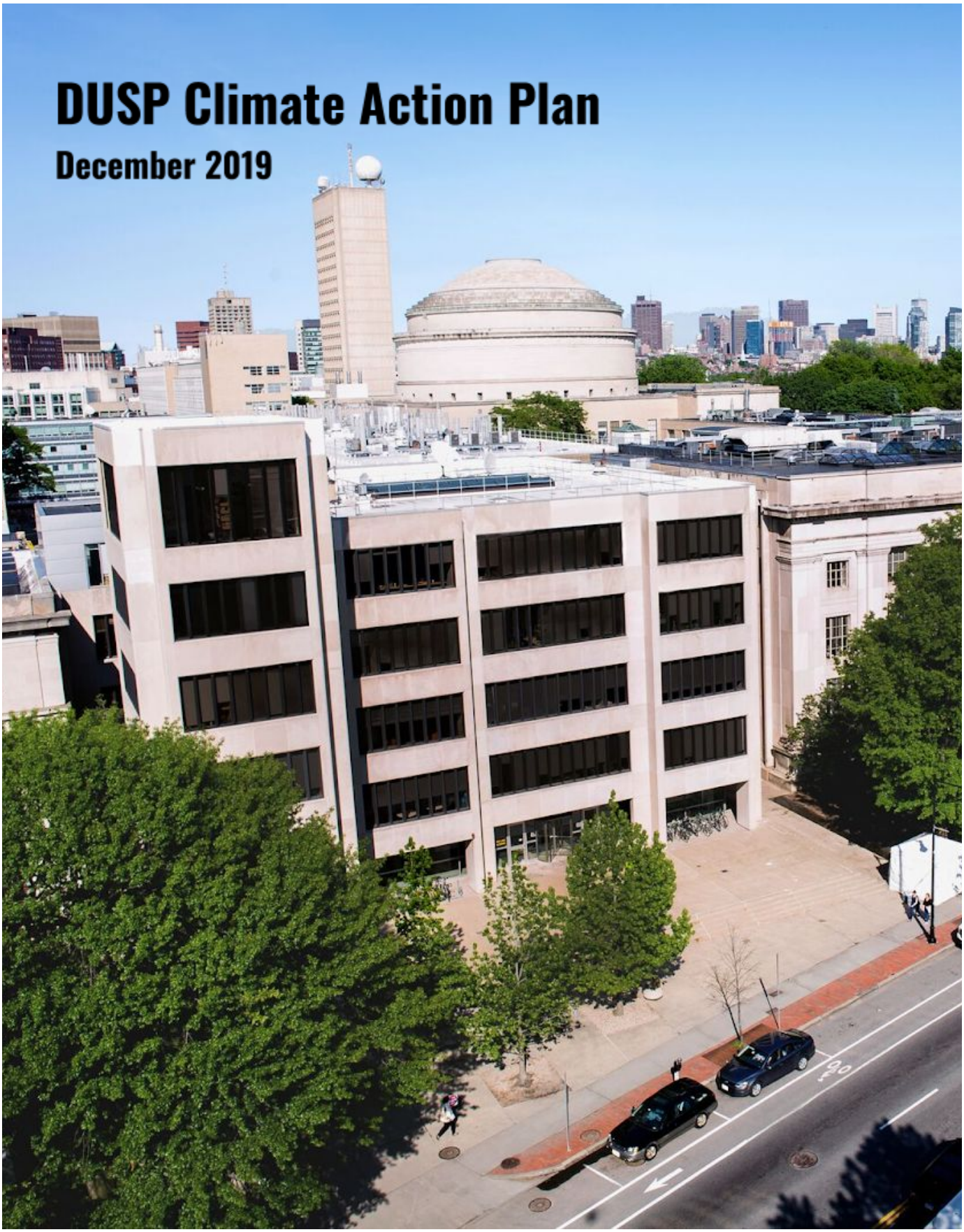
DUSP Climate Action Plan

December 2019



DUSP Climate Action Plan

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1. Executive Summary

In light of the climate crisis and the impacts already being felt around the world and in our own backyard, institutions such as MIT have a responsibility to mitigate their greenhouse gas (GHG) emissions. This work is crucially important as we know that those who have contributed the least to global carbon emissions will feel the impacts of climate change the most. As such, institutions must leverage their privilege and resources to reduce these disparate impacts.

While there is much that can and should be done at the institutional level, individual departments may have even more flexibility and agency to make change. MIT's Department of Urban Studies and Planning (DUSP) should lead by example through immediate action to reduce its GHG emissions and environmental impact. DUSP has demonstrated that it feels this urgency, through the support of DUSP Climate's departmental recommendations in Spring 2019 and the selection of climate change as the faculty's primary issue of concern in a 2017 visioning exercise; now is the moment to act.

The following report introduces our theory of change for how the department can use specific actions to reduce GHG emissions and environmental impact, as well as generate various co-benefits (including financial savings, alignment with our departmental values, and increased awareness). DUSP has three roles to play in this effort: 1. educating "changemakers"; 2. modelling change by demonstrating how to effectively reduce GHG emissions and environmental impact; and 3. becoming an "agent of change" by developing new solutions, advocating for political action, and leveraging its status as a renowned urban planning institution to elevate the importance of this work.

From this framework, we began our analysis by calculating an emissions baseline for DUSP from readily available data for travel (flying and commuting), building energy use, procurement, and waste. We calculate that DUSP's current annual GHG emissions are an estimated 1,917.9 metric tons of CO2 equivalent (MTCO2e). With an understanding of the proportion of our emissions in each category, we then include recommendations to the department with specific actions by category, as well as recommendations for how to formalize these efforts. The most important next step will be to dedicate staff time (beginning at 50% FTE) and two 50% student Research Assistants to implement the next stages of this process. These three individuals will initially be responsible for carrying out a community engagement process, improving the baseline emissions calculations, and implementing recommendations over time as pilot projects.

This report is the work of four DUSP students over the course of a semester, and does not represent the views of all students within the department. Now is the moment for conversations amongst ourselves to determine how to make this type of action a priority for the department, decide on next steps, and discuss the tradeoffs we are willing to make. The

following analysis may act as a guide for this process, but more collective reflection is needed to define the path forward.

2. Introduction

Motivation and History

This department-level DUSP Climate Action Plan is motivated by the sobering realities of the climate crisis and the dire projections for the planet if we do not reduce our current rate of emissions and avoid a warming of 1.5°C or greater.[1] MIT and DUSP must lead by example and work to reduce the institution's carbon footprint. Keeping in mind that those who have contributed the least to global carbon emissions will face the brunt of climate change impacts, it is crucial that elite institutions like MIT consider how to leverage their privilege to reduce these unequal impacts. To be climate leaders, it is not enough to contribute to climate science and policy research; we must also lead by example by taking concrete actions.

MIT's goal is to reduce greenhouse gas (GHG) emissions from 2014 levels by 32% by 2030.[2] This work is directed by the MIT Office of Sustainability (MITOS) and guided by "A Plan for Action on Climate Change."[3] There are opportunities, however, to experiment with more ambitious actions at the department level. As a department, DUSP can push for greater action by reducing its emissions faster than the campus goal and piloting environmentally sustainable and emissions-reducing practices that are difficult to test at the campus-scale.

This DUSP Climate Action Plan is ultimately the result of a year-long effort by DUSP Climate, a group of students and faculty concerned about the climate crisis. DUSP Climate formed in Fall 2018 to reinvigorate climate change-related conversations within the department and prompt both reflection and action. The involved students and faculty were concerned with how DUSP, through its education and research, was urging cities to take drastic action to reduce their GHG emissions, but was not critically assessing how the department could reduce its own contribution to climate change.

In Spring 2019, DUSP Climate hosted a lecture series to support a department-wide discussion on climate change. This series also became an opportunity to discuss the state of the department's climate change action and research. The opening event of the lecture series attracted over 100 people from DUSP, the greater MIT community, faculty and students from other universities, and other interested members of the broader community. Following the opening event, DUSP Climate hosted five additional lectures, which attracted an average of 30-40 students and faculty. These were meant to examine what the community understands as the strengths and weaknesses of climate change learning and research within DUSP and what could be the future of climate education and action within the department.

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[1] "Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C Approved by Governments — IPCC."
[2] MITOS, "MIT Campus Greenhouse Gas Emissions Reduction Strategy Published | MIT Sustainability."
[3] "A Plan for Action on Climate Change."

In parallel with these educational efforts, DUSP Climate drafted recommendations for the department that called for elevating the topic of climate change in DUSP classes, research, and educational programming, and for reducing the department's carbon footprint. DUSP Climate hosted two workshops to discuss the recommendations with students and incorporate feedback. One hundred DUSP students signed on to the final recommendations.

As of Fall 2019, many of the recommendations related to educational opportunities on climate change have already been realized. The annual Lightning Talks and alumni DUSPx program were combined into one local event that focused on climate change research and professional projects. The department's "Planning Ideas that Matter" lecture series focused on climate change and the Gateway introductory course for Master in City Planning (MCP) students included a two-week module on climate change. These types of educational opportunities and events should continue to be a priority for the department.

Developing the DUSP Climate Action Plan

Among the DUSP Climate recommendations was one that directed the department to set emissions-reducing goals and benchmarks. Motivated by this recommendation, Professors Mariana Arcaya and Chris Zegras developed a semester-long class, "11.S952: Developing a Climate Action Strategy for DUSP," for master's students in the department. This DUSP Climate Action Plan is the product of that class, and is motivated by the values of DUSP, MIT, and the American Planning Association (APA).[4] Reducing the department's carbon footprint specifically addresses:

- DUSP's "critical focus area" to "create ecologically resilient and adaptive urban regions";[5] and, in 2017, department faculty voted climate change as their number one issue of concern, followed by economic inequality, as part of an ongoing visioning process;
- MIT's document on the Institute's Pathway to Sustainability Leadership, which, among other goals, calls upon MIT to become:
    - "An exemplar that incorporates sustainability considerations into campus infrastructure, operations, student life, and daily decisions";
    - "A model of organizational transformation for sustainability leadership";[6]
- The APA's principle to "strive to protect the integrity of the natural environment and the heritage of the built environment";[7] and, in response to the U.S. withdrawal from the Paris Agreement, the APA responded stating that "APA believes that climate change is one of the most important planning challenges of the 21st century requiring local, national, and global action."[8]

[4] Note: while the students in the class are also members of the ongoing DUSP Climate group, this Climate Action Plan is a specific effort of 11.S952.
[5] DUSP, "About | MIT Department of Urban Studies and Planning."
[6] MIT, "Pathway to Sustainability Leadership."
[7] APA, "Ethical Principles in Planning."
[8] Christiansen, "APA Statement on the Paris Climate Agreement."

As the city planning field is concerned with improving society and ensuring equitable, just, and sustainable cities, DUSP is uniquely positioned to propose more radical changes to its own practices that emit carbon. Although DUSP's carbon footprint is relatively small compared to the rest of MIT, its actions can serve as a potential model and stimulus for the rest of the university. In fact, as of the writing of this report, we know that other departments have heard of DUSP's effort to conduct and implement its own Climate Action Plan and are interested in doing the same. Bottom-up departmental action on climate change is critical to push MIT to undertake more ambitious policies and goals to truly be a leader in climate action and cultivate future leaders equipped to tackle climate change.

The remainder of this report consists of six sections. Section three presents the theories of change which guide our recommendations. Section four outlines our process, strategy, and scope. Section five presents our estimate of DUSP's current greenhouse gas emissions to provide a baseline. Section six details our recommended emissions reduction strategies and section seven details the implementation of these recommendations. Section eight includes brief conclusions. The appendices contain: further information on all of our recommendations to DUSP, including key actors and rollout strategies; additional details on the methods and analysis used in our baseline emissions calculations; and a proposed work plan for new sustainability-focused staff and student RAs.

