AN ANALYSIS OF SUSTAINABILITY STRATEGIC PLANNING AT DUKE UNIVERSITY

by

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Abstract

This study was conducted in order to inform the sustainability planning process at Duke University and similar institutions of higher education. Through interviews of Duke University Campus Sustainability Committee members and a cost-benefit analysis of Duke's Climate Action Plan, we evaluated the effectiveness of Duke's sustainability planning and implementation process. Additionally, we investigated the widely varying sustainability approaches and metrics used by fifteen peer institutions to evaluate their relative merits. In depth interviews were also conducted with Brown University and Yale University staff members for comparison to Duke. Our work resulted in (1) a generic roadmap for universities seeking to develop their own sustainability plan and (2) a list of recommendations to improve upon Duke's already successful model.

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Introduction

Duke University has a long history of environmental stewardship, dating back eighty years to the establishment of the Duke Forest in 1931. Over the past two decades, Duke has steadily expanded and formalized its sustainability efforts. In 1993, Duke adopted design guidelines that incorporate sustainability elements into campus building and planning. A formal campus LEED building policy was enacted in 2003, and Duke has now achieved LEED certification for 22 buildings. The year 2004 marked the start of a more aggressive stance towards tackling campus sustainability, when Duke hired its first Environmental Sustainability Director, adopted a campus Green Purchasing Policy, and conducted its first greenhouse gas emissions inventory. Since then, new sustainability-related initiatives have been introduced each year, with the overall sustainability program growing and efforts building off one another.

In 2007, Duke University President Richard Brodhead signed the American College and University Presidents' Climate Commitment (ACUPCC), propelling Duke University along a path towards carbon neutrality and serving to formalize and coordinate its diverse sustainability efforts. The first steps along this path were prescribed by the ACUPCC. As a signatory, Duke agreed to complete a greenhouse gas emissions inventory, set a target date and interim milestones for becoming climate neutral, take immediate steps to reduce greenhouse gas emissions, integrate sustainability into the curriculum, and allow public access to all environmental action plans and progress reports (ACUPCC "Mission and History" 2012). Following this roadmap, Duke convened a Campus Sustainability Committee (CSC) and in two years published its Climate Action Plan (Duke University 2009). The Climate Action Plan (CAP) outlines in general terms the steps that the university plans to take in order to become climate neutral by 2024, the 100th anniversary of the university.

Now, five years later, Duke has submitted two CAP Progress Reports (Duke University 2010; Duke University 2011) to the ACUPCC and initiated many of the actions outlined in the CAP. In addition, Duke's efforts towards sustainability have expanded well beyond the relatively narrow scope of reducing greenhouse gas emissions. Duke has eliminated the use of coal on campus, established a campus farm, and purchased 10 new hybrid/diesel buses, to highlight just a few recent sustainability initiatives. Looking forward, development of an overarching

Sustainability Strategic Plan that will help formalize efforts in varied sustainability areas such as water, recycling, and transportation is now underway.

Duke is not alone in its commitment to pursue sustainability. Other universities and colleges across the nation and throughout the world also seek to decrease their environmental impacts. Over 600 schools have signed the ACUPCC, and over 1500 have created greenhouse gas emissions inventories (ACUPCC "Homepage" 2012).

In an attempt to monitor progress and compare Duke's sustainability activities to those at other colleges and universities, Duke has reported on its environmental efforts to the Sierra Club's Cool Schools list, the College Sustainability Report Card, and the Association for the Advancement of Sustainability in Higher Education Sustainability Tracking Assessment and Rating System (ASSHE STARS). These reporting tools, each slightly different, look at sustainability from a broad perspective. The tools require that schools report on areas in addition to carbon emissions such as water, recycling, and purchasing.

Some institutions have used the same approach that Duke has thus far, first making a concerted effort to work towards carbon neutrality by signing the ACUPCC and then later organizing other aspects of sustainability and reporting to rating systems such as STARS. Others have approached sustainability from the opposite direction, first developing general sustainability programs and later making a concerted effort to tackle climate change. A third group has felt it more beneficial to set their own targets instead of using STARS or signing the ACUPCC. A complicating factor in these efforts is the growing number of reporting tools universities can use and green associations schools can join in order to share their data, highlight their successes, and compare their work to peer institutions. Additionally, there is a wide variety of aspects of sustainability a university could focus on, ranging from dining, to computing, recycling, waste, water use, purchasing, events, and landscaping among others. As a result, there is no one standard or prescribed approach used to pursue sustainability at institutions of higher education.

Objectives

The objective of this study is to evaluate the sustainability planning and implementation efforts of Duke University and similar institutions in order to generate (1) a generic roadmap for universities seeking to develop their own sustainability plan and (2) a list of recommendations to

improve upon Duke's already successful model. Although there is enormous variety in the sustainability planning and implementation efforts of colleges and universities, some informative trends can be identified.

When it comes to addressing sustainability issues, large institutions such as Duke University have the ability to set an example for other organizations to follow. We hope this analysis will enable not only Duke, but other colleges, universities, businesses, and perhaps even city governments to make future sustainability efforts more effective.

Methods

This study combines several different assessment methods: literature review, data collection, interviews, and a cost-benefit analysis. To analyze Duke's sustainability efforts, we reviewed internal documents, interviewed Campus Sustainability Committee members, and performed a cost benefit analysis of Duke's Climate Action Plan efforts to date. To compare Duke's actions to those of other large research institutions, we conducted a literature review, researched the sustainability practices of fifteen colleges and universities similar to Duke, and interviewed Yale and Brown Universities. With the combined information, we identified several trends and recommendations for both Duke and the growing community of colleges and universities aiming to decrease their environmental impacts.

1. Literature Review

To understand the context and goals of Duke's sustainability planning efforts, we reviewed documents provided by our client, Duke's Environmental Sustainability Director, Tavey McDaniel Capps. These documents include Duke's CAP (Duke University 2009), Duke's STARS submission (AASHE "Duke University" 2011), the CSC meeting minutes and presentations, and two sustainability assessments, one from the University of North Carolina Greensboro (Capps 2003) and the other from North Carolina State University (North Carolina State University 2011).

Building on this foundation, we conducted a review of published papers and on-line materials relevant to the sustainability planning process at institutions of higher education. A number of the papers we found most relevant are publicly available on AASHE's website and at the International Journal of Sustainability in Higher Education.

2. Campus Sustainability Committee Interviews

Using the information collected during the literature review, we developed interview questions for members of Duke University's Campus Sustainability Committee. Through these interviews we sought to obtain more detailed information about Duke's sustainability planning process and its strengths and weaknesses. As all of our interviews were conducted with the aim of program evaluation and program improvement, we received IRB exemption.

The interview questions were developed to assess key aspects of the sustainability planning process at Duke such as student involvement, measuring progress, and establishing appropriate goals and targets. The specific interview questions, presented in Appendix 1, were intended to be broad so respondents would have the opportunity to reflect on diverse aspects of sustainability planning at Duke.

3. Cost-Benefit Analysis of Duke's Climate Action Plan

During our interviews with CSC members we collected data for a cost-benefit analysis of Duke's CAP. We asked members of the Campus Sustainability Committee for numeric costs that were associated with efforts made toward achieving the goals of the CAP. We also discussed what benefits they thought had accrued from these efforts. The costs for CAP efforts were relatively straightforward in comparison to estimating the less quantifiable benefits from these projects. Further details of the methods used for the cost-benefit analysis are included with results below.

4. Research on 15 Peer Institutions

We collected information about sustainability planning at fifteen specific universities (Appendix 2) from their websites, published sustainability documents, and any sustainability reporting tools to which they had submitted information. These reporting tools included the Sierra Club Cool Schools list, the Sustainable Endowments Institute College Sustainability Report Card, and AASHE STARS. All fifteen of the universities we researched are large, private research universities that are members of the Consortium on Financing Higher Education (COFHE) and were suggested by our client for comparison.

The information collected on the fifteen institutions and Duke was organized into a spreadsheet to facilitate comparison and analysis (See Appendix 3). The data includes whether or not each school has made certain specific public commitments, enacted sustainability policies, and published sustainability planning documents. This spreadsheet also lists the sustainability areas each school has concentrated on and in which areas they have set numeric goals.

Determining whether a school focuses on a particular aspect of sustainability was somewhat subjective. In general, if a school had an initiative, a section of their website, or a section of a published sustainability document on the issue, this was regarded as evidence of a focused effort in that area.

5. Interviews of Yale and Brown Universities

We also interviewed sustainability staff members from two peer institutions: Yale University and Brown University. We decided to obtain more in depth information about these two institutions because they are similar to Duke in terms of enrollment, endowment, and physical and functional characteristics to allow for comparison, but each approached sustainability planning in a different way. A similar set of questions to those asked of CSC members were asked of Yale and Brown. Specific questions are included in Appendix 4.

Results

1. Literature Review

Rauch and Newman (2009a) argue that long term quantitative sustainability targets are often unaccompanied by information on the specified path to achieve them. Furthermore, they highlight that if a path to a target is outlined, it is often arbitrarily derived. They suggest that a three-tiered framework, consisting of three time horizons, should be used to set sustainability metric targets. First, in the institutional time frame consisting of the next 15-20 years, the process through which the metric targets are established is through multiple stakeholder consensus given present day circumstances. This is essentially what Duke's CAP is: a collaborative effort resulting in a plan for reducing carbon emissions. Second, in the generational time frame, which extends up to 50 years from present, scientifically based environmental scenarios and in-house projections are used to guide target setting. To date, Duke has not relied on such internal

projections to guide its target setting with respect to climate change, but rather accepted the target of climate neutrality set by the ACUPCC. Third, in the visionary time frame of up to 100 years, the ideal targets for the institution are set. As for this time frame, Duke aims to remain carbon neutral after achieving that status, but targets in other areas of sustainability have not been set.

