

Student Knowledge and Perceptions of a Green Campus



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1 Introduction

The United Nations Environment Programme reports in October, 2021 that over 1,000 universities throughout the world have committed to “reach net-zero emissions by 2050 and transform their impact on nature” (UNEP 2021). Many institutions demonstrate their commitment to sustainability through the signing of declarations, charters, and partnerships that state the institution will engage with sustainability initiatives and focus these efforts in areas such as “education, research, campus operations, community outreach, and assessment and reporting” (Lozano et al. 2013, 2015). Additional initiatives toward sustainability that are happening across campuses include energy efficiency and management, minimizing water consumption, and affordable public transport in an effort to make a positive difference in a college or university’s carbon footprint (Lozano et al. 2015). Cai and Shafiee-Jood (2017) report that renewable energy labs, green infrastructure, a Campus Sustainability Innovation Fund, stormwater management wetland demonstration project, and student funds for research exist at some of the most prestigious green campuses within the US. Additionally, many schools have committed to the goal of carbon neutrality which has been achieved by reducing their C footprint and supporting methods of carbon sequestration (Jain et al. 2017).

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A wide variety of sustainability initiatives have proven to be useful at reducing waste, saving money, and greatly decreasing the impact of institutions of higher education on the environment. However, research suggests that sustainability efforts have not been integrated seamlessly across all operations of institutions of higher education (Lozano et al., 2015). Venkataraman (2009) states, “Embracing ESD at all levels of education and assessing programs and efforts to establish best practices... are crucial to producing citizens that embrace sustainable development as a guiding principle of their lives.” Many campuses offer sustainability courses as well as Environmental Science and Sustainability majors that incorporate issues of campus sustainability; however, beyond these programs and departments sustainability efforts often remain unknown to the campus community (McMillin and Dyball 2009). Institutions of higher education must seek ways to ensure that their sustainability efforts are known and understood by the student body. Only then will the efforts to create sustainable campuses translate into developing citizens of the world that prioritize sustainability.

Allegheny College is a small undergraduate, liberal arts school located in Meadville, Pennsylvania. Allegheny was the eighth college in the U.S. and first college in PA to reach carbon neutrality (“Allegheny...” 2020; Holthouse 2020). Additionally, it is home to the nationally ranked Environmental Science and Sustainability department (“Top Environmental Science Schools” n.d.). The college has undertaken large-scale initiatives, such as retrofitting buildings to make them more energy efficient, purchasing 100% renewable energy, installing geothermal heating and cooling in multiple buildings across campus, along with a suite of additional efforts (Sustainability n.d.). Across campus you will find students using “green boxes”, our reusable to-go food containers, refilling water bottles at one of the 2-dozen plus bottle refills stations and composting their food scraps, utensils, napkins and cups in the dining halls. Student residence halls participate in an annual energy challenge and the savings generated through this program are used to fund more sustainability efforts (Sustainability n.d.). The campus garden produces 2000 pounds of organic produce each year that is served to the students and faculty through the campus dining halls and catering (Sustainability n.d.). While on campus, most students are engaging with initiatives that reduce their environmental footprint on a daily basis (Bethurem et al. 2021); however, we remain unsure if students understand the importance of these initiatives.

Ensuring that a green campus is acting as an educational tool for all students is important as we seek to create leaders in making environmental change. The overarching question of this research is to determine if as an institution of higher education we are effectively communicating the importance and environmental impact of our sustainability initiatives in a way that results in the creation of sustainable citizens. Our research begins to address this question by seeking to determine if students are aware of Allegheny’s sustainability efforts and understand their benefits to the environment.

2 Methods

Over a 5-week period from October 16th to November 20th, 2019, we conducted a survey examining students' knowledge and understanding of campus sustainability efforts. The survey was distributed to undergraduate students over the age of 18 at Allegheny College. Students participated in the survey voluntarily and were incentivized with the chance to win a 25-dollar visa gift card. Students were made aware of the survey through a daily online announcement board (myAllegheny), through public tabling conducted over two hours on three different days, via instructors of ESS classes, by instructors of first year seminars, and by building coordinators who emailed it to the majors in their department.

The survey was designed by two Environmental Science professors and two of their students. It consisted of 11 questions total, 2 of which were designed to filter out students who were not eligible and 3 of which were demographic questions. The questions were presented in a variety of formats, including Likert scale, "select all that apply", and short answer questions. The survey asked questions about Allegheny's current sustainability efforts, asking students to identify which efforts were in use, identify the effort that they felt is most important, and explain how that effort benefited the environment. Students were also asked whether they had thoughts for additional sustainability efforts that could be effective on campus.