3. Theories of Change

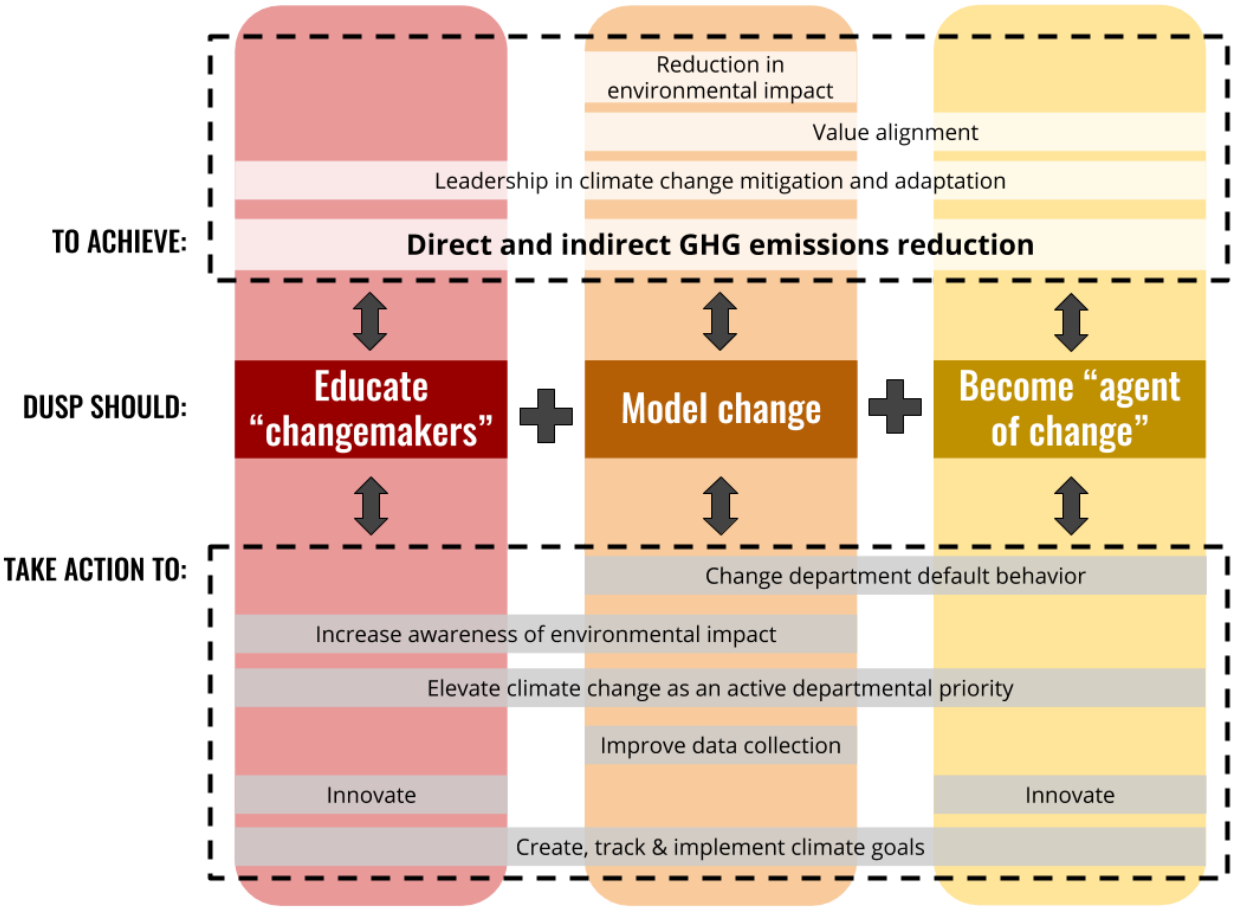
Introduction to our Theories of Change

We believe that as a leading academic institution, DUSP (and MIT) has a responsibility to help humanity lower our collective greenhouse gas emissions. Responding to climate change requires technological innovation, and rapid mitigation and adaptation measures, but it also requires individual behavior changes, which have a cumulative impact. As members of an academic unit, we can serve as examples of how individual actors and small institutional units can reduce their emissions. If we set a higher standard of behavior for ourselves, our actions may spread beyond the campus and into the outside world.

The following section further explains our theories about why we believe DUSP should take a more active role in the global response to climate change, and how we think the department should take action to reduce its GHG emissions. We use the term “theory of change” to explain our understanding and assumptions of how to change institutional and individual mindsets and behaviors to achieve our objectives related to environmental sustainability. The following text and diagrams attempt to contextualize our recommendations and justify future action by the department. Figure 1, “DUSP’s Roles in Climate Action,” depicts DUSP taking on new climate action roles, and how those roles relate to the target outcomes and recommendations of this report. Figure 2, “Mechanisms of Change for DUSP,” illustrates how different mechanisms of change work together to lead to departmental GHG emissions reductions and influence individual behaviors, which might also lead to emissions reductions within and beyond DUSP.

DUSP as a Climate Action Leader

Figure 1: DUSP's Roles in Climate Action



DUSP can catalyze climate action in three main ways based on how campuses approach environmental sustainability more broadly.[9] First, DUSP can educate "changemakers" (e.g. students), on how to help urban areas mitigate and adapt to climate change. Second, DUSP can demonstrate - for the MIT community, other academic institutions, and the broader community - how to lower emissions by "modelling change." Third, DUSP can become an "agent of change" by developing new solutions, advocating for political action, and leveraging its global status as an urban planning institution to elevate the importance of GHG emissions reduction among a broad range of audiences (e.g., local governments, professional associations). These three roles are interlinked and essential to seriously tackling the challenge of climate change as an academic institution.

[9] Washington-Ottombre, Washington, and Newman, "Campus Sustainability in the US."

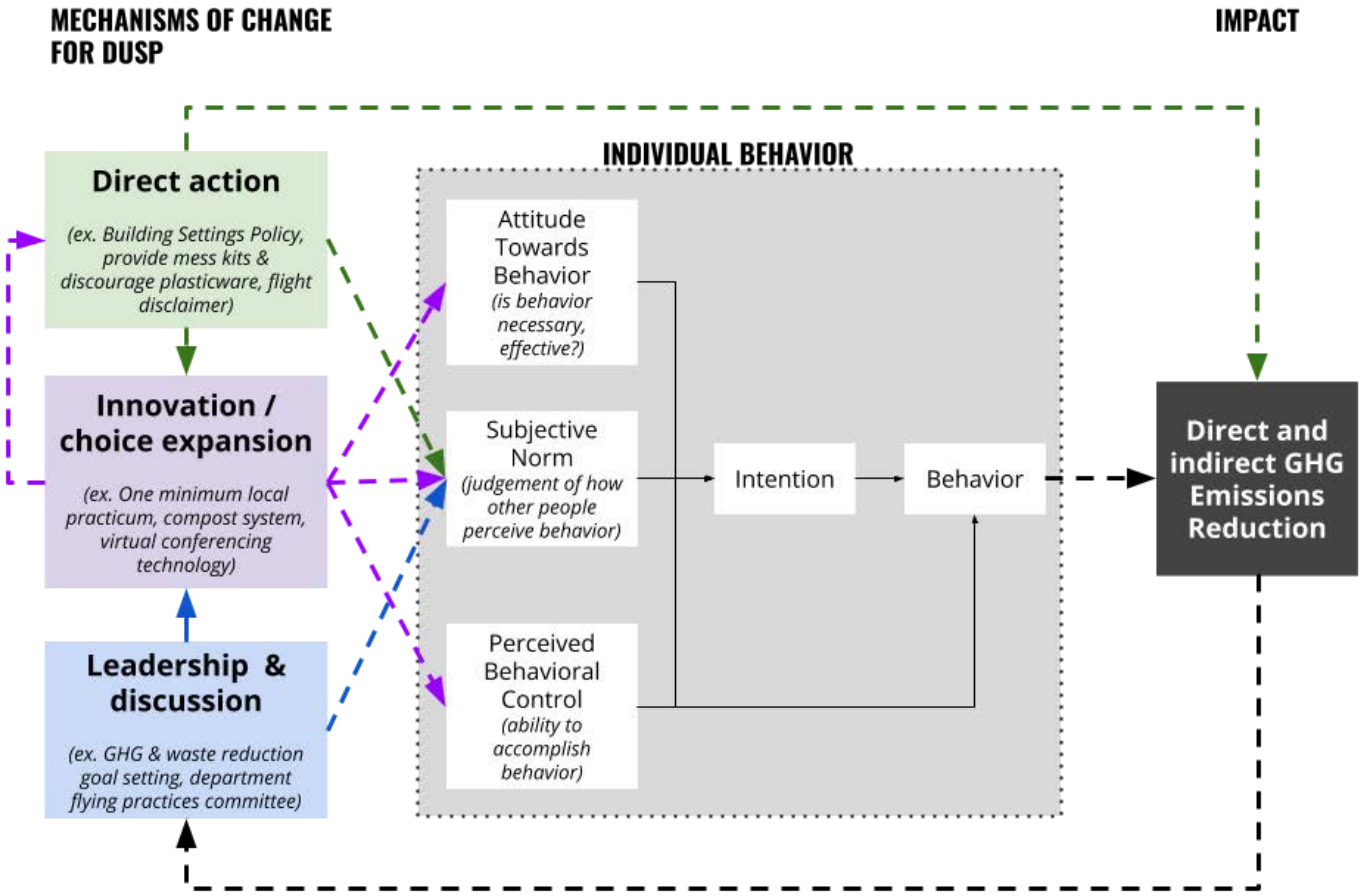
DUSP aspires to focus on addressing "the challenges associated with urban development in the twenty-first century";[10] climate change is certainly one of those challenges. We, as a department, should try to fully engage with the urban transformation necessary to tackle the climate change challenge, practice the behaviors necessary to cut emissions and mitigate global warming, and learn from those attempts. Rather than solely focusing on conducting research or educating professionals, we should recognize that DUSP is very much a part of the global climate system. We generate emissions and contribute to global warming even as we work to help communities adapt to a changing climate. Further, as part of an institution of science and technology, we should lead the way by implementing new solutions, creating new policies, testing the effectiveness of behavioral changes, and using the campus as an example to demonstrate possibilities to the rest of the world.

The recommendations that follow in this report are a call for transformation, and could be the first step in DUSP's evolution to becoming a beacon for climate change scholarship and action. In the future, to create meaningful change, DUSP must use an adaptive and iterative approach to continuously re-evaluate our goals and objectives, and critically assess all relevant processes and practices on an on-going basis.

[10] DUSP, "About | MIT Department of Urban Studies and Planning."

Lowering Emissions from the Top-Down and Bottom-Up

Figure 2: Mechanisms of Change for DUSP



Our recommendations focus on ways in which DUSP can remove barriers to lowering GHG emissions, create opportunities for better individual decision-making, and elevate the climate crisis discussion within and beyond the department. While the goal of this plan is to reduce the department's GHG emissions, our recommendations also aim to promote more general environmentally sustainable behavior.

The recommendations in this Climate Action Plan presume three different mechanisms of change:

- Direct action: department leadership can take actions that lead to direct GHG emissions reductions and/or remove systemic barriers to relevant individual behaviors.

- Innovation and choice expansion: department leadership can encourage or incentivize the creation of new solutions, which in turn lead to new opportunities for environmentally sustainable behavior by individuals within the department, or for direct action by department leadership.
- Leadership and discussion: the department can generate meaningful community engagement around GHG-emitting behavior and solutions, the climate change challenge for cities around the world, and DUSP's role in solving these problems.

Successful emissions reduction, and fulfilling our role as a potential climate leader, may foster a sense of pride in the DUSP community, promoting pro-environmental behavioral norms and cultivating climate crisis recognition as part of the department's identity. Top-down decision-making, however, will not suffice.