If one accepts Rauch and Newman's framework, it follows that an institution such as Duke must regularly review the metrics it chooses to track, targets for those metrics, and progress made. Technology changes with time, as do campus priorities at large and with respect to sustainability. Duke still has a long way to go to achieve its short-term goals including climate neutrality by 2024, so perhaps it has not yet made sense to reflect on longer term goals (30+ years). Rauch and Newman (2009b) describe the need to evaluate progress towards goals: "A goal starts with a vision, followed by development, endorsement and implementation, and leads to institutional change. With change, comes new perspective to define a new vision." Universities are also dynamic environments with frequent faculty, staff, and student turnover. As a result, engendering change at the university requires the development of mechanisms for regularly assessing and updating strategies to ensure that they are relevant and effective (ACUPCC 2009).

Metrics that a school may choose to employ are often constructed in a relational manner (Rauch and Newman 2009a). As no two universities are identical in their scope, location, needs, and goals, it is not simple or convenient for a university to look at the strategies of its peers with regard to sustainability efforts in relation to its own efforts. However, that schools still collaborate and attempt to learn from each other in developing sustainability initiatives was a motivating factor in the decision to compare Duke's approach to improving campus sustainability with the approaches of Yale and Brown. While Yale and Brown are similar to Duke in a variety of ways, there are challenges that are unique to each institution. Due to its geography and climate, sustainable water use is a more significant issue for Duke than it is for either Yale or Brown, so Duke naturally expends more resources on this issue.

Regardless of the internal metrics that a university chooses to track and the goals that it sets for them, schools may submit their progress to ratings systems such as STARS. The STARS rating system provides schools with a standardized assessment tool to evaluate their progress towards sustainability goals. It includes 139 indicators, which are divided into the following

categories: Education and Research, Operations, Planning, Administration and Engagement, and Innovation (AASHE 2011). According to its creators, STARS is designed to provide a framework for understanding sustainability in all sectors of higher education, enable comparisons over time and between schools, create incentives for continual improvement towards sustainability, facilitate information sharing between schools regarding sustainable practices, and build a strong and diverse campus sustainability community.

Krizek et al. (2011) describe a series of phases through which sustainability initiatives may evolve on a campus. First, in the grassroots phase, advocates organize and launch their own efforts. In the second phase, the executive leadership accepts the business case for sustainability. In the third phase, campus leaders openly promote a sustainability vision. Notably, a visionary campus leader will elevate sustainability professionals from mid-level coordination roles to the executive level, or reporting to the executive level. This is arguably the phase where Duke University is at the moment. The final phase is one in which there exists a fully self-actualized and integrated campus community.

In the final phase of the evolution of sustainable initiatives on campus, Krizek et al. describe conditions where "the educational experience is coherent inside and outside the classroom; students learn about sustainability in all majors- and they observe and learn from the campus which physically models sustainability's principles and practices." This is similar to the idea of a 'learning organization' as described in the ACUPCC steering committee document entitled 'Leading Profound Change' (2009). A learning organization must have new governing ideas, innovations in infrastructure, new management methods, and tools to change the way people conduct their work. These 'new' methods and ideas are in comparison to an institution that does not have sustainability as one of its core values. In the transition to such an organization, periodic evaluation methods that allow a university to engage the continually changing student body are required. While meeting this challenge, they must also ensure that progress towards increasing sustainability is achieved. What is needed are planning and organization methods that do not remake history every 4 years, but enable the university to grow, learn from, and build upon its historical foundations without impeding the sense of entrepreneurship and ownership that permeates the university environment.

Hansen et al. 2011 describe a campus-wide sustainability strategic planning event lasting one academic year at Macalester College. The goals of this strategic plan were to create a set of

actionable priorities for the college as well as to generate buy-in from students, staff, and faculty. They noted that while they tried to provide for maximum participation in the project, there were logistical hurdles to doing so, and had problems getting faculty members involved. A major lesson learned was that it was necessary to build the capacity of their sustainability office to be able to reach out to the campus and achieve a high level of useful participation. Similarly, they found it hard to maintain good communication about what was being done with participant input. Overall, the main hurdles they encountered in attempting to engage the campus community through this planning project were related to communication and organization. The emphasis this study placed on communication is acknowledged in sustainability efforts at Duke. In Duke's CAP, the first formal document regarding sustainability initiatives on campus, communication issues were discussed in their own section, and there is a communication subcommittee within the CSC. Campus-wide communication is in many ways far more difficult at a large research institution such as Duke than at a small liberal arts college; there are so many people with diverse passions and demands on their attention that it is difficult to find a way to connect them all.

2. Campus Sustainability Committee Interviews

This section illuminates the findings from interviews with eight members of Duke's Campus Sustainability Committee. We asked approximately twenty questions of each member about sustainability and sustainability planning at Duke. If time allowed, we asked follow up questions. We wanted to allow interviewees to speak to what they thought would be most informative for our analysis, and as a result, these questions were broad and qualitative in nature (See Appendix 1).

Successes

CSC members identified a number of successes that have been achieved to date at Duke with regards to sustainability. The signing of the ACUPCC was widely acknowledged to be a pivotal step in the development of sustainability commitments for the campus. Interviewees noted that this demonstrated that Duke is 'serious' and has acquired and will retain 'upper level support' in tackling sustainability issues.

CSC members also discussed how the structure of their committee is generally very good for promoting involvement and communication. The fact that it involves students, faculty, and

staff is effective, as is the open nature of the subcommittees. Anyone with an affiliation to Duke can be a member of the subcommittees and participate in their meetings. In addition, the flexibility of the CSC was mentioned as a success. Originally the CSC was convened for the purposes of forming the CAP. Now this role has expanded to incorporate sustainability areas outside of greenhouse gas emissions. As a result, subcommittees on water, waste, and recycling have been added, and this transition has occurred seamlessly.

Lastly, CSC members mentioned that Duke is very sustainable and has taken up a leadership position among colleges and universities wanting to decrease their environmental impact. Many CSC members pointed out that Duke consistently achieves high rankings for sustainability. Also many interviewees mentioned the quick timeline over which coal use on campus was eliminated and water conservation achieved during the 2007 drought.

Challenges

One challenge to improving sustainability at Duke was consistently noted by members of the CSC: it is unclear to what extent the Duke Community is engaged with the CAP. There is no clear evidence regarding behavioral changes that have been made by students, faculty, or staff as a result of the CAP, the extent of those changes, or how many members of the community are aware of the CAP and its purpose. It was also pointed out that engaging the effort and attention of an entire campus community might be an aspirational rather than measurable goal. Interviewees mentioned that there has been growth in the number of students, faculty and staff who have become involved through environmentally focused student groups, office green certification programs, campus wide events such as the Green Devil Smackdown or the Sustainability Pledge. However, interviewees also believe that there is a parallel group who has never taken a sustainability class or seen environmental efforts as a major part of their Duke experience.

Some drawbacks to the STARS assessment and many of the other sustainability reporting tools were also mentioned in our interviews. While these tools may help pinpoint areas of sustainability that Duke can improve in, these surveys frequently do not give accurate credit for some of Duke's efforts and are unable to provide suggestions for further improvement in other areas. For example, Duke received the maximum score in the water use category of STARS, but Facilities Management points out that there is still plenty of room for improvement. Although interviewees were proud of how well Duke scored and how well the campus responded to the

drought in 2007, Duke would have benefited more from the STARS assessment had it included further suggestions for improvement.

Regarding challenges preventing progress towards CAP milestones, multiple interviewees noted Duke University's reliance on Duke Energy. In order for Duke University to achieve its CAP goals, Duke Energy needs to meet its projections for the development of cleaner energy sources. It could become a challenge in the future for Duke University to find additional offsets or internal greenhouse gas reductions to make up for the portion of the CAP that includes changes that have yet to be made by Duke Energy.

In addition to these particular challenges addressed above, when asked what they felt the greatest challenge to improving sustainability at Duke is, CSC members generally noted one of three issues: money, and its corollary, staff time; generating behavioral change, i.e. getting people to think about the consequences of their actions from a sustainability viewpoint on a daily basis; and the size of Duke University, and the difficulty of generating change in such a large and complex organization. These are typical challenges for a large university, but if Duke can find creative ways to overcome these challenges and share them with its peer institutions, this could be one of the main ways Duke further cultivates its reputation as a leader in sustainability.

Strategies for Improvement

A variety of strategies for improving the effectiveness of the CSC were suggested. Better utilization and engagement of students on the committee was suggested. One possibility would be to give students projects to work on, perhaps integrated with coursework. This would alleviate some of the challenges of lack of staff time and money. Additional involvement of Duke's Hospitals, the athletics department, and campus recycling officials in the sustainability planning process, specifically through membership on the CSC, was recommended as well. If the committee is to address all aspects of campus sustainability, representation of these groups is necessary. Increased communication with the provost and deans regarding sustainability education was recommended to further the integration of sustainability education into academics.

