Recommendations for Stanford's Air Travel Fee Pilot Program

Scope 3 Student Working Group

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Introduction

In accordance with the Paris Agreement's warming limit of 1.5°C above pre-industrial levels, individual countries, cities, and corporations have set ambitious climate goals of reaching carbon neutrality. Within businesses and institutions, greenhouse gas accounting has been a growing area of interest. As private entities and other organizations begin to decarbonize operations and adopt climate-friendly strategies, rigorous standards of emissions assessments, methodology, and reduction pathways can accelerate the path towards carbon neutrality. At the institutional level, greenhouse gas emissions are divided into three types: Scope 1, 2, and 3. Scope 1 emissions are direct GHG emissions from owned or controlled sources of fuel combustion and transportation.[1] Scope 2 emissions are indirect emissions from "the generation of purchased electricity, steam, heating and cooling consumed by the reporting company."[2] Scope 3 emissions are the broadest set of activities that include all other indirect emissions embedded in the supply chain. Another way of thinking about Scope 3 emissions is to view them as the Scope 1 and 2 emissions of other sources that are encapsulated in supply chain activities. Throughout the full life cycle, Scope 3 emissions often account for the largest portion of the total CO_2 emissions yet are the hardest to measure and mitigate. Within Scope 3 emissions, there are 15 categories such as purchased goods and services, transportation and distribution, waste production, investments and capital projects, and use of sold goods. Scope 3 emissions are often overlooked due to missing best practices in data collection and quality, but further development of tracking methods will ensure all entities will be able to gain a full image of their emissions.

Sustainability is folded into Stanford's mission and long-range vision through its efforts for a new school around climate, decarbonization research, and high environmental standards on its campus. In June 2020, Stanford's Board of Trustees announced its goal to be net-zero by 2050, with special attention towards its Scope 3 emissions.[3] As a result, the Scope 3 Emissions Program formed in 2021 with the support of the Vice President of Business Affairs.[4] The university has already taken strides towards neutralizing its Scope 1 and 2 emissions through its on-campus energy generating facility (Stanford Energy System Innovations) and off-campus purchases of solar energy plants. Stanford's latest goal has been to address Scope 3 emissions–an uncharted territory for higher education institutions–that will require major steps in the university's tracking and mitigation strategies. Of the 15 Scope 3 categories, only 10 apply to higher education and the Scope 3 Emissions Program is currently working on quantifying those

[1] *Technical Guidance for Calculating Scope 3 Emissions*. Greenhouse Gas Protocol. (n.d.). Retrieved November 3, 2021, from https://ghgprotocol.org/sites/default/files/standards/Scope3_Calculation_Guidance_0.pdf.
[2] *Technical Guidance for Calculating Scope 3 Emissions*. Greenhouse Gas Protocol.
[3] Stanford University. (2020, June 12). *Board of Trustees commits to accelerating transition to net-zero greenhouse gas emissions, reports major reduction in fossil fuel investments*. Stanford News. Retrieved December 7, 2021, from https://news.stanford.edu/2020/06/12/trustees-commit-accelerating-transition-to-net-zero-greenhouse-gas-emissions/.
[4] Zbella, M. (2021). *Scope 3 Emissions from Business Travel.* Stanford University.

emissions. From the six most well-documented categories (business travel, student travel, employee commuting, waste, fuel and energy activities, and food), Scope 3 Emissions account for 76% of Stanford's total carbon footprint.[5]

Other than embodied carbon in purchased goods and building materials, travel is the highest contributor of Stanford's Scope 3 emissions. The business travel category–defined as university-sponsored lodging, ground transportation, and air travel for students, faculty, and visitors–constitutes an estimated 17% of Stanford's total calculated emissions and 22% of its currently quantified Scope 3 emissions. Based on a recent study conducted by the Office of Sustainability, "Stanford students, faculty, and staff emitted approximately 66,486 metric tons of CO2 from air travel in 2019, which is equivalent to the total annual energy use of 7,672 homes or of 6,531,041 gallons of gasoline consumed."[6] In 2019, Stanford sponsored 49,826 flights that amounted to 112,120,534 miles flown and $15,240,286 in expenditures.[7] The vast majority (92%) of business travel emissions are attributed to air travel, indicating the potential of significant emissions reductions.[8] This report summarizes research conducted on the best ways to achieve potential reductions in this category based on academic literature and experiences at other higher education institutions.

The following whitepaper is divided into several sections. First, we conduct a literature review on the various approaches to incentivize environmental behavior change and reduce air travel through levers such as financial penalties, education, and administrative policy. Next, we propose arguments in support of an internal carbon price at Stanford and analyze key lessons from other case studies at higher education institutions. Lastly, we consider estimates for an air travel fee aligned with economic literature on the Social Cost of Carbon and provide recommendations for the implementation process. In order to achieve Stanford's net zero goal and push the envelope towards a carbon neutral world, Stanford has the opportunity to be a leader and learning laboratory by adopting an internal carbon price and launching educational campaigns.

Environmental Behavior Change

What mechanisms influence consumer behavior to be more environmentally-conscious and friendly?

[5] Zbella, M. (2021).
[6] Bauer, A., & Jaszewski, T. (2020). *Addressing Stanford's Air Travel Carbon Footprint: Policy Background and Recommendations for Action.* Stanford University.
[7] Zbella, M. (2021).
[8] Zbella, M. (2021).

Financial Incentives

Setting effective carbon prices that change behavior is a challenging endeavor. Implementing carbon fees that are too low will likely cause little substantive change. During an Australian carbon pricing policy which lasted from 2012 to 2014, a carbon fee of about 16.35-20 USD per tonne of CO_2 was levied to determine the impact of such a policy on domestic aviation.[9] Unfortunately, the low price range had little effect, which suggests that higher fees and more coercive actions are necessary.[10] In another study, researchers determined that frequent domestic travelers may feel more responsible for their climate impact than those who take intercontinental flights.[11] Together, these studies may lend some support for higher IPCC carbon pricing suggestions. Namely, a 2018 IPCC report examined a wide range of models and scenarios to determine appropriate carbon mitigation costs. The IPCC concluded that a price per tonne of CO_2 ranging from 175.65 to 7,871.75 USD is appropriate to remain on a pathway that keeps warming below 1.5°C.[12] In addition, if the fees collected from this policy are put towards popular initiatives or alleviating equity concerns, a proposed carbon fee may receive more support.[13]

However, the potential negative impacts of large carbon fees must also be considered. For example, if a carbon price on air travel were to be implemented at Stanford, there could be backlash. First, it's unclear whether a higher carbon fee will disproportionately harm departments with less funding. In addition, to ensure carbon emissions continue to wane, increasing this fee over time would likely be necessary, as suggested by the findings of a Climate Leadership Council report.[14] As such, increasing a fee could irritate Stanford affiliates and create movements against the policy. Finally, large carbon fees would severely impact affiliates who are the most travel-dependent, which may lead to backlash. Thus, there are both advantages and disadvantages of financial penalties (see *Table 1* in the Appendix).

A movement to societally normalize carbon pricing, however, can blunt negative responses. Namely, when examining the behavioral aspect of carbon pricing, studies illustrate that subjective norms formed through social pressure facilitate the adoption of carbon pricing. In other words, if a person's friends, family, and coworkers are supportive of carbon pricing, that

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[9] Markham, F., Young, M., Reis, A., & Higham, J. (2018). Does carbon pricing reduce air travel? Evidence from the Australian 'Clean Energy Future' policy, July 2012 to June 2014. *Journal of Transport Geography*, 70, 206-214. https://doi.org/10.1016/j.jtrangeo.2018.06.008

[10] Markham et al. (2018).

