Boston College

Assessment of Undergraduate Student Attitudes and Behavior Toward Energy Efficiency at Boston College

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Abstract

Climate change continues to accelerate and higher education has a promising opportunity to help support curbing emissions by educating its student body and working to foster an energy conscious campus. The purpose of this research project is to examine how students change their environmental practices and attitudes throughout their four years at Boston College. A total of 140 students across all four years (freshmen, sophomore, junior, and senior) filled out a survey with three main types of questions: energy use, energy footprint knowledge/BC message efficacy, and energy efficiency attitudes. The results revealed that generally there was not a specific upward trend to become more energy conscious as was initially predicted. It was found to be statistically significant that freshmen had greater knowledge of their own footprint and felt that BC messaging had helped them in reducing their footprint. From the results and students input, it is recommended that the university install more motion sensored lights personal thermostats to allow for temperature adjustments. Likewise a core curriculum course should be required for all students alongside a yearly online course that is completed during freshman orientation and a follow-up refresher must be done online each year.

Introduction

Literature Review

With every IPCC report comes a more dire prediction about the harms created by fossil fuels. Energy efficiency has an increasingly important role to play in responses to climate change at both an individual and organizational level (IPCC, 2018). This highlights the need for universities to not only become more energy efficient on an organizational level (by having LEED certified buildings, for example), but also through fostering an energy conscious student body.

Universities often function as small-scale models of cities, due to populations that live and work within the bounds of the campus (Guerrieri et al. 2019). Thus, energy efficiency measures that focus on facilities being used by those populations can be significant. Filho et al. (2019) reports that college and university buildings have the most need for energy efficient improvements, and consequently, initiatives focused on buildings are most common. According to John MacDonald, BC's Energy Manager, Boston College is making significant improvements regarding its buildings. All new buildings are constructed to be LEED certified in accordance with Boston city standards (Boston Zoning Code, Article 37). Furthermore, though Filho et al. (2019) also claims many universities only source 1-20% of their electricity from renewable sources, Boston College sources 100% of its electricity from renewable resources, in a combination of renewable sourced electricity and Renewable Energy Credits (RECs). Due to these measures, Boston College is making strides toward making its infrastructure more sustainably sourced and more energy efficient. The next action toward maximizing energy efficiency is focusing on the people on campus facilitating energy consumption.

Recent studies that emphasize the need for universities to take responsibility for fostering a culture of sustainability and for supporting an energy transition (Adams et al., 2018, Guerrieri et al., 2019). A cultural shift toward sustainability begins with a change within the university itself. Adams et al. (2018) specifically emphasizes ways in which a university can approach embedding a sustainable culture. Analyzing student attitude vs. behavior discrepancies, as well as awareness is important. Additionally, recognizing that student populations are transient is a key consideration when trying to enact a cultural shift. Universities are environments with

thousands of people from all over the world, interacting with one another constantly, therefore green personal consumption patterns can have a large impact. Brounen et al. (2012) discusses how personal consumption patterns, specifically household energy use, are crucial components of lowering carbon emissions and therefore energy-saving behavior should be promoted.

One issue that poses a challenge for energy cultural shifts, highlighted by Emeakaroha et al. (2012) is the invisibility of energy. Students in on-campus residence halls, especially, do not see where their energy goes, how much it costs, or the ways in which their choices affect energy consumption at Boston College. This invisibility was voiced by a senior who wrote, "i think a lot of times my roommates/friends and i have found ourselves not caring as much about energy efficiency on campus because we don't pay the bills for energy." Contributing to that sentiment is the fact that individuals in the United States have a low level of energy literacy, which includes cognitive, affective, and behavioral characteristics. Energy literacy is what allows citizens to make appropriate decisions regarding energy use. Compared to other countries such as Taiwan, Denmark, and New Zealand, the United States is much lower (Martins et al., 2020). Higher education is a place of constant learning, making it a key location for more education regarding energy efficiency which can contribute to shifting behaviors.

While almost all individuals are aware of climate change and want to do something about it, many lack sufficient understanding on how to make environmentally friendly choices (Lorenzoni et al., 2007). Often people are not aware of how much energy it takes to have an air conditioned house or a longer shower. The government and schools should have this be a focus so that people can lower their own footprints. Online intervention programs have proven to be a successful platform for educating professors on how to reduce their footprint by changing their everyday energy consumption behavior (Kastner and Matthies, 2014). This shows the potential to expand web-based energy efficient informational platforms to students. That being said, currently energy education for sustainability has been slow to develop, but there is still strong potential for universities to influence students' energy saving behavior, highlighting the need to act now (Cotton, 2016).

Study Aims

To begin this project, we wanted to analyze energy efficiency at Boston College. Initially, we were drawn to research questions involving new buildings like the Margot Connell Recreation Center, or the feasibility of retrofitting old buildings such as Gasson Hall. We reached out to John MacDonald, BC's Energy Manager, and Bruce Dixon, BC's Sustainability and Energy Specialist. During a meeting, they expressed pride and satisfaction with the current measures in place to improve the campus's energy efficiency. They expressed more concern with the most volatile variable: people. Boston College can put energy saving measures in place, but ultimately, it is up to students and staff—who live in and utilize campus buildings—to maximize those measures. Bruce and John hypothesized that as students move through their four years on campus, they become more energy-minded. Thus, freshmen come in and a new population has to learn about campus energy efficiency measures, restarting a cycle of efficiency habit development. Curious about Bruce and John's inquiries, we turned our research questions in this direction. The current study aims to tackle the following questions:

1) How do perceptions and actions amongst the student body regarding energy efficiency differ as students progress through their four years of undergraduate education at BC?
2) How important is energy efficiency to students?
3) How educated are students on their own energy footprint?
4) To what extent do BC's energy conservation campaigns directed toward students have an influence?

Methods

In order to evaluate student energy consumption habits, attitudes, and knowledge, we conducted an online survey using Qualtrics. This survey aimed to anonymously collect quantitative and qualitative data from participants. Because the survey collects personal information, an IRB proposal was formulated and submitted to the Boston College IRB. Approval was received after edits were made based on prior submission feedback, and we were able to distribute the survey.

Participants were Boston College undergraduate students from all grade levels, classes of 2023, 2022, 2021, and 2020. 66% were female, 34% were male. Participants were recruited via social media posts on Facebook and GroupMe, as well as outreach to professors who then

forwarded the survey to their students. Participants expressed consent to the study by answering "Yes" to the description and consent request that appeared on the initial page. The survey opened April 6, 2020 and closed April 24, 2020. We received a total of 177 responses, but after excluding 35 incomplete responses, 142 were available for analysis.

The survey consists of four sections. Section 1 includes the consent page, then collects demographic information about the students. Section 2 examines students' energy use; Section 3 asks questions pertaining to students' knowledge of their energy footprint, as well as how well Boston College messaging reaches students; the Section 4 questions collect information about students' attitudes toward energy efficiency. The survey contained a mix of multiple choice, fill-in-the-blank, a sliding scale with values 0-10, and 3- and 5-point Likert Scale questions (see Appendix A for full survey). The answer options were coded during analysis to reflect a score, which is further elaborated in the 'Results' section of this paper. The fill in the blank questions were used for qualitative data, to gain a better understanding of students' thoughts and reasons for their responses.

Results

Survey Section 2: Energy Use Questions

The data for this section was analyzed using Excel. There were five questions ranging on a 1 to 5 scale. Each question had 5 answer options which were assigned numerical values of 1 to 5. One consuming the most energy and 5 consuming the least energy. The questions were as follows: The shower portion of the data refers to the question 'On average, how long are your showers?'. The brackets participants could choose from were 20+ minutes, 16-20 minutes, 11-15 minutes, 6-10 minutes, and 1-5 minutes. The laundry portion of the data refers to the question 'How many times a month do you do laundry?'. The brackets participants could choose from were 4+, 3, 2, 1, and 0. The heating and cooling portion of the data refers to the survey questions 'How many months during the academic year (September-May) do you use air conditioning in your dorm/residence?' and 'How many months during the academic year (September-May) do you use heat in your dorm/residence?'. The brackets participants could choose from were 4+, 3, 2, 1, and 0. The transport portion of the data refers to the question 'What mode of transportation

do you use most often to get somewhere off campus?'. The options for this section were personal car, Uber, public transportation, biking, and walking.

There were seven questions on regular energy saving actions. These all had three answer options. The options for participants to choose from were, not regularly, regularly, and very regularly. These were assigned numerical values of 1 to 3 respectively. The higher the score the more energy saved and the lower the score the less energy consumed. The questions were as follows:

- Turn lights off when leaving my dorm room
- Unplug electronic devices and appliances when not in use
- Keep the thermostat below 70F when it is cold outside
- Keep the thermostat above 70F when it is hot outside
- the stairs over the elevator
- Leave windows closed when it is cold outside
- Use windows/natural air flow over AC when it is hot outside

Figure 1 below shows energy use ranking vs. year for the first five questions of this section.