Students were presented with a list of 14 sustainability initiatives and asked to select which initiative Allegheny participates in. For the analysis, these initiatives were classified as visible initiatives, less visible initiatives, and incorrect initiatives. "Water refill stations," "solar panels," "composting facility," and "reusable and compostable food containers" were categorized as visible initiatives. Visible initiatives are those that students engage with regularly and see on a day to day basis. "Geo-thermal heating," "low flow shower heads," "porous pavers in parking lots," "rain gardens," "locally sourced food," "energy efficient lighting," and "purchase 100% renewable energy" were categorized as less visible initiatives. Less visible initiatives are those that students do not engage with daily and are less likely to know they exist (geo-thermal and energy efficient lighting) or their function (porous pavers and rain gardens). There were three initiatives that the college does not do on our campus, "animals as lawnmowers," "incinerate trash for energy," and "own low carbon vehicles".

2.1 Data Analysis

For all questions, the percentage of individuals that selected each response was calculated. For questions that allowed respondents to select more than one answer, multiple answers per individual were tallied as separate responses and recorded. Responses to open-ended questions were coded to identify recurring themes. Quantitative data

were then generated from open-ended questions by tabulating the number of occurrences of each of those themes in the responses. A one-way ANOVA was conducted to determine if sustainability ranking varied significantly by class year, and a Student's *t*-test was conducted to determine if sustainability ranking varied significantly by major.

3 Results

Approximately 23% of the student population ($N = 440$) participated in the survey. Sixty seven percent of participants identified as female, 30% identified as male, 1% identified as nonbinary, and 2% did not include their gender. In the fall of 2019, the student body was comprised of 56% females, 44% males, and 0.5% students identifying as non-binary. The percentage of student respondents within each class year are first year 26%, second year 20%, third year 25%, fourth year 29% and fifth year 0.5%. The distribution of students across each class on campus: first year 31%, second year 23%, third year 21%, fourth year 22%, and fifth year 3%.

Environmental Science and Sustainability (ESS) majors were the most common respondents, accounting for 26% of all responses, despite making up 14% of total campus population. Other common majors include Biology (10.6%), Economics (8.9%), Global Health Studies (8.7%), and Psychology (8.2%). With the exception of Global Health Studies, these majors were among the most popular majors on campus at the time of the survey. All responses from majors outside of these five were combined into a sixth category of major, "other," making up 38% of responses. Eighty five percent of the current majors offered to students were represented in the survey responses.

For the first question, respondents were asked to rank Allegheny's sustainability on a scale from 1 to 5 (1 being "not at all sustainable" and 5 being "very sustainable"). The average ranking was a 3.8 ($SE \pm 0.03$), and the most common response was a 4/5 (57%). No student ranked the college a 1 with regards to sustainability. First year students ranked Allegheny's sustainability highest ($\bar{x} = 4.0$; $SE \pm 0.06$), while second year students had an average ranking of $\bar{x} = 3.8$; $SE \pm 0.08$. Third year students had the lowest average ranking ($\bar{x} = 3.6$; $SE \pm 0.07$) and fourth year students had an average ranking of $\bar{x} = 3.7$; $SE \pm 0.06$. A one-way Analysis of Variance test revealed that there is significant variation between class year and ranking, with first year students ranking Allegheny's sustainability significantly higher than third and fourth year students ($P = 0.0012$). ESS students ranked the college at 3.9 while Economics, Global Health Studies, and Biology majors ranked the college at 3.7. Psychology majors ranked the college a 3.5 and the "other" category of majors ranked Allegheny as a 3.8. A student's *t*-test indicated that ESS majors did not rank the college's sustainability significantly higher than all other majors.

In an open-ended question, students were asked to identify the most important sustainability effort made by Allegheny College. The most frequent responses referred to visible sustainability efforts, including reusable take out boxes (37%)

and composting (20%). Other responses included recycling (6%), carbon neutrality (6%), LEED certified buildings (5%), solar panels (4%), and unknown (5%). The most common response for ESS majors was also reusable take out boxes (24% of ESS majors) and composting (21%), while 19% of ESS student respondents identified Carbon neutrality as the most important sustainability measure. Only 1% of all other majors identified Carbon neutrality for this question. Only ESS majors identified reusable dining utensils in the dining hall, informational signage, and environmental clubs as the most important sustainability measures (Each of these responses was only mentioned once.).

