimated flight carbon footprint for the sector, and if calculators for individual flights were used, the estimates would be greater.

Table 12.2 The estimated carbon footprint of U.S. study abroad by region. Data for student numbers from the Institute of International Education's Open Doors report (2020) for the 2018–19 academic year. Travel distance is calculated assuming all student flights originate in St. Louis, the closest international airport to the population center of the United States, flying direct to the capital city of their destination country. Conversions to the estimated carbon footprint use conversions of 0.099 kg CO_2 per passenger km and a high-altitude radiative forcing multiplier of 2.0. See text for further details.

Destination region	Number of students (2018–19)	Estimated total round trip km flown	Estimated carbon footprint (metric tonnes CO_2-eq including RF = 2.0)	Estimated carbon footprint (megatonnes CO_2-eq including RF = 2.0)
Europe	193,422	2,850,755,824	564,450	0.564
Asia	40,602	948,271,337	187,758	0.188
Oceania, incl. Antarctica	15,520	438,630,139	86,849	0.087
Africa	15,495	372,849,963	73,824	0.074
South America	18,300	243,845,636	48,281	0.048
North America, Central American and Caribbean	31,761	168,707,083	33,404	0.033
Middle East	5,925	127,018,463	25,150	0.025
Multi-destination	26,074	418,279,108	82,819	0.083
TOTALS	**347,099**	**5,568,357,554**	**1,102,535**	**1.103**
Average per student		**16,043**	**3.176**	

Table 12.3 shows the estimated study abroad flight carbon footprints for the 10 most popular U.S. study abroad global destinations. While the United Kingdom hosts the most students, the carbon footprint of study abroad flights is the greatest for Italy owing to the greater distances flown to and from the study abroad site.

Students studying abroad often find themselves living in a country in which the per capita CO_2 emissions are lower than those of the average American, whose emissions amount to 15.5 metric tonnes per capita (Crippa *et al.*, 2020), although the usual lifestyle of U.S. students may be lower than that of the average American. It then stands to reason that a student living the same carbon lifestyle as a local resident while on their study abroad experience could theoretically offset the carbon cost of their flight after a certain time period. Calculations presented in Table 12.3 indicate that a student living the consumption lifestyle of the average Costa Rican would offset their flight carbon emissions after 34 days in the country, living like a local. Students studying abroad in most European destinations could have offset their flight carbon emissions in about the span of one semester, and students

Table 12.3 Total estimated flight carbon footprint of U.S. study abroad to the top 10 global destinations. Per capita production-based emissions from Crippa *et al.* (2020) are used to estimate the number of days 'living like a local' required to offset the carbon footprint of flights to and from the study abroad destination.

Top 10 study abroad destinations	Study abroad students 2018–19	Estimated round trip distance (km)	Estimated total carbon footprint of study abroad flights (metric tonnes CO_2-eq)	Per capita CO_2 emissions using production-based accounting methods (metric tonnes)*	Estimated number of days in the country required to offset student flight when following a local lifestyle
United Kingdom	39,358	13,580	105,827	5.45	97
Italy	39,043	16,351	126,402	5.60	119
Spain	33,849	14,252	95,518	5.58	104
France	18,465	14,156	51,755	4.81	96
Germany	12,029	15,067	35,886	8.52	156
Ireland	11,777	12,620	29,428	7.54	114
China	11,639	21,713	50,038	8.12	212
Australia	10,665	29,609	62,524	17.27	–
Japan	8,928	20,603	36,421	9.10	232
Costa Rica	8,333	6,489	10,706	1.80	34

* production-based carbon emission accounting includes in-country generated emissions only and ignores the production of goods elsewhere for subsequent importation (Franzen and Mader, 2018). For countries that rely heavily on imports, such as Ireland in this listing, this method results in an underestimation of carbon emissions per capita for that country compared to consumption-based carbon accounting.

studying abroad in Australia cannot offset in this manner as the per capita emissions are greater (17.27 metric tonnes) than those of the United States.

This analysis in no way suggests that flight carbon emissions should be considered as offsets using this method, partially because for many locations, it may be rare for a student to fully adopt a local lifestyle but is simply pointing out that life in many study abroad destinations is of lower carbon intensity, and the promotion of 'living like a local' can often have a significant impact. This may include being housed in homestays, using public transportation or walking, shopping for locally-sourced products, and limiting airline travel during academic breaks. This type of calculation also highlights that longer-term study abroad programmes (e.g., semester length) can be considered to have a lower carbon footprint compared to shorter-term programmes, as long as students are living a carbon lifestyle while on site that is lower than their footprint in the United States. Some authors have even called for universities and funding agencies to drastically reduce student mobility on short-term programmes (de Wit and Altbach, 2020) owing to their carbon impact.

