Reaching Carbon Neutrality:
An Analysis of Higher Education Institutions' Approaches to Mitigating Scope 3 Emissions

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Abstract

As the threat of climate change intensifies, 697 higher education institutions across the U.S. have signed onto the ACUPCC, an agreement through which institutions commit to achieving carbon neutrality. To achieve this goal, schools must account for their emissions from all sources, including Scope 3 emissions, which come from indirect sources such as transportation, commuting, air travel, and waste. Due to the lack of standardized protocol for schools to address their Scope 3 emissions, little is known about what approaches schools are using or what influences schools to pursue various strategies. In this study, we investigate how ACUPCC signatories are addressing their Scope 3 emissions to achieve carbon neutrality and the extent to which underlying patterns exist between mitigation strategies and signatories' institutional characteristics. Through a thematic analysis, we find that schools plan to take a variety of approaches centered around education, reduction initiatives, behavioral incentives, infrastructure development, and carbon offsetting, with carbon offsetting being the most common approach. As scholars have engaged in a debate surrounding the controversial and complex implications of global third-party carbon offsetting, some schools are engaging in local carbon offsetting. Through a statistical analysis, we find that schools' engagement with carbon offsets is not predicted by any institutional characteristics of the school but rather by the proximity of a school's carbon neutrality goal year. Our study sheds light on the uncertainty surrounding Scope 3 emissions mitigation and the practice of carbon offsetting, as well as the notion that temporal deadlines may be the most predictive factor of higher education institutions' carbon offset use.

Introduction

In light of the increasing threat posed by climate change, higher education institutions are taking initiatives to reduce their ecological footprints. Since 2007, 697 higher education institutions have signed the American College and University Presidents' Climate Commitment (ACUPCC). Through this agreement, schools commit to a sustainable future by pledging to achieve carbon neutrality. The ACUPCC requires each school to determine a date by which the institution will reach carbon neutrality or net-zero greenhouse gas emissions, meaning that all emissions are balanced by activities that reduce or eliminate carbon emissions (Jain et al. 2017). Since signing on, many schools have implemented a Climate Action Plan (CAP), which outlines their strategies for achieving carbon neutrality. Carbon emissions are classified into three scopes based on the nature of the emissions. Scope 1 emissions encompass direct emissions that are owned and controlled by the college and Scope 2 emissions include indirect emissions associated with purchased commodities such as electricity (Downie and Stubbs 2013). Scope 3 emissions are indirect emissions from sources that are not owned or controlled by the college, such as school-related air travel (Downie and Stubbs 2013). Scope 1 and 2 emissions tend to be prioritized because colleges can implement infrastructure projects like solar panels or geothermal to directly reduce these emissions (Sinha et al. 2010). However, with Scope 3 emissions, colleges do not own the means of production for the emissions sources, posing a challenge for schools working to achieve carbon neutrality.

Scope 3 emissions encompass all indirect emissions from student and employee commuting, business air travel, study abroad air travel, water waste, procurement waste, and landfilled solid waste (Sinha et al. 2010). These emissions are difficult to measure because of their indirect nature, but ACUPCC signatories are required to inventory these emissions as part of their commitment. Additionally, Scope 3 emissions account for approximately one-third of American higher education institutions' total emissions on average, making them a significant source of emissions on most college campuses (Sinha et al. 2010; Klein-Banai and Theis 2013). Because there is no rigorous standard available for documenting and reporting Scope 3 emissions, it is hard to know if schools measure these emissions accurately (Downie and Stubbs 2013). Nevertheless, schools will need to address this significant portion of their emissions to fulfill their commitment to the ACUPCC by their declared carbon neutrality goal year. Our study examines how schools navigate the tension between their approaching carbon neutrality goal year and the difficulty of reducing Scope 3 emissions.

To address Scope 3 emissions, 140 active ACUPCC signatories have elected to utilize carbon offsets.[1] Carbon offsets are a market-based tool through which carbon emissions are reduced in one location to compensate for emissions in another area (USGAO 2008). According to the USGAO (2008), carbon offsets involve paying other entities to undertake activities that reduce, avoid, or sequester greenhouse gases. Examples of carbon offsets include planting trees (biosequestration), capturing methane from landfills for energy, or installing wind farms (USGAO 2008). To implement carbon offsets, schools have the option to purchase offsets from a third party, partner with an organization, or develop their own offset programs. For example, Colgate University has established a partnership with Patagonia Sur, a sustainable development organization in southern Chile that plants tree species native to Patagonia (Brooks 2011). Other schools, including Frostburg State University and Mercyhurst University, have developed their own offset projects within their local communities to plant trees or convert methane from landfills into renewable energy (AASHE Reporting Group 2015; Mercyhurst University 2014).

[1] Because the ACUPCC is voluntary, institutions sometimes leave or drop in and out of being an active signatory. The list we gathered from Second Nature contains all of the active signatories (435 schools) as of November 2019.

While carbon offsets provide a relatively convenient solution to address Scope 3 emissions, the ACUPCC recommends that schools implement offsets only after initiating direct reduction activities (Kollmuss et al. 2008). Second Nature, the non-profit organization that administers the ACUPCC and collects data on higher education institutions' commitments and progress, is one of the only entities that offers guidance on implementing carbon offsets and mitigating GHG emissions in higher education. Second Nature's carbon mitigation guide states that schools must find their own combination of practices, policies, and infrastructure scalable to their campus to produce the most reductions in the shortest time frame at the cheapest cost, tasking schools with a significant challenge ("Carbon Management & Greenhouse Gas Mitigation" n.d.). However, there are no requirements that schools use any specific approach and no standardized, formal guides for Scope 3 mitigation. As a result, little is known about how ACUPCC signatories are responding to this challenge, what influences schools to take which approaches, and how schools decide to implement carbon offsets.

Our study investigates themes in schools' Scope 3 mitigation strategies and tests whether a relationship exists between an institution's characteristics, including student body size, endowment per student, geographical region, public vs. private status, carbon neutrality goal year, and CAP publication date, and the school's approaches to mitigating Scope 3 emissions. In this paper, we ask the following questions: How are ACUPCC signatories addressing Scope 3 emissions to achieve carbon neutrality? To what extent do underlying patterns exist between these schools' characteristics and their approaches to addressing Scope 3 emissions?

We find that schools' Scope 3 mitigation strategies focus on the five following areas: carbon offsets, education, behavioral incentives, water, waste, and food reduction initiatives, and infrastructure development. We also identified that 81% of the schools in our sample mention carbon offsets in their CAPs, and 37% have reported already using carbon offsets to Second Nature. Of the schools already using carbon offsets, 45% of schools use biosequestration offsets, making it the most common offset type. Our binary logistic regression analysis found that the earlier a school's carbon neutrality goal year, the more likely they are to use offsets, suggesting that proximity to goal year is the greatest factor in motivating schools to use carbon offsets. Finally, our regression analysis did not point to any other significant patterns between schools' characteristics and their use of offsets or mention of local offsets.

The results of our study have important implications regarding the apparent contradiction between the necessity of addressing Scope 3 emissions to achieve carbon neutrality and both the lack of clarity on how to do so and the notion that some emissions cannot be reduced entirely. This paradox in achieving carbon neutrality is the driving force behind our project. In a broader sense, this study is relevant to evolving discussions surrounding the role of higher education institutions in GHG emissions reductions and sustainability. Higher education institutions contribute approximately 2% of total annual GHG emissions in the United States, placing these institutions in a position to make an impactful change (Sinha et al. 2010).

Literature Review

Our literature review begins by outlining existing studies that have explored factors that influence GHG emissions at higher education institutions. We then investigate the ongoing debate surrounding carbon offsets and higher education institutions' use of carbon offsets to achieve carbon neutrality, including the type and location of offsets. A review of the existing literature allows us to better understand the nature of GHG emissions in higher education institutions and how they may undertake reduction initiatives, providing the foundation for our study.

GHG Emissions at Higher Education Institutions

Thus far, research regarding greenhouse gas (GHG) emissions of higher education institutions has focused on the process for inventorying emissions and the factors that impact a school's amount of GHG emissions (Andrews et al. 2015; Davies and Dunk 2015; Sinha et al. 2010). Studies have found that colleges and universities' GHG emissions are influenced by characteristics of the school (Fetcher 2009; Klein-Banai and Theis 2013; Sinha et al. 2010). Based on these studies, we hypothesized that these characteristics may also influence how schools engage with Scope 3 mitigation.

Fetcher (2009) found that the gross area of buildings and the number of students at a university influence its GHG emissions footprint. Fetcher models overall GHG emissions as a function of building area, stating that emissions per unit building area (square meters) scaled with an exponent of 1.1. He also modeled GHG emissions as a function of the number of full-time enrolled students at doctorate-granting and master's universities. He found that GHG emissions increased as the number of students increased at both doctorate-granting universities ($R^2 = 0.631$) and master's universities ($R^2 = 0.679$). Moreover, Fetcher found that the climate in the region where a school is located has a statistically significant impact on the school's GHG emissions. His model indicated there is a negative relationship between mean January temperatures and emissions ($R^2 = 0.636$) and a positive relationship between mean July temperatures and emissions ($R^2 = 0.750$), primarily due to an increase in purchased electricity for cooling and heating, and thus greater overall GHG emissions (Fetcher 2009, 366). Building upon

Fetcher's findings, we posit that enrollment and geographic region might also motivate schools' Scope 3 mitigation strategies and their engagement with carbon offsets.

Klein-Banai and Theis (2013) similarly found that GHG emissions of institutions are a function of institutional characteristics. Their regression model confirmed that GHG emissions are a function of the student body size and building area of the institution, the area of laboratory and residential space, the presence of a medical school, and the extent of commuting to campus by faculty, staff and students ($R^2 = 0.954$) (Klein-Banai and Theis 2013, 36). Both Fetcher and Klein-Banai and Theis' studies demonstrate that a relationship exists between a school's institutional characteristics and their GHG emissions. However, little is known about whether institutional characteristics affect how schools engage with various Scope 3 mitigation strategies to achieve carbon neutrality. For example, are bigger schools–which have greater GHG emissions due to a larger student body size–more likely to purchase carbon offsets? Using similar characteristic variables, our study builds upon Fetcher and Klein-Banai and Theis' conversations about GHG emissions and higher education institutions by investigating the relationship between institutional characteristics and Scope 3 mitigation strategies.

According to Williamson, schools and universities should focus on lifestyle changes and behavioral shifts through education, technological advancement, investment, regulations, and policy-driven changes (2012, 49). He outlines two options for reducing GHG emissions: expanding local housing options and investing in alternative transportation, both of which have the potential to decrease commuting emissions from single-occupancy vehicles. He finds that expanding local housing is more effective because it can reduce overall GHG emissions by 2.8%, whereas increasing alternative transportation investment can only decrease total emissions by 0.1% (2012, 57). However, because constructing new local housing options requires such a large initial financial investment, Williamson surmises that this approach would be more common at large, well-endowed institutions with the resources to make such an investment. Conversely, smaller schools with limited endowments might be more likely to focus on minor transportation changes, which would not result in statistically significant decreases in total emissions over time (Williamson 2012, 58). Williamson's research suggests that a relationship exists between a school's institutional characteristics, notably endowment and student body size, and how they might address their emissions from mobile sources, mainly through an exploration of the relationship between housing and commuting. Our research expands upon Williamson's findings to explore other relationships that might exist.

While Williamson's research focuses on options to reduce emissions from commuting, it does not give as much attention to Scope 3 emissions that cannot be directly reduced, such as air travel emissions from study abroad programs. According to scholars Davies and Dunk (2015), colleges and universities will likely need to resort to carbon offsetting to mitigate these types of emissions. As carbon offsets are likely an essential part of achieving carbon neutrality, it is necessary to review the existing literature on the effectiveness and usefulness of carbon offsets.

The Carbon Offset Debate

As aforementioned, carbon offsets are a mechanism in which one pays someone else to reduce their carbon emissions to compensate for their own emissions (Kollmus et al. 2008). Carbon offsets are a response to the growing need to address carbon emissions that are difficult to reduce. The six main types of carbon offset projects are renewable energy, energy efficiency, industrial gases, methane capturing, biosequestration, and carbon capture and storage (Kim and Pierce 2018). Each type of project represents a tangible way to reduce carbon emissions, though the varying social, ecological, and economic impacts of each type have resulted in a debate regarding their utility. Some scholars argue that carbon offsets are a useful market-based tool for addressing carbon emissions, while others believe that offsets are ineffective and problematic (Conte and Kotchen 2010; Gillenwater et al. 2007; Frank 2009; MacKerron et al. 2009).

Carbon offsets can both help combat climate change and result in positive co-benefits. Conte and Kotchen (2010) argue that offsets work in principle because greenhouse gases are uniformly mixed global pollutants, which means that the specific location of an emissions reduction is irrelevant. Silva and Zhu (2009) confirm this, stating that the net effect on emissions is all that matters to combat climate change. Since there is no existing formalized offset market, carbon offsetting is done on a voluntary basis. Kotchen (2006) states that voluntary carbon offsets are considered impure public goods because, while the private market produces them, an emissions reduction will diminish the effects of climate change for the entire public sector. Moreover, the price of a carbon offset is highly variable, depending on the type and organization. According to a 2016 report by Ecosystem Marketplace, the average cost of offsets in 2015 was $3.30/tonne, though the lowest recorded transaction was $0.10/tonne and the highest recorded transaction was $44.80/tonne (Hamrick and Goldstein 2016). The price of offsets can incorporate the marginal damage costs of pollution and the preferences for a broader bundle of characteristics (Conte and Kotchen 2010). For instance, in addition to offsetting carbon, firms may purchase offsets for desired co-benefits, such as poverty alleviation and biodiversity conservation (Conte and Kotchen 2010). Thus, carbon offsets can be a useful market-based tool for mitigating the effects of climate change, while also addressing other social concerns.