Our theory of change is based in part on the theory of planned behavior (TPB). TPB has frequently been used to study individuals' participation in environmentally-friendly behaviors, like those proposed in our recommendations.[11] TPB focuses on psychological reasons individuals behave in a certain way:

> "According to the TPB, intention to perform a behavior is influenced by three constructs: the subject's attitude of favorableness to the behavior, their willingness to comply with pressures from external sources of influence (subjective norm), and perceived behavioral control (their perceived ability to actually engage in the behavior). In turn, intention along with perceived behavioral control directly affects actual behavior."[12]

In this theory, intention is defined as "an indication of how hard people are willing to try, or how much of an effort they are planning to exert, in order to perform the behavior."[13] Other factors like age and background also influence behavior, as do systemic barriers, or those things that constrain our ability to engage in certain behaviors.[14] While the theory of planned behavior does not capture the full complexity of individual decision-making, it has been a useful framework to ground our recommendations and analysis.

We propose some recommendations solely because they influence attitudes, norms, and perceived behavioral control towards pro-environmental behavior. We expect that these behaviors contribute to GHG emissions, or contribute to environmentally sustainable norms and, therefore, indirectly may contribute to lowering GHG emissions over time. While it is impossible to compute the GHG emissions impact of these recommendations, we believe they

[11] Taylor and Todd, "Understanding Household Garbage Reduction Behavior"; Chan and Bishop, "A Moral Basis for Recycling"; de Leeuw et al., "Using the Theory of Planned Behavior to Identify Key Beliefs Underlying Pro-Environmental Behavior in High-School Students."
[12] Swaim et al., "Influences on Student Intention and Behavior Toward Environmental Sustainability," 468.
[13] Ajzen, "The Theory of Planned Behavior," 181.
[14] de Leeuw et al., "Using the Theory of Planned Behavior to Identify Key Beliefs Underlying Pro-Environmental Behavior in High-School Students."

will substantially contribute to lowering the department's GHG footprint by guiding individuals within the department towards pro-environmental behavior.

Finally, while direct action is key to reducing GHG emissions, we believe that DUSP must also leverage its competitive advantage by encouraging innovative, results-oriented solutions to climate change. The department should devote new efforts to generating ideas that are testable on campus, engage students, and can be modified until they work and then exported to the campus at large and perhaps, the global urban community. In this way, DUSP is not only modelling change and educating changemakers, but also becoming an "agent of change."

4. Process, Strategy, & Scope

We started our process by conducting a baseline assessment of DUSP's GHG emissions. We worked closely with staff and faculty at the MIT Office of Sustainability (MITOS) and within DUSP to assess what datasets existed for the baseline and to determine the most feasible methods to derive emissions calculations. Once we completed the baseline, we had many conversations with staff members in the department to better understand how DUSP currently runs facilities and programs, and to gather their thoughts on how we can make changes to reduce our consumption and associated negative environmental impacts. We also researched actions other schools have taken to reduce their carbon footprints and environmental impacts for ideas that could also be implemented at DUSP. Finally, we presented our findings and progress to the School of Architecture and Planning's School Council twice over the course of the semester (October 16 and November 26, 2019) and received positive feedback.

Our goals and approach to developing this Climate Action Plan were greatly influenced by time and capacity constraints -- we had one semester to produce this report as four masters students guided by two professors as part of a 9-credit hour class. Recognizing that we did not have the capacity to produce a comprehensive deep dive, our goal for this report was to achieve breadth over depth and be illustrative rather than conclusive. The numbers and calculations in the report are rough estimations using readily accessible data. However, we believe they are useful and appropriate for understanding the sources and magnitudes of DUSP's emissions, thinking about DUSP's trajectory, and making recommendations.

The scope of this report is limited to DUSP, meaning actions which DUSP controls, funds, and influences through policies. There are a few references to the larger institution of MIT, but these are limited to situations where changes at the level of MIT can help DUSP achieve greater GHG reductions. A dramatic reduction in DUSP's, and subsequently MIT's, carbon emissions requires changes beyond those considered in the scope of this report. For example, if affordable housing were more readily available for students and staff, commuting distances could be reduced. Individuals forced to live far from campus because of the lower costs of housing would not have to rely on cars as frequently. Also, SA&P, and MIT more generally, faces continuous pressures to expand campus building space; such efforts should be closely scrutinized, as buildings represent the largest share of the institute's carbon emissions. Existing space should be utilized to its maximum potential before new buildings are constructed. Finally, the current discussions around higher education funding also need to consider the climate impacts of investments and funding sources. Again, these are all important points to reflect upon, but are outside the scope of this report.

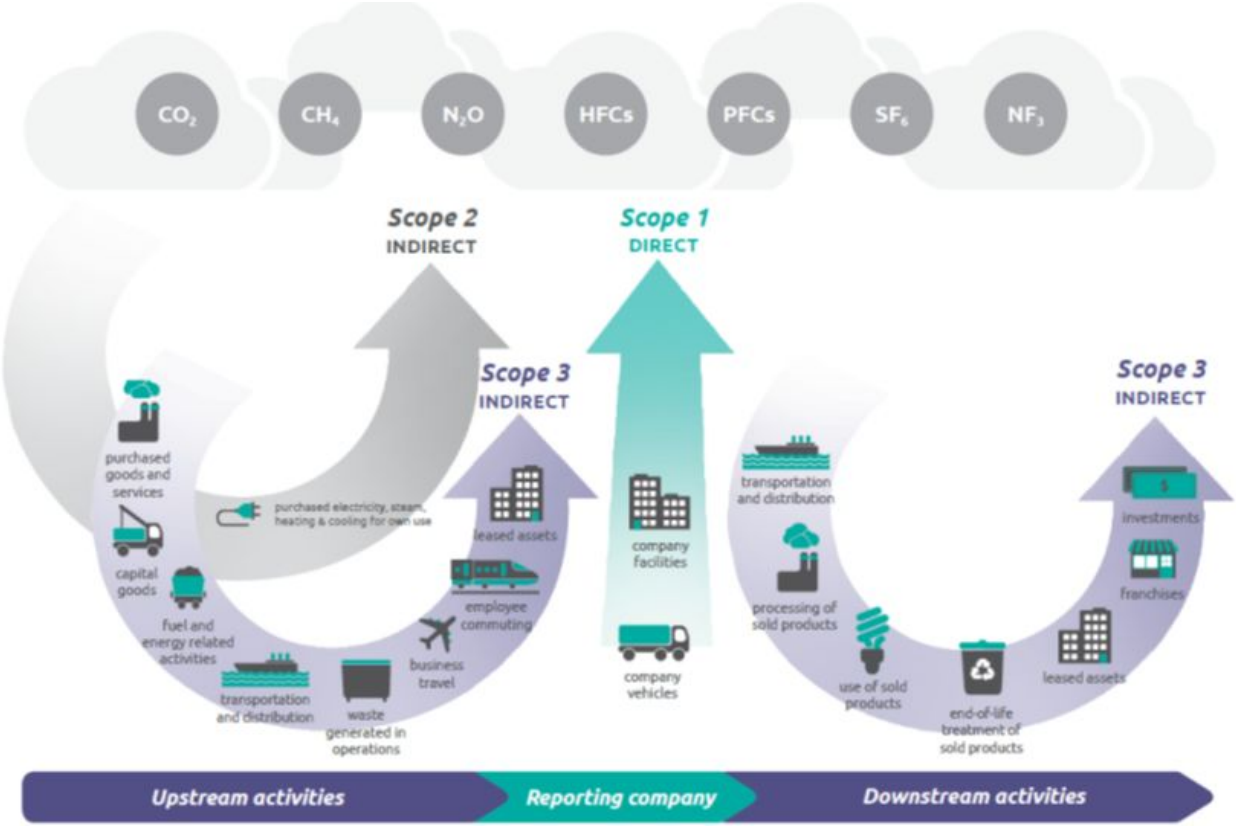
Our recognition of the need for action beyond the scope of DUSP is based in our understanding of how the climate crisis is rooted in and linked to systemic issues of inequality. Developed nations and the wealthy have disproportionately fueled global warming. And yet, the consequences will be felt across the world, and often more severely by those with the least

culpability. In this way, climate change will exacerbate issues of inequality and injustice, including, but not limited to, environmental injustice, racial injustice, economic marginalization, lack of adequate housing, food insecurity, and more. While we cannot address all of these interrelated issues, working to significantly mitigate our GHG emissions as a department, and institution, is one way that we can attempt to hold ourselves accountable and minimize the detrimental impacts of climate change.

5. Baseline Emissions by Category: Calculations and Discussion

This section provides estimates of DUSP's greenhouse gas emissions, using readily available data sources. The prevailing method used for estimating organizational GHG inventories includes three "scopes" of emissions (see Figure 3).[15] Scope 1 includes emissions from direct fuel use, such as fuel burned in company vehicles or by heating systems. Scope 2 includes emissions resulting from the electricity, steam, or heat purchased from a provider (e.g., an electricity company). Scope 3 emissions are from sources related to an organization's relevant activities, but outside its direct ownership or control, such as products consumed, business travel, commuting, investments, and more. MIT's current GHG emissions inventory calculated by the MIT Office of Sustainability (MITOS) does not include Scope 3 emissions.

Figure 3: The Scopes of Carbon Emissions



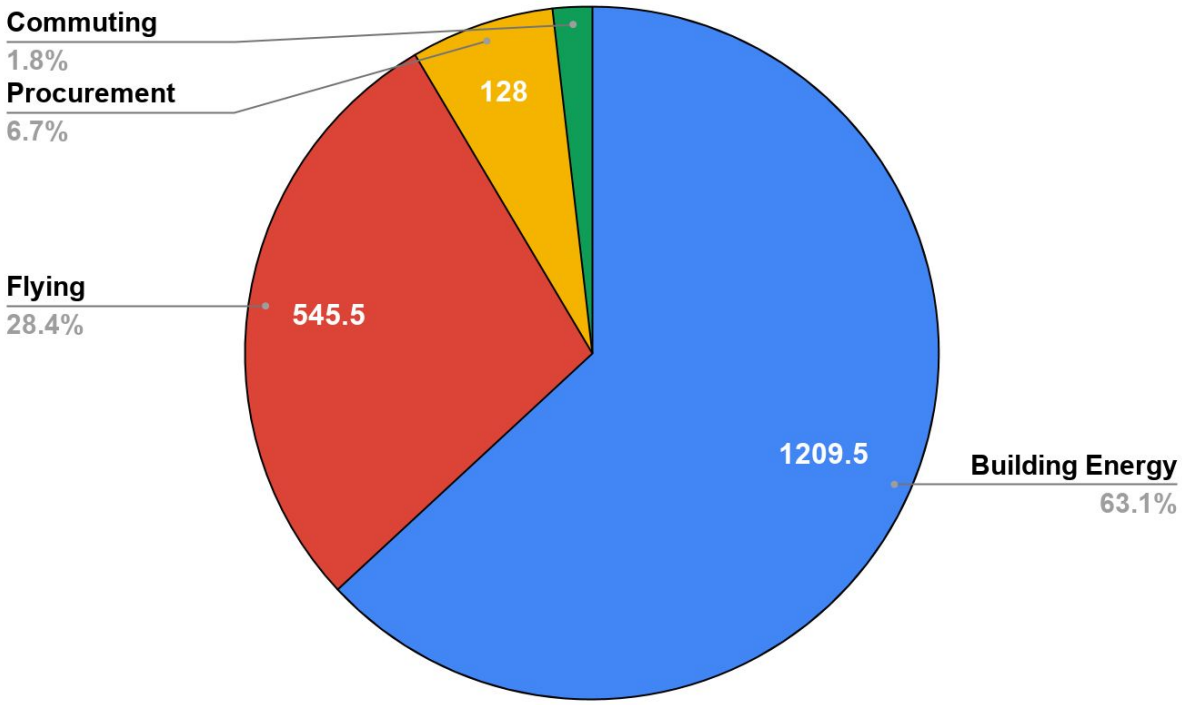
Our emissions baseline is primarily for FY2019 (although not all data were available for that timeframe) and is focused on three categories -- building energy use (scopes 1 and 2) and a partial scope 3 inventory, including travel (flying and commuting) and procurement/waste. We focused on these categories because they contain actions over which DUSP has control, either through funding or policy, and/or because they directly relate to working or studying at DUSP.