A few suggestions were made to improve the CAP and its implementation. Interviewees noted that it would be useful to have more frequent reviews of progress towards CAP target goals (every 4-5 years), including more detailed interim targets for each area of the CAP. Also, a few CSC members indicated that it might be useful to standardize the way that progress is

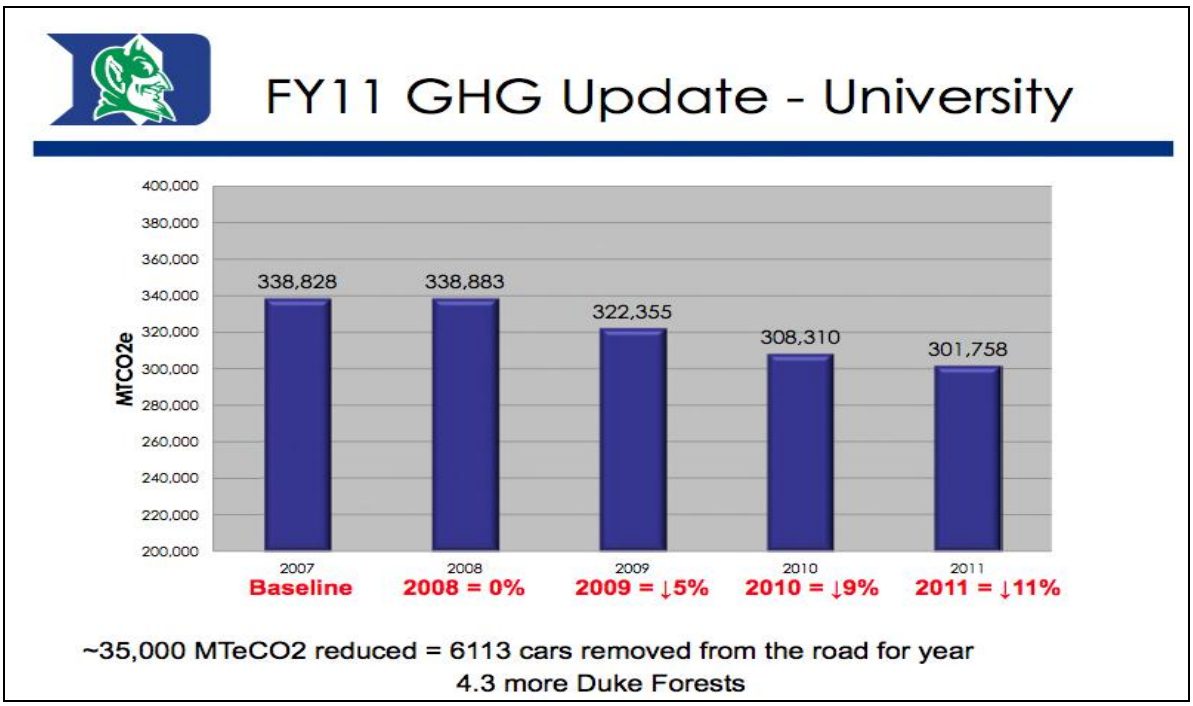
evaluated in all categories of sustainability (water, energy, food, transportation, etc.) especially now that Duke is starting work on its Sustainability Strategic Plan.

Regarding reporting, streamlining of data collection was recommended. Although most interviewees commented that AASHE STARS had not significantly affected sustainability planning at Duke, some noted its helpfulness in being an all-inclusive survey. Its comprehensive nature has meant that for some CSC members and their staff, they have only needed to fill out one sustainability reporting form, saving them much staff time. It was recommended that the collection of data for the CSC and these sustainability reporting tools needs to be simplified so that it is easier to perform year after year.

3. Cost-Benefit Analysis of Duke's Climate Action Plan

Duke's Climate Action Plan set a goal to become carbon neutral by 2024. An evaluation of the CAP to date is a requisite for developing ideas on how Duke can improve its future sustainability efforts. Duke's CAP is ambitious; however, despite the daunting task of becoming carbon neutral, Duke has kept pace with reduction targets as shown in Figure 1. Such measurable results are important not only for benchmarking but also to act as a driver for overall, less obvious sustainable actions. While Duke has made progress in a variety of sustainability indicators, the CAP has been a central part of sustainability planning. Consequently the most expensive, impressive, and meaningful decreases in Duke's environmental impact have resulted from initiatives that originated from the CAP.

Figure 1: Duke Greenhouse Gas Update; University Only



The measured reductions in greenhouse gasses (GHG) for Duke University, as shown in Figure 1, are a result of standardized GHG accounting practices. However, despite such standardization, it can be difficult to assess the cost effectiveness of each CAP project completed to date. A full and comprehensive C/B analysis is beyond the scope of this study, therefore, a limited, first-order analysis was conducted instead. The aim of this analysis is a comparison of magnitude of cost-effectiveness for each climate action plan area.

Quantitative Analysis Assumptions, Data, and Calculations

The quantitative portion of the cost-benefit analysis results in the dollars spent per metric ton of CO2 equivalent saved; the lower the number, the greater benefit to the cost. These numbers are derived from annualized costs and CO2 savings as provided by the CSC subcommittees.

In this analysis, many simplifying assumptions were made, and the numbers were used as provided by the CSC subcommittees. This cost-benefit analysis is not completely comprehensive given the greater scope of this master's project and, therefore, should not be viewed as such. If an analysis of greater detail and accuracy is required, it is recommended that a future assignment solely dedicated to this task be given.

Each topic area requires a unique set of assumptions that differ amongst the various projects. Transportation has the most elements, and required the most assumptions. Below are the details regarding the calculations for the CAP transportation efforts:

- Bull City Connector: a free bus service that runs from the University through to Downtown Durham
    - used monthly savings as given by the transportation subcommittee to calculate potential annual savings
    - annualized costs as given by the transportation subcommittee
- GoPass: a free service that allows students to ride local bus systems
    - used monthly savings as given by the transportation subcommittee to calculate potential annual savings
    - annualized costs as given by the transportation subcommittee
- Biking Infrastructure:
    - Adjusted the monthly savings given to account for lack of student traffic during the summer
    - annualized costs as given by the transportation subcommittee
- Electric Charging Stations for WeCars:
    - Chevy Volt usage data
    - Assumed the average trip was 10 miles because of the density of retail establishments along 15/501
    - Used EPA emissions ratings to find the difference in emissions between Chevy Volts and the average mid-size vehicle
- Green Ride:
    - used monthly savings as given by the transportation subcommittee to calculate potential annual savings
    - annualized costs as given by the transportation subcommittee

The Energy sector has two main elements: Solar thermal water heating on the Bryan Center and East Campus Steam Plant. The Assumptions used are as follows:

- Solar Thermal:
    - used monthly savings as given by facilities management to calculate potential annual savings

    - annualized costs as given by facilities management
- East Campus Steam Plant conversion:
    - Does not include total building rehab only the conversion costs as given by facilities management (costs of equipment changes required to allow the burning of natural gas rather than coal)
    - Savings calculated by:
        - multiplying the BTUs replaced with NG by the average emissions rate of bituminous coal (EPA)
        - multiplying the BTUS replaced with NG by the average emissions rate of natural gas
        - finding the difference and dividing the cost by this amount

The Offsets department has one major project underway: a waste-to-energy project at Loyd Ray Farms (The Loyd Ray Farms Swine Waste-to-Energy Offsets Project). All savings and cost estimates come directly from the offsets department.

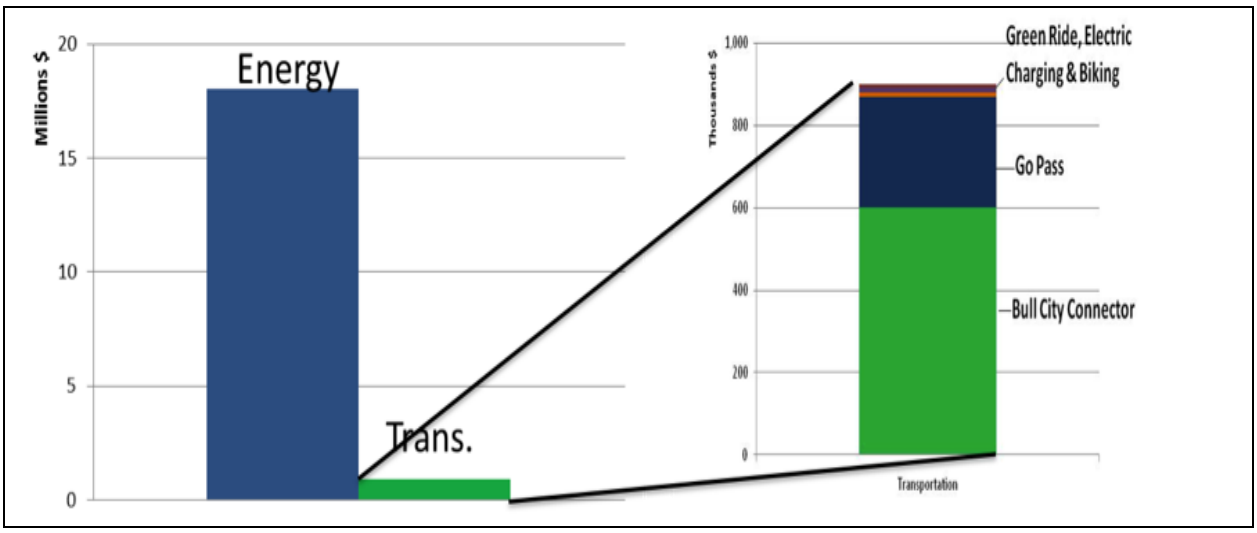
The Communications costs were provided by the communications committee but benefits from these efforts are hard to quantify. Qualitative benefits from Communications efforts, as well as other efforts, are discussed below.