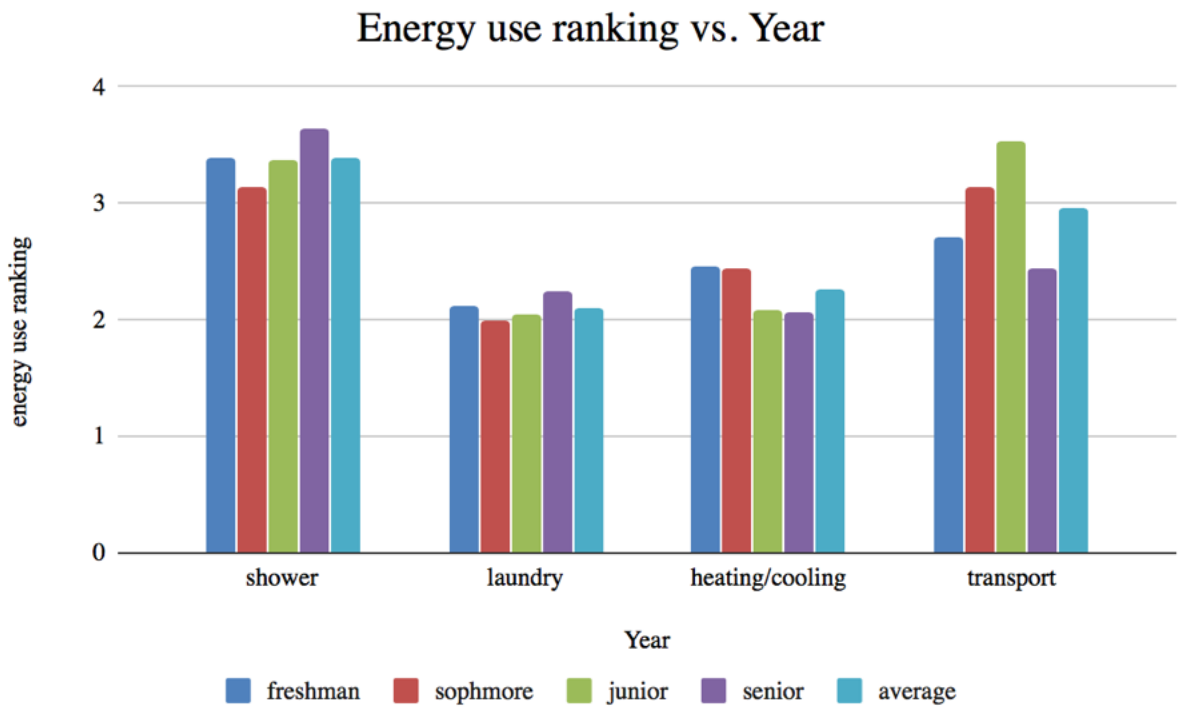


Figure1: Energy use ranking vs. year

For length of shower, as seen in *Figure 1*, the Freshman class had an average of 3.39, Sophomore class had an average of 3.13, Junior class had an average of 3.37, and Senior class had an average of 3.64. The average of all participants came in at 3.38. The data is displayed in *Figure 1* and shows that the Senior class is way above the average. The other classes are around or below average.

For laundry, the Freshman class had an average of 2.11, Sophomore class had an average of 2.00, Junior class had an average of 2.05, and Senior class had an average of 2.24. The average of all participants came in at 2.1. The data is displayed in *Figure 1* and shows that the senior class is above average. The freshman class is also above average while the other two classes are noticeably below average.

For heating/cooling, the Freshman class recorded an average of 2.45, the Sophomore class an average of 2.44, the Junior class an average of 2.08, and the Senior class an average of

2.26. The data displayed in *Figure 1* shows freshman and sophomore are significantly above the average, while juniors and seniors are significantly below the average.

For transport, the Freshman class had an average of 2.71, the Sophomore class had an average of 3.13, the Junior class had an average of 3.53, and the Senior class had an average of 2.44. The average of all the data was 2.95. The data displayed in *Figure 1* shows that freshman and senior classes were below average, the sophomore class was slightly above average, and the Junior class was well above the average.

Figure 2, Figure 3, and Table 1 display each class' energy saving habits, and how regularly they are implemented. *Figure 2* displays Freshman averaging 2.02, Sophomore class averaging 1.85, Junior class averaging 2.04, and Senior class averaging 1.98. The average of all data was 1.97. This shows that Freshman and Junior classes are above average when it comes to saving energy habits, Sophomore class is below average, and Senior class is about average. *Figure 3* displays each specific energy saving action mentioned above. *Table 1* outlines the data displayed in *Figure 3*.

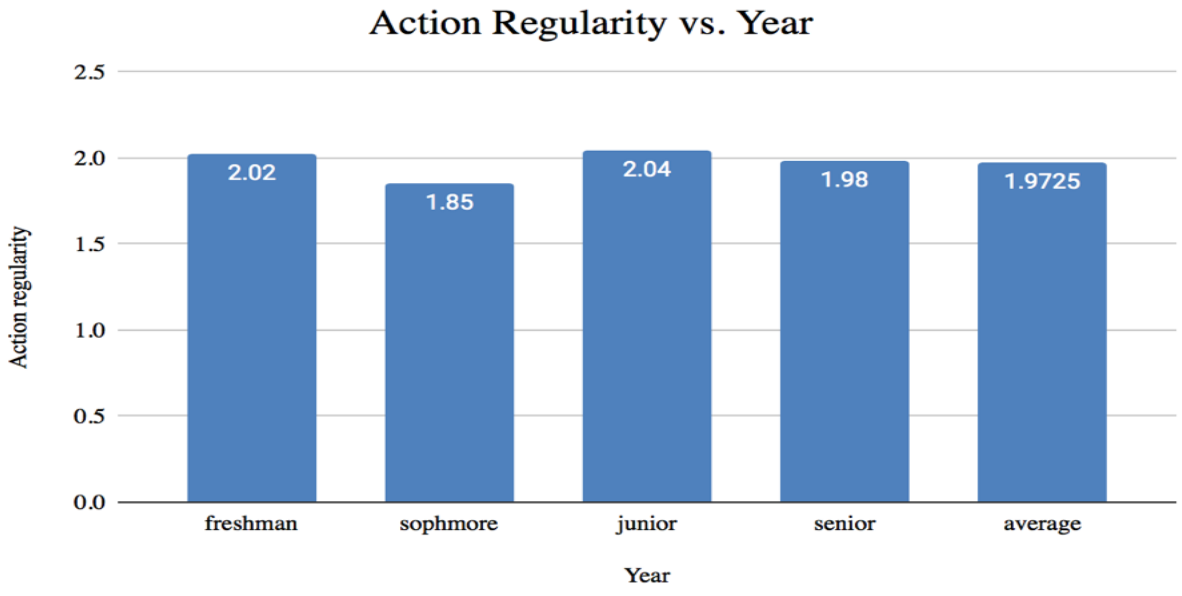


Figure 2: Action Regularity vs. Year

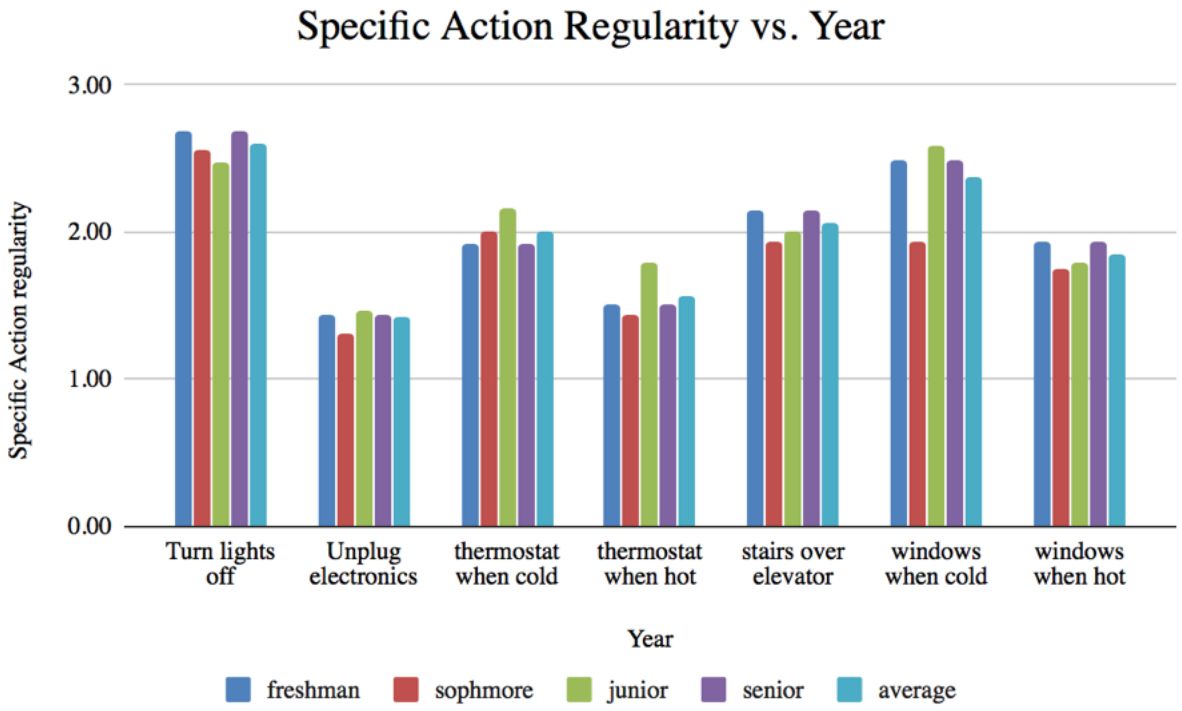


Table 3: Specific Action Regularity vs. Year

	Freshman	Sophomore	Junior	Senior	Average
Turn lights off when leaving my dorm room	2.68	2.56	2.47	2.68	2.60
Unplug electronic devices and appliances when not in use	1.44	1.31	1.47	1.44	1.42
Keep the thermostat below 70F when it is cold outside	1.92	2.00	2.16	1.92	2.00
Keep the thermostat above 70F when it is hot outside	1.51	1.44	1.79	1.51	1.56
the stairs over the elevator	2.15	1.94	2.00	2.15	2.06
Leave windows closed when it is cold outside	2.49	1.94	2.58	2.49	2.38
Use windows/natural air flow over AC when it is hot outside	1.94	1.75	1.79	1.94	1.86

Table 1: Specific Action Regularity

Survey Section 3 Results: Energy Footprint Knowledge and BC Messaging Efficacy

Analysis

Survey results for Section 3 were analyzed using Excel and IBM SPSS Statistics version 24.0. The first three questions were a scale rating from 0-10, with higher ratings being indicative of more knowledge or awareness, and lower ratings showing less knowledge or awareness. The next three questions were translated into numerical scores: "No" = 1, "I'm not sure" = 2, "Yes" = 3. Answers for each participant were summed, and these scores were averaged depending on graduation year. Additionally, multivariate analyses and independent t-tests were conducted on SPSS to compare the averages between freshmen and seniors.