[11] Choi, A. S., Gössling, S., & Ritchie, B. W. (2018). Flying with climate liability? Economic valuation of voluntary carbon offsets using forced choices. *Transportation Research Part D: Transport and Environment*, 62, 225-235. https://doi.org/10.1016/j.trd.2018.02.018

[12] Rogelj, J., Shindell, D., Jiang, K., Fifita, S., Forster, P., Ginzburg, V., Handa, C., Kheshgi, H., Kobayashi, S. Kriegler, E., Mundaca, L., Séférian, R., Vilariño, M. V., Calvin, K., Correia de Oliveira de Portugal Pereira, J., Edelenbosch O., Emmerling, J., Fuss, S., Gasser, T.,... Zickfeld, K. (2018). *Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development*. The Intergovernmental Panel on Climate Change is an intergovernmental body of the United Nations. Retrieved from https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_Chapter2_Low_Res.pdf

[13] Shultz, G. P. & Halstead, T. (2018). *THE DIVIDEND ADVANTAGE*. Climate Leadership Council. Retrieved from https://clcouncil.org/media/The-Dividend-Advantage.pdf

[14] Shultz, G. P. & Halstead, T. (2018).

person is cognitively pressured to participate as well. The effect of societal acceptance was illustrated by China's 2021 voluntary carbon offset adoption program. In this study, researchers originated "the theory of planned behavior" method, during which participants' attitude towards, ability to perform, and social pressure regarding a specific behavior was recorded.[15] Moreover, the study indicated that subjects were willing to pay roughly 61.2 USD per year (0.5% of their annual income) to offset carbon emissions.[16] The results affirm that subjective norms had the most influence on individual consumers when the willingness to offset was brought up. Thus, institutions can look to promote social pressure and influential knowledge as a system to adopt wide spread carbon pricing and to change behavior.

Education and Social Norming

While financial incentives are useful, they aren't enough. Research has shown that social norms are the main driver of behavior change, and behavior change as a whole can reduce emissions by at least 5-10%.[17] Thus, behavioral alterations facilitated by policies and logistics–social norms, in other words–are more influential in reducing Scope 3 emissions than a carbon price alone.

Social norms, or second-order normative beliefs, are actions, culture, and behaviors that are considered normal in a society or one's perceptions about what is commonly believed.[18] Changing a person's second-order normative belief about "the right thing to do" can spur behavior change. In our case of air travel, the social norm is to fly to and attend in-person conferences, wherever they may be. To reduce air travel and its respective Scope 3 carbon emissions, the perception of the social norm should be altered towards a norm that promotes land travel or no travel at all to conferences. Social norms can be modified by distributing monthly carbon emission reports, creating educational campaigns, and promoting hybrid conferences.

Second-order normative beliefs can be influenced by providing comparisons between the recipient and those around them about a behavior such as energy usage. In their study, Jachimowicz et al. (2018) presented participants with reports that told them their energy usage was higher than others and that a low or a high percentile of people in their country care about energy conservation.[19] They found that participants with the high percentile were more willing to decrease their energy consumption. Though not all other studies they found had the same effectiveness, altering second-order normative beliefs, especially the social norms of a person's

[15] Tao et al. (2021). *Using an extended theory of planned behaviour to explain willingness towards voluntary carbon offsetting among Chinese consumers.* Retrieved from https://www.sciencedirect.com/science/article/pii/S0921800921001269?via%3Dihub
[16] Tao et al. (2021).
[17] Fernbank, D. (2021). *University of Reading Net Zero Carbon Plan*. University of Reading. https://sites.reading.ac.uk/wp-content/uploads/sites/15/2021/06/University-of-Reading-Net-Zero-Carbon-Plan.pdf
[18] Jachimowicz, J. M., Hauser, O. P., O'Brien, J. D., Sherman, E., & Galinsky, A. D. (2018). The critical role of second-order normative beliefs in predicting energy conservation. *Nature Human Behavior, 2.* https://doi.org/10.1038/s41562-018-0434-0
[19] Jachimowicz et al. (2018).

community, can prompt behavior change. Applied to Stanford air travel, social norms can be influenced through monthly reports providing each department with air travel carbon emissions and a comparison to other departments with lower carbon emissions, similar to consumer energy consumption reports. Beyond these reports, educational campaigns can also provide information to alter social norms to change behavior.

Promoting hybrid conferences can also reduce the need to travel. The most effective conference model that balances reducing carbon emissions and the benefits of an in-person conference are multi-site conferences.[20] This model includes one main site, or hub, with many spread-out smaller sites, or nodes, that are connected online.[21] Multi-site conferences connected online with a land transport requirement for closer attendees decreases carbon emissions up to 82%, while increasing attendance.[22] However, some issues that arise with virtual meetings must be addressed like networking challenges, technical difficulties, and time zone differences, which can decrease attendance.[23] Overall, the goal of promoting hybrid conferencing would be to normalize hybrid conferencing as a social norm, even outside of the pandemic. Hybrid conferences will remove and reduce the need to travel long distances for conferences through air travel, and provide the option for land transportation or staying at home or in the office.

Air travel behavior can be changed by altering the perception of social norms through monthly carbon emission reports and by encouraging hybrid conferences. These strategies (*see Appendix Table 2*) can be partnered with carbon pricing to improve its effectiveness.

Administrative Policy

Beyond educating people through comparison reports or encouraging hybrid conferences, administrative policies can be used to effectively change social norms. One helpful framework is University of Oxford's "travel hierarchy" in *Figure 1*: avoid travel, reduce travel, travel without flying, and if absolutely necessary, travel by flying.[24] Avoiding travel is mostly done through virtual conferences, which are an effective method of reducing emissions. To reduce travel, Oxford suggests combining multiple events into one trip, such as giving a talk and spending time as a visiting professor, or even taking a vacation during the same trip. Reducing group size can also help.[25]

[20] van Ewijk, S, Hoekman, P. Emission reduction potentials for academic conference travel. *J Ind Ecol*. 2021; 25: 778– 788. https://doi.org/10.1111/jiec.13079
[21] Fraser, H., Soanes, K., Jones, S. A., Jones, C. S., & Malishev, M. (2017). The value of virtual conferencing for ecology and conservation. *Conservation Biology*, *31*(3), 540–546. https://doi.org/10.1111/cobi.12837
[22] van Ewijk, S., & Hoekman, P. (2020).
[23] van Ewijk, S., & Hoekman, P. (2020).
[24] University of Oxford. (2020). *Guide to Sustainable Business Travel*. https://travel.web.ox.ac.uk/files/business-travel-toolkit-2020.pdf
[25] University of Oxford. (2020). *Guide to Sustainable Business Travel*.

When travel is necessary, community members should use trains, public transportation, cars, or other non-flight vehicles. Jocelyn Timperley suggests deranking flights as the default option in travel booking systems, requiring additional permission in the system for flights, and granting extra time and funds for modes like long-distance rail travel.[26] These strategies break habits and disincentivize flying. Janisch et al. in their 2017 study further suggest regulating the use of public transportation (or cars instead of planes) for certain routes or distances.[27] A public transportation policy can be easily implemented in Stanford's booking system, which already has a mileage cutoff to be more economical in travel. There are various calculators that can help determine the appropriate cut-off, although factors like number of passengers and car model can complicate the results.[28]

Finally, if one must fly, requiring economy and nonstop direct flights (which Stanford already does for monetary reasons) will reduce emissions, as will choosing more efficient airlines.[29] The Atmosfair Airline Index has comprehensive information on airlines' carbon emissions and efficiency over flight distance.[30] According to Timperley, newer airplanes and medium-sized ones are also more efficient. Timperley also describes some individual behavior changes that reduce emissions (e.g., packing lighter for travel) that can be encouraged but probably not required.