Gillenwater et al. (2007) and Whitehead and Stavins (1997) argue that offsetting carbon is an important climate-related economic initiative because it creates a way to achieve significant reductions in GHG emissions in a cost-effective manner. Similarly, economist and professor Robert Frank states, "If our goal is to reduce carbon emissions as efficiently as possible, offsets make perfect economic sense" (2009). Frank argues that carbon offsets are a small price to pay for the efficiency in emissions reductions that they provide. Pedroni et al. (2011) builds on this argument, asserting that privatized carbon offsets markets provide a faster, more reliable way to address carbon emissions than government and policy initiatives. In addition, Hall (2007) and Mickle (2016) claim that carbon offsets that support energy efficiency and renewable energy projects can provide a way for people to support sustainable development initiatives across the globe and use the market to internalize the negative externality associated with carbon emissions. Further, reforestation offsets may protect millions of at-risk forests and lands and promote biodiversity across the globe through the long-term sequestration of carbon associated with planting trees (Mickle 2016). In summary, scholars argue that offsets are a cost-effective way to achieve significant GHG emissions reductions, support sustainable development worldwide, and incentivize the protection of ecosystems across the world.

However, scholars such as Polk and Potes (2008) and Boyd (2009) have also raised various concerns about the associated social, ethical, and ecological implications and verifiability of carbon offsets, especially on a global level. McAfee (1997) argues that the global carbon offsets market allows privileged entities to "buy their way out" of internal emissions reductions. Bachram (2004) adds that carbon offsets can also represent a form of "carbon colonialism" that displaces the burden of emissions reductions onto poorer, developing countries around the world. Bachram makes the following argument regarding the implementation of carbon offsets in developing countries and its relationship to neo-colonialism:

> …[Emissions] trading is being used to distract attention away from the changes that are urgently needed. In this way corporations and government are able to build the illusion of

> taking action on climate change while reinforcing current unequal power structures. Emissions trading therefore becomes an instrument by means of which the current world order, built and founded on a history of colonialism, wields a new kind of "carbon colonialism" (2004, 19).

Bachram's argument can be applied to American colleges and universities that engage in global emissions trading by purchasing carbon offsets from third-party organizations. Carbon offsets often overlook the importance of making structural changes that address the sources of emissions themselves by passing off the responsibility of one's carbon footprint to another entity (Bachram 2004).

Additionally, Boyd (2009) argues that sustainable development projects funded by carbon offsets in foreign countries can undermine local governance structures or neglect to improve the social and ecological conditions of local communities. Boyd contends there are governance challenges associated with global institutions implementing offset projects in developing countries, suggesting global actors need to strengthen local relationships with communities to understand how international offset projects impact the local communities. Bumpus and Liverman further argue that the implementation of projects by global actors must be well-managed or they run the risk of resulting in local inequity and "restrictions of access to resources crucial to some of the poorest local people, such as landfill sites and community land" (2011, 212). This can occur when third-party companies establish offset projects in developing countries without the consent of local communities when they purchase their land. These local communities may also lack the knowledge or skills to allow them to demand higher, fairer prices for the carbon reductions, resulting in exploitation (Bumpus and Liverman 2011). Possible interference with local communities caused by transnational offsets projects can pose ethical and social issues.

Additionally, McAfee (1997) argues that carbon offsets are fundamentally difficult to construct and verify, and place entities at risk due to changing carbon prices in volatile markets. Similarly, Song (2019) finds that many carbon offsets projects did not reduce the amount of carbon emissions they were supposed to, quickly reversed the gains they had brought, or were unable to be accurately measured. Song's findings suggest carbon offset programs are not following through on their promised climate benefits, in turn raising concerns with the verification processes for offset projects (2019).

To verify carbon offset projects, third-party certifiers evaluate numerous metrics: additionality, or whether a project would or would not have happened without the incentives provided by carbon offset purchases; permanence, or whether the carbon reduction is irreversible; absence of leakage, meaning inadvertent increases in emissions elsewhere due to the project have been accounted for; verifiability, or quantifiable evidence that a reduction has occurred; transparency, meaning all project details are provided and publicly available; and enforceability of the offsets, meaning the project must be backed by an official contract (Second Nature 2016). It can be quite challenging to ensure that a carbon offset satisfies all these criteria, given the voluntary nature of the carbon offsets market and the lack of an official, standardized protocol for verifying offsets. Thus, the lack of consensus on how to evaluate carbon offset projects is the source of much criticism within the scholarly debate.

As scholars have both argued for the benefits of carbon offsetting and questioned the associated social, ethical, and ecological implications, the use of carbon offsets remains complex and controversial.

Carbon Offset Approaches in Higher Education

To address Scope 3 emissions, over 140 schools are purchasing carbon offsets, or about 32% of total active ACUPCC signatory schools (Second Nature 2016). Considering the complex nature of carbon offsets, Second Nature encourages higher education institutions to use carbon offsets as a last resort after other direct emissions reductions strategies have been utilized ("Carbon Management & Greenhouse Gas Mitigation" n.d.). Colleges reflect this sentiment in their CAPs. For example, Carleton College's CAP outlines strategies to reduce on-campus emissions, stating the school first plans to reduce or avoid as many GHG emissions as possible before implementing carbon offsets to mitigate the remaining emissions (Carleton Climate Action Plan Steering Committee 2011).

Given the concerns associated with international third-party carbon offsets, some colleges have invested in or developed local offset projects.[2] Kinsley and DeLeon (2009) argue that local offsets can provide social benefits to the school's local community, educational opportunities for students and community members, and a sense of responsibility for the school and developers. This may not be the case with international offsets, as these offset projects often occur in an anonymous community with no personal connection to the campus community (Polk and Potes 2008; Kinsley and DeLeon 2009; ACUPCC Voluntary Carbon Offsets Working Group 2008). According to Second Nature, "Local projects inherently reduce the risks that accredited programs attempt to mitigate through extensive monitoring and verification requirements, but they also enable ecological and social co-benefits for campuses' and their surrounding communities" (2016, 36). Because of the proximity to the campus, local offsets may allow

[2] According to Second Nature (2016), it is up to the institution to determine what is considered "local," but common definitions include within the same state, within 100 miles of the school, or able to be visited within one day of round-trip travel from the school.

schools to ensure the verifiability and validity of the carbon emissions reductions and track the project's ecological impacts more closely, which is more difficult to do with international third-party offset programs that can lack transparency. Additionally, local offset programs may create jobs for the local community, promote local biodiversity, and increase the likelihood of securing funding from donors and community members, which can be more valuable and meaningful for the school (Polk and Potes 2008; MacKerron et al. 2009).

However, the resources, time, and monitoring required of local offsets programs may pose a challenge for schools with fewer resources or staff. Many of the co-benefits, such as job creation and increased biodiversity, could also result from internationally-based carbon offsets in the local community in which the offset program is implemented. Regardless of where the offset occurs, scholars such as Boyd (2009) argue that offsets should be implemented thoughtfully and carefully in order to incorporate local representation and participation of those who will be most directly impacted by the offset project. Because a school's access to resources may affect whether they engage with local offsets over international third-party offsets, our study examines possible correlations between schools' institutional characteristics, such as endowment and status, and their use of local offsets to test if different types of schools are more likely to take certain approaches regarding offset use.

Sustainability Commitments in Higher Education

Our study is also interested in the interaction between schools' offset use and the features of their ACUPCC commitment. Through the ACUPCC commitment, schools commit to establishing a goal year by which they will achieve carbon neutrality and creating a CAP. Slawinski and Banal (2012) conducted a study on the role of time in organizational responses to climate change. They found that given a temporal deadline, "firms aimed to mitigate risks and tried to control their immediate environments through such measures as modeling the impact of carbon prices and purchasing offsets" (Slawinski and Banal 2012, 1555). Slawinski and Banal (2012) also found that, in holding a linear view of time for climate change mitigation, firms tend to look for efficient solutions. However, these approaches tend to be narrow and firms may miss some of the problem's complexities. These findings that a time component may influence how a firm approaches climate mitigation serve as the basis for our own analysis, in which we test if schools' carbon neutrality goals and the year that they wrote their CAPs are correlated to their institutional characteristics or Scope 3 mitigation approaches, and specifically offset use.

In a general sense, the ACUPCC commitment is what scholars Grindsted and Holm (2012) would classify as a declaration on sustainability in higher education, or a non-binding regulation that shapes an institution's role in ensuring sustainable development. Grindsted and Holm conducted a systematic investigation of sustainability declarations across various colleges, universities, and governments through a thematic analysis of the declarations' content and development. Their methodology included collecting publicly available sustainability declarations from higher education institutions and then categorizing, coding, and condensing their findings to identify common themes. Our study borrows from Grindsted and Holm's methodology, as we apply their process for thematic analysis to our own analysis of themes among ACUPCC signatory schools' approaches to Scope 3 mitigation.

Literature Review Summary

In summary, existing research regarding GHG emissions of higher education institutions has focused on the institutional features that impact the amount of GHG emissions a school emits, such as student body size, climate, and endowment. Additionally, there is limited guidance for schools looking to reduce their Scope 3 emissions, though Second Nature (2016) recommends that schools reduce what they can and offset what they cannot. Although there is a scholarly debate on the nuances of carbon offsetting and the associated economic, ecological, and social considerations, ACUPCC signatories have already begun to purchase or produce carbon offsets both locally and globally (ACUPCC Voluntary Carbon Offsets Working Group 2008). Little is known about the best approaches to mitigating Scope 3 emissions for higher education institutions, schools' decisions surrounding offsets, and how these decisions relate to the school's characteristics. Through a thematic analysis of ACUPCC signatories' mitigation strategies based on Grindsted and Holm's (2012) methodology, our research sheds light on themes among schools' strategies for achieving carbon neutrality. Lastly, given the findings by Fetcher (2009), Klein-Banai and Theis (2013), Williamson (2012), and Slawinski and Banal (2012), this study expands the breadth of analysis to investigate whether these strategies are statistically correlated to institutional characteristics and how time may be a factor in decision making as well.

Methodology

This study employs a combination of thematic and statistical analysis to understand how ACUPCC signatories are approaching Scope 3 mitigation. This mixed qualitative and quantitative approach allowed us to gain a better understanding of common themes among schools' strategies and how schools incorporate offset use given their ACUPCC commitments and institutional characteristics.

Data Collection

To collect our sample, we obtained a list from Second Nature of the 435 active ACUPCC signatories, or schools that are currently engaging with their commitment. From this list, we randomly selected 20% of ACUPCC signatory institutions from each U.S. Census Bureau region (U.S. Bureau of the Census, Appendix A). This resulted in 17 schools from the Midwest, 26 schools from the Northeast, 23 schools from the South, and 21 schools from the West for a total of 87 schools. Data for colleges and universities were obtained from Second Nature, the organization that oversees the ACUPCC commitment. For any schools that published more than one CAP or reported emissions data for more than one year, we used their most recent data available on Second Nature's reporting database. We eliminated 9 schools from our sample because they did not have CAPs posted on Second Nature or their websites, giving us a final sample of 78 signatories.[3] Additional contextual information about the schools was obtained from the National Center for Education Statistics and Data USA (National Center for Education Statistics; Data USA). The data of interest included size, status as public or private, and endowment per student (Table 1).[4]

[3] The schools we removed from our sample are: Bay de Noc Community College, Eastfield College, Harvey Mudd College, Jacksonville University, Mary Baldwin University, Otis College of Art and Design, Prescott College, Purchase College, and Springfield Technical Community College.
[4] To view our full data set online, visit shorturl.at/dkzB8.

Table 1: Variable Descriptions

	Description	Type	Unit/Metric	Data Source
Carbon neutrality goal	Year school has declared they will achieve carbon neutrality under ACUPCC	Continuous	Year	Second Nature Reporting Database
CAP year published	Year of most recently published CAP	Continuous	Year	Second Nature Reporting Database
Gross carbon emissions	Indicates total carbon emissions for a given institution	Continous	MTCO2e (metric tons of carbon dioxide equivalent) – The unit "CO2e" represents an amount of a GHG whose atmospheric impact has been standardized to that of one unit mass of carbon dioxide (EPA 2014).	Second Nature Reporting Database
Total scope 3 emissions	Total emissions from Scope 3 sources	Continuous	MTCO2e	Second Nature Reporting Database
Use of carbon offsets	Indicates whether school has implemented carbon offsets	Dichotomous	Yes or No	Second Nature's Reporting Database
Mention of local offsets	School's mention of locality in considering offsets	Dichotomous	Yes or No	Created using information found in CAPs
Geographic region	Region in which the school is located	Categorical	Midwest, West, Northeast, South	United States Census Bureau
Status	Indicates whether a school is private or public	Dichotomous	Private or Public	National Center for Education Statistics
Student body size	Students enrolled full-time	Continuous	Number of enrolled students	National Center for Education Statistics
Endowment per student	Endowment divided by number of full-time enrolled students	Continuous	Dollars	Data USA

Thematic Analysis of Scope 3 Mitigation Strategies

To answer our first research question regarding how ACUPCC signatories are addressing Scope 3 emissions to achieve carbon neutrality, we conducted a thematic analysis of mitigation strategies mentioned in CAPs. This methodology is based on the aforementioned study by Grindsted and Holm (2012) that analyzes thematic developments of declarations on sustainability in higher education. To begin, we read through the CAPs of schools in our sample, writing down any strategies that specifically addressed Scope 3 emissions. As a reminder, Scope 3 emissions fall into these general categories: air travel, commuting, solid waste, waste water, and purchased goods and services. Then, similar to Grindsted and Holm (2012), we categorized, coded, and condensed our list of approaches to identify specific themes that describe the types of mitigation strategies.