Section 3

Figure 4 shows the average cumulative scores for each class. Freshmen showed the highest average score at 21, sophomores showed an average of 16, juniors showed an average of 18, and seniors showed an average of 17.

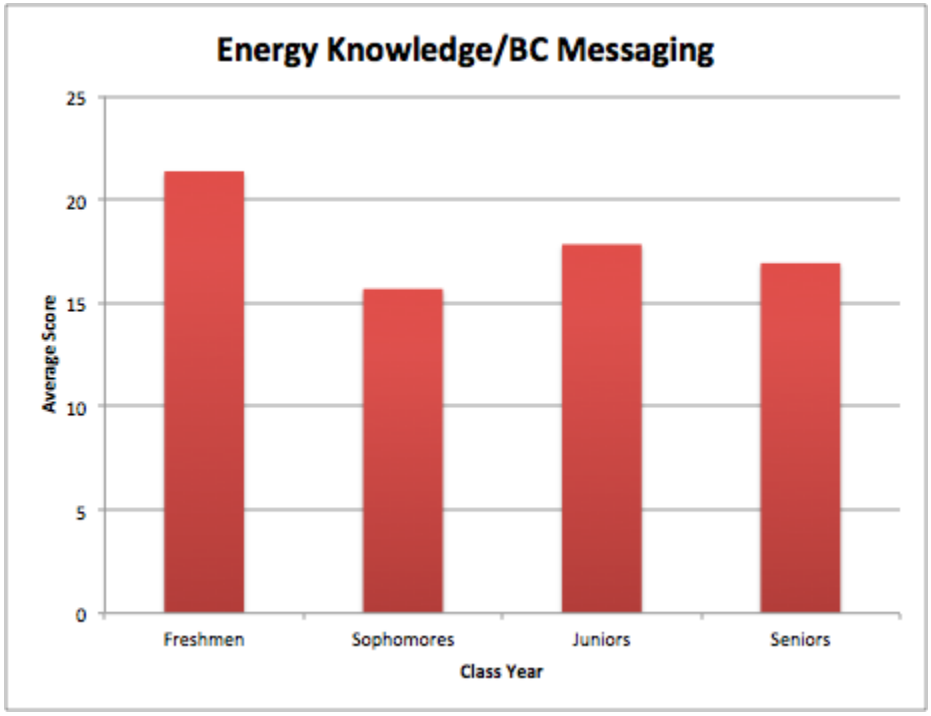


Figure 4: Student's energy footprint knowledge and perspective on BC energy messaging efficacy

An independent, two-tailed t-test showed the difference between freshmen and senior averages is significant (where $\alpha = 0.025$, $t_{105} = 3.548$, $p < 0.025$).

Self Rating Questions

The first three questions of Section 3 asked participants to rate their responses on a 0-10 scale. Across all classes, students rated the effects of Boston College energy efficiency messaging efforts on their own energy habits at 3.981. Students rated their knowledge of their own energy footprint at 5.348. Students rated the effect of their overall education at Boston College on their general energy efficiency knowledge at 3.521. Averages by class are shown in *Figure 5*. Freshmen consistently have higher ratings than the other classes.

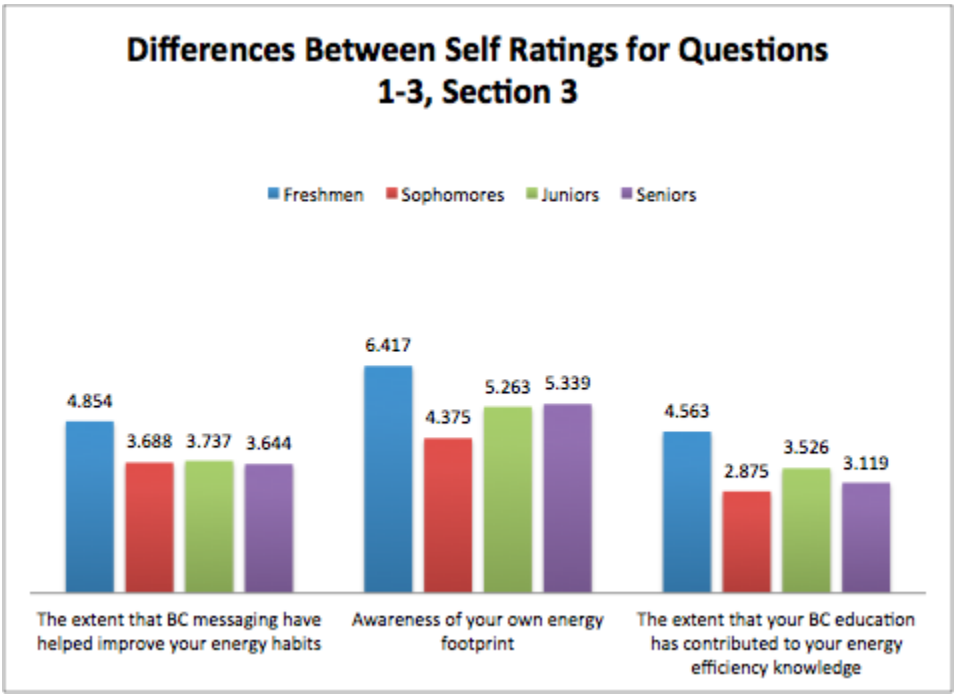


Figure 5: Class average for self-rating questions 1-3, in Section 3 of the survey.

An independent, two-tailed t-test was run for each of these three questions to assess the significance between the means of freshmen and senior ratings. The first two resulted in significance at $\alpha = 0.025$, equal variances assumed ($t_{102} = 2.295$, $p < 0.025$, $t_{104} = 2.490$, $p < 0.025$, respectively). The difference of means for the third question approaches significance, at $t_{95} = 2.219$, $p = 0.029$, but does not reach $p < 0.025$. (See Appendix B)

Boston College Energy Efficiency Education Efforts

The next part of Section 3 asked participants to answer "Yes," "No," or "I'm not sure" to three questions that elaborate further on the efficacy of Boston College's efforts to inform students about energy efficiency.

Do you consider BC to be an energy efficient campus?

When students were asked if they consider Boston College to be an energy efficient campus, the plurality answer of the freshmen and sophomore class were "I'm not sure", while the plurality answer of the juniors and seniors were "No." (See *Figure 6*)

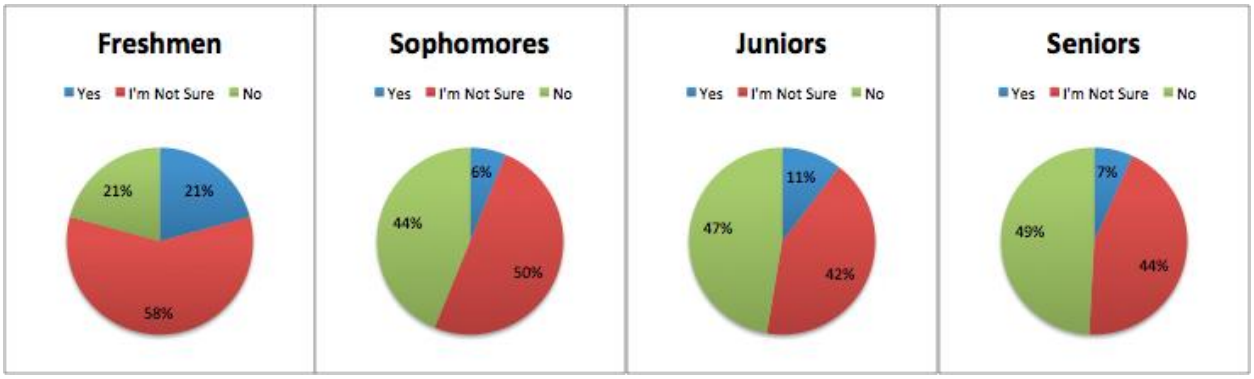


*Figure 6: Results by class to the question "*Do you consider BC to be an energy efficient campus?*"*

If you had a question about energy use at Boston College, do you know what university resources are accessible to you?

For the inquiry regarding whether or not students know how to access resources on campus to pursue questions about energy at Boston College, the majority of every class answered "No." 8% of both freshmen and senior participants answered "Yes." 19% of sophomore participants and 0% of junior participants answered "Yes." (See *Figure 7*)

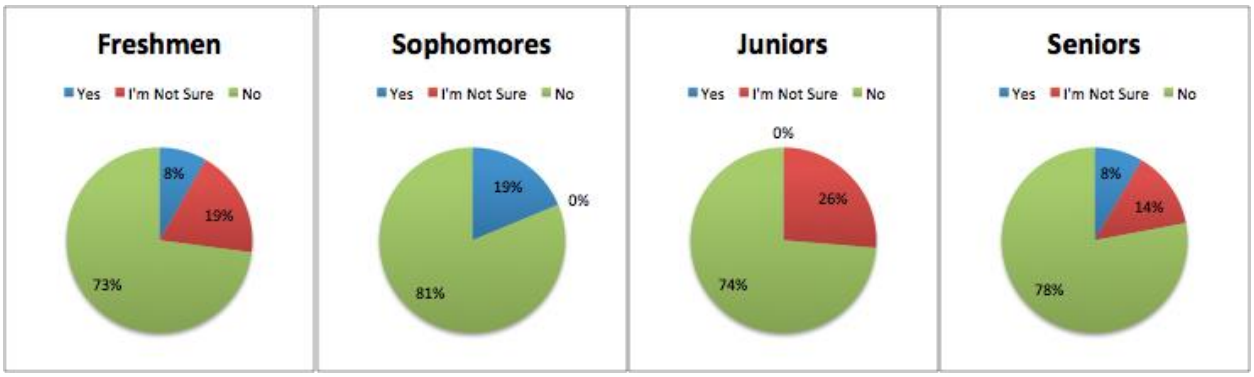


*Figure 7: Results by class to the question "*If you had a question about energy use at Boston College, do you know what university resources are accessible to you?*"*

Have you discussed energy efficiency and/or energy conservation in any of your classes, clubs, or residence hall meetings?