Figure 1: Oxford University's Travel Hierarchy

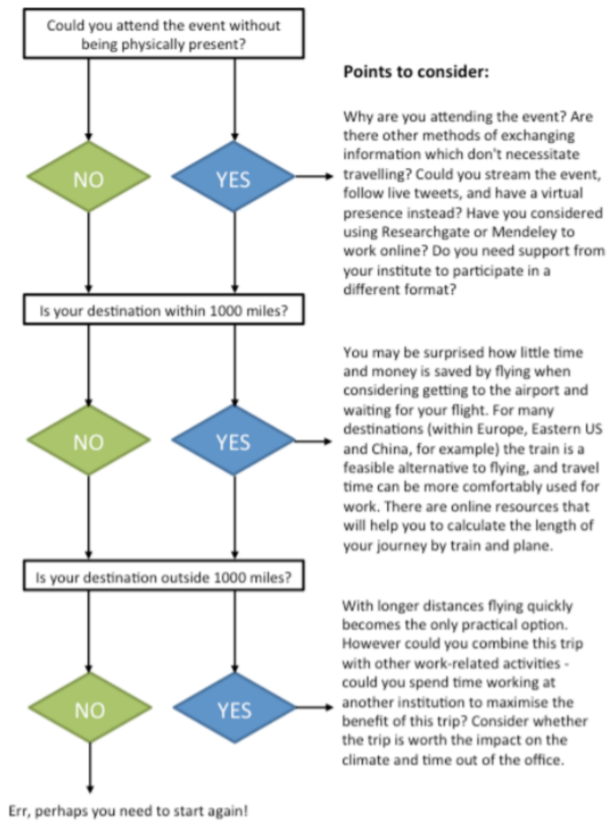
Travel Hierarchy
Avoid travel
Reduce travel
Travel without flying
Fly when there are no alternatives

Janisch et al., among other papers about social norms, heavily emphasize the importance of communication in implementing these strategies. For example, Janisch found that many people simply did not know about the availability of video technology for their PhDs, but would have used it if they had known. Awareness campaigns can also encourage actions that reduce emissions.[31] One popular tool is a decision tree created by the Tyndall Centre for Climate Change Research, as shown in *Figure 2*. Tyndall emphasizes the importance of openness about one's

[26] Timperley, J. (2020, February 19). *Should we give up flying for the sake of the climate?* BBC. https://www.bbc.com/future/article/20200218-climate-change-how-to-cut-your-carbon-emissions-when-flying
[27] Janisch, T., & Hilty, L. (2017). *Changing university culture towards reduced air travel*. ETH Sustainability. https://ethz.ch/content/dam/ethz/main/eth-zurich/nachhaltigkeit/Bildmaterial/virtualconference/Janisch%20et%20al%202017_Changing%20university%20culture%20towards%20reduced%20air%20travel_Background%20Report%20Virtual%20Conference.pdf
[28] Wihbey, J. (2015, September 2). *Evolving climate math of flying vs. driving*. Yale Climate Connections. https://yaleclimateconnections.org/2015/09/evolving-climate-math-of-flying-vs-driving/
[29] University of Oxford. (2020). *Guide to Sustainable Business Travel*.
[30] *atmosfair Airline Index*. (2018). Atmosfair. https://www.atmosfair.de/en/air_travel_and_climate/atmosfair_airline_index/
[31] Janisch, T., & Hilty, L. (2017).

travel, self-reporting and justification, and comparison with colleagues (which is a social norm strategy).[32] Requiring certain travel protocols and building them into booking systems goes a long way towards enforcing and measuring behavior change and emissions reduction. More importantly, a communication-based approach should be used in conjunction with administrative strategies. It will not only create transparency, but also will educate people about why they are traveling the way they are. Keeping these thoughts in mind will encourage more overall culture change and environmental awareness.

Figure 2: Tyndall Centre Decision Tree



As our literature review has shown, there is great value in using behavioral methods to deter travel. However, in institutional settings, there will continue to be a need for travel. As a result, unavoidable travel elicits the need for a carbon price that both reaffirms behavioral change and provides revenue for carbon offset projects. Implementing carbon offset projects that adhere to Stanford's sustainability principles will further Stanford's goal of reaching net zero emissions by 2050.[33] Beyond reaching net zero, there needs to be a shift in travel culture and awareness of

[32] Le Quéré, C., Capstick, S., Corner, A., Cutting, D., Johnson, M., Minns, A., Schroeder, H., Walker-Springett, K., Whitmarsh, L., & Wood, R. (2015). *Towards a culture of low-carbon research for the 21st Century*. Tyndall Centre for Climate Change Research. https://tyndall.ac.uk/wp-content/uploads/2021/09/TWP-161.pdf

[33] Stanford University. (n.d.). *Sustainability at Stanford: 2020–21 Year in Review.* Retrieved April 12, 2022, from https://sustainability-year-in-review.stanford.edu/2021/

the environmental significance of Scope 3 emissions. From our research, we have summarized some of the main points below as a call to action to reduce Stanford's Scope 3 emissions.

Key Points:

- Finding a carbon price that can meaningfully change behavior has been a challenging endeavor.
- While financial incentives are useful, behavior change is mainly driven by social norms.
- Ways to alter social norms are through promoting hybrid/virtual conferencing to deter travel and providing emissions footprint reports.
- Educational campaigns and clear communication to students, staff, and the Stanford community will be crucial to shifting the culture around institutional emissions management and individual carbon footprints.
- Administrative policies can nudge behavior change towards reduced air travel by altering Stanford's default transportation choices.

In our research, the idea of a carbon price has become very apparent. However, literature has illustrated that there is yet to be an influential and overarching price for universities to adopt. To elucidate what such a carbon price should be and how to administer it, carbon price programs that have been implemented at other universities will now be discussed.

Case for an Internal Carbon Price

What are the benefits of an internal carbon fee at a higher education institution?

Carbon pricing is a popular mechanism amongst economists to internalize the quantified costs of damages from greenhouse gas emissions. From an economic perspective, climate change is a negative externality, or an outcome that is not accounted for in a market transaction, that imposes risks to society. To incentivize the development and deployment of less carbon-intensive activities, carbon pricing policies ensure the price of fossil fuel consumption accounts for the full climate costs and requires polluters to pay their fair share of the climate burden. An efficient carbon price raises the private costs of production closer to the social marginal cost. An additional benefit of carbon pricing is the generation of revenue, which can be reinvested in advancing lower carbon technology, purchasing offsets, or paying public dividends.

While other universities have employed air travel fees to mitigate emissions, Stanford's Scope 3 Working Group has proposed a combination of mechanisms such as biofuel alternatives, offsets, virtual conferencing, education, and carbon pricing. A direct carbon fee on business air travel holds the most potential to generate revenue, incentivize decisions to reduce travel, and support local offset projects in order to meet Stanford's goals and inform larger climate policy decisions. As a higher education institution, Stanford's mission is to advance education to find solutions for society's greatest challenges and to disseminate knowledge to campuses, businesses, and governments. By reducing its own emissions by piloting a carbon pricing scheme, Stanford will be able to reach its own sustainability goals as well as identifying best practices for broader climate policy. The benefits of a carbon price at a university include encouraging cost-effective and low-emissions decisions, providing revenue streams to support further climate-oriented projects, engaging the campus community on environmental consciousness, refining pricing mechanisms to inform policymakers, and preparing institutions for potential future external carbon prices.[34] Scope 3 emissions are especially difficult to mitigate, but a carbon price will nudge decisions towards lower CO_2 activities such as reduced air travel.

Case Studies of Other University Programs

How have other universities implemented internal carbon prices and air travel fees to address emissions?