In the next open-ended question, students were asked to indicate the benefit of that sustainability effort to the college. The most common response to this question was to reduce waste in general (20%) (Fig. 1). Other responses related to limiting physical waste of all kinds with answers including reducing dining/food waste (12%), limiting plastic (11%), reducing single use plastic (7%), and less landfill waste (6%) (Fig. 1). Other responses included working towards reducing fossil fuels (7%), achieving Carbon neutrality (6%), and spreading awareness (5%) (Fig. 1). There were a large number of responses to this question coded as N/A due to incoherent or off topic responses (6%) (Fig. 1). Additionally, the responses “prevents runoff”, “boosts student enjoyment”, “convenience”, and “looks good for admissions” were mentioned once each. ESS majors showed the most diversity in responses with answers covering 26 different codes. The common responses for ESS majors mirrored the common responses of the entire study, with the addition of “prevents climate change.”

An additional open-ended question asked specifically how the most important sustainability effort identified benefits the environment. Responses were similar to those for the question above despite the altered language. The most common responses were “limit landfill waste” (19%) or a general “reduce waste” (19%). Many of the most common responses to this question involved Allegheny limiting outputs, including waste, carbon and other fossil fuels, and pollution in general. Compared to the previous question, fewer responses were coded N/A for being confusing (3%). Some students indicated that we return to their answer to the last question “what is the benefit of this effort?” for their response (1%). The most common responses among ESS majors were “reduce fossil fuels” and “less landfill waste”.

The next question in the survey provided students with a list of sustainability initiatives and asked students to identify all of the initiatives that the college actually participates in. This question had 14 total options with 11 true initiatives and 3 decoys. Out of all 14 initiatives, the decoys were chosen the least frequently. Three percent of respondents selected “animals as lawnmowers,” 5% of respondents selected “incinerate trash for energy,” and 7% selected “own low carbon vehicles” (Fig. 2). Of the 11 true initiatives, “porous pavers in parking lots” (23.7%) and “purchase 100% renewable energy” (20.1%) were selected the least frequently (Fig. 2). The most commonly identified initiatives were water refill stations (93.5%) and reusable and compostable food containers (92.3%) (Fig. 2). Approximately 50% of respondents correctly identified geothermal heating as one of Allegheny’s sustainability initiatives (Fig. 2). On average, the initiatives labeled as visible were identified more

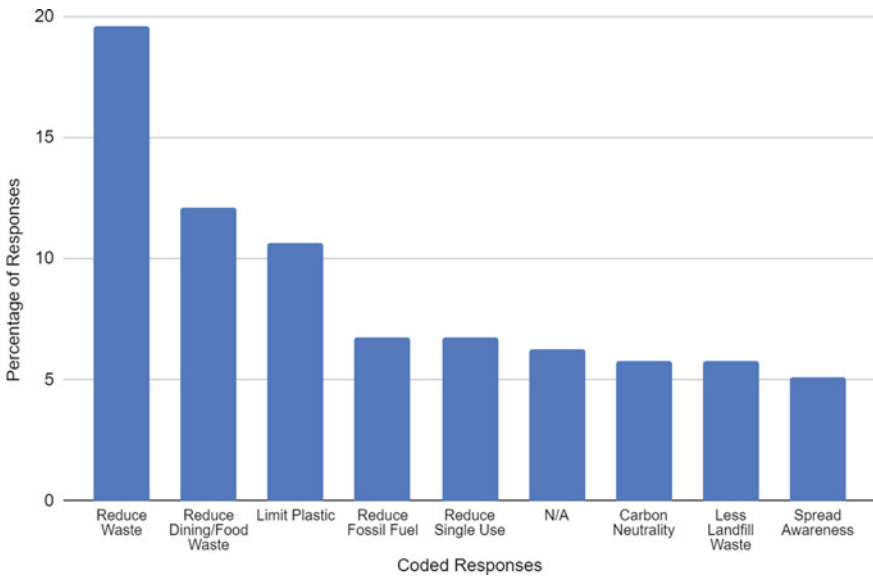


Fig. 1 The most common answer codes when students were asked to indicate the benefit of the most important sustainability effort to the college that they identified in the previous question

frequently than less visible initiatives. Locally sourced food, the third most common selection, was determined to be a less visible initiative, but was correctly identified in 82% of responses (Fig. 2). Geothermal heating was only correctly identified as one of Allegheny's initiatives in 50% of responses (Fig. 2).