The last question in Section 3 asked if energy efficiency or energy conservation has been discussed in various campus settings. A majority of freshmen participants (58%) answered "Yes" while 41% of senior participants answered "Yes." (See *Figure 8*)

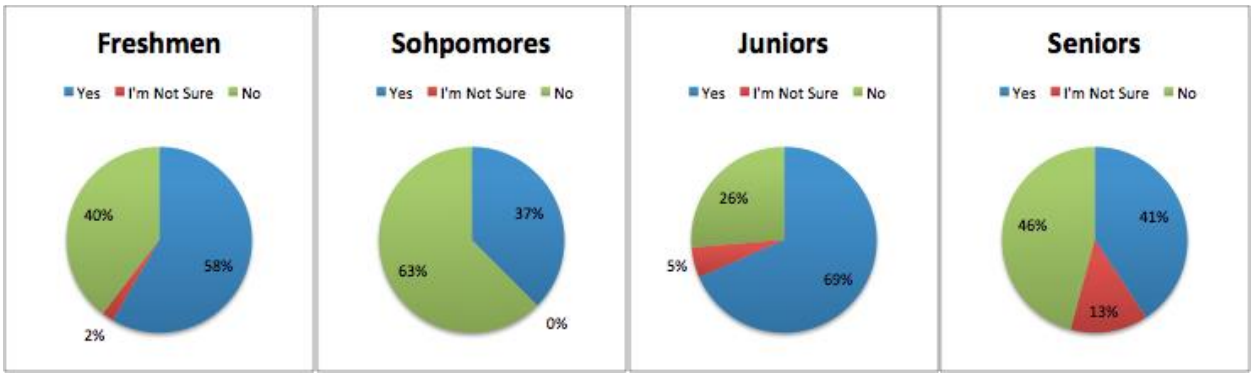


*Figure 8: Results by class to the question "*Have you discussed energy efficiency and/or energy conservation in any of your classes, clubs, or residence hall meetings?*"*

Overall

Total scores and class distribution of these scores are illustrated in *Figure 9*.

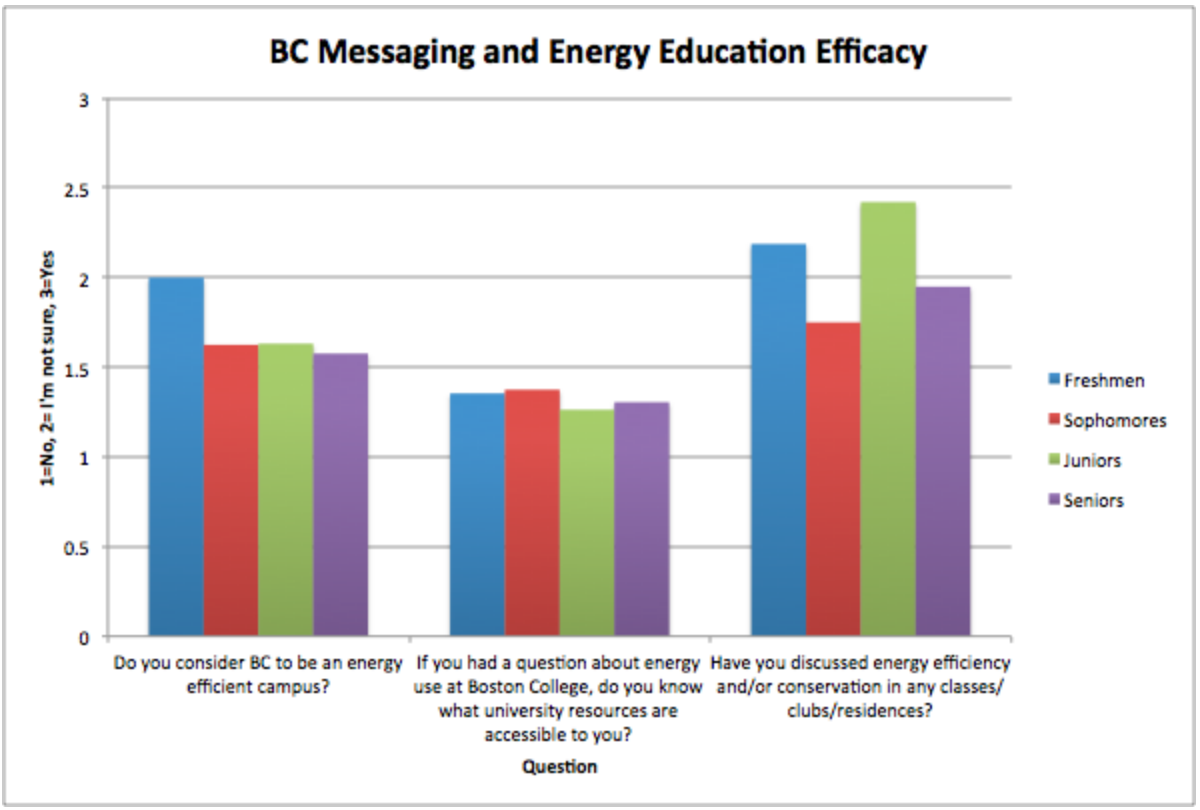


Figure 9: Average scores per question, per class for the latter three questions of Section 3

Survey Section 4 Results: Energy Efficiency Attitudes

Analysis

Survey results for Section 4 were analyzed using Excel and IBM SPSS Statistics version 24.0. There were five statements on a five point scale ranging from strongly disagree to strongly agree. These statements were translated to numerical scores. For the first four statements, strongly disagree was given a score of 5 and strongly agree was given a score of 1. For the final question strongly disagree was given the score of 1 and strongly agree was given the score of 5. The higher ratings related to more positive energy conservation attitudes and the lower ratings showing more negative energy conservation attitudes. The scores for each class year were averaged and then compared. Additionally, multivariate analyses and independent t-tests were conducted on SPSS to compare the averages between freshmen and seniors for each statement.

Section 4

Figure 10 shows the average scores for each class. All four years had similar attitudes, with only slight differences. Freshmen averaged 3.62, Sophomores were a bit lower at 3.45, Juniors had an average of 3.43 and Seniors had an average of 3.56. *Figure 11* shows the averages for each individual question for each class. *Table 2* lists the percentages for each answer for all the statements each statement.