[15] Greenhouse Gas Protocol, "Corporate Value Chain (Scope 3) Standard | Greenhouse Gas Protocol."

This baseline can help guide DUSP in deciding on what areas it must focus if the department is serious about reducing emissions and cultivating climate leaders. In summing together these three categories, we calculate an estimate of DUSP's current annual GHG emissions as 1,917.9 metric tons of CO2 equivalent (MTCO2e) (see Figure 4). For reference, in 2018, MIT emitted 204,000 metric tons of CO2 equivalent.[16] (Solar Power Purchase offsets bring the MIT total down to 170,960 metric tons of CO2 equivalent.)

As stated in the introduction, this baseline is a rough estimate of the department's current emissions. Nevertheless, we believe it is valuable in providing an initial framework for thinking about the different sources of the department's emissions, how they relate to one another proportionally, and where data gaps exist that could be corrected through improved data collection or data sharing protocols. Appendix B provides a detailed look at the data sources and methods used to calculate the baseline in each category, together with assumptions and limitations. Figure 4 (below) provides a breakdown of GHG emissions total by category, and the following text summarizes these results.

Figure 4: Estimated DUSP GHG Emissions (in metric tons of CO2 equivalent)



[16] MITOS, "Climate Action Plan Update: Reducing MIT's Emissions."

Travel

For travel emissions, we gathered readily available data on flying by DUSP students and faculty, and commuting by DUSP students, staff, and faculty. First, related to flying, we discussed what would ideally be included in a full scoping of all department-related flying emissions. This would include:

1.) faculty travel (for conferences, research, and lectures, when paid for by the faculty member or MIT)
2.) student travel (for conferences, research, and class travel, when paid for by the student or MIT)
3.) staff travel (for DUSP-related events, fundraising, etc. when paid for by the staff member or MIT)
4.) visitors (for lectures and events, when the visitor's travel is paid for by MIT)

For the purposes of our baseline, we focused on gathering all readily-available data for students and faculty for Fiscal Year 2019. In order to convert miles flown into metric tons of CO2 equivalent (MTCO2e), we used an online carbon footprint calculator, assuming direct flights and including radiative forcing.[17] [18] Table 1 shows the breakdown of our calculations by subcategory for faculty and students, for a total of 545.5 MTCO2e.[19] This is most likely a significant underestimate, as not all faculty and student travel is captured in our data sources. Additionally, this estimate does not include the other potential components of a full scope of flying emissions, including staff travel and visitors invited by DUSP.

Table 1: DUSP's Emissions from Flying by Actor and Category.

	Source of Emissions	**Total Emissions (MTCO2e)**
Faculty	Concur-recorded Flights	86
Students	Conferences	57.93
	Practica	171.33
	Research Grants (internal, PKG, and MISTI)	230.25
Total Flying Emissions		**545.5 MTCO2e**

[17] Carbon Footprint Calculator: https://calculator.carbonfootprint.com/calculator.aspx
[18] Planes at high altitudes have an increased effect on global warming. By including radiative forcing, carbon emissions are multiplied by DEFRA's (Department for Environment, Food, and Rural Affairs in the UK) recommended Radiative Forcing factor of 1.891, when using this online calculator.
[19] Thank you to DUSP HQ for assisting with flight data from Concur and conferences, Ellen Rushman for practica data, Ezra Glenn for internal grants, and staff at MISTI and the PKG Center.

For commuting-related emissions, we gathered data from the 2018 version of MIT's biennial Commuter Survey to estimate emissions from faculty, staff, and student's daily commutes to and from DUSP.[20] We are considering commuting as part of DUSP's scope 3 emissions, which include a calculation of travel to and from work or school. As a result, DUSP students had annual commuting emissions of 2.78 MTCO2e in 2018, or 0.01 MTCO2e per capita. DUSP faculty and staff had annual commuting emissions of 32 MTCO2e in 2018, or 0.3 MTCO2e per capita. The total estimated annual commuting emissions of DUSP is 34.9 MTCO2e, which is 1.8% of DUSP's annual GHG emissions.

Table 2: DUSP's Emissions from Commuting by Actor.

Category	Sample Size	Estimated Population	Total Emissions (MTCO2e)
Student	105	203	2.8
Faculty	15	27	12.0
Administrative Staff	7	10	8.2
Other Academic Group	16	20	2.4
Sponsored Research Staff	4	38	3.9
Support Staff	11	13	5.6
Total Commuting Emissions	**158**	**311**	**34.9 MTCO2e**

Building Energy Use

The emissions from building energy use were obtained from the MIT Office of Sustainability (MITOS) using data from building meters and calculated as metric tons of carbon dioxide equivalent (MTCO2e) for Fiscal Year 2019 (July 1, 2018 - June 30, 2019).[21] Building energy uses included in the calculations are: electricity, steam (heating), and chilled water (cooling) both produced by MIT's central plant and purchased from utilities. Data about building energy use can also be accessed through MITOS's Energize MIT platform.[22]

[20] Thank you to Elena Renda, Visiting Scientist at DUSP, for help in extracting the relevant data from the survey and to DUSP HQ, especially Karen Yegian, for data collection assistance.
[21] Thank you to Steven Lanou at the MIT Office of Sustainability for calculating DUSP's building energy use emissions for FY2019.
[22] https://tableau.mit.edu/views/Energize_MIT/Energize_MIT?:embed=y&:showShareOptions=true&:display_count=no&:showVizHome=no#1

DUSP occupies space in three buildings: 9, 10, and 7. However, since DUSP shares all of the buildings with other departments, DUSP emissions were calculated as a percentage of the total building emissions according to DUSP-assigned space in each building. The assigned space designation only applies to discrete spaces such as classrooms, and faculty and staff offices. Common spaces such as hallways and bathrooms are not included; however, the percentage used to calculate DUSP emissions was derived using the total assigned space (not total building area), so the building emissions figure captures all emissions. To put DUSP building energy use emissions in perspective, DUSP makes up 0.64% of the MIT Cambridge campus's total building emissions.

Table 3: DUSP Assigned Building Space and Building Emissions

Building	DUSP Assigned Sq Ft	Building Total Sq Ft	% DUSP Space of total building area	FY19 Total DUSP Emissions (MTCO2e)
9	23,669	77,414	61	923.1
10	7,245	144,463	8.4	246.3
7	1,113	119,015	1	40.1
Total	**32,037**	**340,892**	**70.4**	**1,209**

Procurement and Waste

Procurement is a part of scope 3 and not currently considered in the MITOS inventory of MIT's total GHG emissions. Preliminary research indicates that the campus purchased one million items in 2016 and, in 2018, produced an estimated 6,100 tons of waste.[23] Embedded emissions in procurement also requires calculating the transportation emissions related to delivering procured items to campus, which are a growing concern for MIT given a rise in Amazon deliveries.[24]

Jeremy Gregory, a research scientist at MIT, and MITOS estimate GHG emissions based on the dollar amount spent in three procurement categories: computers, furniture, and food. Using the Gregory/MITOS model, we estimated procurement emissions based on the dollar amount of DUSP purchases (made with the department credit card) in Fiscal Year 2019 on food (~$300,000) and the combined equipment and furniture expenditures (~$100,000). This results in a rough estimate for procurement emissions of around 128 MTCO2e.

[23] This is in-progress research by MITOS and Rachel Perlman, 2018.
[24] This is in-progress research by MITOS, 2019.

Waste is directly related to the life-cycle of items we procure. We do not, however, include waste in DUSP's estimated GHG inventory, due to uncertainties with data and the possibility that the MIT waste stream results in net negative GHG emissions (see Appendix B for more details). Nonetheless, MIT produces significant quantities of solid waste, estimated at 554 lbs per person in 2018.[25]

[25] This is in-progress research by MITOS and Rachel Perlman, 2018.

6. Recommendations by Category

These recommendations are divided into four categories, for each of the major categories in which DUSP could make changes to substantially reduce its greenhouse gas emissions and environmental impact: travel (including flying and commuting), building energy use, procurement, and waste. Each of these categories includes an introduction, which frames the importance of taking action within this category and states any overarching considerations that should be taken into account before moving forward. Each recommendation is accompanied by important precedents and primary expected outcomes. See Appendix A for additional details related to implementation of each recommendation, including central actors and a rollout strategy.

The recommendations within each subsection are divided into three types of potential actions. First, "By Design," refers to actions that are ready to be implemented, in that we know how they could be implemented, and they impose a direct change that individuals would not necessarily be able to opt out of. Second, "By Choice," refers to actions that are similarly ready to be implemented or have a known path forward, but they result in a change that gives individuals the choice to opt into an action that will have a beneficial environmental impact. Third, "To Solve For," refers to actions that are not yet ready to be implemented, as they require more research, technological development, and/or process invention. The latter category is a call to utilize the immense resources available to us at MIT and within DUSP, including financial, technological, and human, to creatively solve the problems before us.[26]

[26] MITOS is currently piloting this framework of "By Design, By Choice, To Solve For" as a way of presenting sustainability actions across the institution. It is used in this report with permission from Julie Newman, Director of MITOS.

Travel

The recommendations in this category, all flying-related, are put forth with a particular emphasis on the collaborative processes to determine how the department as a whole should set goals and implement specific actions in order to reduce our flying. Our baseline estimates that flying is nearly 30% of DUSP's total emissions. Additionally, it is a category over which we as individuals have a lot of direct control. This means that if the department is to reduce its carbon emissions, actions that limit flying could go a long way towards meeting that goal. At the same time, we recognize that our department is strengthened by the research and engagement that our students, staff, and faculty realize across the United States and around the world. We also recognize that imposing limitations on flying without careful consideration of the impacts would have an undue burden on those students and faculty with deep connections in far-away places, such as international students who seek to maintain academic and/or familial and social connections with their home. This is especially true for those who work in underserved geographies and whose research and practice can provide significant benefits. As such, our recommendations are meant to encourage deeper conversations and reflection within the department around why and how we travel in order to inspire more conscientious flying practices by everyone. Until now, decisions to fly have primarily involved only time- and money-related considerations, but the urgency of climate change and the impacts it will have on people around the world, particularly vulnerable populations, means that we must now also begin to consider the environmental consequences of our actions.[1]

[1] Tabuchi, "'Worse Than Anyone Expected.'"