Independent Student Travel While On-Site

Students most often study abroad in a set location but often use that location as a hub for travel at weekends and over academic break periods independent of the program. Off-program independent travel is common on European study abroad programs, where inexpensive flights can often be found.

In a survey conducted by the authors in April 2021, 23 European study abroad Resident Directors reported with fairly high confidence that students averaged 5.6 round trip flights within Europe (range: 1–12) during their semester abroad. Response data either came from travel details filed by students for emergency response reasons or from estimates based on years of experience running abroad programs. Most commonly, students traveled by flight outside of the country of their program, with the most popular destinations being London, Barcelona, Paris, Dublin, and Rome. Students abroad for periods less than a semester were estimated to take 1.7 additional round trip flights within Europe independent of their program (range: 0–4). These European study abroad leaders also reported an estimate that, on average, 26% of overnight non-program trips taken by students were by more environmentally friendly travel methods, such as train or bus. Some students may also arrive early in the host region, or stay after the program ends, in order to travel. This type of pre- and post-program travel remains unaccounted for in any estimates.

While these data only represent estimates from program leaders and not directly from the students themselves, it is apparent that there is a significant carbon footprint associated with independent travel while on a study abroad program, at least in the European context.

A student taking 5 independent trips from Madrid, a popular study abroad host city, to each of the five most popular independent destinations listed above, would accumulate a carbon footprint of 2,257 kg CO_2-eq for those trips (using ICAO's calculator and an RF factor of 2.0), significantly greater than the carbon footprint of the round-trip flight from St. Louis to Madrid, via Chicago, of 1,757 kg CO_2-eq, to actually be on the program.

This suggests that the carbon footprint of student independent travel while on a semester program may be at least equal to, and likely greater than that of the flights taken to attend the program, at least in the case of European study abroad. It should be noted that only about 35% of U.S. study abroad students spend a semester or more abroad (Open Doors, 2020), with the remainder participating in shorter programs where there may be a decreased opportunity for independent travel.

Study Abroad Carbon Footprints as a Proportion of the Whole-Campus Carbon Footprint

Many U.S. campuses estimate the carbon footprint of their physical campus and their activities, and in some cases, this reporting includes student study abroad travel. Campus carbon emissions calculation and reporting follow a standard that is broken down into emission sources, or Scopes. Scope 1 covers direct emissions from owned or controlled sources, and Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating, and cooling consumed by the institution. Scope 3 includes all other indirect emissions that occur outside of a campus's immediately controlled operations and, where reported, includes carbon associated with university-sponsored study abroad. Most institutions restrict air travel reporting to directly financed air travel, and some, but certainly not all, also include study abroad air travel as a category under Scope 3 reporting. It is thought that Scope 3 carbon is underreported by many institutions.

Using institution-reported data in the University of New Hampshire's Sustainability Indicator Management and Analysis Platform (SIMAP) database, Table 12.4 shows the percent of overall campus operations carbon footprint that is attributed to study abroad travel from 113 doctoral, masters, baccalaureate, and associate and tribal college institutions in the United States that report study abroad flight information.

The median estimated footprint of study abroad flight carbon is greatest for doctoral institutions, yet this footprint represents a lower percentage of the overall campus carbon footprint than for master's or baccalaureate institutions. Study abroad flight carbon estimates are significantly lower for associates and tribal college institutions. Study abroad flight carbon contributes a median of 855.5 metric tonnes of CO_2-eq per institution and represents a median of 3.1% of the overall campus carbon footprint for the 113 institutions.

Converting Study Abroad Carbon Footprints to More Meaningful Measures

Presenting carbon footprint data in terms of CO_2-eq is very useful in an accounting sense, but many people will struggle with conceptualizing this relatively abstract number in terms of real-world impacts.

The U.S. Environmental Protection Agency (2021a) provides a calculator intended to convert carbon dioxide equivalent emissions into more easily understood, concrete terms. Table 12.5 provides a sampling of results from this calculator.