In order to prepare for a potential air travel fee program at Stanford, we began by examining existing policies at comparable institutions. A significant number of universities have implemented a carbon tax or offset program to tackle Scope 3 emissions for air travel. The universities sampled include:

- University of Pennsylvania (UPenn)
- California State University, East Bay (CSUEB)
- Arizona State University (ASU)
- University of California, Los Angeles (UCLA)
- University of Toronto (UofT)
- University of Maryland (UMD)
- University of British Columbia (UBC)
- University of Edinburgh

All of these institutions have either a carbon tax program or specific policies implemented to decrease the amount of air travel, particularly from faculty business trips. In order to gather this data, we began with an initial framework from Clea Schumer's thesis "Learning by Example: Designing an Optimal Internal Carbon Price to Implement at Harvard University,"[35] and other resources from Second Nature's "Internal Carbon Pricing in Higher Education Toolkit".[36] We

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[34] *Why price carbon?* Second Nature. (n.d.). Retrieved November 5, 2021, from https://secondnature.org/climate-action-guidance/i-why-price-carbon/.
[35] Schumer, C. (2020). Learning by Example: Designing an Optimal Internal Carbon Price to Implement at Harvard University
[36] Second Nature. (n. A.). Internal Carbon Pricing in Higher Education Toolkit. Retrieved from: https://secondnature.org/climate-action-guidance/carbon-pricing/

then added our own research from schools' published reports on the subject. In addition to a desk review, we conducted interviews with university officials who either created or currently managed the carbon tax air travel programs at each of the respective universities. We searched for the following pieces information, as well as qualitative observations and learnings from the interviews:

- Climate goals: *greenhouse gas reductions, dates/years, sustainability plans*
- Specifics about what/who is priced: *departments, students, funded by whom*
- Specific fees levied: *flat rate, international vs domestic, by flight length*
- Management of program in university: *who/which department oversees the program*
- Use of funds collected: *offsets purchased, investments from the money collected*
- Pilot process *(if applicable)*
- Public opinion/reception: *pushback or encouragement from faculty, students, etc, any learnings from this process*

With Stanford's unique needs and abilities, the Scope 3 program will not look exactly like any of the following programs. We have looked into different behavioral methods for flight reduction and proposed our own pricing system through research on the social cost of carbon. However, it is valuable to learn from other institutions' approaches and key lessons to establish a baseline for Stanford's program. A detailed review of each university's program is available in the Appendix (*Tables 3 - 10*).

Summary of Results[37]

Climate goals: In general, schools' Scope 3 programs were part of a larger set of climate goals and emissions reductions. Scope 3 emissions are typically the last step, after reducing or eliminating Scope 1 and Scope 2 emissions, because Scope 3 emissions are the least direct and hardest to quantify. For most schools, the end goal is complete carbon neutrality in years ranging from 2035 to 2050, with transportation neutrality on a shorter timeline.

Pricing guidelines: Each school differed on the guidelines for who and what were included under the carbon pricing scheme. All of the schools studied had a program for air travel that included at least the monitoring of flight data – most had a direct pricing program or air travel restrictions. The prices range from \$8 (at program's start) to \$130 per flight (with some being priced based on direct carbon emissions). Many schools based their pricing levels on what they

[37] This specific section pertains to universities who have designed a direct pricing system to mitigate emissions from air travel. They are: University of Pennsylvania; California State University, East Bay; Arizona State University; University of California, Los Angeles; University of Toronto and University of Maryland. Other schools such as University of British Columbia and University of Edinburgh had other types of flight restriction or pricing programs that are not a direct carbon tax. These are included in the annex but not the summary.

observed from comparable universities. Some of the schools had differences based on whether it was a domestic or international flight, or business class or economy, with a higher price for international flights and business class. Most schools did not charge for every flight in the scope of the university – it was generally for university funded flights/business flights, sometimes with the exception of study abroad and athletics travel. Schools such as ASU and UPenn have a program with an escalating carbon tax price, up until a final goal. To add, UofT plans to transition to a price-per-mile-traveled after their pilot program.

Management of program: Most of the schools have sustainability offices that oversee the carbon pricing programs, often alongside an office of transportation or finance. The schools often use a centralized program to track the flight data, allow faculty members to book their flights, and collect the funds. Sometimes, the reports are distributed to each school/center, who then conduct the finances on their own.

Use of funds: There are 3 main ways in which schools have chosen to delegate the funds collected from air travel taxes, and many schools adopt more than one way. The first way is purchasing verified carbon offsets in an external market, which has been adopted by UPenn, ASU and UMD. Another choice of delegating funds has been local or university catalyzed offset programs. These calculate the exact emissions to offset and directly tackle them through planting trees, installing solar panels, or implementing other projects. Some schools commented on how this method was extremely costly and that calculating the exact emissions being mitigated was difficult. UPenn, ASU and UofT participate in this stream of funding. The final choice for investing capital has been funding for on-campus projects that reduce emissions. These projects either directly or indirectly reduce carbon emissions, but the exact offset amount is not calculated. Some examples consist of research grants for sustainable projects, start-up grants, university infrastructure changes, etc. Certain universities supported this method, since university members could directly see and experience the consequences of the air travel tax. This method is being used at CSUEB, ASU and UCLA.

Pilot process: Some universities were able to provide information about their pilot processes if they underwent one. UPenn's program is very recent (2021), so they are currently still in their pilot process for all university-sponsored business travel. University of Toronto is also undergoing their pilot, which will only concern around 120 university faculty/staff members. UCLA's pilot process lasted 3 years and was campus wide. ASU initially had a voluntary environmental impact fee as of 2007, but it was not successful due to low awareness and interest, as well as logistical issues.

Public opinion/reception: In general, universities' air travel emission fees were welcomed and faced little resistance. However, specific departments, such as Study Abroad or Athletics, faced budget or administrative efficiency issues, since there were some disagreements concerning if they should be included in the carbon tax or not. These problems were rectified by implementing centralized charging programs integrated with the air travel booking system. University officials emphasized the importance of communication with students and faculty to answer questions, raise awareness, and discourage nonessential air travel.

Economics of an Air Travel Fee

What does academic literature suggest about the Social Cost of Carbon? How would SCC estimates translate into flight fees?

The Social Cost of Carbon

To effectively implement carbon pricing, the trickiest part is setting the fee at the right price. Theoretically, economists set carbon taxes equal to the marginal social cost of CO_2 emissions. The social cost of carbon (SCC) is an estimate of the monetary damages of carbon dioxide, which are determined by integrated assessment models and applied to cost-benefit analysis in policy decisions. The process of calculating SCC includes predicting future emissions production, modeling future climatic and biophysical impacts, quantifying the economic damages on sectors such as agriculture and energy, and converting future damages into present-day values.[38]

SCC estimates range drastically. Frequently, the SCC is underestimated due to the compounding effects of climate change and uncertainty in the model inputs. In other words, the monetary estimate of the economic damages of emissions will grow exponentially as CO_2 accumulates in the atmosphere and the climate approaches tipping points. Based on Bill Nordhaus's 2017 Dynamic Integrated model of the Climate and Economy (DICE), the estimated SCC is $31 per ton of CO_2 in 2010 and grows at a rate of 3% annually.[39] His equation inputs climate systems, such as geophysical equations and the carbon cycle, as well as economic capital to calculate avoided damages from emissions mitigation costs. Politically, the price has varied depending on the discount rate, or factor of diminishing future value. In other words, it is how much people care about the future relative to the present. Higher discount rates would result in lower SCC estimates and vice versa. The Biden Administration's estimate from March of 2020 is approximately $51/ton of CO_2.[40] Other estimates have ranged from $12/ton CO_2in the Trump

[38] Rennert, K., & Kingdon, C. (2019). Social Cost of Carbon 101. Resources for the Future. Retrieved November 5, 2021, from https://www.rff.org/publications/explainers/social-cost-carbon-101/.
[39] Nordhaus, W. D. (2017). Revisiting the social cost of carbon. Proceedings of the National Academy of Sciences, 114(7), 1518–1523. https://doi.org/10.1073/pnas.1609244114
[40] Chemnick, J. (2021, March 1). *Cost of carbon pollution pegged at $51 a ton*. Scientific American. Retrieved November 5, 2021, from https://www.scientificamerican.com/article/cost-of-carbon-pollution-pegged-at-51-a-ton/.

administration to upwards of \$200/ton CO_2. The US EPA Working Group on Social Cost of Greenhouse Gases presented multiple scenarios with estimates ranging from \$14 to \$152/ton.[41] A summary table of the literature review of the SCC can be found in the Appendix (Table 11).

Our Proposed Scenarios

Given the range of the SCC, we divided our proposed carbon prices into three categories which can best be summarized as a low, medium, and high price:

(1) **Low:** Our first price will achieve net zero emissions via generating revenue that will be used to delegate in emissions-reduction projects. Given the cost of carbon offsets, which range from \$7-15, we averaged this price to achieve a cost of \$11.