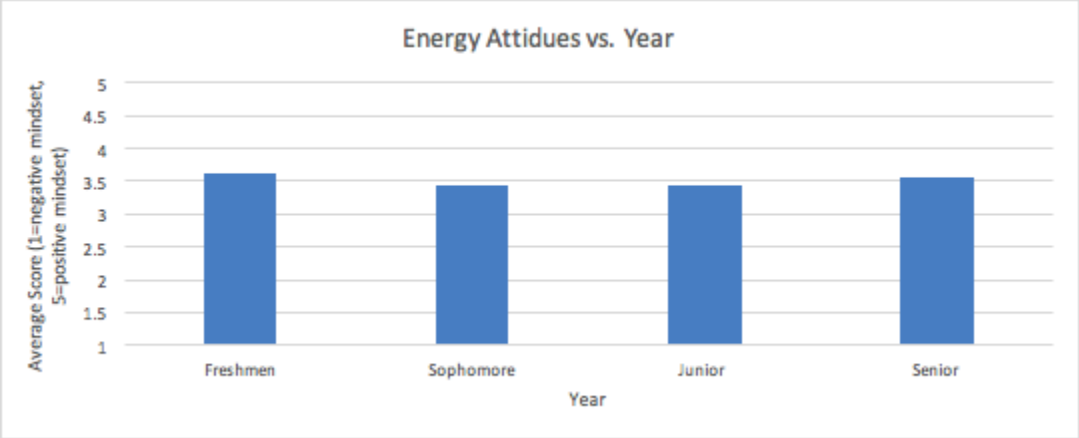


Figure 10 Average Score for Energy Attitudes by Year

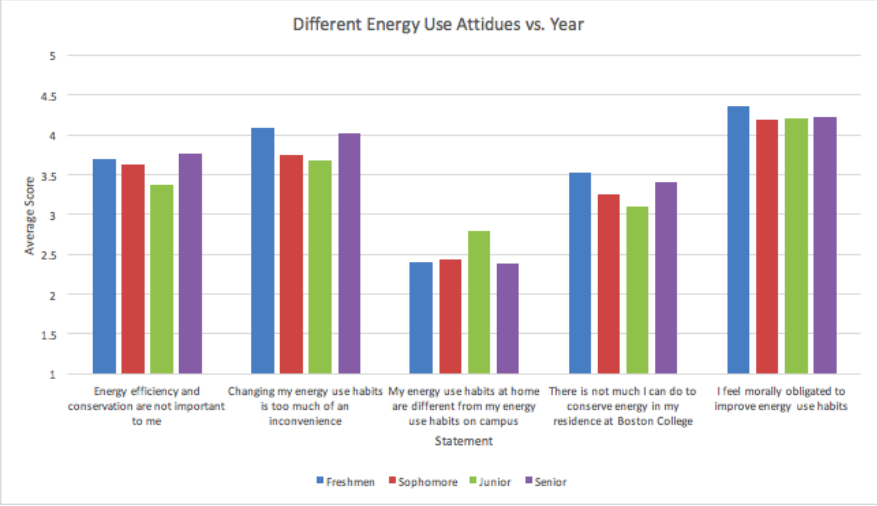


Figure 11 Numerical Results of 5 Attitude Statements

Statement #	1	2	3	4		5
Freshman						
Strongly disagree	40%	36%	3%	18%	Strongly agree	45%
Somewhat disagree	28%	30%	45%	38%	Somewhat agree	47%
Neither agree nor disagree	6%	7%	10%	9%	Neither agree nor disagree	9%
Somewhat agree	13%	14%	21%	18%	Somewhat disagree	0%
Strongly agree	13%	14%	21%	18%	Strongly disagree	0%
Sophomore						
Strongly disagree	31%	19%	13%	14%	Strongly agree	38%
Somewhat disagree	25%	25%	27%	29%	Somewhat agree	50%
Neither agree nor disagree	19%	31%	7%	14%	Neither agree nor disagree	6%
Somewhat agree	25%	25%	27%	29%	Somewhat disagree	6%
Strongly agree	0%	0%	27%	14%	Strongly disagree	0%
Junior						
Strongly disagree	37%	26%	11%	11%	Strongly agree	47%
Somewhat disagree	21%	32%	21%	32%	Somewhat agree	37%
Neither agree nor disagree	5%	32%	16%	26%	Neither agree nor disagree	11%
Somewhat agree	16%	5%	42%	21%	Somewhat disagree	0%
Strongly agree	21%	5%	11%	11%	Strongly disagree	5%
Senior						
Strongly disagree	40%	30%	0%	11%	Strongly agree	39%
Somewhat disagree	33%	49%	18%	46%	Somewhat agree	53%
Neither agree nor disagree	2%	14%	18%	19%	Neither agree nor disagree	4%
Somewhat agree	12%	7%	51%	23%	Somewhat disagree	4%
Strongly agree	12%	0%	14%	2%	Strongly disagree	2%

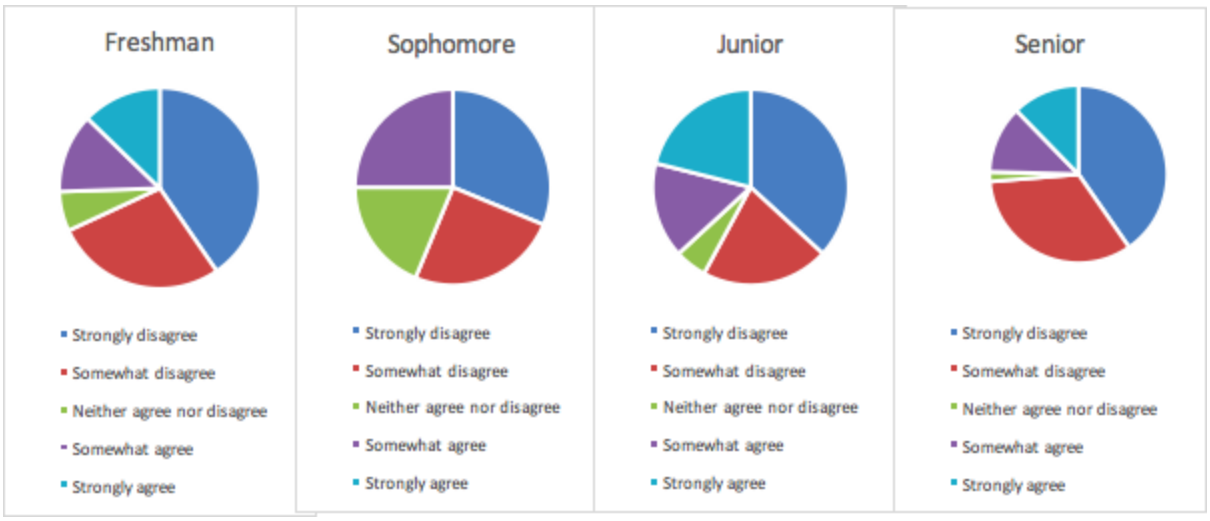
Table 2. Percentaaes for each of the five statements.

Individual Attitude Statements

In this part of the survey students were asked to choose between a scale of five choices ranging from strongly disagree to strongly agree for the following statements.

Statement #1: Energy efficiency and conservation are not important to me.

When students were asked if energy efficiency and conservation are not important to them the majority said strongly disagree. Freshmen and seniors were particularly similar, with 40% of both claiming strongly disagree and only 26% and 24% respectively saying somewhat agree and strongly agree (See *Table 2* and *Figure 12*).



Statement #2: Changing my energy use habits is too much of an inconvenience.

The majority of freshmen and seniors either strongly disagreed or somewhat disagreed with this statement saying changing energy habits is not inconvenient (68% and 73% respectively). A large portion of both sophomores (31%) and juniors (32%) neither agree nor disagree (*see Table 2 and Figure 13).*

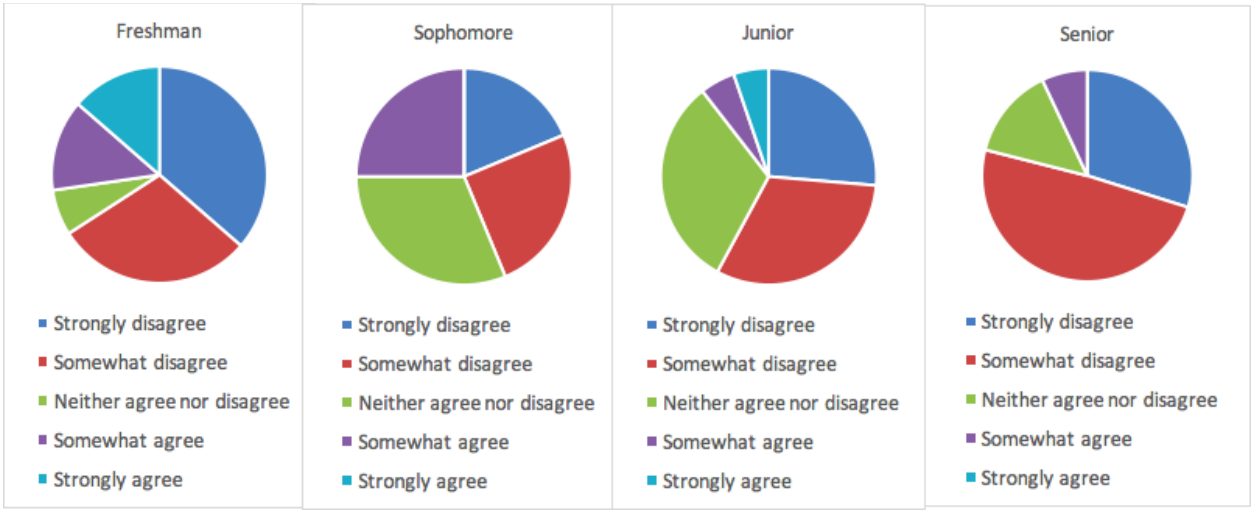


Figure 13. Results by class for the statement, "Changing my energy use habits is too much of an inconvenience"

Statement #3: My energy use habits at home are different from my energy use habits on campus.

In response to the statement about having different energy habits at home and at school, freshmen and seniors differed, with freshmen mostly somewhat disagreeing (45%) and seniors

mostly somewhat agreeing (51%). Similar to seniors, juniors also tended to mostly somewhat agree (42%) while sophomores were fairly equal among the groups (See *Table 2* and *Figure 14)*.

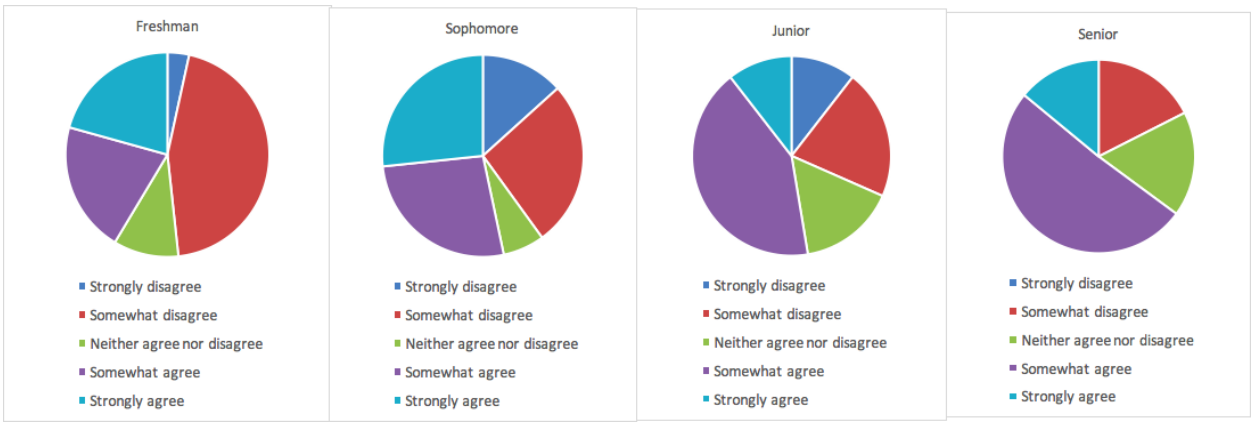


Figure 14. Results by class for the statement, "My energy use habits at home are different from my

Statement #4: There is not much I can do to conserve energy in my residence at Boston College.