Table 4: Flying Recommendations

Type of Recommendation	Recommendations	Primary Expected Outcomes					
		Leadership/ Precedent Setting	Increasing Education & Awareness	Reduction in Emissions	Reduction in Env. Impact	Financial Savings	Value Alignment
By Design	**Data Collection System:** Implement a data collection system requiring students, staff, and faculty to record all academic- or department-related flights in order to better understand DUSP's travel patterns. *Precedent: ETH Zurich uses a database to enter flight-related data, and each professor receives a monthly report of their activity (a)*	Leadership/ Precedent Setting	Increasing Education & Awareness	Reduction in Emissions			
	Funding Disclaimers: Attach disclaimers to all internal funding applications that ask petitioner to calculate and consider the GHG impact of their travel, and advocate for external funders to do the same.	Leadership/ Precedent Setting	Increasing Education & Awareness	Reduction in Emissions			
By Choice	**Local Practicum:** Require at least one local practicum be offered every semester. *Example: If one local practicum (8 students, 2 faculty) replaced one international practicum in Italy, that would be a savings of roughly 18-20 MTCO2e or 3.5% of our estimate of DUSP's flying-related emissions. If it replaced a practicum in Singapore, that would be a savings of roughly 42 MTCO2e or 8% of our estimate of DUSP's flying emissions.*	Leadership/ Precedent Setting		Reduction in Emissions		Financial Savings	Value Alignment

To Solve For	**Department-wide Collaborative Process:** Initiate internal process to reflect on current department flying patterns, collaboratively decide on a flying-related emissions reductions goal, and implement actions in order to reduce emissions. This could include setting up a committee tasked with leading this process, but should include significant engagement with students (undergraduates, graduates, and PhDs), staff, and faculty. *Precedents:* *ETH Zurich: collaborative intra-university process through which each department unit set its own flight reduction goal and determined how to meet it. (b)* *UCLA: internal carbon tax of $9 for every domestic roundtrip travel and $25 for every international roundtrip travel that goes towards their Carbon Offset Fund to support on-campus projects that "provide measurable reduction in GHG emissions." (c)* *MIT: current air travel offset efforts, being led by the Sloan Sustainability Initiative, the Environmental Solutions Initiative, etc.*	Leadership/ Precedent Setting	Increasing Education & Awareness	Reduction in Emissions			Value Alignment
	Faculty Collaborative Process: Initiate a process of flying-related dialogue and reflection among all faculty about drivers of travel (What are all of the reasons you fly? Do you want to fly in all of those situations? How could you cut a trip or more each year? What would be the cost to you to reduce your flying?) in order to determine possible next steps. This is particularly important for faculty as our baseline found that they travel almost 3X as much as students on a per capita basis (6.2 MTCO2e/faculty versus 2.3 MTCO2e/student).	Leadership/ Precedent Setting	Increasing Education & Awareness	Reduction in Emissions			Value Alignment
	Make MIT a Regional Hub: Initiate process to explore positioning MIT as a regional hub with state-of-the-art virtual technology for conferences, speaking events, etc.	Leadership/ Precedent Setting	Increasing Education & Awareness	Reduction in Emissions			

Notes: (a) https://ethz.ch/en/news-and-events/eth-news/news/2019/01/flugreisen-reduktion.html
(b) https://ethz.ch/en/news-and-events/eth-news/news/2019/01/flugreisen-reduktion.html
(c) https://www.sustain.ucla.edu/airtravelfund/

Building Energy Use

Building energy use is the largest component of DUSP's GHG emissions, accounting for 64% of total emissions. Buildings are often areas of focus to significantly reduce GHG emissions, through structural building retrofits, such as insulation, energy efficient lighting, and HVAC upgrades. However, due to the School of Architecture and Planning's decision to move to the Metropolitan Warehouse (MET in the near future, there is little incentive to make investments in DUSP's current buildings. Therefore, the building energy use conservation recommendations are more focused on individual behavioral changes to reduce energy consumption. Although these changes may not have as large of an effect on GHG emissions as building systems upgrades, they are very important in shifting norms towards more sustainable habits and expectations.

Table 5: Building Energy Use Recommendations

Type of Recommendation	Recommendations	Primary Expected Outcomes					
		Leadership / Precedent Setting	Increasing Education & Awareness	Reduction in Emissions	Reduction in Env. Impact	Financial Savings	Value Alignment
By Design	**Building Energy Management Settings Policy:** Set a strict DUSP Building Energy Management Settings Policy defining default settings that cannot be changed via individual requests to facilities. This includes thermostat settings, room sensors installations (for lighting and temperature control), appliance energy savings settings, etc. Ensure that there is consistency in how the policies are implemented. In addition, improve signage to remind individuals to turn off lights and electronic screens.			Reduction in Emissions		Financial Savings	Value Alignment
	Holiday Building Curtailment: Implement holiday building curtailment for DUSP buildings. *Precedent: UC Berkeley turns down lighting, ventilation, and heating in buildings for about a week and a half each year over winter break. Last year, curtailment saved about 452,000 kWh of electricity and about 2,238,000 pounds of steam. Together these savings totaled over $112,000. (a)*	Leadership / Precedent Setting		Reduction in Emissions		Financial Savings	Value Alignment

	Crowdsourced Energy Review Convene a yearly departmental student, faculty, and staff meeting with SA&P Director of Facilities to crowdsource ideas on how to conserve building energy and voice concerns.	Leadership / Precedent Setting	Increasing Education & Awareness				Value Alignment
By Choice	**Conduct Building Energy Audit:** Conduct a building energy audit to determine further target areas for energy efficiency and a comprehensive list of actionable items.			Reduction in Emissions	Reduction in Env. Impact	Financial Savings	
	Establish Sustainability Best Practices Orientation Session: Start a best practices education campaign including a sustainability orientation session on DUSP behavioral standards such as turning off lights and unplugging charged devices (as well as waste reduction practices).		Increasing Education & Awareness				Value Alignment
To Solve For	**High EE Standards for the MET Building:** Ensure the new MET Building is held to high energy efficiency and sustainability standards.	Leadership / Precedent Setting	Increasing Education & Awareness	Reduction in Emissions	Reduction in Env. Impact		Value Alignment
	MIT Financial Incentives for Energy Conservation Program: Create an MIT policy to incentivize DUSP (and other departments) to conserve energy by giving DUSP a percentage of financial savings from lower energy bills (policy can be extended to waste).	Leadership / Precedent Setting		Reduction in Emissions	Reduction in Env. Impact	Financial Savings	

Notes: (a) https://facilities.berkeley.edu/operating-units/engineering-and-technical-services/energy-office

Procurement

Climate-friendly purchasing is a growing area of interest for those concerned with the emissions embedded in what we buy. Calculating products' embedded emissions requires understanding their life-cycle, which is divided into five main phases: extracting and processing raw materials, and manufacturing, transporting, using, and disposing of products.[2] In this way, procurement practices are also tied to waste practices -- by reducing how much and what we procure, we consequently reduce waste. Currently, there is little data collected on procurement, MIT and DUSP should start to collect data on the embedded emissions in procurement.

Table 6: Procurement Recommendations

Type of Recommendation	Recommendations	Primary Expected Outcomes					
		Leadership / Precedent Setting	Increasing Education & Awareness	Reduction in Emissions	Reduction in Env. Impact	Financial Savings	Value Alignment
By Design	**Provide Mess Kits:** Provide mess kits and/or silverware to all professors, staff, and students, and institute a policy where DUSP events no longer purchase plasticware. *Examples:* *-Each paper plate is responsible for ~3.8 grams of carbon emissions; plastic cutlery is responsible for ~2.8 pounds of carbon emissions per pound of cutlery (a)* *-Basil Tree (frequent vendor for DUSP events) charges $1.29 per person for cutlery (utensils, plates, napkins, etc.); If there are 120 MCP students, it would cost approximately $660 to buy each student a plate and set of silverware; the cost of providing "mess kits" and buying flatware with each food order breaks even after DUSP hosts 25 events, assuming 20 people attend each event.*		Increasing Education & Awareness	Reduction in Emissions (b)	Reduction in Env. Impact	Financial Savings	

[2] MacKay, *Sustainable Energy - Without the Hot Air*; EPA, "Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM)."

	Black and White Printing Preset for CRON Printing: Preset standards for printing that print in black and white in addition to the current preset that prints two-sided.			Reduction in Emissions (c)	Reduction in Env. Impact	Financial Savings	
By Choice	**Default Vegetarian Food for Event Catering:** Change food procurement practices by making the default option vegetarian, requiring those who prefer a meat dish to specify their request. Provide a list of approved food vendors that prioritize plant-based food, use recyclable or compostable materials, and/or provide composting services. Precedent: Sloan Sustainability for ordering only vegetarian meals; DUSP Students of Color Committee primarily order from minority-owned vendors. *Example: vendors that are vegetarian or vegan and minority-owned:* *https://docs.google.com/spreadsheets/d/1xZ8i89zX86jR98WXi3hJwsug3ssNA9-zmQuxEQsJlpU/edit#gid=553690150*			Reduction in Emissions (d)	Reduction in Env. Impact	Financial Savings	Value Alignment
	Bring Your Own Plates/Silverware: In conjunction with the "By Design" option to buy mess kits for students, DUSP will advertise "bring your own plate and utensils" to events. If mess kits are not bought for students, this option can still be implemented and students can bring their own flatware. *Precedent: Graduate dorms at MIT let those with their own utensils go first in line at events.*	Leadership / Precedent Setting	Increasing Education & Awareness		Reduction in Env. Impact	Financial Savings	
	Furniture and Procurement Practices: Furniture and equipment practices: 1) encourage extending the life of furniture, equipment, supplies, and materials so that we replace things as infrequently as possible; 2) buy the most environmentally friendly options; (e) 3) encourage product reuse by donating it to the MIT Furniture Exchange (f) or utilizing the MIT Rheaply app. (g)			Reduction in Emissions	Reduction in Env. Impact (h)	Financial Savings	
To Solve For	**MET or Building Expansion Including Kitchens:** Ensure that the MET or any new building additions provide adequate kitchen space for washing dishes or a dishwasher; this will help create waste-free food events in the department.			Reduction in Emissions	Reduction in Env. Impact		

	Reduce Waste in Procurement Packaging: Improve packaging used for deliveries, as current packaging practices use a lot of plastic and cardboard; work with vendors to reduce wasteful packaging brought to our campus.	Leadership / Precedent Setting		Reduction in Emissions	Reduction in Env. Impact		
	Streamline Campus Deliveries: Streamline deliveries to SA&P: DUSP already tries to order in bulk from Staples, encourage this practice across campus and find ways to limit the number of deliveries from other vendors (Amazon, etc.).	Leadership / Precedent Setting	Increasing Education & Awareness	Reduction in Emissions	Reduction in Env. Impact	Financial Savings	Value Alignment

Notes:
(a) Stanford Magazine, “Green Dinner Parties.”
(b) According to David Mackay, the average Brit uses 3kWh/d in drink packaging and 4kWh/d in other packaging (mostly food packaging), total this is 7 kWh/d (Mackay 2008: 89)
(c) Black and white printing requires only one toner, color printing requires four toner cartridges, each cartridge emits an estimated 4.8kg CO_2 Greenhouse Gases. https://www.energycentral.com/c/ec/ink-waste-environmental-impact-printer-cartridges
(d) A vegan diet requires 3kWh per day, a vegetarian diet that consumes dairy and eggs requires 5.5 kWh per day, and a meat diet requires 12 kWh per day. If over the course of a week DUSP provides three meals to 20 attendees, the break down is the following: Carnivore meals: 240 kWh/day; Vegetarian meals: 110 kWh/day; Vegan meals: 60 kWh/day. (Mackay 2008:76-77)
(e) University of California, “Sustainable Procurement Guidelines.”
(f) https://www.facebook.com/MITFX/
(g) https://solve.mit.edu/challenges/circular-economy/solutions/10158
(h) http://www.nwclimate.org/green-home/low-voc-carpets-and-rugs/

Waste

While waste is not a large source of existing GHG emissions for DUSP, reducing our production of solid waste within the department can provide co-benefits for the department, the environment, and the environmental justice communities that live near landfills and toxic waste.[3] With minimal initial investment in new tools to support waste reduction, and the support of department members willing to change their behavior, DUSP may be able to achieve deep reductions in "landfill" waste, putting us on a path to becoming the university's first zero-waste department.

Table 7: Waste Recommendations

Type of Recommendation	Recommendations	Primary Expected Outcomes					
		Leadership / Precedent Setting	Increasing Education & Awareness	Reduction in Emissions	Reduction in Env. Impact	Financial Savings	Value Alignment
By Design	**Compost Pilot:** Institute a compost pilot in Building 9 (and potentially other SA&P buildings), and switch to compostable paper towels in bathrooms (which includes providing a small trash can for landfill waste with a larger bin used for composting paper towels).	Leadership / Precedent Setting			Reduction in Env. Impact	Financial Savings	Value Alignment
	Better Signage: Use visual signals to help members of the department dispose of waste correctly. Strategies include: 1.Posting standard MIT facilities' signs for compost, landfill waste, and recycling bins on all waste receptacles at DUSP. 2.Working with janitorial staff to ensure that the correct lids are placed on the appropriate bin.		Increasing Education & Awareness		Reduction in Env. Impact	Financial Savings	
	Sustainability Training: Increase education and awareness about how to discard waste with a short DUSP waste/recycling/compost training during orientation led by MCP2s or a future SA&P Sustainability Coordinator (combined with energy use best practices referred above), and ensure all continuing faculty, staff, and students are aware of correct behavior and the implications of waste.		Increasing Education & Awareness		Reduction in Env. Impact		Value Alignment

[3] Schlanger, "Race Is the Biggest Indicator in the US of Whether You Live near a Toxic Waste Site."