(2) **Medium:** Our second price was taken from the EPA SCC standard of \$51/ton of. This is the average carbon price to reach net zero emissions by 2050 given multiple simulations run by the EPA. A 3% discount rate was used to calculate this cost.

(3) **High:** Our third refers to the 95th percentile of simulations run by the EPA to achieve net zero emissions by 2050 at a cost of \$152. Under the high scenario, the

We would recommend beginning with the low price (\$11), to be able to purchase offsets for emissions and also monitor any behavioral changes. Given the preliminary data, we would then recommend increasing the prices as we near the target net zero emissions year of 2050. This method of setting a target year and consistently increasing prices until the target is reached eliminates uncertainties about future carbon prices–due to the established pricing schedule–and integrates risk from climate-related damages.[42] The research found that the reliability of the target emissions reduction year and the consistent increase in prices more effectively drove behavior changes to reach the emissions target.

Assumptions

(1) Number of flights: 48,765

(2) Average metric tons of CO_2e per flight (with Radiative Forcing Factor Of 2.7 applied): 0.8

- 78% of flights were domestic, and 22% were international (that is, ~38,037 flights were domestic, and ~10,728 were international)

[41] United States Government. (2021). *Technical support document: Social cost of carbon, methane, and nitrous oxide interim estimates under executive order 13990.* https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.

[42] Kaufman, N., Barron, A.R., Krawczyk, W. et al. A near-term to net zero alternative to the social cost of carbon for setting carbon prices. Nat. Clim. Chang. 10, 1010–1014 (2020). https://doi.org/10.1038/s41558-020-0880-3\

(3) Calculations made based on Radiative Forcing Factor–rate of change in energy per unit area–of 2.7 to estimate an average of 0.8 tons of CO_2 emissions per flight, total number of flights from 2019 data, and SCC from literature review.
(4) Major assumption: Note that the same RFF and price for international and domestic flights was applied.

Calculated Estimates of Flight Fees

To generate the following table of estimates, the following equations were used:

(1) Average Per Flight Fee = SCC * Average Metric Ton of CO_2e
(2) Surplus Funds (Total Additional Funding) = Revenue - Cost = (Average per flight fee * number of flights) - (cost of offset * number of offsets)
(3) Metric Tons of Offsets, number of offsets that can be purchased given revenue = Revenue / cost of offset
  (a) Note that for the low price, the number of offsets equals the university's current emissions level, 39,012 metric tons.

	Avg Per Flight Fee	Surplus Funds	Metric Tons of Offsets	Goal
Low Price ($11/ton)	$8.80	$0	39,012	Net Zero Air Travel
Medium Price ($51/ton)	$41	$1,560,480	180,874	Reflect EPA's Expected SCC
High Price ($152/ton)	$140	$5,500,692	539,075	Reflect Highest SCC

Key Points:

- If we want to influence behavior, we should levy a higher fee and/or combine a pricing approach with behavioral policies and/or normative communications.
- There is precedent for air travel fee programs at other universities that are mostly per flight costs rather than per emission cost, but these fees have not typically altered behavior and instead act as a funding mechanism for purchasing offsets.
- SCC values in use tend to be underestimated. We have an opportunity to both reflect a more accurate SCC and drive more behavior change.

Recommendations

1. *The university should administer a carbon fee for air travel that should fall between the price of offsets and the social cost of carbon, slowly rising over time with the most updated economic estimates.*

   The starting price of offsets is extremely low (a couple of dollars) compared to the estimated social cost of carbon (upwards of a hundred or more dollars). A higher fee could accelerate the transition towards virtual conferencing, generate more revenue, and capture the full externality of travel emissions, but it could face political pushback from academic departments. On the other hand, a low tax has greater political feasibility, but it may have no effect on discouraging travel. Given the disparity, there should be a sweet spot in between that functions as an incentive to reduce emissions as well as a source of funding to offset emissions. As the damages of CO_2 compound over time, the SCC and carbon fee should reflect the rising societal costs in accordance with integrated economic models.

   Based on other university programs that used carbon prices of ($8-$18 per flight), we propose starting at a lower price range between $10 to $50/ton of CO_2. After a carbon price is put in place, no matter how small, it is easier to increase the price because the fee has been instituted. Starting the price in between needed offsets and the SCC can achieve the goals of gaining revenue and aligning partially with the SCC. As the SCC increases over time, it will be vital to increase the carbon price accordingly to effectively discourage air travel and reduce emissions.

2. *The revenue generated from a carbon fee should be used to support external verified offset projects and local on-campus sustainability initiatives*

   In order to reach complete carbon neutrality with Scope 3 emissions, offsets of some kind will be needed to achieve ambitious targets. Once levied, the fees should contribute to a green revolving fund modeled by other higher education institutions in order to supply a self-replenishing source of funding. Revenue could be pooled for use in the Scope 3 Emissions Program and reallocated towards sustainability-related projects. Example projects could renovate energy efficiency in student housing and buildings, improve energy consumption monitoring, incentivize sustainable practices such as reducing food waste, support Jasper Ridge Biological Preserve, restore natural habitats rather than simply planting trees, and more. However, the criteria and purpose of the offsets matter in order to ensure verified, effective, and impactful projects. Similar to the methane capture offsets in the SCORE project[43], the offsets must be US-based, double-checked, and measurable.

3. *The university should pursue behavioral change strategies and educational campaigns alongside an air travel fee.*

The education of individual influential faculty and the student body will be valuable to ensuring the broader community is informed and makes long-lasting lifestyle changes. A carbon price alone may not discourage flying, especially for faculty in departments that depend on in-person conferencing or external grants. To prevent pushback and encourage discussion, there could be educational campaigns to students or workshops targeted towards faculty to engage in conversations about sustainable aviation, carbon accounting, and individual climate action. Potential events include panels, workshops, or brief meetings with senior faculty to discuss ways to reduce non-essential travel. External webinars could also educate the public and community about the environmental benefits of virtual conferencing. Administrative policies are also necessary to enforce some of these changes. For instance, university policies could encourage virtual conferences, combine multiple events or purposes in a single trip, make public transportation or other more efficient travel modes the default option, and require the most efficient flight routes and airlines when air travel is necessary.

These strategies and campaigns will influence social norms about air travel, prompting change in behavior and attitudes towards flying. They will make air travel fees more effective because they will supplement the economic incentive with social incentives. Behavior change strategies like administrative policies and department carbon reports act as social incentives. Educational campaigns will increase faculty knowledge on air travel and Scope 3 emissions to help the Stanford community make more informed decisions on conference air travel.

4. *The university should equally apply carbon pricing to Stanford-sponsored academic, athletic, and staff travel.*

To ensure that all community members are equally affected by this policy, the carbon fee should apply to all Stanford-sponsored academic, athletic, and staff air travel. The intention of this uniform application is to guarantee that individuals who significantly contribute to Stanford's Scope 3 air travel emissions, regardless of their title, are responsible for contributing significantly to projects that offset their emissions. The travel-booking systems used to reserve air travel should already include the carbon tax in

[43] Stanford Carbon Offsets to Reduce Emissions (SCORE) was a student-driven project in 2016 led by Emma Fisher ('17) that offset student athlete travel from 2015. In collaboration with 3Degrees and the Billings Landfill Gas Destruction Project, the program purchased certified credits and offset 2640 metric tons of CO_2.

the upfront price. The air travel fee should not be paid as an end-of-year expense because this tends to lead to logistical issues and "surprise" costs. To add, at the moment we do not recommend that Stanford-affiliated travel *not* directly funded by the University be taxed. This includes student funded travel to Study Abroad programs, external research grants, externally funded conferences, sponsorships and others. Nonetheless, working towards a Scope 3 air travel carbon tax that *does* include these types of travel would align Stanford with its sustainability goals.