Out of 414 total responses, only 13 students were completely correct. Ten of the 13 correct responses came from ESS majors. Third year students had the most correct responses (6), followed by fourth year students (5), and then by second year students (2). No first year students submitted a completely correct response.

The final question asked students what efforts they felt the college should be making towards sustainability. Nineteen percent of student responses were categorized as "Unknown" since many did not answer the question or responded N/A. The second most common answer was that Allegheny needs to have more renewable energy (9%). Over half of the students that responded to the question (55.07%) listed a sustainability effort that is already happening at the college, or suggested that the college needs to increase their commitment to efforts already being done at the college, such as obtaining more renewable energy (10%), more solar panels (7%), or reaching carbon neutrality (4%). Seven percent of responses recommended that we implement "Animals as lawnmowers", one of the decoy initiatives in the "select all that apply" question at the beginning of the survey. Three percent of students answered that we should focus on improving all current initiatives.

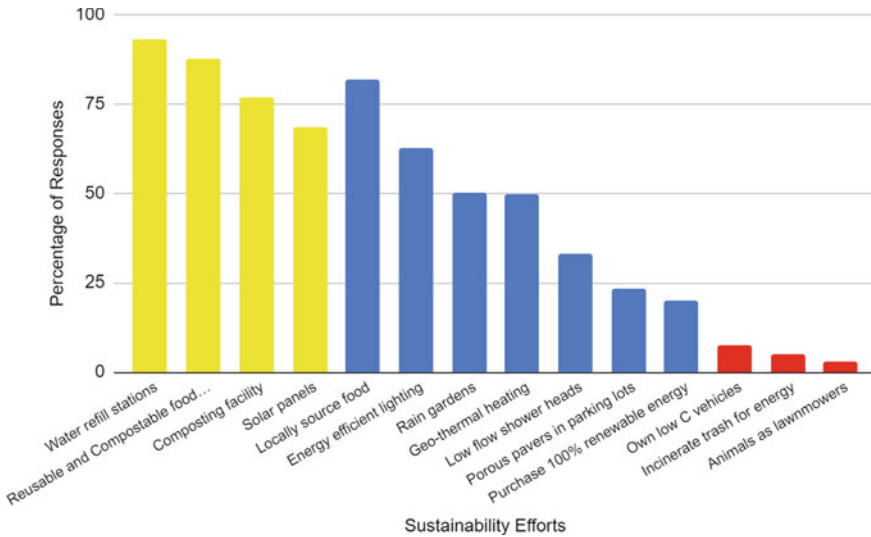


Fig. 2 This figure displays the percentage that each option was selected from a list of 14 sustainability initiatives provided. Students were asked to select all initiatives the college participates in with some initiatives being decoys, initiatives that the college does not do. The yellow initiatives are coded as visible, the blue are coded as less visible, and the red are decoys, initiatives that the college does not do

4 Discussion

Wang et al. (2013) points out that the “impacts” of sustainable campuses on students is not well known, something we must understand to further guide the preparation for students to accomplish the sustainable development goals set out by the United Nations. The results of this survey demonstrate that Allegheny College students are aware of certain sustainability efforts and their impact on the environment. However, they know far more about the sustainability efforts that they are exposed to or use on a daily basis than they do about what many would argue are the most impactful i.e. Carbon neutrality and geothermal heating and cooling.

This survey indicated not only a knowledge of campus initiatives among students, but also which students possessed a majority of that knowledge. A large number of student respondents were Environmental Science and Sustainability (ESS) majors. While this may be considered a limitation of the study, the authors were able to draw conclusions about ESS majors. Two factors likely contributed to the large number of ESS respondents. One is that this survey was marketed as a sustainability survey. Since Allegheny is a small campus, it is easy to identify which department is distributing a survey and for respondents to identify that survey with the focus of that department. Additionally, professors within the ESS department aided in distribution of the survey through their classes and some offered extra credit to students for completing the survey. This method may have unintentionally attracted a

larger proportion of ESS students than students in other popular majors. One positive outcome of this trend is that we had a large enough population of ESS students to compare their knowledge of sustainability to students on campus that are not studying sustainability as a requirement of their major.

All students ranked the college's sustainability above average. Students majoring in ESS gave the college the highest ranking, likely due to increased knowledge about campus sustainability measures being discussed in courses. Previous studies have also shown that students who take courses in environmental studies are more environmentally aware (Smith-Sebasto 1995). Additionally, these students are also more likely to seek out information about the college's sustainability practices due to their interest in the field (Lewington 2020). A positive correlation was also found between first year students and higher sustainability rankings. This is potentially due to the fact that Allegheny's sustainability efforts are so heavily advertised to incoming academic classes with admissions offering a "Green Tour" to interested prospective students.