Across all four years, the most common response to not feeling that they can conserve energy in their dorm was somewhat disagree. Freshmen and seniors were the two largest groups with that response with 38% and 46% respectively (see *Table 2* and *Figure 15).*

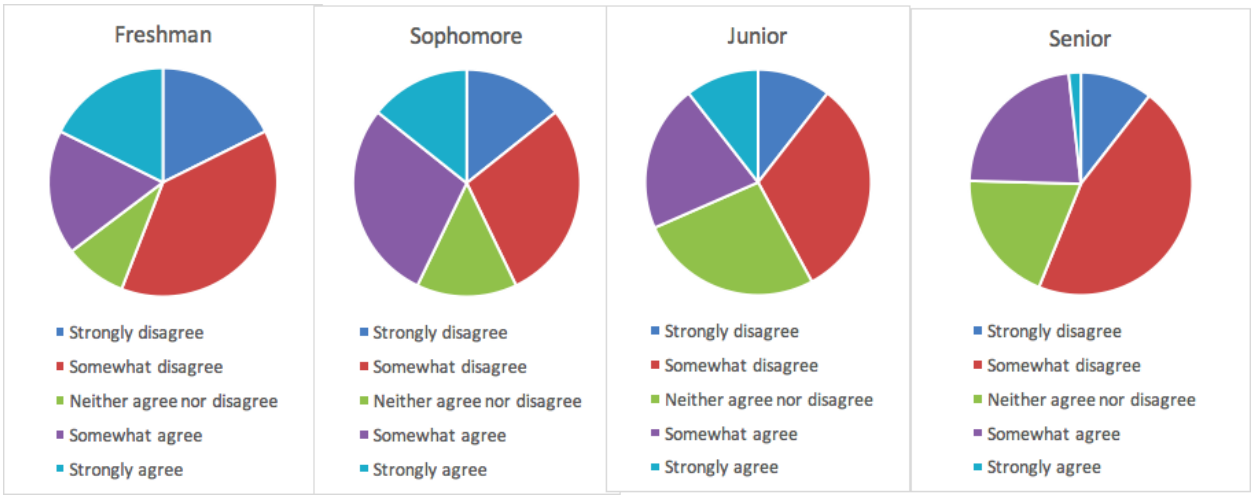


Figure 15. Results by class for the statement, "There is not much I can do to conserve energy in my residence at Boston College"

Statement #5: I feel morally obligated to improve my energy use habits.

Across all four years, individuals overwhelmingly selected strongly agree or somewhat agree. 92% of freshmen and seniors selected one of these two options. Sophomores and juniors were a bit lower with 88% and 84% respectively *(see Table 2 and Figure 16).*

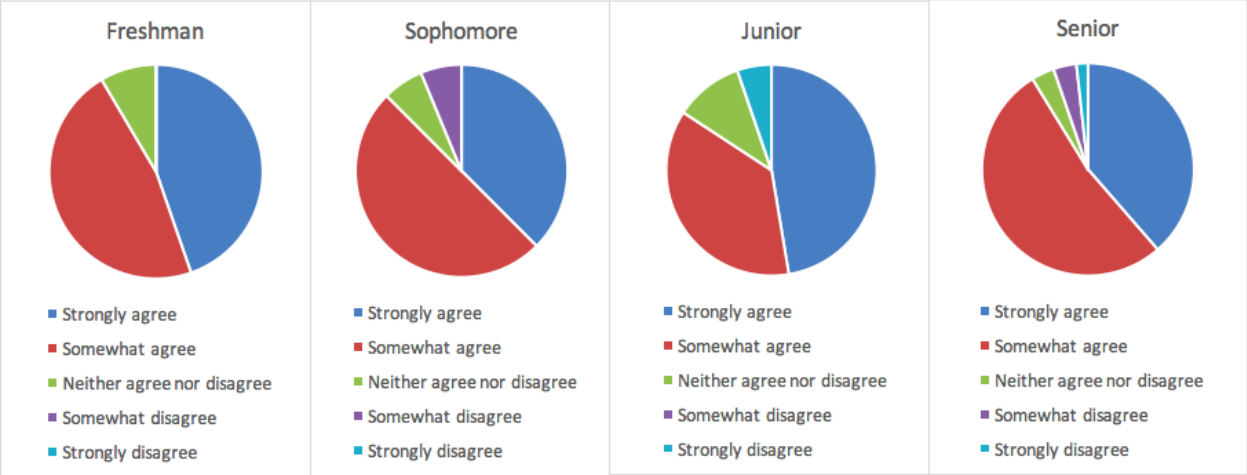


Figure 16. Results by class for the statement, "I feel morally obligated to improve my energy use habits"

An independent, two-tailed t-test was run for each statement to assess the significance between the means of freshmen and senior ratings. None of the statements resulted in significance at $\alpha = 0.025$, equal variances assumed ($t_{102} = -.248$, $p=.805$, $t_{102} = .391$, $p=.697$, $t_{102}= .097$, $p=.923$, $t_{102}= .641$, $p=.523$, $t_{102}= .908$, $p=.366$ respectively).

Discussion

Section 2

Section 2 of the data was geared towards energy saving and energy consumption. This section addresses the questions 'How do perceptions and actions amongst the student body regarding energy efficiency differ as students progress through their four years of undergraduate education at BC?' and 'How important is energy efficiency to students?'.

The energy consumption data from *Figure 1* shows that on average there is no consistent pattern. For the length of shower and number of times laundry was done, seniors topped the list. This shows that, on average, seniors take the least amount of time showering, and do laundry the least each month. Both data have a similar pattern. Starting off with the Freshman class as the second highest, decreasing to the sophomore class before increasing to the Junior then Senior class.

Heating/ cooling saw Freshman and Sophomore equally above average, while Junior and Senior were equally below average. This shows that Freshman and Sophomore classes use

heating and cooling more than Junior and Senior classes. This can be due to the fact that some freshman and sophomore dorms do not have control of heating and cooling systems, whereas the Junior class is mostly off campus. This class, for the most part, has complete control over heating and cooling of off campus houses. Therefore, this class will freely use these systems to be as comfortable as possible. Also, senior dorms have control of heating and cooling systems. The senior class is therefore able to adjust the thermostat in rooms to comfort. Therefore, it is no surprise that freshman and sophomore classes use less energy than junior and senior classes with respect to this particular aspect.

The last portion of energy consumption is transport. From *Figure 1* we see there is a trend upwards from freshman class to junior class, then a sharp decline with the senior class. This shows that seniors use the most energy with respect to transport and the junior class uses the least energy. Senior class averaged a 2.44 and the Junior class averaged a 3.53. The freshman class averaged a 2.71, which scores the class between Uber and public transportation as modes of transportation. The score is skewed towards public transportation which makes sense as 40% of Boston College freshman live on Newton Campus. Therefore, they take the BC buses to get to and from their dorms. This method of transportation, we assume, is classified as public transportation in the applicants eyes. Next, the sophomore class scored an average of 3.13. This class used less energy than the freshman class. This is because of the dorm location. Greycliff and 2K are both sophomore dorms and are off of BC's main campus. Therefore, commuting to and from classes, to see friends on campus, to see friends off campus, go to the gym, and other activities will all be within walking or riding distance. Hence, the higher average of the sophomore to Freshman class. The Junior class has the lowest energy consumption in the transportation section with an average of 3.53. This is due to the fact that most juniors live in off campus housing which is in walking distance to other students and campus. Therefore, all of their commuting will be walking. This is the same as sophomores, but the average is a lot higher because sophomores take more public transport in the form of BC buses. These buses have stops outside of sophomore off campus housing (Greycliff and 2K), while not all Junior off campus housing have easy access to these bus stops. Lastly, the senior class had the worst score for this section averaging 2.44. This shows that seniors use the most energy on transportation. This is due to the fact that by this time, most of the senior class is 21. Therefore, one to three times a week many senior students will be traveling to Boston via Ubers to enjoy the nightlife. Also,

many seniors would have personal cars on campus and readily take more trips than underclassmen. Therefore, the spike in energy consumption is not surprising.

The energy saving habits data indicated in *Figure 2* and *Table 1*, was surprising. This data was ranked on a scale from 1 to 3, with 3 being more energy saved and 1 being less energy saved. The classes ranked in ascending order from least energy saved to most energy saved are: sophomore, Senior, Freshman, Junior. The sophomore class was significantly lower than the other three classes. This was surprising. The drop off in energy saving practices from freshman to sophomore year is unprecedented. The uptick to Junior year makes sense. Due to off campus living, tenants can see the actual cost of their energy consumption. Therefore, this will drive them to be more energy conscious. This consciousness carries over to senior class. There is a slight decrease from Junior class (2.04) to senior class (1.98). Another surprising aspect is the senior class is less energy conscious than the freshman class.

These results indicate that overall there is no class that is clearly using less energy. Therefore, there is no clear class that is more energy efficient. The energy consumption data in *Figure 1,* shows that Freshman are the most energy efficient class with the highest cumulative scores. This can be due to the rising concerns of climate change. Due to these concerns incoming freshmen may have a more environmentally conscious attitude toward energy use. In the energy conserving portion, the Junior class scored the highest with freshman class coming in second as seen in *FIgure 2.* This was mentioned earlier and could be due to circumstance. Because of the large number of Junior living off campus, they see monthly utility bills and understand how much their energy use costs. This is different from the other three classes. They also more readily walk to campus due to their living situation.

Section 3

Section 3 of this survey homed in on two aspects of our research questions: student's awareness of their own energy footprint, and the influence of Boston College's messaging campaigns and educational resources on student's perceptions of energy efficiency on campus. It is important to note that the sample sizes of sophomores and juniors for this survey were each less than 20 participants (16 and 19 responses, respectively), while freshmen and seniors produced 48 and 59 responses, respectively. Thus, the focus of the results is on the differences between freshmen and seniors. We believe this is still an important representation of the

difference in attitudes across classes, as the oldest and youngest populations on campus are being analyzed.