5. *The process for implementing this program should center on transparency, communication, and involvement of all parts of the Stanford community.*

   When discussing the takeaways from other schools' programs, the managers stressed the importance of communication with the rest of the school. Implementing this type of proposal, which ultimately takes funds from the universities programming, can be controversial around campuses. However, administrations that created the programs in conjunction with student, staff, and faculty inputs did not receive as much negative feedback. In fact, there was sometimes a positive response, if not just neutral. We suggest that Stanford begin with a pilot program, as most other schools did, that implements the price on a subset of the flights that are taken in order to gauge impact, implementation, and public reception. Launching this pilot program with values of transparency, open communication, and collaboration from the beginning will lead to the smoothest implementation and transition.

Conclusion and Next Steps

At Stanford, the introduction of an internal carbon fee on air travel would most effectively reduce air travel emissions, generate revenue for offsets, and motivate changes in administrative policy. In terms of behavior, a fee would disincentivize non-essential trips and a complementary educational campaign could shift cultural norms towards more virtual conferencing. Borrowing from the best practices of other universities, Stanford can serve as a leader for sustainable internal operations and act as an experiential learning hub for internal carbon pricing. The process of planning, implementing, and improving a carbon price on Stanford's own campus will inform other higher education institutions and move the needle on broader carbon pricing policy decisions in corporations. Moreover, the combination of offsets, virtual conferencing, and educational programming around climate related issues will advance the mission of the university and increase environmental awareness amongst faculty, staff, and students. With a tremendous endowment and ability to influence other institutions, Stanford is positioned with the opportunity and resources to spearhead novel approaches to combating climate challenges.

Ultimately, the frontier of Scope 3 emissions is an emerging area of investment and attention in all levels of institutions, from universities to companies. More countries, institutions, corporations, and other agents are beginning to consider cost-effective methods of reducing their carbon footprints and mitigating Scope 3 emissions. Similar to the fossil fuel industry, the aviation industry will lobby against the implementation of climate policies such as low-carbon transportation and carbon taxes. To advocate for more climate-oriented policies against major lobbying powers, private and public institutions can demonstrate the economic and environmental benefits of more sustainable practices. With the rapidly decreasing carbon budget, cost-effective and efficient mitigation strategies such as internal carbon pricing tools will be critical for helping local and international-scale institutions reach their carbon neutrality targets.

Appendix

Table 1: Pros and Cons of Financial Incentives on Behavior

Benefits of a High Carbon Fee (e.g., > $50 USD per tonne of CO_2):	**Drawbacks of a High Carbon Fee (e.g., > $50 USD per tonne of CO_2):**
➢ Will likely incentivize less travel (Markham et. al, 2018) ➢ More closely aligns with the IPCC's recommendations for carbon pricing (Rogelj et. al, 2019) ➢ For those who are climate conscious and/or are aware of the reason for this fee, this higher price may synergize well with the heightened levels of responsibility frequent domestic travelers feel for their CO_2 emissions (Choi et al., 2018) ➢ If the carbon fee revenue is put towards a cause that many Stanford affiliates support, the fee may be more widely supported (e.g., according to the Climate Leadership Council, carbon fees across nationwide could be bolstered by the popularity of an equally-distributed carbon dividend) (Shultz and Halstead, 2018)	➢ May heighten disparities between differently funded departments ➢ Without a thorough understanding of the importance of climate change and this fee's purpose, a high carbon free could spark backlash ○ May lead to whataboutism arguments (e.g., what about the sports teams and the band that fly quite often for games?) ➢ Increasing carbon fees consistently to incentivize less travel may be needed to ensure emissions do not start climbing again, which could be unpopular and lead to backlash (Shultz and Halstead, 2018) ➢ The effect this fee could have on more travel-reliant and vulnerable groups of people would be quite detrimental

Table 2: Efficacy of Social Norming Strategies on Carbon Emissions

Areas	Benefits	Drawbacks
Hybrid Conferences	- More accessible to attendees (increase in attendance) - Less travel and carbon emissions	- Decreased networking opportunities - Possible technical difficulties and time zone differences can

	- Still able to have social interactions	decrease people's desire to attend
Compiling Carbon Emission Reports for Departments	- Targets second-order normative beliefs and has been effective for decreasing energy usage - Decreases emissions because there is less motivation to fly	- Not always effective - Potentially time intensive

Detailed university policies on an air carbon tax

Table 3: University of Pennsylvania

Climate Goals	Carbon emission neutrality, as a University, by 2042
Specifics about what/who is priced (departments, students)	Fees applied to business travel through the University. They use a booking system called CONCUR, and gather that data as well as flight data from other sources to create a report for each school/center on their air travel impact. The schools then offset carbon emissions individually. These reports are very detailed, showing each flight taken by members of the school/center.
Specific fees levied	\$11 for domestic flights \$25 for international flights Assuming that the price will go up over time, cost is dependent on pricing of offsets. If the university moves to local offsets (see below), the price will be much higher.
Management of program in university	Penn Procurement Services and Penn Sustainability The procurement team generates the reports for each school/center.
Use of funds collected	Climate Impact Offset: currently purchasing offset from market provider. Also, the University will be seeking to invest the proceeds in local offset projects. Examples include tree planting, weatherizing local residences, or installing solar panels.

Status report	No updates yet, as it was implemented July 1, 2021
Pilot process if applicable	Currently in a type of pilot process
Public Opinion/Reception	Reception of the program was very positive, most likely due to a collaborative and inclusive process with students and faculty in the planning phases. Additionally, communication on the onset was important, helping to mitigate questions and be proactive about what questions might arise. Lastly, framing the program as something that is both impactful and exciting, and also a very minimal fee that will not be recognizable in terms of what the university can accomplish.
Notes	The university does not have any other specific air travel sustainability policies, but in their flight booking system (CONCUR), they use behavioral nudges to influence behavior. These include aspects such as "big red banners" when booking certain flights and the sharing of carbon offset information in the booking process that convince a user to consider other transportation options.

Sources:

(1) Announcement About Climate Impact Offset Charges | University of Pennsylvania Almanac. (2021, September 7). UPenn Almanac. https://almanac.upenn.edu/articles/announcement-about-climate-impact-offset-charges

(2) Personal correspondence with Natalie Walker (Sustainability Manager, University of Pennsylvania) on December 15, 2021

Table 4: California State University, East Bay

Climate Goals (greenhouse gas reduction)	The University Air-Travel Offset Policy aims to help CSUEB meet goals laid out in its Climate Action Plan (CAP). The CAP requires that all state-funded travel be carbon neutral or 100% offset by 2022, and that CSUEB achieve campus carbon neutrality by 2040.
Specifics about what/who is priced (departments, students)	Air travel funded by the university or affiliate
Specific fees levied	$9 carbon fee for every air-travel round trip
Management of program in university	The CSUEB Climate Action Plan Implementation Task Force developed the policy and vetted it through the CSUEB Division of Administration & Finance. The Office of Sustainability manages the policy.
Use of funds collected	The money is deposited into the university's Climate Action Plan Fund. The Campus

	Sustainability Committee will invest the funds in on-campus projects that reduce GHGs.
Status report	N/A
Pilot process if applicable	N/A
Public Opinion/Reception	N/A
Notes	Lessons Learned - Having a university-approved CAP with an air-travel offset goal set a clear expectation for the policy development process and removed the need to advocate for the policy. Instead, it allowed conversations to focus on policy design, since the concept was already approved in the CAP. - Developing friendly relationships early on with Procurement and Finance staff was critical. They championed the policy and should be recognized.