Statistical Analysis

To examine the extent of underlying patterns between schools' characteristics and their approaches to addressing Scope 3 emissions, we first selected characteristic variables that we hypothesized would influence schools' mitigation strategies (Table 1). We selected these variables based on the aforementioned studies by Fetcher (2009), Klein-Banai and Theis (2013), and Williamson (2012) that suggest these factors can predict institutions' gross emissions. Williamson (2012) also proposes that a relationship may exist between institutional characteristics and mitigation strategies based on their endowment size and student body size. We selected school status (public vs. private) as a variable of interest because Lerner et al. (2008) found that public schools have much lower endowment values per student than private schools on average, suggesting private schools tend to be better resourced. Given these scholars' findings, we propose that different approaches to Scope 3 mitigation and offset use may be implemented by schools with varying access to resources depending on their size, geographic region, endowment per student, and status. Moreover, based on Slawinski and Banal's 2012 study investigating the role of time in climate action planning, we included schools' carbon neutrality goal year and the year the institution wrote its CAP to see if time is also statistically significant in schools' decisions surrounding Scope 3 mitigation. We focused our statistical analysis on carbon offsets given their complex and controversial nature, and because 32% of total active ACUPCC signatories are already using some form of offsets.

We then devised several sub-questions from which we developed regression models to test:

1. As previous studies have found, are the gross emissions of higher education institutions affected by institutional characteristics such as student body size, endowment per student, geographic region, and public vs. private status?

To confirm the findings of Fetcher (2009), Klein-Banai and Theis (2013), and Williamson (2012), we ran the following multivariate linear regression with gross carbon emissions as the dependent variable and a function of student body size, endowment, geographic region, and school status:

$$\textbf{Gross Carbon Emissions} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\textbf{Size} + \boldsymbol{\beta_2}\textbf{Endowment} + \boldsymbol{\beta_3}\textbf{Region} + \boldsymbol{\beta_4}\textbf{Status}$$

2. Previous scholars have found that gross emissions are affected by institutional characteristics such as student body size, endowment per student, geographic region, and public vs. private status. Can these also influence the amount of Scope 3 emissions produced by a higher education institution?

This question suggested the following multivariate linear regression with Scope 3 emissions as the dependent variable and function of the following student body size, endowment, geographic region, and school status:

$$\textbf{Scope 3 Emissions} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\textbf{Size} + \boldsymbol{\beta_2}\textbf{Endowment} + \boldsymbol{\beta_3}\textbf{Region} + \boldsymbol{\beta_4}\textbf{Status}$$

3. Is the use of carbon offsets influenced by student body size, endowment per student, geographic region, carbon neutrality goal, public vs. private status, and/or CAP year?

This question suggested a binary logistic regression model with carbon offset use as the dependent variable and a function of student body size, endowment per student, geographic region, public vs. private status, carbon neutrality goal, and/or CAP year. We ran this model twice, once with carbon offset *mention* as the independent variable (1) and once with carbon offset *use* as the independent variable (2). This is because carbon offset use data is available for ACUPCC signatory schools via Second Nature, so we wanted to examine if differences existed between the schools that had only mentioned it in their CAPs versus schools that have already implemented offsets.

(1) **Log(Offset Mention/1 - Offset Mention) = β_0 + β_1Size + β_2Endowment + β_3Region + β_4Status + β_5Goal Year + β_6CAP Year**

(2) **Log(Offset Use/1 - Offset Use) = β_0 + β_1Size + β_2Endowment + β_3Region + β_4Status + β_5Goal Year + β_6CAP Year**

4. Is the mention of local offsets influenced by student body size, endowment per student, geographic region, public vs. private status, carbon neutrality goal, and/or CAP year?

This question suggested a similar binary logistic regression model but with local offset mention as the dependent variable. Unlike with carbon offset use, Second Nature does not report data on whether schools are already using local offsets, so we relied on mentions of local offsets in CAPs for our independent variable.

Log(Local Mention/1 - Local Mention) = β_0 + β_1Size + β_2Endowment + β_3Region + β_4Statusl + β_5Goal Year + β_6CAP Year

By undertaking these analyses, we were able to explore possible patterns between higher education institutions' characteristics and their engagement with carbon offsets.

Results

This section provides an overview of the results from our thematic and statistical analyses. We begin by discussing the common themes we identified in Scope 3 mitigation strategies in schools' CAPs. From there, we verify the findings of Fetcher (2009), Klein-Banai and Theis (2013), and Williamson (2012) that investigate the factors correlated to GHG emissions in higher education. Lastly, we present the results of our own statistical analysis that tests whether there are relationships between institutional characteristics, CAP publication year, carbon neutrality goal year, and engagement with carbon offsets.

Thematic Analysis: Results

Our thematic analysis revealed that carbon offsets are the most commonly stated strategy for addressing Scope 3 emissions in schools' CAPs. Figure 1 displays the number of schools that stated each approach to mitigating Scope 3 emissions in their CAPs, including strategies listed by a minimum of 10 ACUPCC signatories. See Appendix B for a full list of strategies mentioned in CAPs to address Scope 3 emissions. The most common strategy that schools mentioned in their CAPs was carbon offsets, with 63 schools (81%) in our sample stating carbon offsets would be part of their path to carbon neutrality. We also identified a distinction between schools that mention carbon offset use in their CAPs and schools that have already implemented offsets, according to Second Nature's reporting database (Second Nature n.d.). This number differs because the CAPs–many of which were written over a decade ago–only outline proposed strategies rather than formal plans. We found that 34 schools (44%) mentioned they would use carbon offsets in their CAPs but have not yet implemented them according to Second Nature (Table 2). Schools also mention in their CAPs that carbon offsetting will be a last resort after implementing other emissions reductions measures first. For example, Central Connecticut State University's CAP states that "although the purchase of carbon offsets may be necessary to achieve the end goal of climate neutrality, CCSU will reserve this action as a last resort (*Climate Action Plan Central Connecticut State University* 2009). The College of St. Benedict, Eastern Washington University, and Chandler-Gilbert Community College, among other schools, make similar declarations in their CAPs.

Figure 1. Frequency of Approaches to Scope 3 Emissions Stated in CAPs[5]

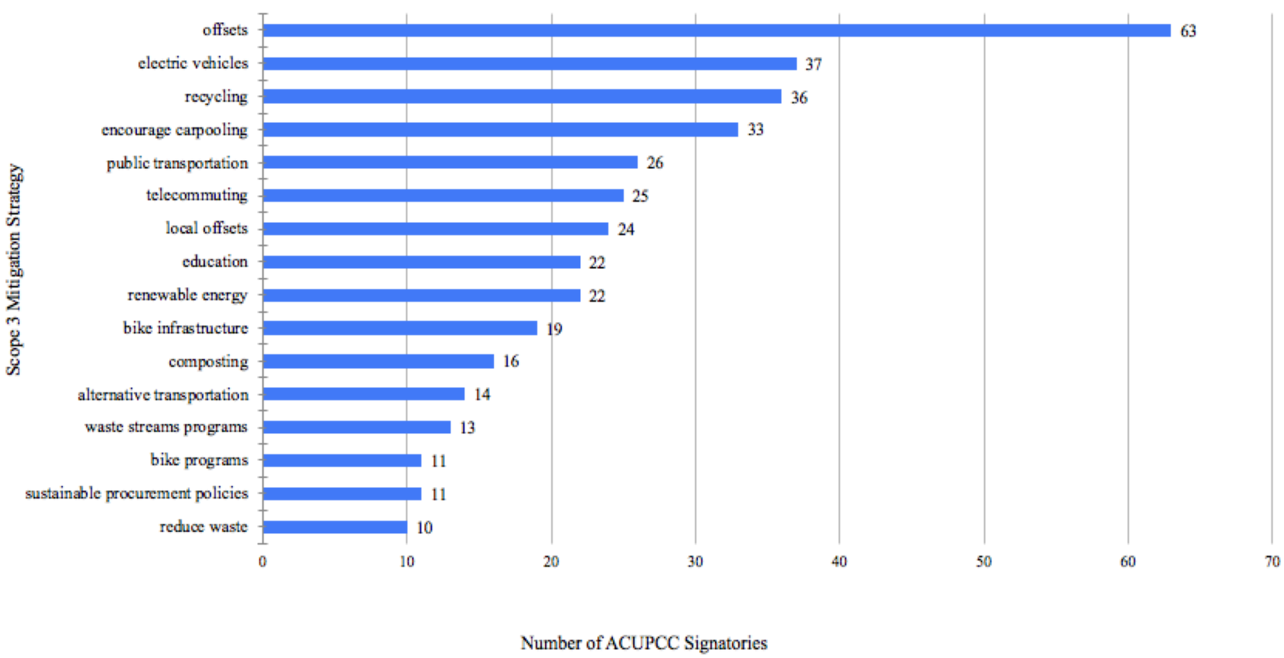


Table 2: Number of ACUPCC Signatories Mentioning Offsets vs Using Offsets

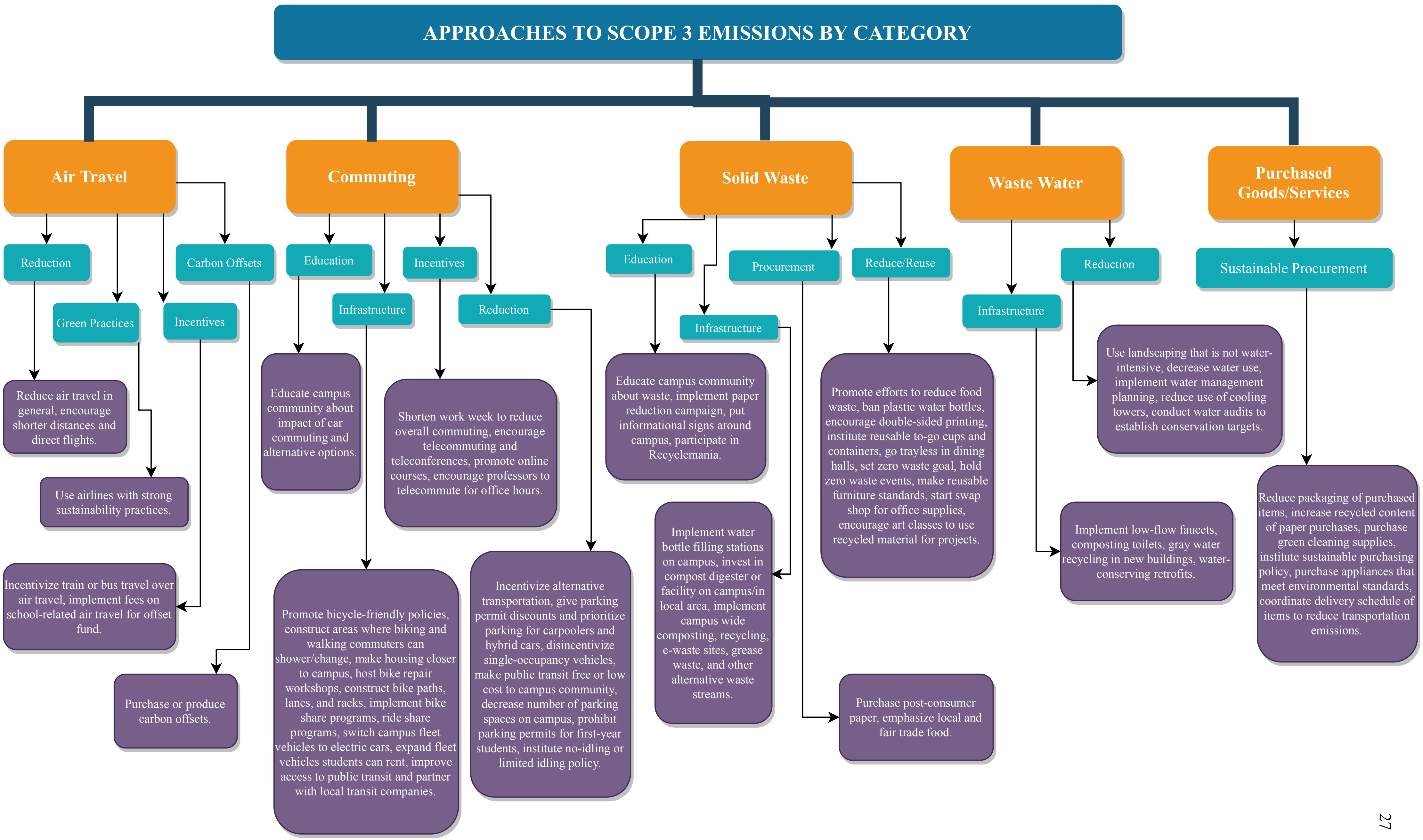
		Uses Offsets According to Second Nature	
		Yes	No
Mentions Offsets in CAP	Yes	29	34
	No	0	15

[5] Note that the 24 schools that mentioned "local offsets" were also included in the subset of schools that mentioned "offsets" in general.

After offsets, some of the most frequently mentioned strategies pertain to transportation and commuting, with 47% of schools mentioning electric vehicles, 42% of schools mentioning they would encourage or incentivize carpooling, and 33% stating they would improve public transportation options. Establishing alternative waste streams is also a priority, with approximately 46% of schools mentioning recycling, 21% of schools mentioning composting, and 18% of schools including the development of waste streams programs as a Scope 3 mitigation strategy.