Table 12.4 The median and range of institutional study abroad carbon footprints and percentage of the total campus carbon footprint attributed to study abroad flights based on Carnegie classification for 113 U.S. institutions. Several institutions with strong study abroad participation are found in each classification dataset and skew the data. For this reason, median data is presented. Data was reported from 2016 to 2019 to the Sustainability Indicator Management and Analysis Platform (SIMAP) database by the University of New Hampshire and is used here with permission. The most recently reported year for each institution was used in the calculations. Any data reported for 2020 was not used owing to the significant decline in study abroad air travel due to COVID-19. Note that while original SIMAP data used a radiative forcing (RF) factor of 2.7, this data has been converted to use a RF of 2.0 for use in this chapter.

Institution type	Institutional study abroad flight carbon footprint in metric tonnes CO_2-eq; median (range)	Study abroad carbon footprint as percent of total campus carbon footprint; median (range)
Associates and Tribal Colleges (n=11)	28.7 (2.0–580.8)	0.12% (0.01–1.1%)
Baccalaureate (n=38)	546.3 (1.4–6,530.1)	3.6% (0.01–14.9%)
Master's (n=30)	1,163.0 (2.5–3,007.6)	3.6% (0.1–15.9%)
Doctoral (n=34)	2,392.1 (27.6–9,700.2)	2.4% (0.05–13.8%)
All Institutions (n=113)	855.5 (1.4–9,700.2)	3.1% (0.01–15.9%)

Table 12.5 Carbon footprint conversions to other measures using the carbon equivalencies calculator from the U.S. EPA (2021a). Conversions are from the footprints of (a) the estimated average study abroad student flight carbon footprint to and from the abroad site (Table 12.2), (b) the estimated median study abroad flight carbon footprint of a sample of 113 U.S. institutions (Table 12.4), and (c) the total estimated carbon footprint of U.S. study abroad flights during the 2018–19 academic year (Table 12.2).

Conversion to:	a) 3.176 metric tonnes CO_2-eq	b) 855.5 metric tonnes CO_2-eq	c) 1,102,535 metric tonnes CO_2-eq
Greenhouse gas emissions from this number of passenger vehicles driven for one year.	0.69	186	239,779
CO_2 emissions from this number of homes energy consumption for one year	0.38	103	132,771
Greenhouse gas emissions avoided by this number of incandescent lamps switched to LEDs	120	32,424	41,787,155
Greenhouse gas emissions avoided by this number of wind turbines operating for one year	0.0007	0.178	229
Carbon sequestered by this number of tree seedlings grown for 10 years	52.5	14,146	18,230,633
Carbon sequestered by this number of acres of US forests preserved from conversion to cropland in one year	0.022	5.8	7,538

Carbon Offsetting of Study Abroad Flights

The presented data shows that air travel for study abroad has a significant carbon footprint and is a large contributor to anthropogenic climate change. We are not suggesting study abroad be stopped or significantly scaled back, yet the environmental impact of the sector has been recently called into question (Hale, 2019; Redden, 2019). If we are to consider the majority of study abroad travel worthwhile in terms of the educational, cultural, and social development of students, then the sectors, including students, programs, and institutions, need to take steps to minimize or even neutralize its environmental and climate impact.

Carbon offsets are actions that attempt to neutralize carbon emissions by supporting projects or actions that reduce or sequester emissions. The carbon footprint can be estimated using the techniques shown in this paper, but calculating our carbon reduction through offset measures is much trickier. There are many ways in which we can offset carbon emissions, but in many cases, the accounting for carbon in the offset process is much more vague and inexact.

Many airlines provide optional opportunities to offset the carbon produced, often in partnership with external organizations, with costs added to the price of the flight ticket. For example, American Airlines partners with Cool Effect (2021) to support projects including forest preservation and regeneration in Mexico, peatland restoration in Indonesia, and funding fuel-efficient cookstoves for families in Honduras. Cool Effect (2021) indicates that the cost of offsetting flights is $10.64 per metric tonne in October 2021. This suggests the average study abroad student, emitting 3.176 metric tonnes for their flights, could offset the carbon impact by donating slightly less than $34. The sector as a whole could offset all of the flights to and from study abroad sites for about $11.7 million. Note that other offset providers may value the cost of carbon offsetting differently, and often higher, with the price depending on the type of carbon offset project, the carbon standard under which it was developed, the location of the offset, and the co-benefits associated with the project.

The concept of the 'social cost of carbon' includes the economic harm associated with the impacts of climate change, expressed as the value of total future damage caused by the emission of one metric tonne of carbon. The current social cost of carbon is approximately $51 per metric tonne under the Biden administration (Chemnick, 2021; National Law Review, 2021). Using this value, the social cost of carbon emissions attributed to each student could reach over $160, and for the sector as a whole, it would approach $56.5 million.