Quantitative Cost-Benefit Results

Before valuing the results of this analysis directly it is important to first understand the context of financial allocation as a result of CAP. However, only the costs for Energy and Transportation committees are provided since the costs of the offsets project are not available and the communications costs cannot be attributed directly to savings. Note the graphs below for visual comparison. The graph on the left compares Energy costs to that of Transportation while the graph to the right is a breakout of Transportation costs by project. While it is clear that more was invested in Energy, it is important to note that this only encompasses one project: East Campus Steam Plant Conversion from coal to natural gas feedstock. Transportation, while less expensive, involves a number of projects. The largest Transportation expense is the Bull City Connector, which is a free bus service that runs from downtown Durham to West Campus. Next, comes the GoPass which is a pass available to Duke students, faculty and staff for free rides on regional transportation. Finally, there are three relatively inexpensive projects that include green

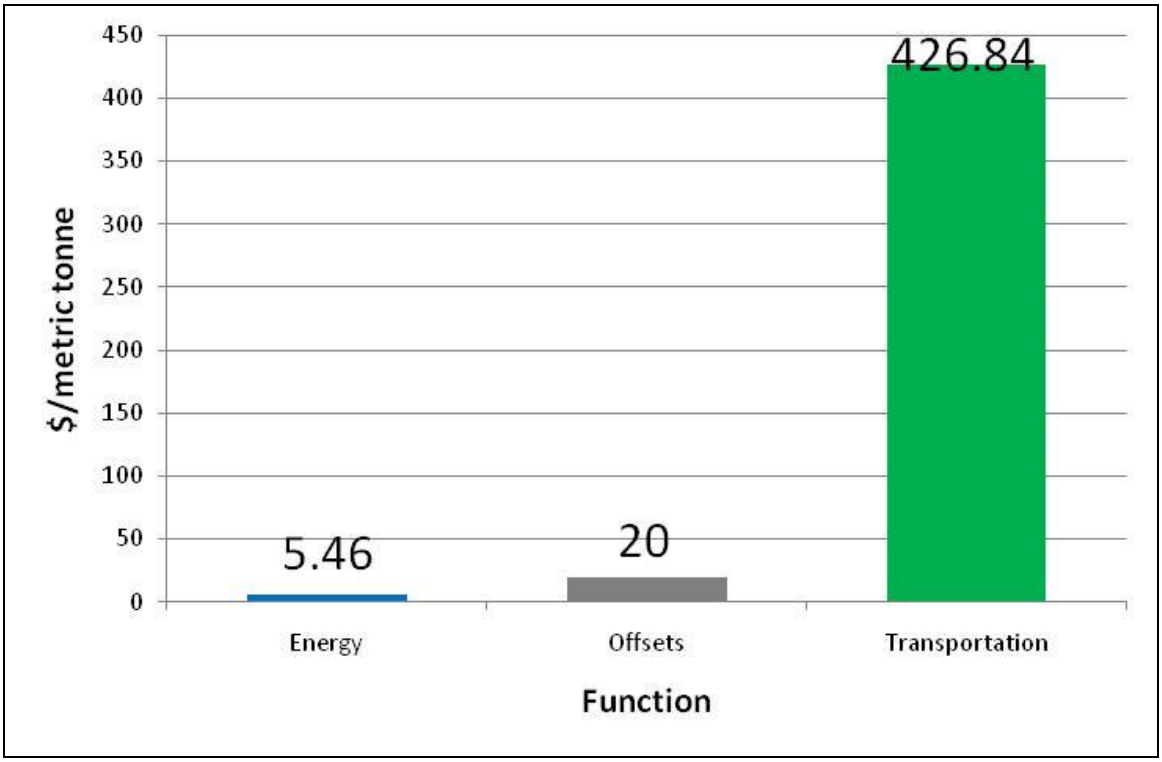
ride (an online carpool application), electric charging stations for on-campus Chevy Volts, and biking infrastructure upgrades.

Figure 2: Comparison of Cost Allocation across CAP Project Areas



With these costs comparisons in mind, the final C/B should be evaluated per the graph below. Once again, the lower the number the more cost effective a project area is. At around five dollars per metric tonne of CO2e avoided, Energy is the most cost effective project area despite being the most expensive at 18 million dollars. The next most cost-effective project area is Offsets which includes the Lloyds Farms Hog Waste methane capture project which was estimated at 20 dollars per metric tonne of CO2e avoided. While the offsets office estimated this amount, it is important to remember that we are only comparing magnitudes rather than precise amounts. Finally, the least cost-effective of these project areas is transportations at over 400 dollars per metric tonne of CO2e avoided. However, Transportation is not only the least-cost effective, it is also the least cost intensive per the cost comparisons above. So the conclusion to be drawn here is that scale matters. The bigger projects can often yield the greatest savings while being the most cost-effective. But Duke has committed itself to move beyond the most cost-effective solutions in order to further its sustainability goals. To further explore the data used in these analyses please see the charts in Appendix 5.

Figure 3: Cost-Benefit Analysis Results by CAP Project Area



Qualitative Benefits

Not all benefits from the Climate Action Plan can be meaningfully quantified or valued in dollar terms. However, as a university, Duke's mission extends beyond maximizing returns. There are elements of each endeavor that conform well to the University's values, with education, of course, being paramount. This section describes a number of important these benefits.

The first qualitative benefit of note is Leadership. Duke is already a leader in academics, medicine, and athletics. Sustainability is another opportunity for Duke to remain a leader amongst academic institutions. Duke is already taking advantage of this fact. While investments in steam plant feedstock conversions are having the most profound impact on Duke's carbon footprint to date, it is the more creative, less impactful solutions that are drawing the most attention. For example, Duke's biking infrastructure investment upgraded the previous biking system under significant budgetary and time constraints. What resulted was a safer and broader biking system within Duke's campus. During our interview with members of the transportation subcommittee, it was mentioned that a number of institutions have approached Duke for advice on how to implement such upgrades on their own campuses. Thus, despite not being a cost

effective climate action plan project, the biking infrastructure upgrades contributed to Duke differently.

A second qualitative benefit is Innovation. Sustainability is an opportunity for Duke to develop new solutions to pressing global problems. The best example of innovation resulting from Duke's CAP is the Hog Farm Offsets Project. This resulted in a partnership with Google, Inc. to assist in the company's offset efforts, and provides unique opportunities for education and research. It also has the potential to be expanded for waste and emissions mitigation for hog farming across North Carolina and beyond. Thus, sustainability-driven innovation can produce a ripple effect that engages not just the Duke community but the world at large.

A third qualitative benefit is Community Building through outreach and awareness. Each project undertaken has the potential for outreach that builds awareness and engagement. Much of this effort falls under the purview of the communications subcommittee. Some of these efforts are quite simple. Throughout Duke's campus are informative signs, appropriately placed, indicating average paper usage, average water usage, the benefits of reducing water and electricity consumption, and the impacts of using paper towels, water, and electricity, such as the following:

Figure 4: Communication Signage

While, it is difficult to measure the direct change in behavior of each individual as a result of such signage, an informed staff, faculty, and student body likely leads to changes in individual behavior that also helps an individual feel part of a larger community dedicated to a common goal.

Dissemination of information can have effects rippling beyond the boundaries of the campus itself. Outreach regarding individual projects allows transfer of knowledge, perpetuating Duke's standing as a leader. The development of Duke's biking infrastructure under limited budgeting has been the source of intrigue by other institutions. Therefore, outreach regarding Duke's unique and innovative approach will not only improve the potential for reduction elsewhere but attract more attention and collaboration for future projects.

Duke's commitment to carbon neutrality doesn't require action limited to the campus borders. Climate change is inherently a global problem. Therefore, actions taken to mitigate it reach beyond the University itself. Momentum from the commitments of the university will help drive commitments from the public if properly engaged.

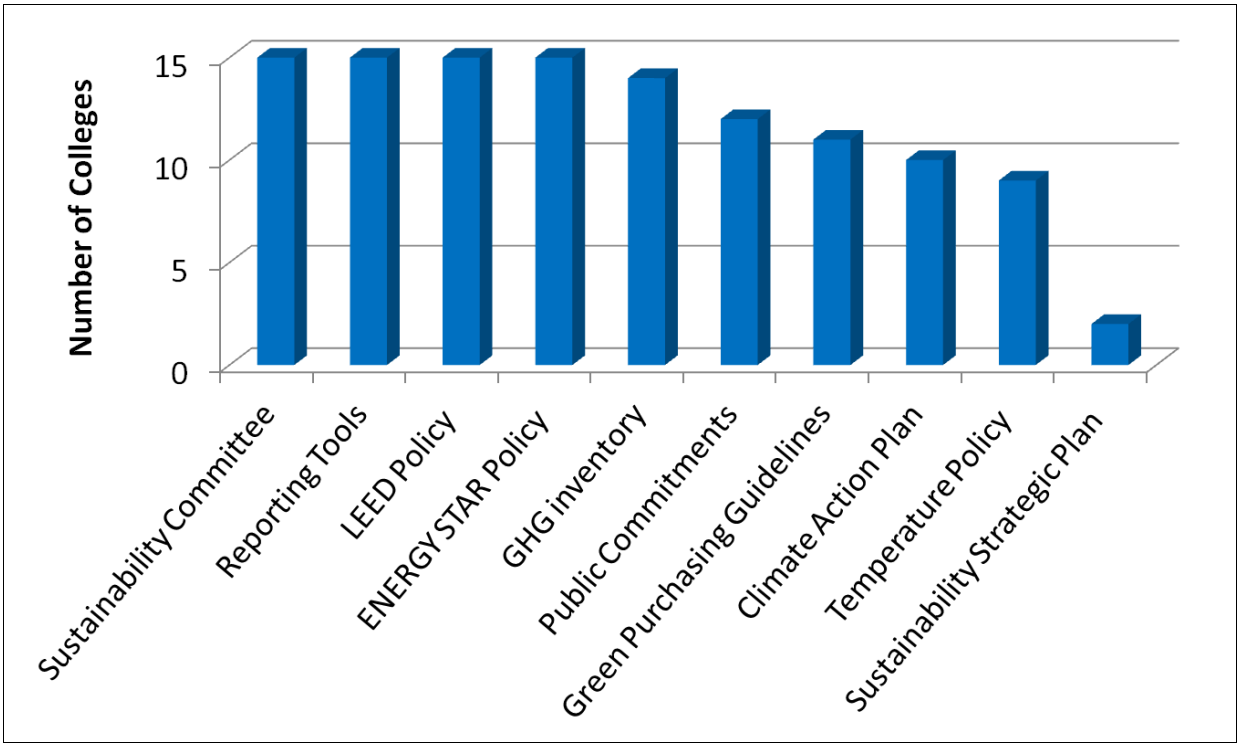
A summary of some of the qualitative benefits for the CAP projects to date follows:

- Bull City Connector:
    - Provides for easier transportation for people in Durham
    - Makes Duke's sustainability efforts more visible to the public
- GoPass: a free service that allows students to ride local bus systems
    - Increased ridership of buses reduces emissions per passenger
    - Reduces parking on campus
    - Promotes mass transit "literacy"
- Biking Infrastructure:
    - Increases bicyclist safety on campus
    - Health benefits for new cyclists
    - Leadership, as discussed above
- Electric Charging Stations for WeCars:
    - Leadership: Duke is the first school to have plug-in hybrids as rentals
    - Outreach: Demonstrates the viability of plug-in hybrids
- Green Ride:
    - Promotes a communal effort towards emission reductions
- Energy initiatives: Solar Thermal and East Campus Steam Plant conversion
    - Improved local air quality generates health benefits
- Loyd Ray Farms Swine Waste-to-Energy Offsets Project
    - Innovation, as discussed above
    - Outreach: great way to engage agriculture in North Carolina
    - Education: teach about agricultural sources of emissions
- Communication initiatives
    - Education, leading to behavioral change

4. Research on 15 Peer Institutions

In our research, we found that COFHE schools have not consistently signed any one public sustainability commitment. Although twelve of the fifteen schools we researched have signed some sort of public commitment, only two of the institutions have signed the Talloires Declaration (a declaration for sustainability created for and by presidents of institutions of higher learning which states that institutions of higher learning will be leaders in creating, developing, supporting, and maintaining sustainability), and only four have signed the ACUPCC. The commitment we found to have the most signatories is the ISCN-GULF Sustainable Campus Charter with ten. We hypothesize that signing this commitment is more attractive to schools than either the ACUPCC or Talloires Declaration because schools are not required to pursue carbon neutrality. They are allowed to set and pursue their own unique sustainability goals (International Sustainable Campus Network 2012).

Figure 5: Peer Institution Comparison: Sustainability Planning Characteristics



The figure above highlights some of the other trends we found while researching the sustainability practices of these fifteen schools. All fifteen have campus committees that are tasked with planning sustainability initiatives on a campus-wide scale. In addition, all fifteen schools have reported to one of the sustainability reporting tools we researched: the Sierra Club

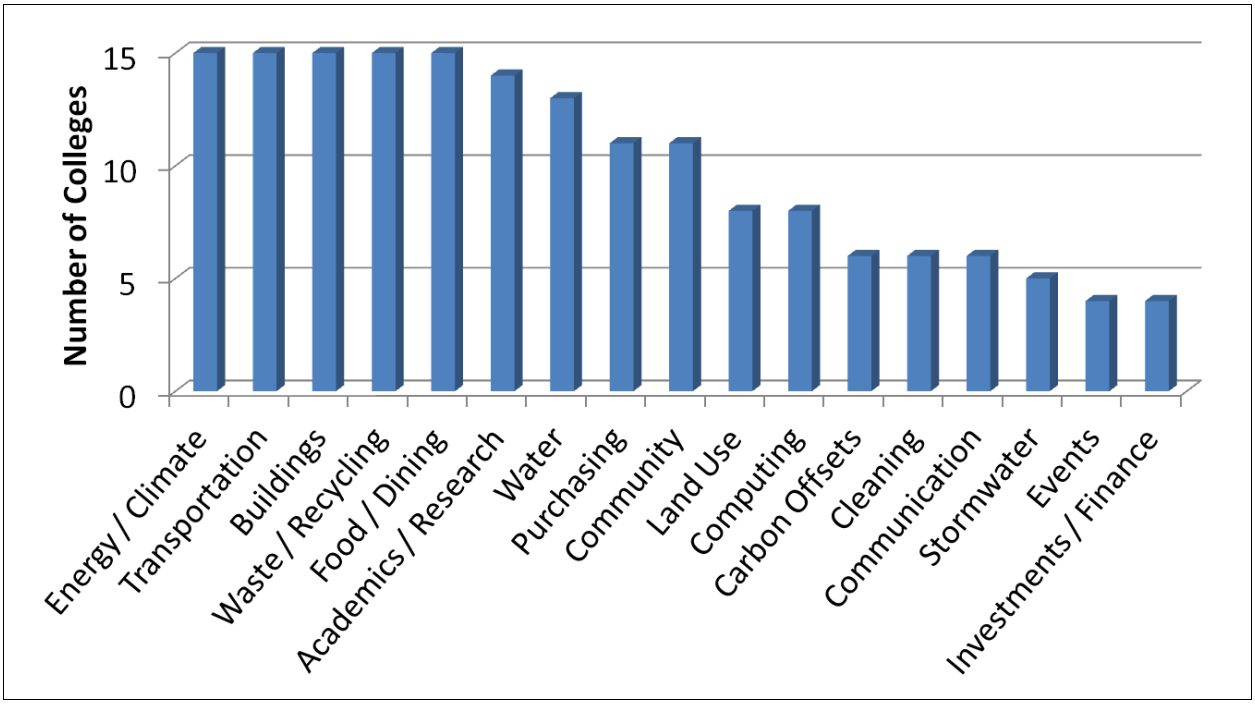
Cool Schools list, AASHE STARS, and the College Sustainability Report Card. All fifteen of the schools researched have made it a campus policy to pursue LEED standards for new buildings on campus, and all fifteen schools have a policy that encourages the purchase of Energy Star certified or equivalent products when available.

Policies that represent low hanging fruit for universities are green purchasing guidelines and temperature policies. These purchasing guidelines encourage staff to make sustainable purchases but are not binding. Temperature policies apply to centrally heated and cooled facilities, and are not strikingly different than typical heating and cooling settings. These indicate that the university is encouraging sustainability, but aren't as meaningful as LEED or Energy Star certification. We found that nine schools have published temperature policies and eleven have public green purchasing guidelines.

While many of the schools have published greenhouse gas inventories and almost as many have created climate action plans to reduce these emissions, only two of the schools in our research have developed sustainability strategic plans that set goals in focus areas beyond climate. This is an area of growing interest for universities. As most schools have settled on plan with regards to climate efforts, they are starting to broaden the scope of their sustainability plans and focus on recycling, water, purchasing, computing, etc. However, as is evident in our data, not many schools have made significant progress on such a broad range of topics.

After looking at the overall sustainability planning processes at other schools, we looked at what aspects of sustainability these schools have focused on. All schools have focused on climate and energy topics such as greenhouse gas emissions, alternative transportation, and green buildings. In addition, all fifteen schools have looked at ways to improve recycling, reduce waste, and improve the sustainability of their dining facilities. The figure below displays the rest of the sustainability topics we researched and how many of the schools have focused on them.

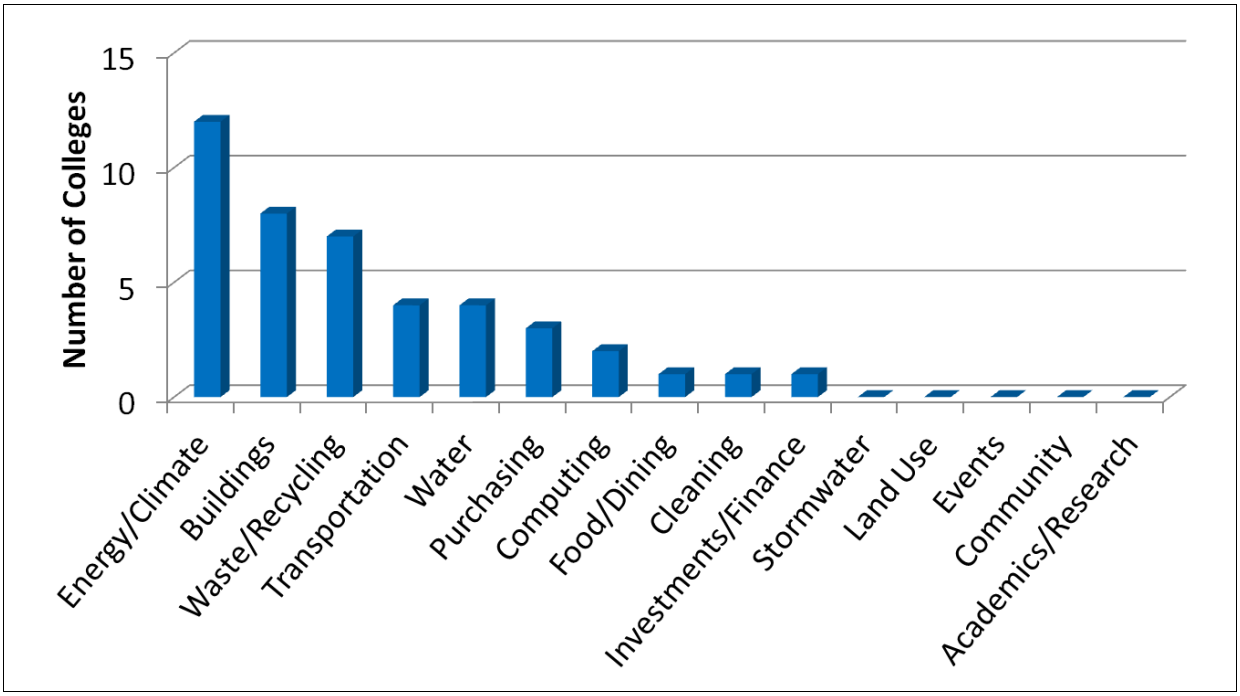
Figure 6: Peer Institution Comparison: Sustainability Focus Areas



We then researched if schools had made any numeric goals to pursue in these focus areas. This indicated a greater level of commitment and accountability. Outside of greenhouse gas emissions, we found few numeric goals on schools' sustainability websites or publications. We found that only thirteen of our sixteen schools had numeric goals for greenhouse gas emissions reductions. The next highest category was buildings with only nine schools having measurable goals to improving their sustainability in this area.