When students were asked about the most important sustainability effort on campus, the most common responses were the green box program, composting, and water bottle refill stations. Uncoincidentally these initiatives are also the ones that are the most visible. Students from every major were able to identify at least one of these programs. Common responses by ESS majors were evenly split between green boxes, composting, and reduced carbon emissions/ESS students responded with a broader range of responses, many of which would be considered "less visible". Some of the least mentioned initiatives were the LEED certified buildings, geothermal heating, and wind energy. It was surprising that only 6 respondents mentioned the energy challenge. This is a month-long event that encourages dormitories to compete for the greatest reduction in energy usage for the month of October (Boulton et al. 2017).

The next two questions asked "what is the benefit of this effort?" and "how does this effort benefit the environment?" One limitation of the study was the large amount of overlap between the answers to these two questions. The original intent of the question "what is the benefit of this effort?" was to collect answers about the benefit of these efforts to the college, but not from an environmental view point. We anticipated the majority of the answers to focus on college operations and business, but instead received a majority of responses regarding sustainability. The emphasis of the following question, "how does this effort benefit the environment?" was the question that was designed to draw answers about environment-related benefits. Instead, both questions drew similar responses, with the most popular answer for both questions was "reduce waste (general)," accounting for 20 and 19% of the responses respectively.

When asked to identify sustainability efforts from a list, results indicate that students are more likely to correctly identify sustainability efforts that are visible to them, such as solar panels, or efforts that they frequently use, such as water refill stations or the composting facility. Certain sustainability efforts, such as geothermal heating, were only mentioned in half of the responses. Locally sourced food was classified as a "less visible initiative" but was correctly identified by a large number of respondents. This is likely the result of a very visible college garden on the campus.

While the Carr-den does provide a small percentage of food to the dining halls, this response was meant to indicate that the college's dining provider makes every effort to source food from within a 100 mile radius of the college (Sustainability n.d.).

ESS students seemed more knowledgeable about a variety of sustainability efforts, as well as their benefit to the environment. Fisher and McAdams (2015) found that coursework in higher education plays a major role in how students view sustainability; however, studies have also shown a strong connection between emotion and behavior, suggesting that creating environmental emotion in students would make them more likely to be sustainable citizens when given the option (Carmi et al. 2015). Perhaps students who chose to major in ESS come to college with strong emotions toward environmentalism and the question becomes how to evoke that in students within other majors.

This study is an important first step to understanding the role of campus sustainability in creating sustainable citizens. Universities are no longer assessed for their provision of education alone, but are also regarded for their commitment to move society forward (Nejati and Netaji 2013). As the importance of sustainability practices evolve in society, so should they in a university. Despite the fact that many of our students are aware of our sustainability efforts, the authors question if their engagement with those efforts is the result of being on a college campus that makes it extremely convenient to be environmentally friendly. Studies such as Thondhlana and Hlatshwayo (2018) and Bethurem et al. (2021) identify that students are more likely to participate in pro-environmental behavior if it is convenient to do so. The question now becomes how do sustainable institutions ensure that they are serving as learning laboratories for students to become sustainable citizens and leaders.

5 Conclusion

In order for institutions of higher learning to create the sustainability leaders of the future, they must consider how to use sustainable campuses as living laboratories. Through a survey, it was determined that Allegheny College students are aware of the sustainability efforts with which they interact on a daily basis; however, the less visible efforts such as Carbon neutrality and purchasing renewable energy are less well known. ESS students seem to be more aware of sustainability likely due to discussions within their courses, yet the aim should be to reach students majoring in all disciplines. The college must find ways to better communicate their own sustainability and ensure that all students understand the importance of efforts such as greenhouse gas and waste reduction on their future. All students graduating from Allegheny College should be prepared to become environmental change agents.