Carbon offsetting organizations pool funds to sponsor projects, often working directly with communities to plant trees, preserve forests, lessen dependence on carbon-intensive fuels, and invest in clean energy. Gold Standard (2021) is an organization established by the WWF and other international NGOs to ensure environmental integrity and contributions to the sustainable development of offset programs.

Some study abroad providers are already working to offset the carbon footprint of their students' flights. U.K.-based FIE has been working with Climate Care for several years to offset all staff flights, and all student flights from the U.S. to their centers in London and Dublin. This initiative came directly from FIE's senior leadership and, in the past few years, has resulted in the offsetting of about 1,500 flights at an average cost of approximately $10 per return flight (M. Blakemore, personal communication, 2021). Student reaction to this initiative has been very positive.

Similarly, The Asia Institute has sponsored the planting of almost 4,000 trees in Asia through the Million Tree Project and Trees for All to partially offset the student travel carbon footprint (B. Fueling, personal communication, 2021).

On-Site Program Options for Offsetting Carbon

There is great potential for students and programs to take a more proactive role in reducing carbon footprints, as opposed to paying someone else to take care of it for them. Students directly involved in the offsetting process, when coupled with clearly defined learning outcomes, are likely to develop a more meaningful commitment to future sustainable choices. Abroad programs stand to play a major role in educating students of their carbon footprint and environmental impact and facilitating activities to help offset this carbon.

Tree Planting

Tree planting is a commonly used method of offsetting carbon. The exact number of trees needed to be planted to offset a flight is a challenge to calculate, as the amount of carbon sequestered depends on species, climate, soils, the likelihood of survival, and time period for growth. So, the question of 'how many trees do I have to plant' does not have an easy answer. Using the U.S. EPA equivalencies calculator and data in Table 12.5, it is estimated that the average students' study abroad flights could be offset by the growth over 10 years of 53 planted tree saplings. It should be noted that tree planting has significant long-term carbon storage benefits but a much reduced short-term benefit during the early growth stages. In many countries, there are environmental organizations that will work with groups to facilitate local tree plantings, such as Hometree (2021) and Crann (2021) in Ireland and Reforest'Action (2021) in France.

Wetland Restoration

Wetlands, especially peatlands with thick stores of organic material, store far more carbon per area than forests. In many countries, wetlands and peatlands have been degraded through drainage, peat extraction, or conversion to agricultural land. As the environmental benefits of wetland preservation and restoration have become more widely known, many countries have established programs to preserve existing wetlands and restore those whose environmental functions have been degraded. Activities suitable for student involvement include blocking drainage channels (raising the water level and promoting carbon storage), replanting wetland species, and monitoring projects. Again, it is difficult to calculate or estimate the carbon offset impact on a per student basis in wetland restoration projects.

Other Program Energy Reductions

Study abroad programs can also contribute to lowering the carbon footprint of study abroad through various measures. These include switching to renewable energy suppliers, reducing energy usage, avoiding non-essential flights, reducing waste, promoting recycling and reusing, using local suppliers with sustainability credentials, and providing resources on sustainability to students, housing providers, and host families. Carbon offsets or savings are difficult to quantify except in the case of measured reductions in energy usage and the use of renewable resources.

Educating Students and Promoting Less Carbon-Intensive Lifestyle Options

Educating students and involving them in lifestyle activities related to reducing their carbon and environmental footprints should be embedded within study abroad programs (Hale, 2019) (Table 12.6). One way to do this effectively is to have students conduct a carbon footprint of their U.S. lifestyle and contrast it with a footprint of their time studying abroad, with the aim of highlighting where carbon savings can be made or are being made while living abroad. Several personal carbon footprint calculators exist for this purpose, including those from the U.S. EPA (2021b), the University of California at Berkeley's Cool Climate Network (2021a), and the University

Table 12.6 Lifestyle actions that students can take in order to lessen their environmental and carbon impact while studying abroad.