By Choice	**Institute reusable cup discount on campus:** Work with on-campus vendors near DUSP, such as Steam Café in Building 10 and Bosworth's Café in Building 7, to discount the price of coffee/tea if someone brings in their own mug, incentivizing sustainable behavior.	Leadership / Precedent Setting			Reduction in Env. Impact		
To Solve For	**Alternative Physical Modelling Materials:** Innovate alternative materials (that are more recyclable or compostable) for physical design and modelling in design studio classes, and then implement new practices.	Leadership / Precedent Setting			Reduction in Env. Impact		
	Waste-free Goal: Set goal of being a waste free-department (or school).	Leadership / Precedent Setting			Reduction in Env. Impact		Value Alignment

7. Recommendations for Implementation

This section of the report provides thoughts on the process of implementing departmental change, with the understanding that it will require institutional support and commitment on both the departmental and school levels.

There are two processes that must happen in parallel, from the beginning. First, a process of community engagement throughout the department will be crucial in order to decide how to move forward. As we have noted in this report, there have been indications of broad support for these measures, from 100 students signing DUSP Climate's recommendations in Spring 2019 to DUSP faculty identifying climate change as the number one issue of concern in their 2017 visioning efforts. However, the specific reflections and recommendations included in this report only represent the ideas of four students. Significant work remains for our community to clarify our values and the relevance of this work, weigh potential paths forward, and discuss what kind of tradeoffs we are willing to make. Second, there is a need for more in-depth data collection and refinement to form a more thorough baseline for each inventory category, to decide on a plan for monitoring and evaluation, and to better understand impacts throughout the process of implementation.

With these next steps in mind, our primary recommendation regarding implementation is to officially dedicate staff time to initiating and managing the two processes described above, as well as implementing pilots and projects. We think that it is important to maintain strong student involvement and ownership of this initiative moving forward, but also recognize that staff support will be crucial to maintaining momentum in the long term. As such, we recommend that DUSP work with the School of Architecture and Planning to allocate existing staff hours to the role described above or hire for a new position (beginning with a dedication of at least 50% FTE). This might mean eventually allocating some staff hours at the department level and some at the school level, in order to maintain coordination on the different scales and, hopefully, catalyze similar initiatives in the other units within SA&P; this future position might be referred to as the "SA&P Sustainability Coordinator." In addition to this, we recommend the department sponsor two 50% student Research Assistantships to work in partnership with staff on the initiation of the processes described above, as well as the implementation and assessment of specific pilots and projects.

In addition to the implementation-related recommendations above, there are important steps to take in order to better institutionalize these efforts and ensure that this momentum continues. First, we think that DUSP should make a public statement about its commitment to reducing its greenhouse gas emissions and environmental impact, primarily to keep itself accountable in the long-term. DUSP should use strong language in this statement, including referring to the

current moment as a “climate crisis” or “climate emergency.”[27] Additionally, a public commitment, in connection with tangible actions, will help to establish DUSP as a leader amongst its peers and build recognition for the important work that the department is doing to take responsibility for its impacts. Initially, this could entail including a public commitment on the DUSP website but, in the future, should include broader actions, such as publishing reflections on our departmental process and progress, and advocating for change within our professional associations.

Second, recognizing the value of iteration and continued reflection, we recommend that DUSP institutionalize a process for continually updating its Climate Action Plan, potentially every few years. Future iterations of this plan should include more robust data collection and an updated emissions inventory, reflections on continued community engagement efforts, assessment of progress on implemented pilots and projects, and new recommendations.

[27] Currently, around 250 higher and further education institutions have signed on to The SDG Accord’s letter to collectively declare a “Climate Emergency.” https://www.sdgaccord.org/climateletter

Table 8: Implementation Recommendations

Type of Recommendation	Recommendations	Primary Expected Outcomes					
		Leadership / Precedent Setting	Increasing Education & Awareness	Reduction in Emissions	Reduction in Env. Impact	Financial Savings	Value Alignment
By Design	**Dedicate Staff Time to Implementation** DUSP should work with SA&P to allocate existing staff hours or hire for a new position (beginning with 50% FTE). Ultimately, there should be some staff hours allocated at the department level and some at the school level, in order to maintain coordination on the different scales and, hopefully, catalyze similar initiatives in the other units within SA&P.	Leadership / Precedent Setting					Value Alignment
	Create Two 50% Student RA Positions Create two 50% student Research Assistantships to work in partnership with the staff member(s) on the initiation of the community engagement and data management processes, as well as the implementation, monitoring, and evaluation of specific pilots and projects.	Leadership / Precedent Setting					Value Alignment
	Make a Public Statement about Commitment Make a public statement about commitment to reducing the department's greenhouse gas emissions and environmental impact. This could entail including a public commitment on the DUSP website in a central place, but in the future should include broader actions, such as publishing reflections on our departmental process and progress and advocating for change within our professional associations.						Value Alignment
To Solve For	**Plan for Future Iterations of the DUSP Climate Action Plan** The staff and students leading this work should create follow-up DUSP Climate Action Plans in the future, potentially every few years. Future iterations of this plan should include more robust data collection and an updated emissions calculation, continued community engagement efforts and reflections on those processes, progress on implemented pilots and projects, and new recommendations.	Leadership / Precedent Setting					

8. Conclusions

This report is the first step in recognizing our responsibility for the greenhouse gas (GHG) emissions and environmental impacts DUSP produces, and identifying ways to reduce them. The analysis above includes a first attempt at calculating our carbon emissions, initial reflections on the importance of DUSP taking action, and recommendations for specific actions that the department could take to begin to implement changes. If DUSP and its community members are serious about reducing their environmental impact, much more remains to be done in the coming years.

We are asking DUSP as a department to take bold actions to fight the existential challenge of climate change, recognizing the privilege and status we have as a part of MIT and a renowned urban planning program. Being in this position, we believe there is a moral and ethical imperative for DUSP to lead. The recommendations outlined in this report provide a roadmap for DUSP to become a climate leader at MIT by setting an example for other departments and pushing MIT towards more ambitious goals. However, this is not a comprehensive or final plan. As stated earlier, we hope that DUSP will build on these ideas through an iterative community engagement process.

We also realize that climate change is not the only pressing societal issue that requires greater leadership from DUSP. This report is not advocating that climate change be elevated as a singular priority. Rather, we believe that this process of student-led organization, culminating in a practice-based class to further develop ideas, and an eventual institutionalization of an action plan, can serve as a model for student-led visioning processes for other critical issues that students hope to elevate. In this manner, DUSP can truly become a leader among planning schools in pushing boundaries and innovating ideas.

Through this exercise, we have learned much about the difficulties in developing an accurate baseline of GHG emissions, which requires precise and accurate data, as well as an understanding of the multi-layered nature of institutions that can inhibit radical change. Striking the right balance between incremental and radical change is always difficult -- and this process is no different. Within these contexts, we aimed to suggest ideas that range from easy implementation to more aspirational actions, but all are actions that we think DUSP can reasonably implement or support.

As DUSP develops its values statement next semester, we hope that the department will reflect on how to prioritize climate change action in its values and mission statement. We encourage DUSP to commit to nothing less than a full-embrace of climate action leadership.

Appendix A:

Table 9: Air Travel Recommendations

Recommendations	Actors	Potential Rollout Strategy
Data Collection System	DUSP Department Head	Spring 2020: Sustainability Coordinator and RAs research possibilities, and gather ideas through community engagement process Fall 2020: Roll out system for beginning of FY20
Funding Disclaimers	DUSP Department Head DUSP Headquarters	Spring 2020 - Fall 2020: Implement on all internal funding applications Fall 2020: Advocate to external funders, including MISTI and PKG
Local Practicum	DUSP Department Head	Fall 2020: Implement in time for this semester
Department-wide Collaborative Process	DUSP Department Head leads committee selection process	Spring 2020: Form internal committee and focus on departmental engagement to set a flying emissions reduction target (with short- and medium-term benchmarks) and discuss implementation options Fall 2020: Begin to implement specific actions as pilots, including recommendations such as: ● Implement an internal carbon tax or require the purchase of carbon offsets for all DUSP-related flights ● Encourage a smaller carbon footprint for all practica-related travel, including minimum stay requirements, maximum number of trips per student per practicum, and required offsets ● Implement incentive system to encourage students, staff, and faculty to choose to reduce their flights or choose an alternative mode of transportation over a flight, when possible
Faculty Collaborative Process	DUSP Department Head as process lead	Spring 2020: Plan process and initiate conversations Fall 2020: Commit to specific decisions, including recommendations such as: ● Make individual flying reduction goals, based on what travel is easiest to cut ● Explore reimbursement restrictions (e.g., no flight reimbursement under a specific distance) ● Advocate to change culture around tenure designation, if this is a reason that faculty are flying, but gaining little personal or professional value ● Advocate within professional associations (APA, etc.) to change norms within the field related to conferences, lectures, etc.
Make MIT a Regional Hub	DUSP Department Head as initiator	Spring 2020: Department Head should make contact with others in SA&P, in labs/research groups at MIT, and at other local universities to form a committee dedicated to this. Responsibilities would include: technology development and implementation, physical space selection and design, and broader coordination.

Table 10: Building Energy Use Recommendations

Recommendations	Actors	Potential Rollout Strategy
Building Energy Management Settings Policy	DUSP Department Head SA&P Director of Facilities	Spring 2020: Issue memo to faculty about permanent building settings showing the energy/emissions/financial savings from the settings
Holiday Building Curtailment	DUSP Department Head SA&P Director of Facilities	Spring 2020: Conduct a survey to see what is the general opinion on closing buildings over breaks Fall 2020: Issue policy of curtailing Building 9 for X days over winter break
Crowdsourced Energy Review	DUSP Department Head SA&P Director of Facilities	Spring 2020: Discuss and schedule an annual departmental meeting
Conduct Building Energy Audit	DUSP Department Head SA&P Director of Facilities	Fall 2020: Hire auditors to conduct an audit of DUSP spaces
Establish Sustainability Best Practices Orientation Session	DUSP Department Head Future SA&P Sustainability Coordinator	Spring 2020: Create a short 15-20 minute presentation for incoming MCP1s about the DUSP Climate Action Plan and the recommendations Fall 2020: Approve and launch the addition of this program in the orientation schedule
High EE Standards for the MET Building	MIT President SA&P Dean Adaptive Reuse & Sustainability Working Group SA&P Steering Committee	Spring 2020: Faculty and students should revive and update the MET petition from last year and ask Steering Committee for updates on the status Spring 2020: DUSP and other SA&P department heads urge President Reif and Dean Sarkis to make the MET the most energy efficient and sustainable campus building and adopt the Sustainability Working Group's recommendations
MIT Financial Incentives for Energy Conservation Program	DUSP Department Head MIT Executive Vice President and Treasurer MIT Vice President for Finance	Spring 2020: Department Head/faculty spreads the idea to other SA&P department heads to get their support, as this may work better if implemented school-wide. Spring 2020: Department Head shares the idea with SA&P School Council to ask them to raise the proposal with MIT leadership (President/VP) Spring 2020: Meet with MIT leadership to discuss details of policy and rollout including how much of the savings will be returned to DUSP Fall 2021: MIT leadership can implement energy conservation program as a pilot