The results of this section suggest that, contrary to the views of Bruce Dixon and John MacDonald, freshmen participants pick up on Boston College messaging efforts and are more knowledgeable about energy use than senior participants. The highest score possible for this section is 39. Freshmen had the highest average score at 21, the highest maximum score at 36, and the highest minimum score at 7. Senior participants had an average score of 17, a maximum score of 29, and a minimum score of 5.

For the self-rating questions, freshmen participants consistently had higher scores. Additionally, this class had the most answers equaling a rating of 10, while seniors only had one participant give an answer of 10 in any of the three questions. Results indicate that freshmen may have a better understanding of their own energy footprints, and a trend toward being more cognizant about various messaging efforts put in place by Boston College.

The next set of three questions showed a relatively more even distribution of responses. When asked if students considered BC to be an energy efficient campus, freshmen participants showed a statistically significant difference in response when compared to senior participants (see Appendix B). This was not the case for the next two questions, asking about university resources and on campus discussions about energy efficiency. The latter two questions showed a more evenly distributed average throughout the four classes. These results suggest that many students within the undergraduate population at Boston College are not aware of resources available to them, since most answers were either “No” or “I’m not sure.” Resources include contact information of people on campus who can answer energy related questions, such as Bruce Dixon and John MacDonald, as well as web resources that contain information about energy and sustainability, and access to clubs such as EcoPledge and Climate Justice. The Boston College Office of Sustainability has both a website and a physical office location, however, these are not common knowledge to the average student. The survey suggests that these resources are not very accessible to students, as illustrated by written responses containing phrases such as “not sure,” “I think there is an office somewhere,” and several “have not heard of”/ “was never told.” Responses such as these are present in all four class year groups.

The results for this section, especially the third self rating question, may be skewed due to a significant portion of freshmen participant recruitment coming from a core course titled

"Global Implications of Climate Change." However, a number of factors may also contribute to freshmen having higher scores. The first may be that climate change has become a topic that is increasingly in the public eye. Since 2016, the Trump administration has repeatedly been in the news with countless environmental rollbacks and controversial moves like pulling the United States out of the Paris Agreement (*The New York Times*; *Statement by President Trump*). Additionally, the upcoming 2020 election has increasingly brought climate change to news platforms. Another factor that may contribute to higher freshmen scores is that they have been deemed "the most talented and diverse class in its 156-year history," and have been praised by Boston College as a particularly social-justice minded class, already demonstrating a commitment to "make a positive impact on the world" (*Meet BC 2023*). Because of these factors, we may be able to speculate the freshmen class is coming into college as a more environmentally educated class, and thus more attuned to efforts Boston College is making toward energy efficiency messaging and education.

Section 4

Two main research questions are addressed in this section: how students' perceptions and actions regarding energy efficiency change throughout the four years and the overall importance of energy efficiency. As stated in the previous section, most students who completed the survey were freshmen and seniors and the research question asks about changing perceptions over time, so they will be the focus of this discussion section.

In terms of environmental conservation attitudes, the freshman and seniors mostly had similar results, contrary to Bruce Dixon and John MacDonald's predicted, which was that over time students develop more energy conscious attitudes. Out of the four years, freshman and seniors were the most energy conscious overall with average scores of 3.62 and 3.56 (out of 5).

In response to all of the five statements, freshmen and seniors responded similarly. For the first statement which claims, "energy efficiency and conservation are not important to me" 40% of both years said they strongly disagree. In regards to the second statement about whether changing energy habits was inconvenient both overwhelmingly disagreed (68% and 73%), while sophomores and juniors were more indifferent, with a larger portion stating neither agree nor disagree. For the fourth statement about not being able to control energy in personal dorms, freshmen and seniors more heavily responded with somewhat disagree and strongly disagree

than sophomores and juniors. For the fifth statement regarding having a moral obligation to be more energy efficient, all four groups agreed, with freshmen and seniors having the highest percentage with that response at 92%.

These findings can be explained by the fact that both freshmen and seniors are at points in their life where they either recently have or will experience a big change which makes them think about how they want to better themselves going forward. Sophomores and juniors are less focused on adjusting to a new environment so they may feel less inclined to need to change their attitudes. The reason freshmen scored highly could be attributed to the fact that they are coming from an environment where they controlled more of their energy (such as the temperature of their room), therefore making them more aware of it and viewing it with a better attitude. In addition, parents tend to be more responsible about energy footprints than college students who may have other priorities, leading them to remind their kids of energy saving strategies such as turning off the lights when they leave the room. Seniors' responses can be linked to the fact that many individuals are returning from living off campus where they were directly financially responsible for their energy usage, causing them to have more positive energy attitudes because they could see directly how much they were wasting and they may have been able to develop better habits through this experience. The final question regarding having a moral obligation to conserve is likely related to the Catholic, Jesuit worldview of caring for not only oneself, but for others which includes mother Earth. The students that come to Boston College likely resonate with this teaching, thus explaining the overwhelmingly positive agreement across all years.

The only statement where freshmen and seniors differed was the third statement about having different energy habits at home and at school. Freshmen mostly somewhat disagreed (45%) and seniors mostly somewhat agreed (51%). This is likely because seniors have been away from home for longer, causing them to change their habits for the better or worse while freshmen are still fairly new so they haven’t changed their habits as much.

A limitation is that since the attitudes are measured on a five point scale (strongly disagree to strongly agree) there is the issue of central tendency. Individuals tend to lean towards the more moderate statements. This makes it harder to observe differences. That being said, students still designated the extremes (strongly agree and strongly disagree) as responses, minimizing the impacts of this limitation. The last question, for example, had over 30% of responses designated as strongly agree.

Recommendations

In order to educate students on their energy footprint, create a greater importance for energy efficiency, and create a greater impact of BC's energy conservation campaigns directed toward students, there are multiple avenues to be explored. Many recommendations were sourced from current students via surveys, other recommendations were from paper researchers after conduction data analysis.

Current Boston College students believe that thermostat control and motion sensor lights in dormitories will contribute to less energy consumption and better energy saving habits. Most Boston College dorms are not outfitted to have each room control temperature. Therefore, the temperature of the entire building is regulated by the BC administration. Students believe that with the flexibility to control the thermostat, their energy efficiency will increase. More than 10% of all survey participants who answered the fill-in-the-blank questions complained about heating when talking about BC as an energy efficient school. Also, no BC dorm room is outfitted with motion sensor lights. More than 24% of all research participants who answered fill-in-the-blank questions complained of lighting when considering BC as an energy efficient school (see *Figure 17*). If motion sensor lights are implemented in every dorm room, this will be a big contribution to energy saving. Students forgetting to turn lights off when leaving the room will be vindicated of wasting energy. Students could be forgetful - they are rushing to class, stressed from school work and extracurriculars, or caught up with all the on campus activities. Therefore, this recommendation has the potential to save a lot of money, and create a more energy efficient campus.

The researchers also have a couple recommendations to increase energy efficiency, and educate the students on energy use through effective energy conservation campaigns. These recommendations include a recurring course on energy efficiency and energy saving methods that begins with orientation, and a class incorporated into the core curriculum. The recurring course will be taken during orientation and students will be required to take a shorter, refresher course on canvas at the beginning of every school year. This course will be geared towards guiding students to be more conscious of their energy footprint, and will increase the energy efficiency of students. This course will be similar to the 'academic integrity' course on Canvas.

Students will log on at the beginning of each semester to complete the 15 minute course, giving them guidance to more energy efficient practices.

The second recommendation is a core curriculum class. A class incorporated into the core curriculum that preaches the importance of energy efficiency. This course will address the dangers of climate change, the positives of a more energy efficient world, and will guide students to more energy conscious practices. This will be a semester long class where students will understand the importance of their energy footprint.

Future studies may involve furthering the nexus between energy consumption, energy footprint knowledge, and energy efficient behavior influences/engagement at Boston College. Studies may include an in depth analysis of Boston College messaging. It could examine which types of messaging (stickers on lightswitches, emails from resident assistants, flyers, etc.) are most noticeable for students, or which are most effective in influencing student behavior. Another study may examine energy literacy among the population, and whether or not this correlates with energy efficiency behaviors. Moreover, a study that may also contribute to this body of research might look at whether or not Boston College's reputation as being a 'green campus' or not being a 'green campus' has an influence on student energy efficiency behavior.