Water and Recycling targets have been made for several of the COFHE schools, and as a result of this, Duke's CSC has been developing targets for water use reduction on campus over the 2011-2012 academic year and will focus on making targets for waste and recycling in the 2012-2013 academic year.

Figure 7: Peer Institution Comparison: Numeric Sustainability Goals



5. Yale and Brown Interviews

Sustainability staff from Yale and Brown Universities were contacted and asked questions similar to those asked of Duke's Campus Sustainability Committee (See Appendix 4). Key points from these interviews are discussed below.

Public Commitments

In terms of sustainability reporting using the ACUPCC and STARS, neither Brown nor Yale has signed the ACUPCC, and neither thought that STARS had changed much about how sustainability reporting or planning was carried out in their universities. Brown has not yet submitted information to STARS; however, Yale has reported to STARS and received a silver rating (AASHE 2012). Although these tools have not made an impact on sustainability planning at these two institutions, both of these universities have had success setting goals and implementing their own unique sustainability programs. These two schools exemplify the idea that universities can use the knowledge base and capabilities of their students, faculty, and staff to create and implement customized sustainability programs independently.

Administrative Structure

While Brown does not have an Office of Sustainability, they have an "Energy and Environmental Programs" office within their Facilities department. Yale has a sustainability office that reports to the Executive Vice President, similar to Duke. Brown reported that connecting with a large and diverse set of stakeholders around a variety of issues with a very small staff is a challenge. This difference highlights the importance of having upper level administrative support and a sustainability office positioned centrally within the university organization.

Engagement

Representatives from both Brown and Yale highlight that there are many ways for students, faculty, and staff to become involved in sustainability initiatives on their campuses. Brown noted that they were currently working on ways to gain further involvement of faculty. This appears to be a general concern; universities struggle to find ways to engage faculty, whose focus is commonly directed to their individual research and teaching.

Although neither Brown nor Yale has done any research or ventured to guess what percentage of their faculty or staff members are involved in sustainability issues, Brown University has conducted an impressive survey to gauge student involvement. They found that while 43% of their students did know about Brown's GHG goals, 55% were unsure what the goals are or if Brown had any. Other results of their study include:

- The majority of students had heard of, or were involved with, the Beyond the Bottle campaign (82%) and Brown's EcoReps program (66%).
- 87% of Brown students believe that they can make choices that positively impact the environment.
- In the past year: the majority of students, 70.3 %, recycled whenever possible and 76.5% turned off lights when leaving the room.
- 80% of Brown students believe that climate change will be a defining issue in their lifetime

Next Steps

New areas of focus for Brown are: laboratory energy efficiency, dormitory energy efficiency (with a focus on behavior change) and integrating with academics to use campus sustainability initiatives as a "living lab" for learning. Yale is also focusing on education and

how their sustainability curriculum could create synergies with their on-campus efforts. As the ultimate goal of these institutions is education, universities wanting to improve their sustainability efforts will have to find ways to integrate green initiatives into the curriculum. As graduating students take lessons learned about sustainability in the academy into their careers, benefits of university sustainability efforts will a more far reaching impact.

Discussion

Throughout this study, the idea that there is no specific path for universities to follow regarding sustainability has recurred again and again. However, some trends in university sustainability have been illuminated through our research. These trends are discussed below and recommendations based on them follow.

Focus Areas

Colleges and universities typically begin their sustainability efforts by focusing on greenhouse gas emissions and energy. In our research of fifteen COFHE schools, we found that, independent of whether schools have signed the ACUPCC, most have created GHG emissions inventories and most have created Climate Action Plans. In addition, we found that all fifteen schools have some sort of policy regarding LEED building standards. Although grassroots efforts across campus may spring up regarding many aspects of sustainability, when it comes to organized planning and commitment, climate action is where universities begin their journey towards sustainability.

Schools vary in terms of their focus on other aspects of sustainability. This may be driven by particular school strengths, foci, or by student interests. For instance, Duke has focused on water conservation because of the 2007-2008 drought and pressures from the city of Durham. At this time, this flexibility seems to be beneficial because schools are free to pursue those aspects of sustainability where they feel they can or should make the greatest impact. Eventually, precedents will be set for these other areas of sustainability as well. But for now, we recommend that universities let their students, faculty, staff, and community interests, their unique strengths and challenges, and their knowledge base guide them as to which aspects of sustainability to pursue.

For aspects of sustainability other than energy and GHG emissions there are not, as of yet, accepted metrics to gauge success or targets that are deemed aggressive yet attainable. Until

the number of schools with published sustainability strategic plans that address actions outside carbon reduction increases drastically, schools will have to work independently or in small cohorts to develop individual goals.

Engagement

With education the main purpose of these institutions, student involvement in the sustainability planning and implementation process is crucial. As a result, the number of ways students can become involved in and learn about sustainability initiatives on campus is generally large. Most universities have a sustainability committee that students may serve on. Student-run sustainability initiatives are blossoming in schools across the country. In addition, the number of courses on sustainability and, more specifically, the number of courses involving projects related to campus sustainability, is rapidly increasing.

Because sustainability efforts require cross campus collaboration, sustainability committees that involve a representative sample of faculty and staff from all departments on campus have been identified as very successful. This involvement not only facilitates communication efforts with the wide range of campus constituents, but better enables the university to identify and address sustainability issues in all aspects of campus operations.

Determining how many students, staff members, and faculty are engaged in sustainability efforts on campus is difficult to quantify, but in general, the goal of most sustainability offices is to increase that number until the entirety of the campus community is involved. As schools continue to publish climate action plans, and make other sustainability goals and targets, it will become increasingly important for university sustainability offices and committees to know which sectors of the campus community are not informed about campus greening efforts. Only in this way will they be able to better target their communication efforts.

Administrative Support and Structure

The importance of high level, administrative commitment and support for sustainability efforts was highlighted in both the literature and in our interviews with Campus Sustainability Committee members. As Krizek et al. (2011) describe, in order to move beyond an unorganized collection of grassroots sustainability initiatives, administrative organization and support is necessary. The CSC members we interviewed emphasized this point and how it played out at Duke. Although sustainability initiatives had been undertaken across Duke's campus, President

Brodhead's signing of the ACUPCC was the catalyst that started bringing together these disparate efforts and organizing them into a coordinated campus-wide effort.

In addition to top-down support, a sustainability office or committee that is centrally located within the university is important. As sustainability issues arise in every department of a university, a centrally located and relatively senior position within the organization better enables sustainability staff to engage and work with the entire campus community. This finding became most evident in the comparison between the Yale Sustainability Office and the Brown Office of Energy and Environmental Programs.

The Yale Sustainability Office, like Duke's, reports to the Executive Vice President of the university. In contrast, the Brown Energy and Environmental Programs Office is located within facilities. Although sustainability professionals at universities collaborate with facilities personnel frequently, having a higher position within the university is beneficial. Brown highlighted that their sustainability efforts had been focused on energy and buildings because those are the efforts facilities can work on most easily. They noted that connecting with groups across campus is challenging. When they must collaborate with other departments to fill out sustainability reports or implement initiatives such as their real food campaign, Brown indicated that their work was made much more difficult. These efforts would be more easily facilitated if their office were in a higher, more centralized position within the university organization.

Resources

A challenge associated with implementing sustainability at universities and colleges is a lack of staff time and resources. Often, the real costs of sustainability projects underestimate extra hours devoted by staff who may not even have sustainability initiatives as a part of their job description. Data collection for sustainability projects requires facilities staff to spend additional time sorting through spreadsheets and checking meters. Communication efforts place additional demands on staff time for the creation of advertisements, designing layouts for presentations and documents, and in writing articles. Meetings of the Campus Sustainability Committee also take time; this makes it critical that such meeting time is used to not simply present reports, but to solicit feedback and generate ideas for how to improve sustainability efforts.

New Trends

Our research also identified two emerging areas in sustainability in higher education: incorporating sustainability into academics and engaging faculty. To date, most university

sustainability efforts have focused on facilities. As a result, building efficiencies are improving and energy use on campuses is decreasing. Schools are increasingly beginning to grapple with how to integrate sustainability principles into their curricula. As the main goal of these institutions is education, finding a way to bring these behind-the-scenes efforts to the attention of students through academics is a crucial next step.

In this regard, it is important to note that these large research institutions include students and faculty whose interests extend well beyond the environmental sciences. Finding ways to engage faculty in diverse fields may prove challenging, but it also may reveal surprising new partnerships and approaches to education and engagement.

Reporting Tools

CSC interviewees highlighted the difficulties in comparing data across campuses and with reporting tools such as AASHE STARS. However, all of the fifteen schools we examined have made use of at least one of the sustainability reporting tools. Duke has reported to several. As a result, we can identify that sharing information and benchmarking success in comparison to other schools are important facets of sustainability programs for institutions of higher education.

Although, as CSC members indicated, these tools are not perfect and depend largely on the specific details included in the report submitted, these tools do allow for comparison and identifying areas of improvement. In the absence of an alternative, the use of these reporting tools will, at least in the near future, remain important.

Respondents from CSC interviews also noted that filling out numerous reporting forms takes a significant amount of staff time. However, there is potential for progress here as these forms are, in large part, redundant asking for the same general information. In the future the ability to submit one set of information to fill out all of the sustainability reports would be extremely useful. Also, respondents questioned the usefulness of these rating systems. It is difficult to compare the range of schools because there is a mix of private, public, large, small, four year, and two year institutions and these are located across the country where there are different numbers of heating and cooling days and different problems associated with weather and rainfall.