Table 11: Procurement Recommendations

Recommendations	Actors	Potential Rollout Strategy
Provide Mess Kits	DUSP Headquarters	Spring 2020: Determine which type of kit to order based on cost, recommend the following: • Reusable plates: $18 for 12 plates[1] • Reusable silverware sets: $12 for 3 sets[2] Fall 2020: Require students to attend brief training (10-15 minutes) or to sign a pledge, committing them to using their reusable sets for DUSP meals Fall 2020: Work with those who order food for events (student groups, faculty, staff) to ensure that plates and silverware are no longer ordered with food order
Black and White Printing Preset for CRON Printing	CRON	Spring 2020: Email out to department about the change with step-by-step guide of how to change a print job to color and put up signs at all CRON computers and printers explaining the change
Default Vegetarian Food for Event Catering	All who order food in the department and organize events	Spring 2020: Change the format of event RSVPs (to set vegetarian as default option), compile a list of approved vendors and share this list with the department
Bring Your Own Plates/Silverware	All who order food in the department and organize events, and event attendees	Spring 2020: Begin advertising that for food related events, you are encouraged to bring your own utensils. DUSP should begin to provide less cutlery and paperware. Those who bring their own utensils could get to go first in a food line (this is the practice in MIT graduate dormitories).
Furniture and Procurement Practices	SA&P Director of Facilities, and others who purchase equipment at DUSP	Spring 2020: Work with SA&P Director of Facilities to determine how to source environmentally friendly products, lengthen the use of furniture and equipment, and provide support in ensuring the reuse of products after DUSP no longer needs them.
MET or Building Expansion Including Kitchens	Any involved in the building design	Throughout MET working group: Support a strategy to solve for this identified problem.
Reduce Waste in Procurement Packaging	Those involved with procurement and vendors	Spring 2020: Support a strategy to solve for this identified problem.
Streamline Campus Deliveries	Those involved with procurement and vendors	Spring 2020: Support a strategy to solve for this identified problem.

[1] https://www.amazon.com/dp/B07S9SW16Y/ref=twister_B07S8QGYQB?_encoding=UTF8&psc=1

[2] https://www.amazon.com/Chopsticks-SENHAI-Rustproof-Stainless-Dinnerware/dp/B01N1XKBYS/ref=sr_1_18?keywords=reusable+silverware&qid=1576287958&rnid=366862011&s=home-garden&sr=1-18

Table 12: Waste Recommendations

Recommendations	Actors	Potential Rollout Strategy
Compost Pilot	DUSP Department Head Architecture Department Head Dean of SA&P Director of SA&P Facilities MIT Recycling Manager	Alternative 1: MITOS pilot study. Alternative 2: SA&P funded initiative. 1. Spring 2020: Waste audit to calculate baseline amount of compostable waste in SA&P trash cans. 2. Spring 2020: Director of SA&P Facilities works with MIT Recycling Manager and custodial staff to establish new waste practices for SA&P spaces. 3. Spring 2020: Director of SA&P Facilities purchase snew compost bins. 4. Summer 2020: Roll-out compost bins and new waste practices to faculty and staff. Use the summer months as a mini-pilot for training, education materials, and facilities staff behavior changes. 5. Fall 2020: Educate all students on the first day of term about new waste procedures (see below). 6. Fall 2020: Conduct waste audits throughout the term to determine effectiveness of program in diverting compostable waste from landfill and recycling.
Better Signage	Director of SA&P Facilities MIT Facilities	Spring 2020: MIT Facilities provides laminated signs for Director of SA&P Facilitiesto install on all waste receptacles. Spring 2020: Director of SA&P Facilities contacts MIT Facilities to request that custodians correct misplacement of recycling lids on trash cans and vice versa when they change trash bags.
Sustainability Training	DUSP Department Head DSC Future SA&P Sustainability Coordinator	Spring 2020: Sustainability RAs will create brief educational materials on waste system at MIT and consequences of discarding waste, to be distributed within the department. Fall 2020: DSC member or DUSP Climate members will inform new MCP1s about correct waste disposal behaviors at DUSP (what materials are recyclable, compostable, and for landfills within MIT's waste system).
Institute reusable cup discount on campus	SA&P departmental leadership Marissa LaMalfa (Assistant Director of Retail for Bon Appetit Catering Company) Samuel Martin (Fellow with role related to sustainability Bon Appetit Catering Company) MITOS	Spring 2020: Department leadership OR MITOS contacts Bon Appetit Catering Company to request discounts for people who bring their own containers.

Alternative Physical Modelling Materials	CDD faculty DUSP Department Head	Spring 2020: Consult with CDD faculty on problem of waste in physical designs and modelling. Establish if there are readily available alternative materials to blue foam, and establish whether there are any other readily available alternative materials that can be recycled. Fall 2020: Institute new recycling policy for DUSP studios. Late-Fall 2020: Enforce policy that all modelling materials must be recyclable after model is complete.
Waste-free Goal	Depends on whether this is a department, school, or campus-wide goal, but should involve a combination of institution leaders, students, faculty and staff. Needs department backing at a minimum (DUSP Department Head), but also requires that someone plan for waste-free goal and monitor progress.	Spring 2020: Potential waste education event that also functions as a community engagement opportunity to see whether department wants to sign up for this goal, and encourage students to sign-up for initial data collection. Spring 2020: Collect data on waste sources through waste audit. Late-Spring 2020: Formally publish goals and strategic plan for waste reduction. Fall 2020-2022: Work on implementing strategies.

Table 13: Implementation Recommendations

Recommendations	Actors	Potential Rollout Strategy
Dedicate Staff Time to Implementation	DUSP Department Head SA&P Dean	Spring 2020: Implement strategy to hire for a new staff position or allocate existing staff hours, preferably at both the departmental and school levels.
Create Two 50% Student RA Positions	DUSP Department Head	Spring 2020: Hire two 50% student RAs. Fall 2020 (and all following semesters): Continue to hire two 50% RAs.
Make a Public Statement about Commitment	DUSP Department Head SA&P Dean	Spring 2020: Publish initial commitments and goals to websites, social media, and through MIT-wide publications. Fall 2020 and beyond: As plans and implementation formalize in the department, advocate within APA and other professional associations for other departments to follow DUSP's example.
Plan for Future Iterations of the DUSP Climate Action Plan	Future SA&P Sustainability Coordinator Future Student RAs	Fall 2021 (and every two years after that): Publish update to the DUSP Climate Action Plan that includes more robust data collection and an updated emissions calculation, continued community engagement efforts and reflections on those processes, progress on implemented pilots and projects, and new recommendations.

Appendix B

Travel

Flying

In terms of flying, we gathered all readily-available data (for students and faculty) for Fiscal Year 2019. In order to convert miles flown into metric tons of CO2 equivalent (MTCO2e), we used an online carbon footprint calculator, assuming direct flights and including radiative forcing.[28] [29]

To calculate faculty emissions, we gathered all faculty flights that were reimbursed through Concur, with help from staff members in DUSP Headquarters. This resulted in a total of 86 MTCO2e. Accounting for the approximately 30 faculty in the department, this results in a per-capita flying emissions of 6.2 MTCO2e.

To calculate student emissions, we gathered flights in three different categories: conferences, research, and practica. For conferences, with data provided by staff in DUSP Headquarters, we summed all student flights that were reimbursed through DUSP's Student Conference Fund, resulting in 57.93 MTCO2e. For research, we summed all student flights from the department's various travel grants (with data provided by Ezra Glenn for the William Emerson Fund, Lloyd and Nadine Rodwin Fund, Ross Silberberg Memorial Fund, Harold Horowitz Student Research Fund, and Bill Mitchell ++ Fund), from Priscilla King Gray Public Service Center-awarded grants, and from MIT International Science and Technology Initiatives-awarded grants, resulting in 230.25 MTCO2e. (We were not able to confirm that all awarded money was ultimately used, so these are estimates solely based on money awarded for potential travel.) Lastly, for practica, we summed all student flights related to those classes in FY19, resulting in 171.33 MTCO2e (with data assistance from Ellen Rushman). These three categories resulted in a total of 459.51 MTCO2e. Accounting for the approximately 200 students in the department, this results in a per-capita flying emission of 2.3 MTCO2e.

These two approximations of faculty and student flying-related emissions result in a total of 545.5 MTCO2e. We know that this is most likely a significant underestimate of these two categories, as not all faculty travel is captured in Concur and not all student travel is captured in our data sources. Additionally, this estimate does not include staff travel and visitors invited to DUSP.

[28] Carbon Footprint Calculator: https://calculator.carbonfootprint.com/calculator.aspx

[29] Planes at high altitudes have an increased effect on global warming. By including radiative forcing, carbon emissions are multiplied by DEFRA's (Department for Environment, Food, and Rural Affairs in the UK) recommended Radiative Forcing factor of 1.891, when using this online calculator.

Table 14: DUSP's Emissions from Flying by Actor and Category.

	Source of Emissions	Total Emissions (MTCO2e)
Faculty	Concur-recorded Flights	86
Students	Conferences	57.93
	Practica	171.33
	Research Grants (internal, PKG, and MISTI)	230.25
Total Flying Emissions		**545.5 MTCO2e**

Commuting

In terms of commuting, we calculated the emissions using data from the 2018 MIT Commuting Survey for students (MCPs and PhDs) and each faculty and staff type as categorized in the study: faculty, administrative staff, other academic group, sponsored research staff, and support staff. We received assistance compiling this data from Elena Renda, a Visiting Scientist at DUSP and from DUSP Headquarters, including Karen Yegian. The study provides miles traveled in a one-way commute, so we doubled the commuting mileage for each person and summed up the total mileage for each category. Then, to convert this to miles traveled we used the same online carbon footprint calculator as above to calculate both car travel (assuming 25 mpg efficiency) and public transportation (assuming an even split in miles between buses and the subway).

For students, we assumed they commute to campus 30 weeks a year, 4 times a week. So we multiplied the total miles traveled by 30 and 4 and then converted that number to MTCO2e. The survey only included responses from 105 graduate students, so we scaled up from this sample to estimate commuting emissions for the population of 203 DUSP students by dividing the total for the 105 students by 105 and multiplying that number of per capita emissions by 203. Thus, our total student annual commuting emissions estimate is 2.78 MTCO2e.

For faculty and staff, we assumed they commute to campus 48 weeks a year. We then classified each category's commuting frequency using the survey-reported "Commute per Week" field values as follows:

- More than 40 hours per week = 5 times per week
- 31-40 hours per week = 4
- 17-30 hours per week = 3
- Less than 17 hours per week = 2

We calculated the total emissions for each category using the same method for students and then scaled up the emissions total for the actual number of people in each category at DUSP, based on numbers provided by DUSP Headquarters. Two categories of individuals in the

survey did not match up with two of the categories provided: “other academic group” and “sponsored research staff.” Therefore, we made assumptions and categorized SPURS fellows as “other academic group” and research staff and postdocs as “sponsored research staff.” Again, since not all relevant individuals from DUSP completed the survey, we scaled up from the sample to represent the population using the same method as described for the students above. Then we summed the scaled up figures to estimate the total faculty and staff commuting emissions, as shown in Table 2 below. As a result, DUSP students produced annual commuting emissions of 2.78 MTCO2e in 2018, or 0.01 MTCO2e per capita. DUSP faculty and staff produced annual commuting emissions of 32 MTCO2e in 2018, or 0.3 MTCO2e per capita. The total annual commuting emissions of DUSP is 34.9 MTCO2e, or 1.8% of DUSP’s annual GHG emissions.