Sources:
(1) Buckholz, J. (2020, September). Case Study: University Air-Travel Offset Policy. Second Nature. https://secondnature.org/wp-content/uploads/Cal-State-East-Bay-Case-Study-Rev2.pdf

Table 5: Arizona State University

Climate Goals (greenhouse gas reduction)	ASU has eight climate and sustainability goals ranging from zero waste and circular resource systems to food reconnection, optimizing water, and climate resilience. The university achieved carbon neutrality for Scope 1 and Scope 2 emissions in FY 2019 and it aims to achieve carbon neutrality for Scope 3 emissions by FY 2035. As of now, it has reduced 49% since 2007.
Specifics about what/who is priced (departments, students)	All ASU-sponsored air travel (24,355 trips per year), including student-paid study abroad and projects funded by external organizations for ASU. Air travel paid by another institution or individual is not included nor those funded by federal grants (2017).
Specific fees levied	$8 per round trip flight at project's start in 2018. The rate will escalate to $10 (escalated for FY 20), $12, $15, and finally $18 in successive years in order to ultimately reach the 2025 price ($18).
Management of program in university	University Sustainability Practices (USP) led the effort, coordinating with the finance department (which includes ASU travel)
Use of funds collected	Funds used to finance the ASU Carbon Project

	- ASU Carbon Project purchases and generates offsets for difficult to mitigate ASU carbon emissions - Tree planting projects: Carbon Sink at ASU West, Urban Forestry in surrounding cities - Remaining revenues after emissions were neutralized have been directed to additional offset or removal projects that may cost more but provided additional co-benefits related to the mission of the university (such as education and research opportunities, community-support, or support of ASU-tied start-up companies) The rules of the Carbon Fund (which collected the fee to support the activities of the Carbon Project) were established and agreed to upfront and enshrined in the establishment of the specific account within ASU's accounting system. Adherence to those rules was enforced through periodic review by ASU's internal auditing processes.
Status report	Has increased the pricing to $15 per trip as of 2021.
Pilot process if applicable	ASU implemented a voluntary environmental impact fee (EIF) on air travel around 2007 but experienced minimal adoption due to lack of interest and awareness, and the fact that it was offered after travel during the expense report stages. In March of 2016, ASU began investigating how to better market the EIF earlier in the travel request/expense process, as well as whether the fee could be an allowable expense on a federally sponsored research grant. In 2017, while a levy on air travel was still being developed, ASU's University Sustainability Practices (USP) began collaborating with the Duke Carbon Offset Initiative (DCOI) using accumulated EIF revenues and DCOI funds to plant trees in urban areas and to use a peer review process to verify and validate carbon offsets. With evidence of success from the tree plantings and after discussion of the proposed air travel policy with stakeholders, USP received approval to advance the price on carbon for air travel.
Public Opinion/Reception	- Study Abroad Office: Supported the concept but were concerned relative to the first year of charges because they had a policy of publishing and adhering to a complete listing of any fees associated with a study abroad program well in advance of the course registration window. The fee schedule for the year had already been published. They absorbed the first year cost internally. - Athletics: Had concerns because of their amount of travel and the impact on their budget. - Finance: Had some concerns over the level of staff effort needed to administer

	the fee. However, they developed some automation that streamlined the process and reduced their effort. Overall, there was less concern than we had anticipated. - Other concerns included not having budgeted for the fee in multi-year research grants. - Most ASU employees and students are not aware of the university's price on carbon for air travel. ASU's University Sustainability Practices would like to raise awareness of the carbon price in order to begin to influence decisions to travel.
Notes	ASU found it helpful when individual departments with a high volume of travel (such as study abroad) assessed the price on carbon themselves, rather than waiting for Financial Services to charge the departments based on travel expense reports. When departments assess the price themselves, it increases accuracy and time efficiency.

Sources:
(1) Dalrymple, M. (2018, August 31). Case Study: Price on Carbon for Air Travel - Arizona State University. Second Nature. https://secondnature.org/wp-content/uploads/ASU-Case-Study-Price-on-Carbon-for-Air-Travel.pdf
(2) Personal correspondence with Mick Dalrymple (Chief Sustainability Officer at USC, created ASU air travel carbon offset program)
(3) Personal correspondence with Alexander Davis (Interim Sustainability Director, University Sustainability Practices, ASU)

Table 6: University of California, Los Angeles

Climate Goals (greenhouse gas reduction)	The University of California (UC) system committed to achieving carbon neutrality for all building and vehicle fleet emissions by 2025, and all mobile source emissions (such as air travel and commuting) by 2050
Specifics about what/who is priced (departments, students)	Every flight itinerary purchased for university business travel. Exceptions of student travel for study abroad programs and student travel on UCLA Athletics charter flights
Specific fees levied	$9 per domestic trip and $25 per international trip
Management of program in university	The UCLA Events & Transportation Department collaborated with Corporate Financial Services to develop the Air Travel Mitigation Fund (ATMF) program. The UCLA Sustainability Office will administer and manage the three-year pilot
Use of funds collected	The traveler's university department pays the fee during the travel reimbursement process and the money goes into the ATMF. UCLA will use the ATMF to invest in on-campus energy-efficiency projects and renewable energy installations that reduce

	GHG emissions. There was an initial displeasure with spending funds on forest offsets and other difficult to quantify and verify kind of projects. Departments can apply for grants from the ATMF for campus emissions reducing projects, which have the benefit that people can see the “green” effects of the ATMF. Examples of projects: - Lighting retrofits - Switch generator at White Mt. Research Station to a much more fuel efficient one - EV charges for Fleet unit to charge current and future electric vehicles on campus
Pilot process if applicable	Pilot program implementation: January 2018–December 2020 campus wide.
Status report	Pilot process was approved beyond initial years.
Public Opinion/Reception	Anecdotal feedback has generally been positive.
Notes	- Charges on air travel were not seen to reduce the amount of flights. - This program was not made with increasing fees over the years, something that was a regret as it would provide more funds for the ATMF. - Initial logistical challenges: setting the carbon mitigation fee and adding it to the travel reimbursement system required multiple departments to collaborate and work together to bring the project to fruition. It was critical to have both a staff level champion (department director or similar) who would lead the charge and to have a strong executive sponsor backing the program: someone near the top of the work pyramid who could stave off any type of department workload pushback or similar delay.

Sources:
(1) Katz, N., & Fortier, R. (2019, October). Case Study: Air Travel Mitigation Fund - University of California Los Angeles. Second Nature. https://secondnature.org/wp-content/uploads/UCLA-case-study.pdf
(2) Personal correspondence with Nurit Katz (Chief Sustainability Officer at UCLA)
(3) Personal correspondence with David J. Karwaski (Director, Mobility Planning & Traffic Systems UCLA Transportation)

Table 7: University of Toronto

Climate Goals (greenhouse gas reduction)	Climate Positive Plan: reduce emissions to better than net zero by 2050, cut emissions by almost half in the next five years. This will mainly be achieved through rapid reduction of greenhouse gas emissions (electrification of transport, eliminating natural gas, etc).

Specifics about what/who is priced (departments, students)	Pilot: Air travel by the President, Vice-Presidents, Assistant Vice Presidents, and Deans, as well as other senior leadership in their offices including senior administrative staff and all Vice-Provosts, Vice-Deans, and Associate Deans After the pilot, the plan is to expand this to all university paid travel (conferences, business travel, research, athletics, field trips, etc)
Specific fees levied	$15 CAD per North American round-trip flight (double for business class at $30) $65 CAD per round trip flight beyond North America (double for business class at $130) No intention of raising the fee yet, but may potentially change the methodology to a per kilometer traveled fee (would be easier from an administrative standpoint, do not have to worry about layovers etc)
Management of program in university	President's Advisory Committee on the Environment, Climate Change, and Sustainability Operations and Real Estate Partnerships (OREP) is developing a bespoke air travel emissions mitigation initiative to accelerate U of T's emissions reduction efforts and to help mitigate University related Scope 3 emissions, beginning with air travel.
Use of funds collected	These funds will be invested in projects identified and prioritized by the Tri-Campus Sustainability Board for their respective campuses. The offsets will not be purchased from a third party – will be direct Scope 3 reduction projects at UofT, to reduce their own emissions (ex. Tree planting).
Status report	Currently executing the pilot program.
Pilot process if applicable	Executive pilot in 2020: The Air Travel Emissions Mitigation Initiative Pilot was approved retroactively from January 2020 until the end of the academic year in August 2020. Due to COVID, the pilot has just been launched in the last couple of months. Pilot is only including upper level staff (ex. Deans, provosts, presidents, etc), which ends up being about 120 people. The plan is to track this small group and evaluate how the collection of fees and other aspects work before implementing the entire program.
Public Opinion/Reception	Little public reception because the program hasn't been expanded too much. However, there have been some articles written due to the reports that have been made available. University expects some pushback, simply due to the fact that it is a new program that will cost money.