The Princeton Review, Sierra magazine, and the Sustainable Endowments Institute have worked with AASHE since March 2011 to establish a Campus Sustainability Data Collector (CSDC), which may provide an alternative way for schools to engage in sustainability reporting.

Schools can submit their sustainability information solely to the CSDC and have their results then submitted to STARS, Princeton Review, and Sierra Magazine. However there are still concerns about the program: it requires schools to update their information annually, the process for information rollover from STARS into the CSDC is uncertain, there is a continued difference in due dates between the three reporting tools which require ongoing data collection if ratings from the tools are going to be up to date, and access to submitted data requires continued STARS membership. Finally, it is not clear which questions the different rating organizations will pull from the reported information.

Perhaps one alternative to the use of reporting tools is dedicating a section of the school's sustainability website to data reporting. A well organized dashboard of data and statistics for recycling, water use, energy use, etc. could be a way for schools to share and compare data without using the reporting tools. This website has the added bonus of being easy for campus constituents to view. However, without the guidelines provided by the reporting tools, as to what data to report and in what units to report it in, this could make statistics harder to compare between schools.

Need for Feedback

The effectiveness of outreach and communication efforts on campus was a recurring question among CSC members interviewed. Similarly, Yale indicated they were unsure how or if other universities were keeping track of student engagement. Institutions that are interested in learning about the efficacy of their sustainability efforts in generating awareness should replicate the survey conducted at Brown to see how its students view sustainability on campus. A sustainability focused survey can also be informative as Brown's was in identifying which specific initiatives are best at engaging the student body.

Recommendations & Conclusions

Based on the research and methodology used above, this section outlines a general roadmap for schools looking to pursue sustainability. Recommendations include strategies and techniques to avoid many of the typical challenges schools face when trying to decrease their environmental impacts. All of the recommendations should also be considered for implementation at Duke. We then close with other specific recommendations for improving sustainability and the sustainability planning process at Duke University.

1. A Guide for University Sustainability

Identify top priorities and make them visible

No two institutions are exactly alike, and so not all institutions will or should have the same priorities when it comes to implementing sustainability initiatives. Climate action is a popular rallying point, but some schools may prefer to choose a different option. Whatever goal is chosen, it should be ambitious and motivational. This helps generate buy in from the top-down as well as bottom up. Top-down buy in is generated in the selection and adoption of a priority for an institution; at Duke the signing of the ACUPCC cemented the importance of sustainability to Duke leadership. Bottom-up engagement then follows as the school develops initiatives to tackle its sustainability priority.

One challenge to generating bottom-up engagement in the community is the difficulty of communicating sustainability efforts to the entire campus community and generating behavior change. We see this as an argument for the importance of visible efforts. Although faculty and staff may read the local newspaper, students are more likely to read articles in the campus paper or learn about activities through Facebook or Twitter. There are different ways to connect with the various groups on campus. Finding initiatives such as the Green Devil Smackdown (an eight week long, campus-wide competition that encourages students, faculty, and staff to engage in sustainable behaviors) that can engage the entire campus are great tools to use to communicate the university's sustainability goals. Also, events that play off of the unique strengths of a university are important, such as when students were given "Bleed Blue, Live Green" tee shirts to wear at a Duke Basketball game. Although other sustainability initiatives behind the scenes create a greater impact right now, in the future, schools will increasingly be focusing on behavior change, so these visible initiatives will become far more important.

Adopt public commitments and external evaluators

We recommend the adoption of external commitments, such as the ACUPCC, or regularly using rating tools such as STARS. This encourages transparency and helps ensure follow through on any commitments made. Given our discussion above of problems with reporting tools, for now we recommend that schools pick one reporting tool to work with. As for signing the ACUPCC or choosing between the other commitments, we do not have a specific recommendation for different schools, but simply suggest that schools evaluate the various commitments and choose the one that is most appropriate.

Give sustainability staff a high priority

To ensure that sustainability staff members have the resources they require to make progress towards targets, it is important to have a sustainability office or committee that is centrally located within the university. As sustainability issues arise in every department of a university, a centrally located and senior position enables sustainability staff to engage and work with the entire campus community. Furthermore, successful sustainability planning takes time and much organization, so for those schools that do not have any sustainability staff but would like to significantly decrease their environmental impacts, we recommend hiring at least one full time, dedicated staff member.

Engage the university at-large with a representative committee

As noted in the discussion section, a committee with university-wide representatives offers an effective way to engage the community. Such committees allow for cross campus collaboration, facilitate communication efforts with the wide range of campus constituents, and enable the university to identify and address sustainability issues in all aspects of campus operations.

Regularly survey and evaluate feedback

It is important to incorporate mechanisms to obtain regular feedback from the wider campus community into sustainability strategic plans. Here we are referring to gauging knowledge and practices of the community to evaluate the effects of sustainability activities. As members of the Duke Campus Sustainability Committee indicated, it is difficult to simply guess how aware different populations are of sustainability efforts. Surveys can provide this information as well as offer one effective means of receiving feedback, which can be used to guide future efforts.

2. Recommendations to Improve Sustainability at Duke University

Engage hospital, athletics, and recycling

Duke Hospital, Athletics, and recycling are the three most important and visible aspects of the Duke campus that must become more involved in sustainability planning efforts. Although Duke Hospital is not included in the university CAP, it is one of the largest parts of the Duke community as well as one of the most visible as people travel from around the nation to visit the hospital.

Athletic events also offer an opportunity to reach large numbers of people from the Duke community whose primary interaction with Duke is through sporting events. Sustainability efforts made at Cameron Indoor or Wallace Wade Stadiums in particular will be seen by people from other schools that visit campus for our games or watch them on television. Duke received wide publicity about its sustainability efforts by giving students green sustainable Duke tee shirts to wear in Cameron Indoor stadium for a men's basketball game. Additional visible and perhaps more on-going efforts should be considered.

Finally, improving recycling at Duke is a priority task that the CSC will focus on during the 2012-2013 academic year. Organizationally this will be a challenge as recycling collection involves many stakeholders. Encouraging greater CSC participation from employees working in all three of these departments, hospital, athletics, and recycling, should be a priority for Duke. There is room for improvement in each of these areas, and representatives from these departments could bring different and important perspectives on what sustainability initiatives can and should be carried out.

Undertake a survey to gauge involvement

A survey at Duke, in particular, could provide important insight into the best ways to increase sustainability related involvement among students who are already aware of and interested in sustainability issues and among students not currently involved. Current hindrances to the development of more student projects could be investigated: perhaps faculty interest is not made clear enough to students. Ways to better integrate sustainability projects into student life could be researched, such as whether it is better to pay students to work on projects or to receive course credit. Finally, if Duke or other institutions wish to learn about the awareness of faculty and staff, then surveys to that end would be appropriate as well.

Integrate sustainability into the curriculum

One of the ways schools can reach out to the greater campus community is through having a wide range of classes that incorporate sustainability topics. The more students learn about sustainability, the more they may be interested in participating in campus initiatives, and the more will be able to bring these principles to their lives when they leave the university.

Engaging faculty across the diverse disciplines is a challenge, and breaking down the barriers between disciplines will be an important aspect of addressing complex sustainability issues at the University level. The Duke Trillium Project is an important first step in this regard:

each May a campus workshop is held where participants from prior workshops mentor other faculty on how to incorporate sustainability concepts into their syllabi, across departments and disciplines (Duke University Trillium Project).

Increasing communication with the deans and provost is an area of growing interest among members of the Campus Sustainability Committee, and represents a critical step in further integrating sustainability into the curriculum. Sustainability efforts related to facilities have received a significant amount of attention and continued effort. In contrast, there has been little communication with the provost's office and little collaboration on how to integrate Duke's environmental efforts and goals into what students learn in the classroom. As there is already an education subcommittee of the CSC and Duke has recently created a position titled Faculty Director of Sustainability, it would be advantageous for the CSC to place increased emphasis and focus on their efforts next year. As Yale and Brown will also be focusing on this topic, Duke should look for ways to collaborate with these two institutions.

Increase student involvement

As emphasized throughout CSC member interviews, Duke has access to a vast intellectual resource: its student body. Although student turnover is an issue for ongoing projects such as long term climate action plans, students have already helped conduct valuable research, devised new ways to communicate sustainability, and played integral roles in leading on-campus initiatives among other contributions. In addition, it is the goal of universities and colleges to educate students, and the experience leading sustainability efforts on campus will prepare them to continually make strides to decrease human impact on the environment.

We recommend increasing the involvement of students, both undergraduate and graduate, in the sustainability planning process in order to increase opportunities for sustainability education and alleviate some of the pressure that sustainability programs put on staff and faculty time. Although students may be present at sustainability planning meetings, they need to be actively engaged and working on sustainability initiatives. Students could be immensely helpful researching new technologies and sustainability programs. They could lead communication efforts across campus extremely well, as most students understand the main communication channels of the university. Students could be used to design and conduct surveys to determine how many of their fellow students know about on campus sustainability issues. Currently staff members are spending time doing work that students could, and perhaps ought to be doing. This

year there are eight student representatives on the Campus Sustainability Committee, but we recommend that this should be increased to twelve with a priority for involving underclass students who are not currently represented.

Streamline the reporting process

As with all institutions of higher education, we recommend that Duke choose one reporting tool to utilize. Other opportunities for improved data management exist at Duke as well. For instance, standardizing the way departments report airline use by faculty members could significantly reduce the time costs associated with calculating scope 3 carbon emissions. In addition, formally integrating data collection into the duties of staff members who work in areas associated with sustainability could cement the importance of sustainability tracking on campus, and perhaps encourage the development of more efficient means of data collection and management. If the responsibility for gathering data for a specific metric is not assigned to a specific individual or group, then nobody has the incentive to develop the means to efficiently gather that data. In other words, sustainability reporting tasks should be incorporated into the job responsibilities of relevant employees.