After compiling the stated approaches into a list, we grouped them by broad category of type of Scope 3 emissions: air travel, commuting, solid waste, waste water, and purchased goods/services. For each category of emissions, we condensed the approaches schools mentioned into common themes. Figure 2 shows the themes we identified for each emissions category along with a brief description of the approach. Though the themes varied slightly between categories, the common themes across all emissions categories were education, incentivization policies for various behaviors, reduction initiatives for water, food, waste, and energy, and infrastructure development and improvement. Carbon offsets are listed as a common approach under air travel specifically because they are most likely the only way to reduce emissions from air travel. However, it should be noted that offsets were discussed throughout CAPs as a strategy to reduce all Scope 3 emissions in general.

Figure 2. Approaches to Scope 3 Emissions Grouped by Category



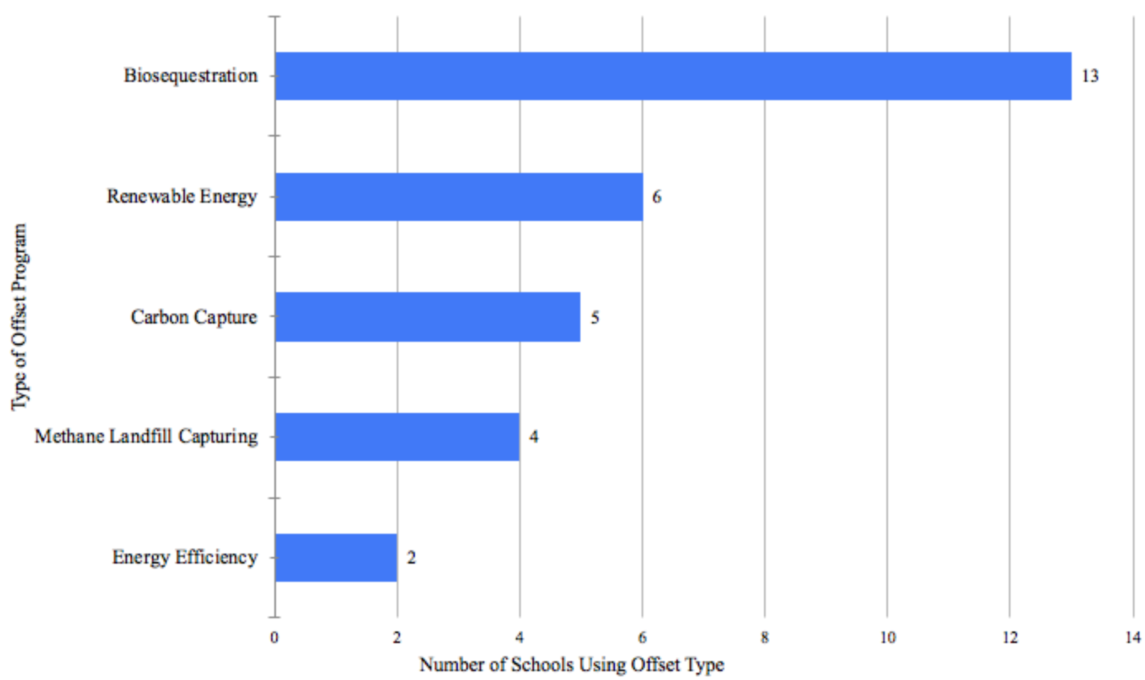
Each schools' descriptions of strategies can be grouped into the themes "education," "incentives," "reduction," and "infrastructure." Strategies related to "education" included providing information for students, faculty, and staff on the impact of commuting, the availability of commuting options besides for single-occupancy vehicles, the importance of alternative waste streams, campus waste stream programs, and campus sustainability efforts in general. Strategies that schools mentioned based on "incentives" focused on transportation, including actions such as encouraging carpooling by offering more or closer parking spots for carpoolers, offering cheaper parking passes for those with hybrid cars or electric vehicles, and financially assisting students, faculty, and staff who travel via bus or train for campus-related travel. These strategies also included dis-incentivizing, such as discouraging cars on campus by offering fewer parking spots, increasing the price of parking passes, prohibiting underclassmen from having cars on campus, and implementing a no-idling policy.

Strategies that fall under the general theme of "reduction" included reducing campus-related air travel in general and encouraging students to study abroad in closer destinations, shortening the work week to reduce commuting needs, encouraging professors and students to take advantage of telecommuting technologies, and promoting waste and water reduction. Finally, strategies related to "infrastructure" included the development of campus facilities, systems, or processes that enable the campus to reduce its overall emissions, such as constructing bike paths, water bottle filling stations, low-flow faucets, and implementing alternative waste stream programs.

Types of Offset Programs

Among the schools that have already reported to Second Nature that they have implemented offsets (37%), the most common type of offset program is biosequestration, which 13 schools have implemented. The next most common type is renewable energy offsets, followed by carbon capturing, methane landfill capturing, and energy efficiency improvements. Figure 3 shows the number of schools using each offset type.[6] To clarify, these only include offset programs that schools have already implemented. Information on offset types was gathered from Second Nature's reporting database or schools' sustainability websites, as much of this information was not listed in schools' CAPs.

Figure 3. Offset Types Used by ACUPCC Signatories



[6] To see which schools are using which type of offset, view our full data set online at shorturl.at/dkzB8.

Schools' carbon offset programs varied in location and type. One notable biosequestration program is Colgate University's Patagonia Sur program. Through this program, Colgate has made a 15-year commitment to purchase forestry-based offsets and plant over 225,000 native-species trees in Chile's Aysén region of Patagonia (Brooks 2011). The agreement also includes the development of a research site on the land for students and faculty to study sustainability initiatives (Brooks 2011). Another biosequestration-based offset program is Dickinson College's Hawk Mountain Sanctuary Forest Project in which Dickinson community members are invited to purchase offsets to counter their air travel emissions. The offsets support reforestation and wildlife restoration efforts in Pennsylvania, just 80 miles from campus (Rosen 2019). Both of these programs incorporate some element of curricular tie-in and community engagement, as both colleges emphasize the ability of their programs to engage students in climate change research and connect them with the community and place in which they are studying.

Locality of Carbon Offsets

In our sample, 24 schools (31%) specifically propose the use of local offsets in their CAPs as a Scope 3 mitigation strategy.[7] We found that the language used in these 24 CAPs regarding local offsets centers on the social, ecological, economic, and educational co-benefits associated with implementing offsets on a local level. For example, both the University of New England and William Rainey Harper College advocate for offsets programs that will reduce emissions by investing in a local offset fund, rather than financially supporting an offset project internationally that would not economically benefit their local communities (*University of New England CAP* 2017; *William Rainey Harper Climate Action Plan* 2013). Similarly, Loyola

[7] To see a full list of which schools mention locality, view our full data set online at shorturl.at/dkzB8.

University Maryland states that they will pursue offset programs that encourage local professional development opportunities in order to support their local economy and reduce university travel miles (*Climate Action Plan: Loyola University Maryland* 2018).

Sweet Briar College's CAP also states that they hope to use local offsets to take on a leadership role in sustainability in the local community, and they express interest in establishing a biosequestration program in the local community to provide educational opportunities for their students (*Climate Neutral by 2030: Climate Action Plan, Sweet Briar College* 2010). Finally, Western Washington University plans to investigate local opportunities for offsetting programs that offer tangible environmental, social, and economic benefits to the local community (*Western Washington University Climate Action Plan* 2010). According to our sample schools' CAPs, locality of offset programs is appealing due to the associated co-benefits that it can provide for the school's local community.

Beyond mentioning local offsets in CAPs, some schools have already implemented offset programs on local levels. For example, Duke University has partnered with a local swine waste operation in North Carolina to capture methane and convert it into renewable energy ("Swine Waste-to-Energy" n.d.). The operation takes methane from a feeder-to-finish swine operation that would be otherwise released into the atmosphere and processes and burns the methane to be used as electricity. This produces offsets equivalent to 2,500 MTCO2e (metric tons of carbon dioxide equivalent) a year for Duke University, which accounts for 2.8% of Duke's Scope 3 emissions. Duke's website explicitly outlines the co-benefits of the project, including the educational, environmental, and social benefits of the project ("Swine Waste-to-Energy" n.d.). Similarly, Mercyhurst University purchases carbon offsets from the local Blue Ridge Landfill, which runs a similar methane capturing project to produce electricity (Mercyhurst University

2014). Mercyhurst University emphasizes the importance of supporting a local offset fund and providing educational opportunities for students.

Statistical Analysis: Basic Trends

We identified several trends in our data regarding CAP year, goal year, and offset use. Table 3 reports summary statistics for the 78 ACUPCC signatory schools in our sample. Detailed variable descriptions with units of measurement can be found in Table 1. Schools wrote their CAPs between 2007 to 2019, with 64% of our sample writing their CAPs between 2009 and 2011. Figure 4 shows the distribution of goal years in our sample. The most common goal year in our sample was 2050, followed by 2030, and the latest goal year recorded was 2099. There were three schools in our sample with a goal year in 2099: Nassau Community College, Washington State University - Tri-Cities, and Washington State University - Pullman. Additionally, more public schools use carbon offsets than private schools, though more private schools mentioned using local offsets than public schools (Figure 5; Figure 6). Of all four regions, schools in the Northeast have the highest proportion of offset use and mention of local offset use (Figure 5; Figure 6). However, colleges in the Northeast make up approximately 30% of our sample, the largest of any region, which could account for the higher representation seen in Figure 5 and Figure 6.

Table 3: Summary Statisics for Selected Variables

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Student Body Size	78	12,127.9	15,269.5	337	2,400	17,306.2	104,068
Endowment Per Student	66	71,559.0	111,763.1	266.0	3,739.0	61,778.8	490,391.0
Carbon Neutrality Goal Year	73	2,043.5	16.2	2,016.0	2,030.0	2,050.0	2,099.0
CAP Year Published	78	2,011.6	2.9	2,007	2,010	2,012.8	2,019
Scope 3 Emissions	78	12,741.8	16,366.7	200	3,198.2	16,163.8	86,555
Gross Emissions	78	46,570.0	69,458.7	2,090	9,374.2	40,990.5	404,913

Figure 4: Distribution of Carbon Neutrality Goal Year

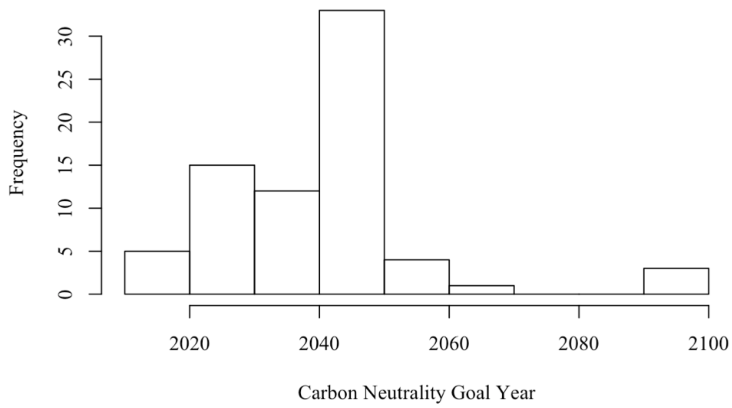


Figure 5. Percentage of Schools that Use Offsets by Region and Status

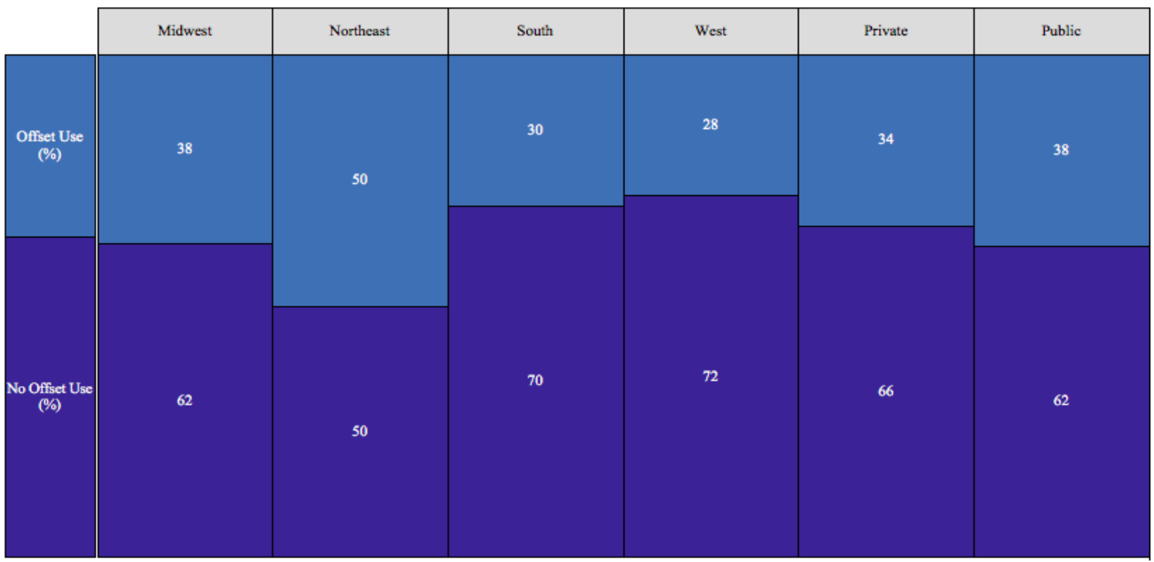
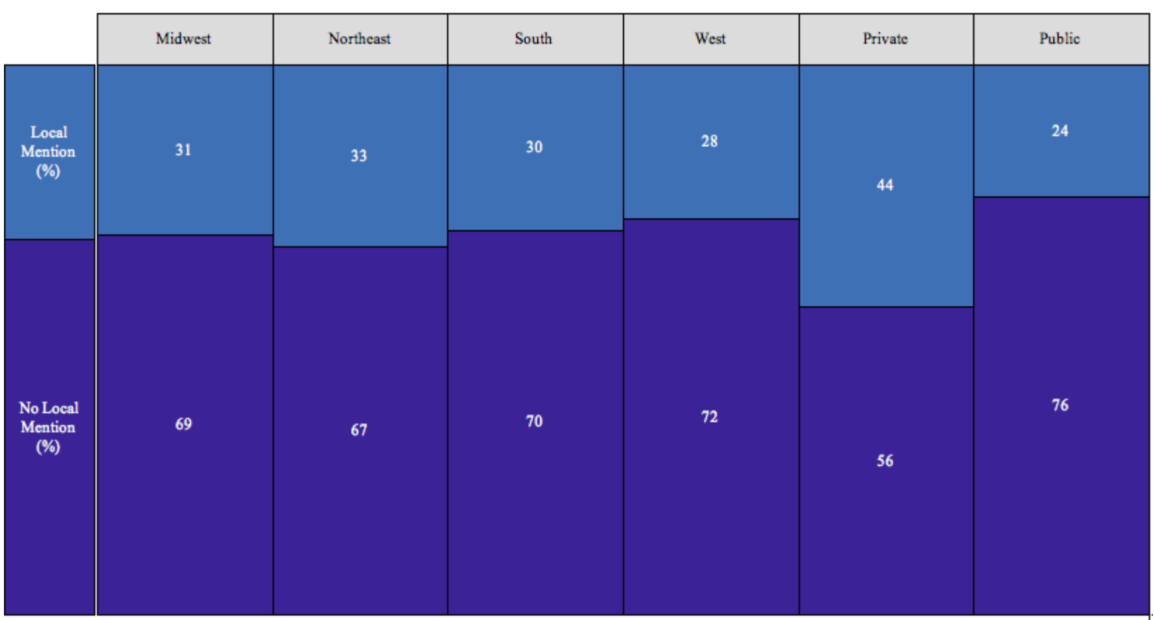