Sources:

(1) Dias, D. (2020, November). Addressing University of Toronto's Business-Related Scope 3 Air Travel Emissions. Sustainability. https://sustainability.utoronto.ca/wp-content/uploads/CECCS_Nov-2020_Business-Air-Travel-Report.pdf
(2) Personal correspondence with Scott Hendershot (Senior Manager – Sustainability Office)
(3) Personal correspondence with Chelsea Dalton (Project Manager – Sustainability Office)

Table 8: University of Maryland

Climate Goals (greenhouse gas reduction)	Reduce campus emissions to 60% below 2005 levels by 2025; achieve total carbon neutrality by 2050
Specifics about what/who is priced (departments, students)	All units sponsoring air travel
Specific fees levied	~$3 or $4/MTCO2e emissions (price of offsets)
Management of program in university	Department-level financial managers
Use of funds collected	Purchase verified carbon offsets on an external market.
Status report	N/A
Pilot process if applicable	N/A
Public Opinion/Reception	N/A

Source:

(1) Clea Schumer, Harvard University thesis: "Learning by Example: Designing an Optimal Internal Carbon Price to Implement at Harvard University"

Table 9: University of British Columbia (UBC)

As of 2018:

- Climate Plan approved in 2016: reduce GHG emissions by 67% from 2007 levels by 2020.
- British Columbia as a province has specific climate legislation, which includes a price on carbon; this price is then applied to UBC flight.

- In British Columbia's legislation, the aim is for public sector carbon neutrality. With this, UBC pays $60 per metric tonne of carbon dioxide equivalent emitted (MTCDE). The $60 comes from a $35/tonne carbon tax on natural gas purchases and a $25/tonne tax for operational emissions offsets.
- The BC government sets the carbon price through two mechanisms:
    1. The BC Carbon Tax: applies to the purchase and use of fossil fuels. Enacted in 2008, but as of April 1, 2018, BC's carbon tax rate increased from $30 to $35/MTCDE. The eventual goal was $50 per tonne in 2021, increasing by $5 each year.
    2. The Carbon Neutral Government Regulation: created in support of the Greenhouse Gas Reduction Targets Act in 2010. The regulation requires public sector organizations each year to define, measure, report, verify, and offset in-scope GHG emissions. Additionally it calls for these organizations to plan and implement internal actions to reduce GHG emissions and offset any remaining emissions. This cost is currently $25/tonne of carbon.
- UBC must pay $60/MTCDE with this tax and regulation.
- Given the rates on each tonne of carbon, if UBC were to take no new climate action, its annual carbon costs could increase drastically from those of 2018 to over $1 million by 2021 and to $5 million by 2040.

Sources:
(1) Madden, J., & Bilodeau, L. (2018, September 3). Case Study: Climate Action in the Context of an Externally Imposed Price on Carbon. Second Nature. https://secondnature.org/wp-content/uploads/UBC-Case-Study-Climate-Action-in-the-Context-of-an-Externally-Imposed-Price-on-Carbon.pdf

Table 10: University of Edinburgh

- Reports on university sponsored air travel/other travel: publishes this info for the public to see.
- As of roughly 3 years ago, it does not allow for flights to London (which had accounted for roughly 50% of air travel before this ban) or any location within Britain, requiring rail travel instead.
    - This action cut much of the Scope 3 emissions from the University of Edinburgh.
- Does not do a carbon tax: mainly concerned about administrative aspects (how long it takes to process so many small payments etc)
    - The university believes that a carbon tax would lead to a lot of resources invested in a system that will not bring much back, will be a net loss in profits

- Aim: to get people to think about their objective for traveling, if it is necessary/if it would be possible remotely or by rail, and then if not, to book the flight
    - Travel is necessary for academic success, the goal is not to eliminate it completely, rather to be intentional about it

Sources:

(1) Personal correspondence with Chris Litwiniuk (Sustainability Innovation and Engagement Manager)

Table 11: Social Cost of Carbon Literature

Article Title	Authors	SCC ($/ton CO_2)	Factors model takes into account
A lower bound to the social cost of CO2 emissions	J. C. J. M. van den Bergh & W. J. W. Botzen	$125 per ton (lower bound)	Risk aversion (need to avoid relatively less likely but catastrophic events); low discount rate (i.e valuing future risks similarly to current risks)
Health Impacts of Climate Change as Contained in Economic Models Estimating the Social Cost of Carbon Dioxide	Kevin Cromar, Peter Howard, Váleri N. Vásquez, and David Anthoff	additional $1.745 added to current calculations	Integrated health impacts (diarrhea, malaria, storms, etc) into calculation of SCC
Estimating a social cost of carbon for global energy consumption	Ashwin Rode, Tamma Carleton, Michael Delgado, Michael Greenstone, Trevor Houser, Solomon Hsiang, Andrew Hultgren, Amir Jina, Robert E. Kopp, Kelly E. McCusker,	project a reduction in energy expenditure from -$3 to -$1 of calculations	Energy Consumption

	Ishan Nath, James Rising & Jiacan Yuan		
Revisiting the social cost of carbon	William D. Nordhaus	$31/ton in 2010, growing at 3% per year	Social welfare equation combines economic growth theory (Ramsey model) and climate systems (geophysical equations, carbon cycle, change in temperature and CO2 concentration, etc). The result is a net output of avoided damages from emissions and abatement/mitigation costs.
A near-term to net-zero alternative to the social cost of carbon for setting carbon prices	Noah Kaufman, Alexander Barron, Wojciech Krawcyzk, Peter Marsters and Haewon McJeon	By 2025: $34 to 64/ton. By 2030: $77 to $124/ton	Different from a conventional SCC approach: instead of trying to quantify the SCC itself, they calculate "what price range is necessary to reach net zero by 2050?" As such, we may or may not want to include these estimates
Estimates of the social cost of carbon: a review based on meta-analysis	Pei Wang, Xiangzheng Deng, Huimin Zhou, Shankun Yu	$112.86/ton, assuming PRTR (pure rate of time preference) = 3%	
Country-level social cost of carbon	Katharine Ricke, Laurent Drouet, Ken Caldeira, and Massimo Tavoni	$177–805/ton	Socio-economic, climate, damages, and discounting modules

The social cost of carbon revisited	Robert S. Pindyck	\$80 to \$100/ton	Average SCC is the ratio of the present value of lost GDP from an extreme outcome to the total emission reduction needed to avert that outcome, based on a survey of experts
Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990	US EPA Interagency Working Group on Social Cost of Greenhouse Gases	\$14/ton (5% discount rate), \$51/ton (3%), \$76/ton (2.5%), \$152/ton (3% 95th Percentile)	Future population, economic, and GHG emissions growth, as well as equilibrium climate sensitivity (ECS)
Developing a Social Cost of Carbon for US Regulatory Analysis: A Methodology and Interpretation	Michael Greenstone, Elizabeth Kopits, and Ann Wolverton	\$21/ton in 2010 at the 95th percentile for a 3 percent discount rate	"1) Enter the baseline path of emissions, GDP, and population, and calculate the associated year-by-year paths of temperature and per capita consumption. 2) Shock the models with additional carbon emissions in year t and recalculate the year-by-year paths of temperature and per capita consumption that result from the adjusted path of emissions in all years beyond t. 3) Compute the marginal damages in each year as the difference between the per capita consumption 4) Discount the resulting path of marginal damages back to the year of emissions and calculate the SCC as a net present value."
Climate Risks and Carbon Prices: Revising the Social Cost of Carbon	Frank Ackerman and Elizabeth A. Stanton	almost \$900/tCO2 in 2010, rising to \$1,500/tCO2 in 2050	