Make planning iterative

This report presents an appraisal of sustainability strategic planning efforts at Duke to date in an effort to inform future efforts. Regular review of the general planning process represented by this project is important. It would also be beneficial to set regular intervals for reviewing progress towards targets for each sustainability related goal that Duke sets. This requires the setting of specific goals for every department that is involved in sustainability efforts; transportation and facilities management, for example, with respect to the CAP. Without a detailed plan describing how Duke is going to meet its goals, it is not possible to effectively evaluate progress towards them. To meet Duke's goal of achieving climate neutrality by 2024, changes will have to be made as difficulties arise in some expected areas of emissions reductions and as new opportunities come to light. Without an iterative planning process, it will be difficult for Duke to meet its sustainability goals.

Extend sustainability planning timeline

Duke should develop a long term vision for the university (50 to 100 years in the future) as it creates its Sustainability Strategic Plan. This will help the university set priorities better. If the goal is to improve sustainability on the campus physically, one potential long term goal is

becoming a waste free campus. If the goal is to increase sustainability awareness, and have a more diffuse impact, one future goal would be to have every student take a sustainability related course. If Duke's goal is leadership and development of ideas, then perhaps Duke should set a goal of becoming the leader in environmental entrepreneurship. These visionary goals ought to be made more explicit. Without a long term vision for the future, it is difficult to remain true to the principle of sustainability, which has intergenerational implications. While the vision might not be achieved, progress will be made towards sustainability, giving future generations the opportunity to define their vision in light of efforts already made.

Consider indirect benefits from Climate Action Plan projects

While cost for CO2 savings should be considered in decisions regarding future projects, it should not be the only consideration. Transportation projects that encourage bicycling provide health benefits for those who choose to commute by bicycle instead of motorized means. Cessation of the burning of coal on campus provides health benefits in reduced local air pollution. Spending on environmental education may result in lifelong behavior changes, which will not be captured entirely by Duke, but will benefit the Earth at large. Projects that result in reductions of CO2 emissions should naturally tend to be cost effective as Facilities Management, Transportation, and other departments understand the seriousness of Duke's commitment to climate neutrality, and yet have limited budgets and personnel with which they can pursue projects. Therefore they will focus on the best opportunities for emissions reductions that are available. In the future, we encourage them to also consider the indirect benefits of potential sustainability efforts as these may produce synergies that help accelerate Duke along its path towards sustainability.

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Appendix 1: CSC Interview Questions

1. When did you first become involved in sustainability planning at Duke?
2. What do you see as your role with respect to sustainability planning on campus?
3. Has signing the ACUPCC affected Duke's sustainability efforts?
4. Has CSC structure affected Duke's sustainability efforts?
5. Has the CSC been able to effectively engage the university at large with the CAP?
6. How successful has Duke been at making progress towards targets and milestones?
7. Does the CSC have adequate resources to ensure that the objectives of the CAP are met?
8. Do you think there is value in having students on the CSC committee?
9. Have targets for the CAP been set in an effective way?
10. Is there anything missing from the CAP, and are there additional sustainability elements that should be addressed at an institutional level?
11. How successful has Duke been at making progress towards targets in areas beyond the scope of the CAP such as water, food, recycling/waste, and purchasing?
12. Is Duke equipped to tackle more broad sustainability issues?
13. Has reporting to STARS changed anything about the way sustainability planning is carried out or thought about at Duke?
14. Is there an adequate awareness of sustainability issues on campus, among students? Staff? Faculty?
15. Has there been enough focus on sustainability awareness education at Duke, at the student, staff, and faculty levels?
16. Compared to our peers, how sustainable is Duke?
17. Compared to our peers, how successful has Duke been at sustainability planning?
18. What changes would enable Duke to better implement CAP strategies and future SSP strategies?
19. What is the biggest challenge to enhancing sustainability at Duke?

Appendix 2: Peer Institutions Researched

1. Brown University
2. Columbia University
3. Cornell University
4. Dartmouth College
5. Georgetown University
6. Harvard University
7. Johns Hopkins University
8. Massachusetts Institute of Technology
9. Northwestern University
10. Princeton University
11. Rice University
12. Stanford University
13. University of Chicago
14. University of Pennsylvania
15. Yale University

Appendix 3: Research on 15 Peer Institutions

		Duke University	Brown University	Columbia University	Cornell University	Dartmouth College	Georgetown University	Harvard University	Johns Hopkins University	MIT	Northwestern University	Princeton University	Rice University	Stanford University	University of Chicago	University of Pennsylvania	Yale University
Staff / Committee	Sustainability Department Staff	5	2	4	6	4	3	21	7	2	3	4	2	5	3	3	5
	Has a Sustainability Committee	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commitments	Signed Talloires Declaration	No	Yes	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No
	Signed ACUPCC	Yes	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	Yes	No
	Reported to STARS	Yes	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No	Yes
	Score on College Sustainability Report Card	B+	A	B+	A-	A-	B	A-	C+	B+	C+	A-	B+	A-	C+	A-	A
	Score and Rank on Sierra Cool Schools Survey	Yes	Yes	No	Yes	Yes	No	Yes	No	No	Yes	Yes	No	Yes	No	Yes	Yes
	Signatory of Sustainable Campus Charter	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes
	Member of Campus Consortium for Environmental Excellence	No	No	Yes	Yes	No	Yes	Yes	No	Yes	No	No	No	No	No	Yes	Yes
	Member of Ivy Plus Sustainability Working Group	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Planning Documents	Has Formal Climate Action Plan	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	IP	Yes	IP	Yes	Yes
	Has GHG Emissions Inventory	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
	Has Formal Sustainability Strategic Plan	IP	No	No	IP	No	No	No	No	No	No	Yes	No	No	IP	No	Yes

		Duke University	Brown University	Columbia University	Cornell University	Dartmouth College	Georgetown University	Harvard University	Johns Hopkins University	MIT	Northwestern University	Princeton University	Rice University	Stanford University	University of Chicago	University of Pennsylvania	Yale University
Policies	LEED	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	EPEAT	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No	Yes
	Energy Star	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bottled Water	Yes	Yes	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No
	Purchasing in General	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes
	Temperature	Yes	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes
Focus Areas	Energy / Climate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Transportation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Buildings	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Carbon Offsets	Yes	No	No	Yes	No	No	Yes	Yes	No	No	No	Yes	Yes	No	Yes	No
	Water	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Stormwater	Yes	No	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes	Yes
	Land Use	Yes	No	No	Yes	No	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
	Purchasing	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
	Waste / Recycling	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Food / Dining	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Cleaning	No	Yes	No	Yes	No	No	No	No	No	Yes	Yes	Yes	No	No	No	Yes
	Computing	No	No	Yes	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes	No	Yes	Yes
	Events	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	Yes	No
	Communication	Yes	No	No	Yes	No	No	No	Yes	No	No	Yes	No	Yes	No	Yes	Yes
	Community	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
	Academics / Research	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Investments / Finance	No	No	No	No	No	No	No	Yes	No	No	Yes	No	Yes	No	No	Yes

		Duke University	Brown University	Columbia University	Cornell University	Dartmouth College	Georgetown University	Harvard University	Johns Hopkins University	MIT	Northwestern University	Princeton University	Rice University	Stanford University	University of Chicago	University of Pennsylvania	Yale University
Numeric Goals	Energy / Climate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes
	Transportation	Yes	No	No	Yes	No	No	No	No	No	No	Yes	No	Yes	No	No	Yes
	Buildings	Yes	Yes	No	Yes	Yes	No	No	No	No	Yes	Yes	No	Yes	No	Yes	Yes
	Water	No	No	No	No	No	No	No	Yes	No	No	Yes	No	Yes	No	No	Yes
	Stormwater	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Land Use	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Purchasing	No	No	No	No	No	No	No	Yes	No	No	Yes	No	No	No	No	Yes
	Waste / Recycling	No	No	No	No	No	Yes	No	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes
	Food / Dining	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
	Cleaning	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No
	Computing	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	Yes
	Events	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Investments / Finance	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
	Community	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Academics / Research	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No

Appendix 4: Brown and Yale Interview Questions

1. Has not signing the ACUPCC affected your school's sustainability efforts?
2. Has AASHE STARS changed anything about sustainability planning and/or reporting?
3. Has the administrative structure at your university affected sustainability efforts?
4. Has the university community at large become engaged with your sustainability efforts?
5. Is there value in having student involvement in the sustainability planning process?
6. Is there adequate awareness of sustainability issues on campus, among students, staff and faculty?
7. How successful has your university been at making progress towards sustainability targets?
8. How successful has your university been at making progress towards targets *in areas beyond climate and greenhouse gases*? (Recycling, water use, land use, purchasing, etc.)
9. Are there any aspects of sustainability that your university hasn't prioritized yet that will be of greater importance in the near future?
10. What is the biggest challenge to enhancing sustainability at your university?

Appendix 5: Cost Benefit Data

Transportation

FY	Project	Cost (Dollars)	Annual CO2 Savings (metric tons)
11	Bull City Connector	300,000	48
10	Bull City Connector	300,000	24
11	GoPass	270,000	1404
11	Biking	10,000	220.08
11	Electric Charging	11,500	3.02868
11	Green Ride	7,900	408
	Total	**899,400**	**2107.10868**

$/ton	**$426.84**

Energy

FY	Project	Cost (Dollars)	Annual CO2 Savings (metric tons)
11	East Campus	18,000,000	3,299,889.52
	Total	**18000000**	**3299910.844**

$/ton	**$5.46**