Figure 6. Percentage of Schools that Mention Local Offsets by Region and Status



Moreover, strong positive correlations exist between student body size and gross emissions, Scope 3 emissions and gross emissions, and student body size and Scope 3 emissions (Table 4). A moderate negative correlation is present between endowment per student and student body size (Table 4). These correlations make intuitive sense, because a larger student body size would mean that there are more people contributing to total emissions, and thus it is likely that both Scope 3 emissions and gross emissions will increase. It also follows that an increase in student enrollment will decrease the endowment per student, given that endowment is a relatively fixed number at an institution.

Table 4: Simple Correlation Tests Among Variables

	Offset Use	*Student Body Size*	*Endowment Per Student*	*CAP Year*	*Carbon Neutrality Goal Year*	*Scope 3 Emissions*	*Gross Emissions*
Offset Use		-0.036	0.026	-0.146	-0.212	-0.036	0.029
Student Body Size			-0.496***	0.066	0.219	0.622***	0.629***
Endowment Per Student				-0.105	0.100	-0.129	0.027
CAP Year					0.001	0.194	0.192
Carbon Neutrality Goal Year						0.053	0.186
Scope 3 Emissions							0.840***
Gross Emissions							

Computed correlation used pearson-method with pairwise-deletion.
**P<0.1; **p<0.05; ***p<0.01*
Note: Strong positive correlations exist between student body size and gross emissions, student body size and scope 3 emissions, and scope 3 emissions and gross emissions. There is a moderate negative correlation between endowment and student body size.

Modeling Results

First, we ran a multivariate linear regression to verify the findings of Fetcher (2009), Klein-Banai and Theis (2013), and Williamson (2012) and confirm that institutional characteristics affect gross GHG emissions sizes. After confirming these findings, we ran an additional regression model to focus on Scope 3 emissions. The results of these linear (OLS) regressions are in Table 5. The results of these regressions suggest that the size of the student body and endowment per student are statistically significant factors in an institution's overall level of GHG emissions and Scope 3 emissions, as previous studies have found. Additionally, the results reveal that the Northeast is statistically different from the Midwest for both emission types, supporting Fetcher (2009) and Klein-Banai and Theis' (2013) findings that regional climate may impact the gross GHG emissions of an institution. For gross GHG emissions, we found that status is also marginally significant, reinforcing our decision to include it in our models investigating the impacts of institutional characteristics on offset mention, offset use, and mention of local offsets.

Table 5: OLS Regression Results for GHG Emissions and Scope 3 Emissions

	Dependent variable:	
	GHG Emissions	Scope 3 Emissions
	(1)	(2)
Constant	0.555 (0.569)	0.310 (0.863)
Student body size	0.859*** (0.049)	0.857*** (0.069)
Endowment per student	0.234*** (0.028)	0.123*** (0.044)
Northeast	−0.455*** (0.126)	−0.431** (0.204)
South	0.085 (0.136)	0.141 (0.215)
West	−0.383** (0.155)	−0.104 (0.241)
Status	0.230* (0.125)	
Observations	61	60
R^2	0.907	0.783
Adjusted R^2	0.896	0.763
Residual Std. Error (df = 54)	0.366	0.575
F Statistic	87.530*** (df = 6; 54)	39.071*** (df = 5; 54)

*p<0.1; **p<0.05; ***p<0.01

Note: Student body size, endowment per student, and the Northeast are all statistically significant contributors to GHG emissions and Scope 3 emissions. Status is a significant predictor of GHG emissions but not of Scope 3 emisisons. The West is also no longer statistically significant in the Scope 3 emissions model. Standard errors are in parentheses.

Given the findings of these initial regressions, we also carried out standard logistic regressions to assess the ability of our aforementioned variables to predict the likelihood of a school mentioning offsets in its CAP, using carbon offsets (as reported to Second Nature), and mentioning locality of carbon offsets in its CAP. As a reminder, the variables that we used were student body size, endowment per student, geographic region, public vs. private status, carbon neutrality goal, and CAP publication year. Table 6 reports the results of the logistic binary regression that investigated the relationship between the aforementioned variables and the mention of carbon offsets in CAPs. The only variable that was statistically significant was status, though status was only significant at the 10% level. Given that this is not very significant, we decided to not make any inferences based on this finding.

Table 6: Logistic Binary Regression Results for Mention of Carbon Offsets

	Saturated Model	Partially Reduced Model	Final Model
	(1)	(2)	(3)
Constant	1.935 (2,772.962)	−347.812 (281.815)	2.603*** (0.733)
Student Body Size	0.027 (0.410)		
Endowment Per Student	−0.230 (0.326)		
Northeast	−17.219 (2,758.295)		
South	−17.677 (2,758.295)		
West	−16.886 (2,758.295)		
Status	−1.039 (1.476)	−1.529* (0.840)	−1.535* (0.812)
Carbon Neutrality Goal Year	0.022 (0.035)	−0.012 (0.018)	
CAP Year Published	−0.012 (0.143)	0.187 (0.138)	
Observations	61	73	72
Log Likelihood	−17.077	−33.034	−31.729
Akaike Inf. Crit.	52.154	74.067	67.458

*p<0.1; **p<0.05; ***p<0.01

Note: The only variable that is statisically significant for predicting the mention of offsets in a CAP is status. That said, status is marginally significant at the 10 percent level, with a p-value of 0.068 in the reduced model and 0.058 in the final model . All schools with a carbon neutrality goal year of 2099 were outliers in this model, so there is no need for a separate model to test their influence. Standard errors are in parentheses.

Table 7 reports the results of the logistic binary regression that explored the use of carbon offsets at ACUPCC schools. In Table 7 (3), the results of our final model show that the carbon neutrality goal year set by an institution was the only statistically significant contributor to a school's likelihood of using carbon offsets. Upon initial review, the three schools with a goal year in 2099 appeared to be outliers. Therefore, we ran a regression without them as well. That said, goal year remained statistically significant at the same significance level (Table 7 (4)). Unlike with the GHG emissions and Scope 3 emissions models, institutional characteristics were not statistically significant factors. Based on model reduction guided by the results of ANOVA drop-in-deviance tests, the model in Table 7 (3) was the statistically preferred model, so this model will be the main model of focus for inference.[8]

Table 7: Logistic Binary Regression Results for Use of Carbon Offsets

	Saturated Model	Partially Reduced Model	Final Model	Final Model Without 2099 Goal Years
	(1)	(2)	(3)	(4)
Constant	291.647 (205.634)	106.034** (49.929)	114.219** (45.185)	111.697** (46.627)
Student Body Size	0.182 (0.284)			
Endowment Per Student	0.046 (0.167)	0.039 (0.157)		
Northeast	0.360 (0.758)			
South	0.148 (0.815)			
West	0.679 (0.869)			
Status	−0.663 (0.701)	−0.454 (0.619)		
Carbon Neutrality Goal Year	−0.024 (0.020)	−0.052** (0.025)	−0.056** (0.022)	−0.055** (0.023)
CAP Year Published	−0.121 (0.102)			
Observations	61	60	72	70
Log Likelihood	−38.419	−36.983	−42.563	−42.522
Akaike Inf. Crit.	94.838	81.965	89.126	89.043

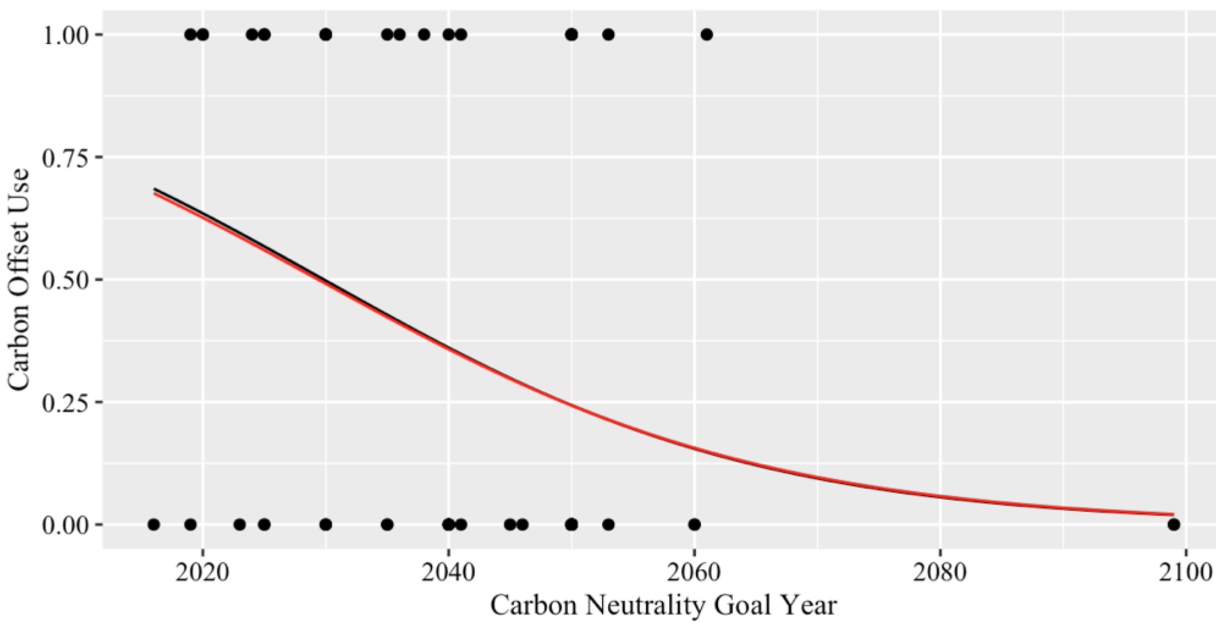
*p<0.1; **p<0.05; ***p<0.01
Note: Except for the saturated model, carbon neutrality goal year is the only statistically significant variable in determining whether a school is more likely to use carbon offsets. It remains significant even when controlling for status and endowment per student, as seen in the partially reduced model. Also note that the model where all schools with 2099 as the goal year is not very different from the final model. Standard errors are in parentheses.

Figure 8 displays the final model's probability plot, which shows that the estimated probability of using carbon offsets is lower with a later carbon neutrality goal. Based on the results in Table 7 (3), we can estimate that the probability of a school with a goal year of 2050

[8] ANOVA tests determine whether a model with fewer parameters fits the data sufficiently well compared to a saturated model that contains all possible parameters. A model with fewer parameters can often give the "best" explanation of underlying trends in the data.

using carbon offsets is 24% versus 2% for a goal year of 2099.[9] Moreover, we are 95% confident that a unit increase in goal year is associated with the odds of using carbon offsets decreasing by a factor of 0.9 to 0.98.[10] For every additional year that a college has until their carbon neutrality goal year, the odds of using carbon offsets as a current strategy decrease by a multiplicative factor of 0.95.[11] As an example, the odds of using carbon offsets at a school with a goal year of 2099 are 0.06 times less than a school whose goal is in 2050.[12]

Figure 8: Predicted Probability of Using Carbon Offsets



Note: For the y-axis variable, carbon offset use, 0 means a school does not use carbon offsets and 1 means that institution does use a carbon offset. The solid black line represents the predicted probabilities of offset use for the final model. The red line represents the predicted probabilities for the model without any schools in 2099.