References

- Allegheny College becomes first college in Pennsylvania, Eighth in nation to achieve carbon neutrality. Allegheny College News Center. April 14, 2020
- Bethurem M, Choate B, Bramwell S (2021) Stop piling on: assessing efforts to reduce single-use water bottles at Allegheny College. *Sustainability* 13(16):8864
- Boulton K, Pallant E, Bradshaw-Wilson C, Choate B, Carbone I (2017) Energy challenges: isolating results due to behavior change. *Int J Sustain High Educ* 18(1):116–128
- Cai X, Shafiee-Jood M (2017) Review of campus sustainability programs: opportunities for education and research. Institute for Sustainability, Energy, and Environment University of Illinois at Urbana-Champaign. <https://sustainability.illinois.edu/wp-content/uploads/2018/02/Review-of-CS-programs.pdf>
- Carmi N, Arnon S, Orion N (2015) Transforming environmental knowledge into behavior: the mediating role of environmental emotions. *J Environ Educ* 46:183–201. <https://doi.org/10.1080/00958964.2015.1028517>
- Fisher PB, McAdams E (2015) Gaps in sustainability education. *Int J Sustain High Educ* 16(4):407–423. <https://doi.org/10.1108/IJSHE-08-2013-0106>
- Holthouse S (2020) Allegheny receives award for being first PA college, 8th in nation to achieve carbon neutrality. *The Campus*
- Jain S, Agarwal A, Jani V, Singhal S, Sharma P, Jalan R (2017) Assessment of carbon neutrality and sustainability in educational campuses (CaNSEC): a general framework. *Ecol Ind* 76:131–143. <https://doi.org/10.1016/j.ecolind.2017.01.012>
- Lewington J (2020) In a climate-anxious world, these colleges are training students to fight back. <https://www.macleans.ca/education/college/in-a-climate-anxious-world-these-colleges-are-training-students-to-fight-back/>. Accessed 29 Sep 2020
- Lozano R, Lukman R, Lozano FJ, Huisingh D, Lambrechts W (2013) Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. *J Clean Prod* 48:10–19. <https://doi.org/10.1016/j.jclepro.2011.10.006>
- Lozano R, Ceulemans K, Alonso-Almeida M, Huisingh D, Lozano FJ, Waas T, Lambrechts W, Lukman R, Hugé J (2015) A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey. *J Clean Prod* 108(A):1–18. <https://doi.org/10.1016/j.jclepro.2014.09.048>
- McMillin J, Dyball R (2009) Developing a whole-of-university approach to educating for sustainability: linking curriculum, research and sustainable campus operations. *J Educ Sustain Dev* 3:55–64. <https://doi.org/10.1177/097340820900300113>
- Nejati M, Nejati M (2013) Assessment of sustainable university factors from the perspective of university students. *J Clean Prod* 48:101–107. <https://doi.org/10.1016/j.jclepro.2012.09.006>
- Smith-Sebasto NJ (1995) The effects of an environmental studies course on selected variables related to environmentally responsible behavior. *J Environ Educ* 26(4):30–34. <https://doi.org/10.1080/00958964.1995.9941449>
- Sustainability (n.d.) Allegheny College Website. <https://sites.allegheny.edu/sustainability/>. Accessed 2 Nov 2021
- Thondhlana G, Hlatshwayo TN (2018) Pro-environmental behaviour in student residences at Rhodes University, South Africa. *Sustainability* 10(8):2746. <https://doi.org/10.3390/su10082746>
- Top Environmental Science Schools (n.d.) EnvironmentalScience.org. <https://www.environmentalscience.org/top-schools>. Accessed 2 Nov 2021
- UNEP (2021) Over 1,000 universities and colleges make net-zero pledges as new nature initiative is unveiled. <https://www.unep.org/news-and-stories/press-release/over-1000-universities-and-colleges-make-net-zero-pledges-new-nature>. Accessed 28 Jan 2022
- Venkataraman B (2009) Education for sustainable development. *Environ Sci Policy Sustain Dev* 51(2):8–10. <https://doi.org/10.3200/ENVT.51.2.08-10>

Wang Y, Shi H, Sun M, Huisingh D, Hansson L, Wang R (2013) Moving toward an ecologically sound society? Starting from green universities and environmental higher education. *J Clean Prod* 61:1–5

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Professor Beth Choate is Chair of the Environmental Science and Sustainability Department. She has conducted a variety of research projects, with students, related to the sustainability of campus and the local community, including reducing waste that goes into our landfills and guiding students in projects aimed at reducing campus energy consumption. In the community, much of her work has focused on the conservation of wild bee species in an urban landscape. Additionally, she is currently focused on how a green campus can be an educational tool to create green citizens.

Professor Matthew Bethurem is an Assistant Professor, who received a PhD in Environmental Science from the SUNY College of Environmental Science and Forestry, and teaches courses focusing on environmental, energy, and climate policy. His scholarship focuses on local-level climate and sustainability actions, and has involved students working on projects related to public opinion on climate issues, local climate vulnerability, and the intersection of local sustainability and social justice.