Table 15: Summary of Commuting Emissions by Category

Category	**Sample Size**	**Total Size**	**Total Emissions (MTCO2e)**
Student	105	203	2.78
Faculty	15	27	12
Administrative Staff	7	10	8.2
Other Academic Group	16	20	2.4
Sponsored Research Staff	4	38	3.9
Support Staff	11	13	5.6
Total Commuting Emissions			**34.9 MTCO2e**

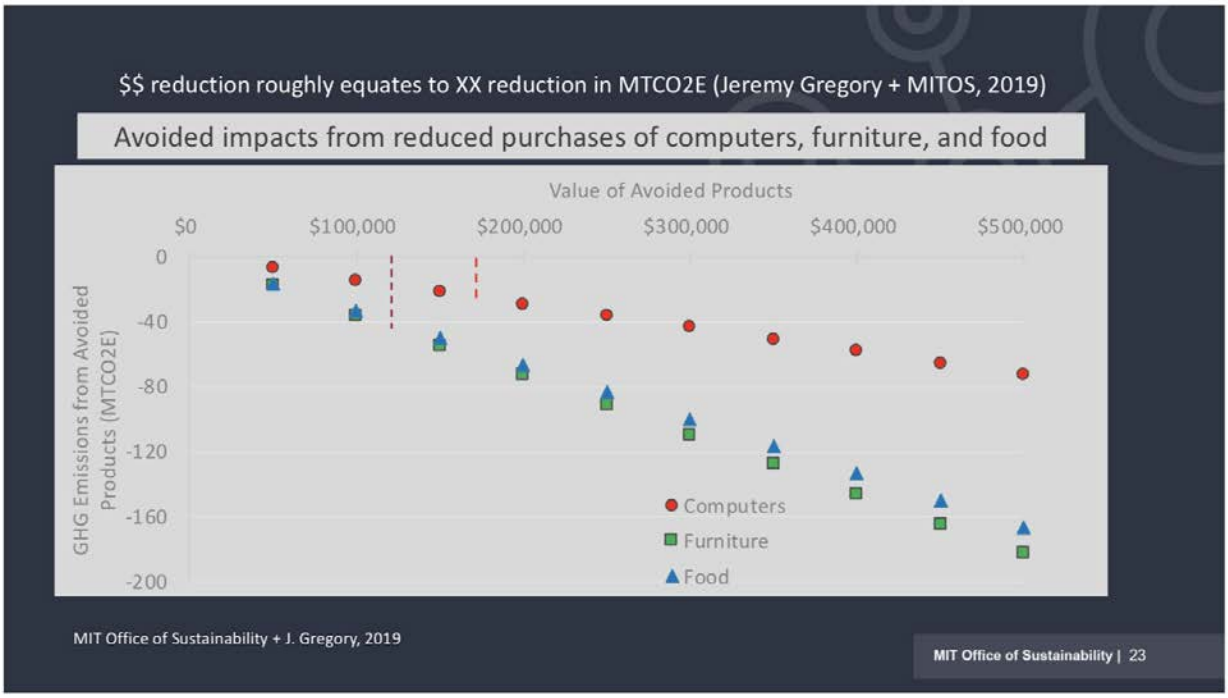
Building Energy Use

No additional information. Please contact Steven Lanou at MITOS for detailed explanation of calculations.

Procurement and Waste

Jeremey Gregory and the MIT Office of Sustainability (2019) created a graph for estimating the avoided greenhouse gas emissions from reducing the purchase of computers, furniture and food, as depicted below.[30]

Figure 5: MITOS procurement emissions graph.



We used the above graph to calculate our best guess for emissions related to procurement in Fiscal Year 2019 for DUSP. Based on the purchases made with the department credit card, DUSP spent the following on procurement:

- Equipment/furniture: **$102,915.78**
- Supplies: $23,238.81 (excluded from emissions because not included in Gregory/MITOS graph)
- Food: **$327,237.80** (this includes the department parties)[31]

The MITOS model makes many assumptions, but it provided the most feasible way to make an initial estimate of DUSP's procurement-related emissions based on the available data. This was done by approximating DUSP credit card purchases on the x-axis and the associated emissions on the y-axis, for a procurement category. We only had access to purchases made with the DUSP credit card, so it is not a full account of procured items. It is important to note that the general ledger number MIT uses for equipment (electronics) and furniture purchases is combined, whereas the Gregory/MITOS graph separates computers and furniture. Considering

[30] Thank you to Brian Goldberg and Rachel Perlman at MITOS for their time, advice, and resources.
[31] Thank you to Karen Yegian and Janine Marchese for providing the procurement data.

these two categories as one, the graph estimates the emissions associated with furniture and equipment, as the following:

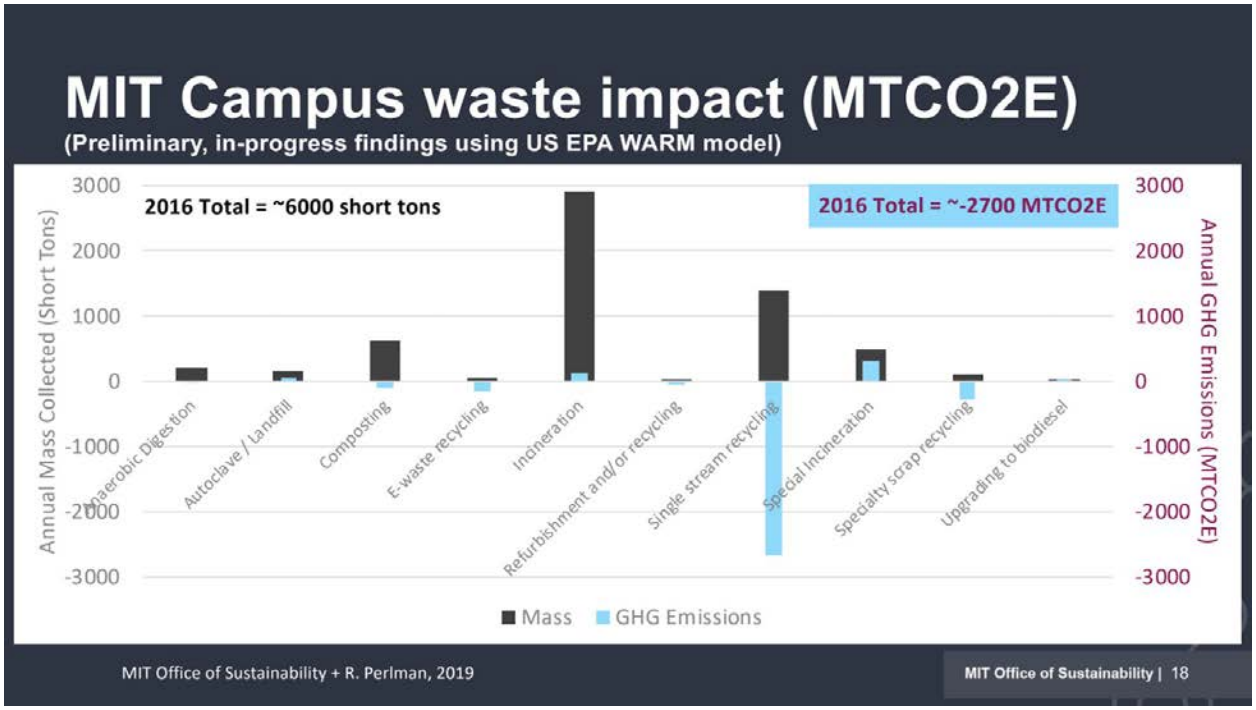
- 18 MTCO2e: assuming all $100,000 of equipment/furniture purchases are *computer purchases* in the MITOS graph;
- Or 38 MTCO2e: assuming all $100,000 of equipment/furniture purchases are *furniture purchases* in the MITOS graph.
- Given the broad range of 18-38 MTCO2e, we estimate the emissions related to furniture and computers to be the middle of the range, that is 28 MTCO2e total for the equipment and furniture category.

For food estimates, the $327,000 spent on food (including all DUSP parties and events) is equivalent to around 100 MTCO2e. This gives us a total estimate of around 128 MTCO2e for procurement emissions.

As we mentioned, waste is not included in our estimation of DUSP's GHG emissions, due to uncertainties with data and the possibility that the MIT waste stream results in net negative GHG emissions. MITOS data was made available to estimate the department's GHG emissions from waste. This data compiled all campus-wide emissions from waste using data from MIT's waste contractors. MITOS knows how many tons are disposed of by different methods, such as composting, anaerobic digestion, or incineration. MITOS then estimated resulting emissions using the EPA Warm Model, which provides estimates for the "end-of-life" emissions associated with disposing of materials in specific ways.[32] According to this model, some waste materials management techniques are associated with negative emissions. For example, in the model, recycling materials saves the GHG emissions from future resource extraction, so recycling results in net negative emissions. The overall result for MIT is net negative GHG emissions (see . Unfortunately, a more precise source of waste data at DUSP is not currently available. A future waste audit would provide a general sense of the types of waste generated by the department, which could then be used to generate a more precise GHG emissions estimate for waste at DUSP. Due to the way waste emissions are modelled and the size of our department, it is likely that DUSP would produce only a minimal positive or negative amount of GHG emissions associated with waste. We have chosen to omit waste from our estimate as changes to the waste system at DUSP are unlikely to directly contribute significant GHG emission reductions.

[32] EPA, "Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM)."

Figure 6: MITOS waste emissions graph.



Appendix C - Proposed Responsibilities for New Sustainability Staff

In order to move this plan forward, we recommend that a staff member take charge of DUSP's climate effort. We suggest at least 20 hours of staff time and 20 hours of graduate RA time per week, to focus on community engagement and implementing pilot activities. We have listed a number of potential responsibilities below.

Within the next year, we recommend hiring a full-time employee with expertise in climate action or sustainability to manage this program for DUSP or all of SA&P. This plan envisions DUSP as a climate leader, but that level of transformation will not occur without on-going, dedicated effort.

Two 50% Research Assistants
(10 hours a week)
Potential Projects:

- Consult with assigned staff member on action plan steps
- Research and draft policy memo on how DUSP/MIT can develop capacity to act as a regional hub by improving remote communication capabilities.
- Research and draft policy memo on options for DUSP to implement carbon tax.
- Research DUSP waste system and monitor behavioral changes resulting from action plan waste recommendations.
- Research and draft policy memo on how to streamline campus deliveries.
- Develop sustainability education materials for DUSP based on research into policy best practice, and track materials' effectiveness at encouraging pro-environmental behavior.
- Research DUSP resource lifecycles and draft report profiling the social and environmental impacts of our department's use of resources, with the goal of educating department on the tangible results of our everyday behaviors.
- Develop action plan for DUSP going waste-free.
- Conduct a survey on the climate norms and attitudes within the department, and develop recommendations to adapt DUSP Climate Action plan based on this new data.

Other responsibilities:

- Support community engagement events, with event set-up, note-taking, facilitation assistance, etc.

<u>50% Staff Member</u>
(20 hours a week)
Potential Tasks:

- Lead department Climate Action Plan community engagement process during Spring 2020 semester. Includes strategizing, planning logistics for, and facilitating engagement process. Engagement could focus on reflection on department flying practices, as well as feedback on the DUSP Climate Action Plan as a whole.

- Produce summary report of engagement process that describes department attitudes toward Climate Action Plan, identifies future climate action pathways that have community support, and notes new action recommendations the engagement process may have produced.
- Lead process to institute better flying and procurement data collection within DUSP.
- Develop draft plan for implementing action plan recommendations. Responsibilities include identifying priority actions ready for piloting, contacting actors, drafting implementation timeline, and developing a baseline for future evaluation and monitoring.
- Prioritize, manage, and track progress on implementation of action plan recommendations. Update plan, if needed, due to community feedback.
- Take responsibility for leading climate action plan recommendations, as needed.
- Develop timeline for future DUSP Climate Action Plan update.
- Act as main point-of-contact for all questions and feedback regarding DUSP Climate Action Plan.
- Act as liaison between MIT Office of Sustainability (MITOS) and DUSP.
- Work with SA&P leadership through the Office of the Dean to develop a plan to expand sustainability initiatives to other departments and groups.
- Produce report on plan progress by the end of Spring 2020 term.
- Supervise work of two 50% Research Assistants.

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