[9] Probabilities were calculated using the following equation: 1/(1 + e^(carbon neutrality goal year coefficient estimate*goal year of interest)).
[10] This was calculated using the following equation: e^(carbon neutrality goal year coefficient estimate +/- 1.96*(standard error for the goal year coefficient)).
[11] This was calculated by exponentiating the coefficient of the carbon neutrality goal year: e^(carbon neutrality goal year coefficient estimate).
[12] This was calculated using the following equation: e^(carbon neutrality goal year coefficient estimate*(2099-2050)).

For our second model that explores the relationship between schools' characteristics and whether or not they mention local offsets, we once again found that the carbon neutrality goal year was the only important predictor (Table 8). This did not change when we removed all schools with a goal year of 2099 (Table 8 (4)).

Table 8: Logistic Binary Regression Results for Local Mention of Carbon Offsets

	Saturated Model	Partially Reduced Model	Final Model	Final Model Without 2099 Goal Years
	(1)	(2)	(3)	(4)
Constant	45.253 (226.868)	59.455 (52.467)	95.551** (47.824)	93.574* (49.048)
Student Body Size	0.050 (0.312)			
Endowment Per Student	−0.273 (0.245)	−0.133 (0.210)		
Northeast	−0.022 (0.846)			
South	1.193 (0.957)			
West	1.569 (1.057)			
Status	−2.338** (1.127)	−1.290 (0.827)		
Carbon Neutrality Goal Year	−0.023 (0.028)	−0.028 (0.026)	−0.047** (0.023)	−0.046* (0.024)
CAP Year Published	0.002 (0.114)			
Observations	57	57	67	66
Log Likelihood	−32.512	−34.410	−39.388	−39.359
Akaike Inf. Crit.	83.023	76.821	82.777	82.719

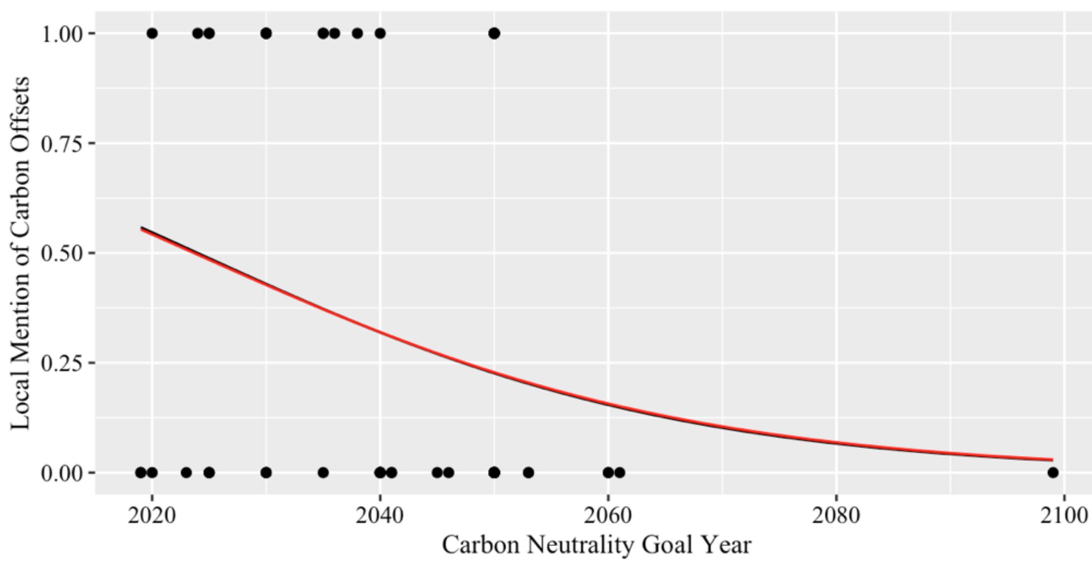
*p<0.1; **p<0.05; ***p<0.01
Note: When controlling for various institutional characteristics, nothing is statistically significant. That said, the prefered model based on drop-in deviance tests only includes carbon neutrality goal year, which is statistically significant in that model. This variable remains significant when all schools with a goal year in 2099 are removed. Also note that the model where all schools with 2099 as the goal year is not very different from the final model. The significance of the constant and goal year decrease, but that is the only major difference. Standard errors are in parentheses.

Figure 9 shows the model's probability plot, which illustrates that the probability of mentioning local carbon offsets becomes lower for ACUPCC signatories with later carbon neutrality goal years. Again, based on ANOVA drop-in-deviance tests, Table 8 (3) displays the results for the statistically preferred model, so this model will be the main focus for our inference. The probability of a school with a goal year of 2050 planning to use local offsets is 22.5%, whereas the probability is only 2.8% if the goal year is 2099.[13] We are also 95% confident that a unit increase in goal year is associated with the odds of using carbon offsets

[13] Probabilities were calculated using the following equation: 1/(1 + e^(carbon neutrality goal year coefficient estimate*goal year of interest)).

decreasing by a factor of 0.91 to 0.99.[14] In sum, every additional year that a college waits to reach carbon neutrality is associated with the odds of mentioning local carbon offsets decreasing by a multiplicative factor of 0.95.[15] For example, the odds of mentioning local carbon offsets at a ACUPCC signatory with a goal of 2099 is 0.09 times less than the odds of a school whose goal is in 2050.[16]

Figure 9: Predicted Probability of Mentioning Local Carbon Offsets



Note: For the y-axis variable, carbon offset use, 0 means a school does not use carbon offsets and 1 means that institution does use a carbon offset. The solid black line represents the predicted probabilities of offset use for the final model. The red line represents the predicted probabilities for the model without any schools in 2099.

[14] This was calculated using the following equation: e^(carbon neutrality goal year coefficient +/- 1.96*(standard error for the goal year coefficient)).
[15] This was calculated by exponentiating the coefficient of the carbon neutrality goal year: e^(carbon neutrality goal year coefficient estimate).
[16] This was calculated using the following equation: e^(carbon neutrality goal year coefficient estimate*(2099-2050)).

Summary of Results

In summary, we found trends throughout schools' stated approaches to Scope 3 emissions. Carbon offsets, education, incentives, reduction, and infrastructure development were the most common themes of approaches that schools mentioned. We also confirmed findings of previous studies that gross GHG emissions and Scope 3 emissions are predicted by institutional characteristics such as student body size and endowment per student. Additionally, it is interesting to note that carbon neutrality goal year persisted in the model as a statistically significant factor. More research is needed to explore this result, but it suggests that proximity of the carbon neutrality goal year influences whether a school uses offsets and whether they mention local offsets.

Discussion

Given the results of our study, we contextualize our findings within the previous literature. We discuss the commonly proposed mitigation strategies, the role of carbon offsets in reaching carbon neutrality, and the notion of locality as it pertains to offset use, highlighting both the patterns and overall level of uncertainty that remains in defining ways to mitigate Scope 3 emissions.

Commonly Proposed Approaches to Mitigating Scope 3 Emissions

As a reminder, Scope 3 emissions account for about one-third of American higher education institutions' total emissions on average, making them a significant source of emissions on any college campus (Sinha et al. 2010; Klein-Banai and Theis 2013). Our findings are consistent with the aforementioned studies, as we found that Scope 3 emissions of schools in our sample account for about 27% of total emissions on average (Table 3). Through our thematic analysis of schools' stated approaches to Scope 3 mitigation, we found that Second Nature's suggestion to "Reduce what you can, offset what you can't"' explains many schools' mitigation strategies–81% of schools mention the future inclusion of offsets in their CAPs and 37% of schools have already implemented some form of offsets.

That said, in the meantime, schools outlined similar plans to make Scope 3 reductions in other ways. These strategies fall into the broad categories of education, incentives, reduction, and infrastructure (Figure 2). These findings support Williamson's results, which state that most colleges and universities reduce their GHG emissions through education, technological advancement, investment, regulations, and policy-driven changes (2012, 49). It also suggests that schools choose to mitigate GHG emissions by restructuring campus processes and social norms, such as instituting bike share programs, incentivizing alternative transportation, and implementing water bottle filling stations. The presence of similar themes in schools' Scope 3 mitigation strategies–for example, 37 schools mentioned switching to electric vehicles–raises questions regarding whether schools communicate among one another and what sources they consult to develop their CAPs. While this was beyond the scope of our analysis, future research could investigate how ACUPCC signatories develop their Scope 3 mitigation strategies and whether they look to other schools or specific sources for guidance.

Though schools' CAPs discuss the Scope 3 mitigation strategies they are planning to take, CAPs do not reveal whether schools have taken these actions. Due to the voluntary nature of the ACUPCC, schools have no real, legitimate, binding commitment to follow through on the statements in their CAPs or their carbon neutrality goal, and schools are even permitted to change their carbon neutrality goal. For example, Bowie State University wrote in their original

2009 CAP that they would achieve carbon neutrality by 2019, though recently published materials on their website indicate that this goal has been changed to 2021 ("Sustainability." n.d."). As Table 2 shows, there are 34 schools that mentioned carbon offset use in their CAPs but have not yet implemented carbon offsets. Therefore, it is important to keep in mind that our results simply encompass the proposed body of actions that institutions plan to take, and cannot be understood as the current actions being taken by ACUPCC signatories.

Further, most CAPs did not discuss the effectiveness of the actions in terms of emissions reductions or the associated money, time, and resources needed for each mitigation strategy. This suggests they had not formed an actual plan for carrying out the stated strategy. This could partly be because they are not required by the ACUPCC to include concrete implementation plans, or specific amounts of emissions that each mitigation strategy will reduce. While CAPs are a good start for planning Scope 3 reductions, it might be more useful for the ACUPCC to require more stringent standards or commitments so that schools have a greater incentive to develop thorough emissions reductions plans. This lack of required specificity and structure raises questions regarding whether outlining intended strategies is enough to incentivize schools to achieve their carbon neutrality goals, and whether certain Scope 3 mitigation strategies are effective in emissions reduction in general, both questions that are beyond the scope of this study.

Carbon Offset Use

While we cannot determine whether schools have implemented the various strategies outlined in their CAP, we can speak to whether they followed through on their plans to use carbon offsets, as schools report this data to Second Nature. Our statistical analysis revealed that carbon offsets use is best predicted by the proximity of a school's carbon neutrality goal year, suggesting that schools are more likely to use offsets as they approach their goal year. These findings support Slawinski and Banal (2013)'s argument that when given a temporal deadline, firms tend to mitigate emissions by looking for efficient, immediate solutions such as purchasing offsets. These immediate solutions replace investments in long-term solutions. Our findings that offset use may be predicted by proximity of carbon neutrality goal year suggest that offsets are used as a last-minute strategy to reduce emissions. That said, the statistical significance of carbon neutrality goal year in our models is congruent with Second Nature's emphasis on reducing emissions elsewhere before resorting to offsetting (2016). Schools likely make reductions elsewhere until their carbon neutrality goal year approaches and then must offset any remaining emissions they are unable to reduce.

Moreover, our statistical analysis revealed that no significant patterns exist between schools' institutional characteristics, such as student body size and endowment, and their offset use. Though our literature review found that GHG emissions are influenced by schools' characteristics and that these characteristics may impact mitigation strategies, we found that none of our characteristic variables explained an institution's use of offsets as we had originally hypothesized (Andrews et al. 2015; Davies and Dunk 2015; Fetcher 2009; Klein-Banai and Theis 2013; Williamson 2012). Additionally, our regression results for offset mention as a function of institutional characteristics similarly found no statistically significant relationships, except status, which was marginally significant at the 10% level (Table 6). Thus, the results of this regression were inconclusive regarding what influences a school to mention offsets in its CAP. Both our offset use and offset mention models raise further questions about what factors impact schools' approaches and present an opportunity for future research on other aspects that may lead schools to engage with carbon offsets and Scope 3 mitigation strategies, such as funding sources, public relations, or climate zones.

Another interesting implication in our data was the gap between schools that mentioned offset use in their CAP (63 schools) and schools that have already implemented offsets (29 schools). Beyond our findings that proximity of carbon neutrality goal year predicts whether schools have implemented offsets, there may be other factors that explain this discrepancy. For example, we found in our literature review that carbon offsets are inherently uncertain and difficult to verify, and that the fluctuating carbon trading market is unpredictable (McAfee 1997; Kollmuss et al. 2008). This uncertainty may explain why 34 schools mentioned offsets in their CAPs but have not yet implemented them, because schools might want to wait as long as possible to see if other emissions reduction technologies develop or more clarity arises surrounding offsets. It may also explain why Second Nature (2016) recommends that schools reduce what they can and offset what they cannot, as various schools mention that they plan to do in their CAPs.

Beyond understanding the role of time and uncertainty in a college's likelihood to use carbon offsets, it is important to note what types of carbon offsets institutions are using. While there are many types of carbon offsets, including renewable energy, energy efficiency, industrial gases, methane capture, biosequestration, and carbon capture and storage, our data revealed that schools utilizing offsets tend to focus on biosequestration, primarily in the form of tree planting programs. Biosequestration programs might be the most popular type of offset program because they can easily occur on or near campus and provide a way for students, faculty, and staff to get involved. For example, the University of Wisconsin - Stevens Point has a tree care program in which student organizations plant trees on campus on Arbor Day each year to establish and maintain healthy community forests on campus (*USWP Carbon Neutrality Plan* 2011). This demonstrates the simplicity and accessibility of tree planting for large groups of people.

Biosequestration offsets, though the most popular, also raise questions of efficiency. A 2009 study done by researchers at California State University Northridge found that the campus' 4,000 trees only sequestered about 154 tonnes of CO_2 a year, or less than one percent of annual campus emissions (Cox 2009). The Urban Forestry Network also reports that it can take up to ten years for schools to reach their most productive stage of carbon sequestration capacity, illustrating that biosequestration offsets may not result in the quick emissions reductions that they promise ("Trees Improve Our Air Quality" n.d.). This poses a contradiction in the practicality of carbon offsetting–schools use offsets to achieve carbon neutrality quickly, but the actual resulting emissions reductions may take years to occur.