Activity	Environmental impacts
Promoting reduced meat, meat-free, vegetarian, and vegan diets	Beef and pork have significantly higher carbon cost per serving than poultry or fish. Fully vegetarian or vegan diets have significantly lower carbon footprints than non-vegetarian diets
Consuming locally-sourced foods	Reduces carbon emissions from the transportation of food supplies while supporting local businesses.
Walking, cycling, and using public transportation	Avoids or reduces carbon emissions from travel while promoting exercise.
Shorter and colder showers	Promotes lower water heating and consumption demand.
Washing clothes in cold water	Reduces water heating energy consumption
Lower the thermostat and reduce air conditioning use in student housing	Reduces energy consumption
Participate in sustainable events, such as community clean-ups, recycling efforts, and composting.	Onsetting activities that may not have a carbon equivalency, but promote more environmentally sustainable communities, lifestyles and behaviours.
Using more environmentally-responsible modes of travel	Train and bus travel, particularly electric or hybrid vehicles, have lower carbon footprints than air travel, and should be promoted where feasible. Direct flights have lower carbon footprints than the same destination with connecting flights.

of Washington's International Student Carbon Footprint Challenge (2021). Many of these personal actions have a much more immediate impact on carbon footprints than the longer-term impacts of tree planting and wetland restoration. Embedding a culture of sustainability in a study abroad program will hopefully inspire students to continue with these measures upon their return home.

Carbon Onsetting

Carbon onsetting refers to the recognition that fossil fuel consumption has positive aspects, such as facilitating educational travel, but we cannot always offset the exact amount of carbon to account for our actions, nor should we limit our actions solely to exact offsetting. Instead, we can fund and support meaningful projects, at home and abroad, that encourage sustainable lifestyles and communities, without the need for accounting for an exact carbon equivalence. Examples of carbon onsetting projects relevant to study abroad include community clean-ups, the development of community organic food production, the preservation of at-risk lands, and projects related to the more sustainable use of resources. As an example, Pacific Lutheran University and its students work with Earth Deeds to reduce study abroad flight impacts through investment in sustainable projects both on campus and abroad (Greenberg and Fang, 2015).

Study Abroad and Sustainable Education for Students

Study abroad, while widely recognized as a valuable academic, cultural, and developmental activity for students, also represents a unique opportunity for educating students on their carbon footprint and sustainable actions in general and challenging them to take action. All study abroad programs hold orientation sessions, at which sustainability and carbon footprints should be discussed, along with options for carbon offsetting and onsetting. Collaboration between international offices and campus sustainability offices could be used to develop programs for students to learn more about study abroad, lifestyle carbon impacts, and options for reducing their footprints. Study abroad programs on-site also hold a significant amount of oversight and regular contact with their student groups, providing a perfect opportunity for promoting sustainability and reduced carbon lifestyles.

Study abroad can be an opportunity not just for intercultural learning but also for environmental learning and the development of eco-learning skill sets that can have long-lasting impacts on a students' environmental behavior. Lessons and best practices learned abroad can hopefully be brought back home for continued commitments to environmental and climate action. Instead of viewing study abroad travel as a negative, we have an opportunity to use the experience as one to teach environmental and sustainability issues for more than just the time abroad but to also instill the principles of lifelong change.

Conclusions

U.S. study abroad is a carbon-intensive endeavor as overseas travel by airplane is often required for participation. Estimates from this chapter indicate that U.S. students travel more than 5.5 billion kilometers annually just to and from their study abroad site. This is estimated to represent a total carbon footprint of over 1.1 megatonnes of CO_2-eq from the more than 347,000 students who studied abroad in the 2018–19 academic year, or an average of 3.176 metric tonnes of CO_2-eq per student. These estimates do not include any additional flights students may take while on the program, which, at least in Europe, are thought to be a significant addition to the overall student carbon footprint during study abroad. At the institutional level, study abroad flight carbon is estimated to account for a median of 3.1% of a U.S. institution's whole-campus carbon footprint. This is based on the bulk data of the low end of the true carbon footprint of study abroad flights.

Students often study abroad in countries with lower per capita carbon emissions than the U.S., and thus being in-country for a period of time and living a local lifestyle can serve to offset some of the carbon emitted during travel. However, best practice suggests that it would be unwise for students, institutions, and programs to rely on such an 'offset' and that other measures should be employed to provide offsets to lessen the environmental impact of study abroad flight carbon emissions. Carbon offsetting and onsetting options include tree planting, wetland restoration, lifestyle adjustments including food consumption and travel habits, and the funding of projects intended to compensate for the carbon emissions and promote sustainable lifestyles. The study abroad experience represents an ideal opportunity for instilling sustainability education, the development of eco-learning skill sets, reduced carbon lifestyles, and environmental action within students.

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