Exploring Locality

The schools in our sample that have implemented local offsets place a strong emphasis on the co-benefits of locality in their CAPs. The emphasis on co-benefits mentioned in the CAPs of schools–such as University of New England, William Rainey Harper College, Loyola University Maryland, Sweet Briar College, Duke University, and Mercyhurst University (as discussed in the results section)–supports the findings of Kinsley and DeLeon (2009), Polk and Potes (2008), and MacKerron et al. (2009) that argue that local offsets can provide social, educational, and economic benefits for the school's local community, which may be more meaningful for the schools than implementing similar programs internationally.

Similar to our results for offset use, we found that a school's mention of locality of offsets in its CAP is predicted by carbon neutrality goal year. None of the other characteristic variables in our model influenced local mention on a significant level, leaving us with more unanswered questions regarding what affects schools' inclusion of local offsets in their Scope 3 mitigation plans. We did find that more private schools mentioned local offsets than public schools (only by a difference of 3 schools), and more schools in the Northeast mentioned local offsets than in any other region, but not to a significant degree. In general, our finding that only 24 schools in our sample mention locality as it pertains to offsets implies that the location of offsets may not be that significant of a factor in schools' decision-making when it comes to Scope 3 mitigation. However, we cannot be entirely sure that this is the case, as many schools have yet to implement or even consider offset use thus far.

Limitations

Our study was limited by several factors, including data consistency, lack of data, and mode of analysis. First, one of the primary limitations was the lack of consistent data and information online about Scope 3 mitigation. Because of the variability and lack of requirements or standardization for CAPs, we found that schools' CAPs were an unreliable data source to determine what approaches schools are taking to address their Scope 3 emissions. CAPs are only proposed plans and not commitments to take any tangible action, so we found that what schools stated in their CAPs was sometimes inconsistent with what schools were actually doing. For example, the Second Nature database indicated that some schools used offsets, though when we searched for that school's offset programs, there was no further information online about the specific program.

To address this issue, we built our list of schools using offsets from the list provided by Second Nature of schools that have reported using offsets, rather than relying on what schools said they were doing in their CAPs. Further, because of the lack of standardized guidelines for what schools should include in their CAPs, each CAP was slightly different and varied in length and description of Scope 3 mitigation strategies. We initially included the number of pages of Scope 3 discussion as a variable in our data collection, but we quickly realized that this number was arbitrary because of the notion that quantity does not equate to quality of description. Also, some CAPs were very vague in nature, so we were unable to gather much valuable data from them. The lack of standardization and clarity among CAPs proved to be a limitation in our data collection.

Another limitation to our study stemmed from the lack of consistency in schools' definitions of locality regarding offset use. According to Second Nature's offset guide, it is up to each institution to determine their own definition of "local" when implementing offset programs. This definition can be anything from within their own city, state, or region, within 100 miles of the school, or even accessible by students without requiring more than one day of round-trip travel. Because of the lack of standardization regarding the definition of locality, it is challenging to compare schools' mentions of local offsets, given that local may mean different things to each school. Distinguishing among schools' definitions of locality is important, because the co-benefits provided by a local offset project may differ vastly depending on the project's proximity to campus.

In addition to lack of consistent data, another limitation to our study was the lack of data available altogether. We found that schools did not include numbers regarding the amount of carbon emissions reductions associated with various strategies and offset types, or the prices of these strategies. We were also not able to find data on commuting distances from schools, size of schools' sustainability office faculty and staff, or the availability of nearby public transportation, and in some cases we were not able to find any details on a school's offset program even if they had reported to Second Nature that they use carbon offsets. The lack of data may be partly explained by the difficulty of measuring Scope 3 emissions, as these emissions come from mobile sources that are challenging to track. Regardless, it would have been useful for our study to have more data available that would help inform our understanding of schools' Scope 3 mitigation processes.

Another limitation we faced was our mode of analysis. While our thematic analysis and statistical analysis were both valuable ways of answering our research questions, we were not able to explore the values and motivations behind schools' approaches to Scope 3 mitigation. A more qualitative mode of analysis, such as surveys and interviews of key figures involved in sustainability at schools, could complement our statistical analysis and provide a more nuanced, interdisciplinary understanding of schools' decisions. As aforementioned, the CAPs only revealed what schools intend to do, not what they are actually doing. It would be useful to talk to people behind the schools' decisions to gain a fuller understanding of schools' actions. Also, to better understand complex, modern environmental issues, modes of analysis from a variety of disciplines should be used to best inform that understanding. The methodological limitations of our project demonstrate the importance of a holistic, interdisciplinary approach to issues in the field of environmental studies.

Future Research

Future research should seek to build upon and expand the findings of this project. To begin, future studies should broaden the sample size to gain a better understanding of what other ACUPCC signatories are doing and see if our study's findings remain consistent. Studies could run additional regression models to explore our data further, including models to predict other types of approaches beyond carbon offsets. If more data becomes available regarding locality of offset programs, such as the type or distance from the school, research could be done to further understand what influences schools' decisions to implement local offsets. Further, other valuable future research could include more specific quantitative analysis of various Scope 3 mitigation approaches, including cost-benefit analyses and levelized cost of carbon measurements to determine which strategies are the most cost-effective and efficient at reducing carbon from the atmosphere.

Moreover, the research could be expanded to include a more detailed qualitative analysis. This could include conducting interviews and/or surveys with upper management sustainability staff at each institution in order to assess the values and priorities behind environmental policy decision-making at these institutions. These interviews or surveys could also be deployed to understand the follow through with the stated strategies in schools' CAPs and effectiveness of any existing mitigation strategies, as effectiveness was not mentioned in the CAPs we read but is a critical component in accurately measuring and reducing Scope 3 emissions. Due to time constraints, we were unable to send our survey out, but have included both our originally proposed survey and an updated one with questions of interest that emerged during the research process, both of which could be used for future research (Appendix C).

In addition, as we previously discussed that the inconsistent definitions of locality were a limitation for our study, future research could investigate schools' local offset projects further. Studies could examine the specific factors that motivate a school to use local offsets, such as which co-benefits schools emphasize through which project types and whether the proximity to campus impacts the effectiveness of educational, social, or economic co-benefits. It would also be interesting to explore the opinions of students, faculty, and staff on local vs. global offset programs and campus perceptions of the importance of locality in implementing offset programs.

Another potential area for future research is investigating how schools develop their CAPs. As our data was mainly based on what approaches schools said they will utilize in their CAPs, we do not know how schools actually developed these strategies or what sources they relied on for guidance. Our thematic analysis showed that common themes exist among schools' stated Scope 3 mitigation strategies, but it was beyond the scope of our study to examine whether this is due to schools collaborating or looking to the same sources for guidance, or whether this is merely a coincidence. Future studies could examine schools' CAPs to better understand how they are created.

Lastly, because 64% of institutions in our sample wrote their CAPs between 2009 and 2011, many schools will likely update their CAPs in the near future. As with any strategic plan, CAPs are dynamic in nature and they evolve as schools and circumstances change and different technologies become available. Schools' CAP updates will present future researchers with the opportunity to investigate and compare how conversations about Scope 3 mitigation have taken shape over time. Future studies could examine how updated CAPs are shifting in content so as to prioritize these emissions in any way or explore particular technological solutions. In sum, due to the complex nature of Scope 3 emissions and emerging interest in effectively and efficiently addressing them, there are a multitude of ways to build upon this study and these topics to more deeply engage our research questions or develop completely new research projects.

Conclusion

In summary, ACUPCC signatories are focusing their Scope 3 mitigation efforts on carbon offsets, education initiatives, policy efforts, campus infrastructure, and overall waste, food waste, and water waste reduction. Schools' strategies focus on restructuring campus processes and social norms, though these do not account for emissions from air travel. While we found patterns in the types of approaches being taken to reduce Scope 3 emissions, it is important to remember that these strategies are proposals that institutions listed in their CAPs; they do not necessarily represent the actions currently being taken by ACUPCC signatories. Moreover, CAPs varied greatly in terms of the length and depth of their explanations for how to execute and evaluate climate mitigation strategies. Therefore, it will be important to track how these strategies change over time, their effectiveness, and their ultimate feasibility as this conversation evolves.

Additionally, we found a relationship between schools' carbon offset use and their carbon neutrality goal year. Understanding the role of time and urgency of climate change in climate action decision-making will only become more important in the future as we grapple with the effects of climate change. Therefore, it is critical going forward to understand which strategies ACUPCC schools prioritize and their timeline for implementing these strategies. Because Scope 3 emissions account for an average of one-third of ACUPCC schools' overall emissions, schools must be deliberate, yet urgent, with their actions to navigate the tension between achieving carbon neutrality and mitigating Scope 3 emissions.

References

AASHE Reporting Group, 2015. *STARS Reporting Tool: Frostburg State University.* https://www.sierraclub.org/sites/www.sierraclub.org/files/frostburg-state-university-md.pdf.

ACUPCC Voluntary Carbon Offsets Working Group. 2008. *Investing in Carbon Offsets: Guidelines for ACUPCC Institutions*. American College and University Presidents Climate Assessment. https://webbrain.com/attach?brain=C00CB79D-B952-3F63-E801-80048C72FBC2&attach=7587&type=1.

Andrews, Jennifer, Dovev Levine, James Kadamus, Heather Finnegan, Blair Li, and Rudy Sturk. 2015. "The State of Sustainability in Higher Education 2015: Emissions Metrics, Consumption Trends & Strategies for Success." The Sustainability Institute. 49. https://scholars.unh.edu/sustainability/49.

Bachram, Heidi. 2004. "Climate Fraud and Carbon Colonialism: The New Trade in Greenhouse Gases." *Capitalism Nature Socialism* 15 (4): 5–20. https://doi.org/10.1080/1045575042000287299.

Boyd, Emily. 2009. "Governing the Clean Development Mechanism: Global Rhetoric versus Local Realities in Carbon Sequestration Projects." *Environment and Planning* 41: 2380-2395. https://doi.org/10.1068/a41341.

Brooks, Barbara. 2011. "Colgate, Patagonia Sur Approve Pact on Carbon Offsets." Colgate University. Colgate University. https://www.colgate.edu/news/stories/colgate-patagonia-sur-approve-pact-carbon-offsets.

Bumpus, Adam G., and Diana M. Liverman. 2008. "Accumulation by Decarbonization and the Governance of Carbon Offsets." *Economic Geography* 84 (2): 127–55. https://doi.org/10.1111/j.1944-8287.2008.tb00401.x.

"Carbon Management & Greenhouse Gas Mitigation." n.d. Second Nature. Accessed February 20, 2020. https://secondnature.org/signatory-handbook/carbon-management-greenhouse-gas-mitigation/.

Carleton College Climate Action Plan Steering Committee. 2011. "Climate Action Plan." Carleton College. https://apps.carleton.edu/sustainability/assets/11.06.13_CarletonClimateActionPlan.pdf.

Climate Action Plan Central Connecticut State University [pdf]. 2009. Retrieved November 2019 from http://reporting.secondnature.org/cap/cap-public!37.

Climate Action Plan: Loyola University Maryland [pdf]. 2018. Retrieved November 2019 from http://reporting.secondnature.org/cap/cap-public!1358.

Climate Neutral By 2030: Climate Action Plan, Sweet Briar College [pdf]. 2010. Retrieved

November 2019 from http://reporting.secondnature.org/cap/cap-public!422.

Conte, Marc N., and Matthew J. Kotchen. 2010. "Explaining the Price of Voluntary Carbon Offsets." *Climate Change Economics* 1 (2): 93–111.

Cox, Helen M. 2012. "A Sustainability Initiative to Quantify Carbon Sequestration by Campus Trees." *Journal of Geography* 111 (5): 173–83. https://doi.org/10.1080/00221341.2011.628046.

Data USA. n.d. Integrated Postsecondary Education Data System. https://nces.ed.gov/ipeds/.

Davies, Jonathan C., and Rachel M. Dunk. 2015. "Flying along the Supply Chain: Accounting for Emissions from Student Air Travel in the Higher Education Sector." *Carbon Management* 6 (5-6): 233–46. https://doi.org/10.1080/17583004.2016.1151503.

Downie, John, and Wendy Stubbs. 2013. "Evaluation of Australian Companies' Scope 3 Greenhouse Gas Emissions Assessments." *Journal of Cleaner Production* 56 (2013): 156–63. https://doi.org/10.1016/j.jclepro.2011.09.010.

(EPA) Environmental Protection Agency. 2014. "Pollution Prevention Greenhouse Gas (GHG) Calculator Guidance." https://www.epa.gov/sites/production/files/2014-12/documents/ghgcalculatorhelp.pdf

Fetcher, Ned. 2009. "Research and Solutions: Effects of Climate and Institution Size on Greenhouse Gas Emissions from Colleges and Universities in the United States." *Sustainability: The Journal of Record* 2 (6): 362–67. https://doi.org/10.1089/SUS.2009.9820.

Frank, Robert H. 2009. "Carbon Offsets: A Small Price to Pay for Efficiency." *The New York Times*, May 30, 2009, sec. Business Day. https://www.nytimes.com/2009/05/31/business/31view.html.

Gillenwater, Michael, Derik Broekhoff, Mark Trexler, Jasmine Hyman, and Rob Fowler. 2007. "Policing the Voluntary Carbon Market." *Nature Climate Change* 1 (711): 85–87. https://doi.org/10.1038/climate.2007.58.

Grindsted, Thomas Skou, and Tove Holm. 2012. "Thematic Development of Declarations on Sustainability in Higher Education." *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2697500.

Hall, Daniel S. 2007. "Offsets: Incentivizing Reductions While Managing Uncertainty and Ensuring Integrity." https://pdfs.semanticscholar.org/c29b/d262d850aab7837d070018672f74f59ed618.pdf.

Hamrick, Kelley, and Allie Goldstein. 2016. "Raising Ambition: State of the Voluntary Carbon Markets 2016." Ecosystem Marketplace: A Forest Trends Initiative. https://www.forest-trends.org/wp-content/uploads/imported/2016sovcm-report_10-pdf.pdf.

Jain, Suresh, Archit Agarwal, Viveka Jani, Shaleen Singhal, Prateek Sharma, and Ramesh Jalan. 2017. "Assessment of Carbon Neutrality and Sustainability in Educational Campuses (CaNSEC): A General Framework." *Ecological Indicators*76 (May): 131–43. https://doi.org/10.1016/j.ecolind.2017.01.012.

Kim, Richard and Benjamin C. Pierce. 2018. "Carbon Offsets: An Overview for Scientific Societies." University of Pennsylvania.

Kinsley, Michael and Sally DeLeon. 2009. *Accelerating Campus Climate Initiatives:* Snowmass, CO: Rocky Mountain Institute.

Klein-Banai, Cynthia, and Thomas L. Theis. 2013. "Quantitative Analysis of Factors Affecting Greenhouse Gas Emissions at Institutions of Higher Education." *Journal of Cleaner Production*, Environmental Management for Sustainable Universities (EMSU) 2010, 48 (June): 29–38. https://doi.org/10.1016/j.jclepro.2011.06.004.

Kollmuss, Anja, Helge Zink, and Clifford Polycarp. 2008. "Making Sense of the Voluntary Carbon Market: A Comparison of Carbon Offset Standards," *Global Carbon Project*, 1-105.

Kotchen, Matthew J. 2006. "Green Markets and Private Provision of Public Goods." *Journal of Political Economy* 114 (4): 816–34. https://doi.org/10.1086/506337.

Lerner, Josh, Antoinette Schoar, and Jialan Wang. 2008. "Secrets of the Academy: The Drivers of University Endowment Success." *Journal of Economic Perspectives* 22 (3): 207–22. https://doi.org/10.3386/w14341.

MacKerron, George J., Catrin Egerton, Christopher Gaskell, Aimie Parpia, and Susana Mourato. 2009. "Willingness to Pay for Carbon Offset Certification and Co-Benefits among (High-)Flying Young Adults in the UK." *Energy Policy* 37 (4): 1372–81. https://doi.org/10.1016/j.enpol.2008.11.023.

McAfee, Kathleen. 1999. "Selling Nature to Save It? Biodiversity and Green Developmentalism." *Environment and Planning D: Society and Space*17 (2): 133–54. https://doi.org/10.1068/d170133.

Mercyhurst University. 2014. "Climate Action Offsetter: Mercyhurst University." Climate Action Reserve. http://www.climateactionreserve.org/blog/2014/07/15/climate-action-offsetter-mercyhurst-university/.

Mickle, Colin. 2016. "Quality Carbon: The Role of Offsets in Meeting the University of California's Carbon Neutrality Initiative." M.S., United States -- California: University of California, Davis. https://search.proquest.com/docview/1878238660/abstract/244AE72C687B42D9PQ/1.

National Center for Education Statistics. N.d. *College Navigator Database.* https://nces.ed.gov/collegenavigator/.

Pedroni, Lucio, Michael Dutschke, Charlotte Streck, and Manuel Estrada Porrúa. 2009. “Creating Incentives for Avoiding Further Deforestation: The Nested Approach.” *Climate Policy* 9 (2): 207–20. https://doi.org/10.3763/cpol.2008.0522.

Polk, Eben, and Andrés Potes. 2008. “The Role of Offsets in Meeting Duke University’s Commitment to ‘Climate Neutrality’: A Feasibility Study.” Sustainable Duke Program. https://nicholasinstitute.duke.edu/sites/default/files/publications/dukeoffsets-paper.pdf.

Rosen, Kyle R. 2019. “Carbon Offsets.” Dickinson College. Dickinson College. December 9, 2019. https://www.dickinson.edu/homepage/1370/carbon_offsets.

Second Nature. n.d. *Second Nature Reporting Database.* http://reporting.secondnature.org/

Second Nature. 2016. “Carbon Markets & Offsets Guidance.” Second Nature. https://secondnature.org/wp-content/uploads/Carbon-Markets-and-Offsets-Guidance-1.pdf.

Sinha, Parikhit, William A. Schew, Aniket Sawant, Kyle J. Kolwaite, and Sarah A. Strode. 2010. “Greenhouse Gas Emissions from U.S. Institutions of Higher Education.” *Journal of the Air & Waste Management Association* 60 (5): 568–73. https://doi.org/10.3155/1047-3289.60.5.568.

Silva, Emilson C. D., and Xie Zhu. 2009. “Emissions Trading of Global and Local Pollutants, Pollution Havens and Free Riding.” *Journal of Environmental Economics and Management* 58 (2): 169–82. https://doi.org/10.1016/j.jeem.2009.04.001.

Slawinski, Natalie, and Pratima Bansal. 2012. “A Matter of Time: The Temporal Perspectives of Organizational Responses to Climate Change,” *Organization Studies* 33 (11): 1537–63, https://doi.org/10.1177/0170840612463319.

Song, Lisa. 2019. “An Even More Inconvenient Truth: Why Carbon Credits for Forest Preservation May Be Worse Than Nothing.” *ProPublica*. https://features.propublica.org/brazil-carbon-offsets/inconvenient-truth-carbon-credits-dont-work-deforestation-redd-acre-cambodia/.

“Sustainability.” n.d. Bowie State University - Sustainability. Accessed February 25, 2020. https://bowiestate.edu/about/sustainability/.

“Swine Waste-to-Energy (Loyd Ray Farms).” n.d. Sustainability. Accessed February 26, 2020. https://sustainability.duke.edu/offsets/projects/lrf.

“Trees Improve Our Air Quality.” n.d. Urban Forestry Network. Accessed March 11, 2020.

http://urbanforestrynetwork.org/benefits/air quality.htm.

University of New England Climate Action Plan 2017 [pdf]. 2017. Retrieved November 2019 from http://reporting.secondnature.org/cap/cap-public!1357.

U.S. Bureau of the Census. 1995. "Statistical Abstract of the United States." Washington, DC. https://www.census.gov/prod/1/gen/95statab/preface.pdf.

(USGAO) United States Government Accountability Office. 2008. "Carbon Offsets: The U.S. Voluntary Market Is Growing, but Quality Assurance Poses Challenges for Market Participants." https://www.gao.gov/assets/gao-08-1048.pdf.

USWP Carbon Neutrality Plan [pdf]. 2011. Retrieved November 2019 from http://reporting.secondnature.org/cap/cap-public!964.

Western Washington University Climate Action Plan [pdf]. 2010. Retrieved November 2019 from http://reporting.secondnature.org/cap/cap-public!643.

Whitehead, B, and Robert N Stavins. 1997. "Market-Based Environmental Policies." In *Thinking Ecologically: The Next Generation of Environmental Policy*, edited by Marian R Chertow and Daniel C Esty, 105–117. New Haven: Yale University Press.

William Rainey Harper Climate Action Plan [pdf]. 2013. Retrieved November 2019 from http://reporting.secondnature.org/cap/cap-public!1161.

Williamson, Sean R. 2012. "A Systems Approach to Reducing Institutional GHG Emissions." *International Journal of Sustainability in Higher Education* 13 (1): 46–59. https://doi.org/10.1108/14676371211190308.

Appendixes

Appendix A: List of Schools in our Sample

(To view our full data set online, visit shorturl.at/dkzB8)

1 Alaska Pacific University
2 Babson College
3 Black Hills State University
4 Bowie State University
5 Bunker Hill Community College
6 California State University-Long Beach
7 Calvin College
8 Central College
9 Central Connecticut State University
10 Chandler-Gilbert Community College
11 Chesapeake College
12 Colby-Sawyer College
13 Colgate University
14 College of Saint Benedict
15 College of Saint Mary
16 College of the Holy Cross
17 Cuyahoga Community College
18 Delta College
19 DePauw University
20 Dickinson College
21 Drew University
22 Drury University
23 Duke University
24 Eastern Kentucky University
25 Eastern Washington University
26 Franklin & Marshall College
27 Frostburg State University
28 Georgia Institute of Technology
29 Institute of American Indian and Alaska Native Culture and Arts Development
30 Jamestown Community College
31 Joliet Junior College
32 Kankakee Community College
33 Lafayette College
34 Lesley University
35 Life University
36 Los Angeles Valley College
37 Loyola University Chicago
38 Loyola University Maryland
39 Mercyhurst University
40 Mesa Community College
41 Messiah College
42 Middlebury Institute of International Studies at Monterey
43 Millersville University of Pennsylvania
44 Nassau Community College
45 Northeast Lakeview College
46 Norwalk Community College
47 Palo Alto College
48 Radford University
49 Randolph College

50 Richland College
51 Rider University
52 Rio Salado College
53 San Francisco State University
54 Santa Monica College
55 Southern New Hampshire University
56 Southwestern University
57 Sweet Briar College
58 Temple University
59 The Community College of Baltimore County
60 University of Arkansas Main Campus
61 University of California, San Francisco
62 University of California, Santa Barbara
63 University of California, Santa Cruz
64 University of Delaware
65 University of Illinois at Urbana-Champaign
66 University of Maine at Farmington
67 University of Massachusetts Medical School
68 University of Mississippi
69 University of Mount Union
70 University of New England
71 University of New Mexico-Valencia
72 University of Tennessee, Knoxville
73 University of Wisconsin-Stevens Point
74 Washington State University, Pullman
75 Washington State University, Tri-Cities
76 Western Washington University
77 Wilkes University
78 William Rainey Harper College

Appendix B: Frequency of Approaches Schools Mention in CAPs

Approach	**Number of Schools Mentioning Approach**
Offsets	63
Electric vehicles	37
Recycling	36
Encourage carpooling	33
Public transportation	26
Telecommuting	25
Local offsets	24
Education	22
Renewable energy	22
Bike infrastructure	19
Composting	16
Alternative transportation	14
Waste streams programs	13
Bike programs	11
Sustainable procurement policies	11
Reduce waste	10
Parking permit fees	8
Shuttles	7
Anti-idling policy	6
Go paperless	6
Plant trees	6
Methane landfill capturing	5
Online classes	5
Reduce school week	5
Reduce water use	5
Technology	4
Ban/reduce plastic bottles	3
Go trayless	2
Reduce air travel	2

Decrease parking spaces	1
Direct flights	1
Discount student bus passes	1
Implement car share	1
Sustainable airlines	1
Virtual office hours	1
Water bottle filling stations	1

Appendix C: Survey Questions

Original Survey Questions from Proposal:

1. What approaches is your school using to address Scope 3 emissions? (trying to verify with our list from CAPs)
2. How did your campus develop these strategies or approaches?
    a. Who was/is involved in these conversations and decisions?
3. Have any of these strategies been implemented?
    a. If yes, have they been successful?
    b. If no, why?
    c. Has your institution experienced any difficulties implementing these strategies? Or challenges in maintaining them?
4. How does your campus measure the impact of these strategies?
5. Does your school use carbon offsets?
    a. If yes, why? How did you decide to use them?
        i. Where do the projects occur?
        ii. Why did you pick to purchase/produce the offsets that you use?
        iii. Are these offsets purchased or produced by the college?
        iv. How are the offsets certified/verified?
        v. How are your offset programs funded?
        vi. Are the offsets mandatory or voluntary (specifically for air travel)?
        vii. Who manages the offset purchases or programs (i.e. the business office, student government, environmental offices, etc.)?
        viii. Do you partner with any outside organizations on these offsets?
        ix. What, if any, are the curricular connections? Are there any recurring educational programs that relate to the offsets?
        x. Can you explain the process of getting offsets approved? How do/did you cultivate buy-in from the campus community, students, administration, etc.?
        xi. Do you plan to continue to use offsets? If so, for how long? If not, why not?
        xii. Has the school experienced any sort of benefits from using carbon offsets? If so, please describe them.
    b. If no, is your school considering using carbon offsets? Why or why not?
6. Has your campus received any sorts of benefits from using any of these strategies that go beyond carbon reductions?

Evolving Survey Questions:

1. How did your institution set your carbon neutrality date?
2. What resources are needed to accomplish these strategies if your campus does not currently have them?
3. When thinking about sustainability initiatives on your campus, what role do your peer institutions play in driving campus programs?
4. How important is mitigating Scope 3 emissions relative to Scope 1 and 2?
5. Is your institution's CAP binding or voluntary? How much buy-in for the CAP is there from your college's sustainability office or team and the college administration?

6. Will your institution reassess your carbon neutrality goal year soon? How about your approaches to mitigating Scope 3 emissions?
7. How does your institution set your priorities for sustainability?
8. What types of Scope 3 strategies are the most appealing, feasible, effective, efficient?
9. How does your college measure the effectiveness of existing or future strategies?
10. What limitations keep your college from addressing Scope 3 emissions?
11. What are your college's next steps regarding climate action?
12. How does your college measure/track Scope 3 emissions?
13. What role, if any, does equity have in your climate action work?
14. How do concerns about verifiability and the fluctuating price of carbon influence your institution's decisions whether or not to use carbon offsets?

    Note: The evolving survey questions were added on as we progressed in our research and thought of new questions that would be more relevant and interesting to ask.