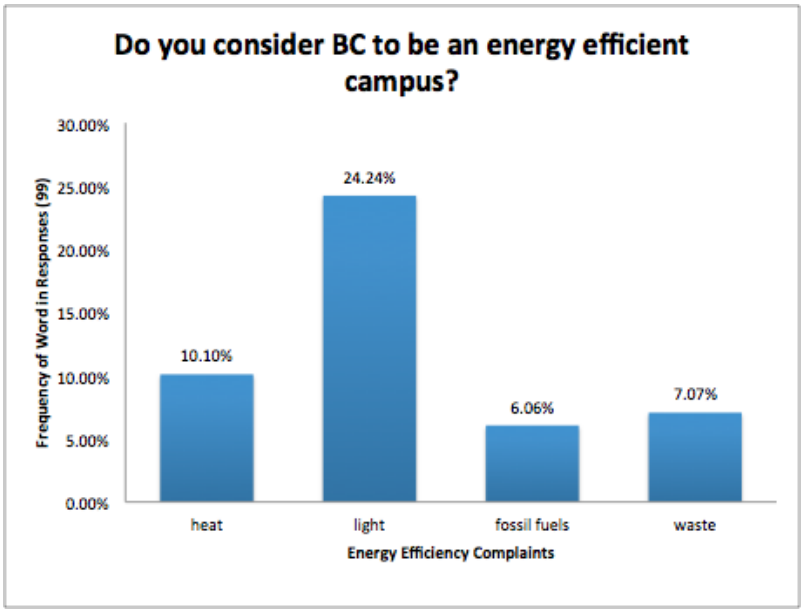


*Figure 17: The percentage of responses to "*Do you consider Boston College to be an energy efficient campus?*" that contained complaints about "heat," "light," "fossil fuel" divestment, and "energy waste" in general*

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Appendix A: Survey

Section 1: Consent/Demographic Questions

1. Consent Question → "... By clicking "yes" below, you are indicating that you are willing to participate in this survey"
    1. Yes
    2. No
2. What is your graduation year?
    1. 2023
    2. 2022
    3. 2021
    4. 2020
3. What is your gender?
    1. Male
    2. Female
    3. Other
    4. Prefer not to say
4. What residence hall do you live in? If you live off campus, please indicate by typing in "Off campus."
    1. (Fill in the blank)
5. Are you a US Citizen?
    1. Yes
    2. No
    3. Prefer not to say
6. Please rate the environmental awareness and practices of your family's home:[MOU1]
    1. Very low
    2. Low
    3. Medium
    4. High
    5. Very high

Section 2: Energy-Use Related Questions

1. On average, how long are your showers?

1. 1-5 minutes
2. 6-10 minutes
3. 11-15 minutes
4. 16-20 minutes
5. 20+ minutes

2. How regularly do you take the following actions to conserve energy:
    1. Turn lights off when leaving my dorm room:

    a) Not regularly b) Somewhat regularly c) Very regularly
    2. Unplug electronic devices and appliances when not in use:

    a) Not regularly b) Somewhat regularly c) Very regularly
    3. Keep the thermostat below 70F when it is cold outside

    a) Not regularly b) Somewhat regularly c) Very regularly
    4. Keep the thermostat above 70F when it is hot outside

    a) Not regularly b) Somewhat regularly c) Very regularly
    5. Take the stairs over the elevator

    a) Not regularly b) Somewhat regularly c) Very regularly

3. How many times a month do you do laundry?
    1. 0
    2. 1
    3. 2
    4. 3
    5. 4+
4. How many months during the academic year (September-May) do you use air conditioning in your dorm/residence?
    1. 0
    2. 1
    3. 2
    4. 3
    5. 4+
5. How many months during the academic year (September-May) do you use heat in your dorm/residence?
    1. 0
    2. 1
    3. 2
    4. 3
    5. 4+
6. What mode of transportation do you use most often to get somewhere off campus?
    1. Uber
    2. Personal car
    3. Bus
    4. Public transportation
    5. Walking

Section 3: Energy Footprint Knowledge/BC Messaging Efficacy Questions

1. On a scale from 0-10, rate the extent that messages given to you by Boston College (e.g., stickers on light switches, refrigerator magnets, residence hall emails, etc.) have helped you improve your energy saving habits.
    1. 0 = "what messages?", 10 = I have changed my habits because of those messages.
2. On a scale from 0-10 what is your awareness of your energy footprint?
    1. 0 = "what's an energy footprint?", 10 = fully aware of everything energy related
3. On a scale from 0-10 to what extent has your education at Boston College contributed to your knowledge about energy efficiency initiatives?
    1. 0 = not at all, 10 = BC has taught me everything there is to know about energy efficiency
4. Do you consider Boston College to be an energy efficient campus?
    1. Yes
    2. No
    3. I don't know

Explain your response :

5. If you had a question about energy use at Boston College, do you know what university resources are accessible to you?
    1. Yes
    2. No
    3. Maybe
6. Have you discussed energy efficiency and/or energy conservation in any of your classes, clubs, or residence hall meetings?
    1. Yes
    2. No

Section 4: Energy Efficiency Attitudes

For the following questions, please indicate the degree to which you agree or disagree with the statement given.

1. Energy efficiency and conservation are not important to me.
    1. (strongly agree, agree, neutral, disagree, strongly disagree)
2. Changing my energy use habits is too much of an inconvenience.
    1. (strongly agree, agree, neutral, disagree, strongly disagree)
3. My energy use habits at home are different from my energy use habits on campus.
    1. (strongly agree, agree, neutral, disagree, strongly disagree)
4. There is not much I can do to conserve energy in my residence at Boston College.
    1. (strongly agree, agree, neutral, disagree, strongly disagree)
5. I feel morally obligated to improve my energy use habits.
    1. (strongly agree, agree, neutral, disagree, strongly disagree)

6.What could BC do to help improve energy efficiency on campus?

Explain:

Appendix B: Statistics

Survey Section 3: Group Statistics and Independent Sample T-tests

Group Statistics

	What is your graduation year?	N	Mean	Std. Deviation	Std. Error Mean
On a scale from 0-10, rate the extent that messages given to you by Boston College (e.g., stickers on light switches, refrigerator magnets, residence hall emails, etc.) have helped you improve your energy saving habits. 0 = "what messages?", 10 = I have changed my habits because of those messages. - Slide the bar	2023	48	4.8542	2.50097	.36098
	2020	56	3.8393	2.00705	.26820
On a scale from 0-10 what is your awareness of your energy footprint? 0 = "what's an energy footprint?", 10 = fully aware of everything energy related - Slide the bar	2023	48	6.4167	2.16189	.31204
	2020	58	5.4310	1.91130	.25097
On a scale from 0-10 to what extent has your education at Boston College contributed to your knowledge about energy efficiency initiatives? 0 = not at all, 10 = BC has taught me everything there is to know about energy efficiency - Slide the bar	2023	46	4.7609	2.96786	.43759
	2020	51	3.6078	2.11734	.29649

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
On a scale from 0-10, rate the extent that messages given to you by Boston College (e.g., stickers on light switches, refrigerator magnets, residence hall emails, etc.) have helped you improve your energy saving habits. 0 = "what messages?", 10 = I have changed my habits because of those messages. - Slide the bar	Equal variances assumed	1.562	.214	2.295	102	.024	1.01488	.44221	.13776	1.89201
	Equal variances not assumed			2.257	89.822	.026	1.01488	.44971	.12142	1.90834
On a scale from 0-10 what is your awareness of your energy footprint? 0 = "what's an energy footprint?", 10 = fully aware of everything energy related - Slide the bar	Equal variances assumed	1.810	.181	2.490	104	.014	.98563	.39579	.20076	1.77050
	Equal variances not assumed			2.461	94.772	.016	.98563	.40044	.19063	1.78063
On a scale from 0-10 to what extent has your education at Boston College contributed to your knowledge about energy efficiency initiatives? 0 = not at all, 10 = BC has taught me everything there is to know about energy efficiency - Slide the bar	Equal variances assumed	6.187	.015	2.219	95	.029	1.15303	.51969	.12132	2.18473
	Equal variances not assumed			2.181	80.527	.032	1.15303	.52857	.10124	2.20481

Group Statistics

	What is your graduation year?	N	Mean	Std. Deviation	Std. Error Mean
Do you consider Boston College to be an energy efficient campus?	2023	48	2.00	.652	.094
	2020	59	1.58	.622	.081
If you had a question about energy use at Boston College, do you know what university resources are accessible to you?	2023	48	1.35	.635	.092
	2020	59	1.31	.623	.081
Have you discussed energy efficiency and/or energy conservation in any of your classes, clubs, or residence hall meetings?	2023	48	2.19	.982	.142
	2020	59	1.95	.936	.122

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Do you consider Boston College to be an energy efficient campus?	Equal variances assumed	4.121	.045	3.430	105	.001	.424	.124	.179	.669
	Equal variances not assumed			3.413	98.517	.001	.424	.124	.177	.670
If you had a question about energy use at Boston College, do you know what university resources are accessible to you?	Equal variances assumed	.301	.584	.402	105	.689	.049	.122	-.193	.291
	Equal variances not assumed			.401	99.792	.689	.049	.122	-.194	.292
Have you discussed energy efficiency and/or energy conservation in any of your classes, clubs, or residence hall meetings?	Equal variances assumed	2.050	.155	1.281	105	.203	.238	.186	-.130	.607
	Equal variances not assumed			1.275	98.555	.205	.238	.187	-.133	.609

Group Statistics

	Year	N	Mean	Std. Deviation	Std. Error Mean
Section3Avgs	Freshmen	48	21.3750	7.07295	1.02089
	Seniors	59	16.9322	5.88061	.76559

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Section3Avgs	Equal variances assumed	2.199	.141	3.548	105	.001	4.44280	1.25211	1.96009	6.92550
	Equal variances not assumed			3.482	91.323	.001	4.44280	1.27607	1.90817	6.97743

Section 4: Group Statistics and Independent Samples T-test

Group Statistics

	What is your graduation year?	N	Mean	Std. Deviation	Std. Error Mean
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - Energy efficiency and conservation are not important to me.	2023	47	3.70	1.443	.211
	2020	57	3.77	1.414	.187
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - Changing my energy use habits is too much of an inconvenience.	2023	47	4.09	.905	.132
	2020	57	4.02	.855	.113
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - My energy use habits at home are different from my energy use habits on campus.	2023	47	2.40	.970	.142
	2020	57	2.39	.940	.125
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - There is not much I can do to conserve energy in my residence at Boston College.	2023	47	3.53	1.018	.149
	2020	57	3.40	1.015	.134
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - I feel morally obligated to improve my energy use habits.	2023	47	4.36	.640	.093
	2020	57	4.23	.824	.109

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - Energy efficiency and conservation are not important to me.	Equal variances assumed	.207	.650	-.248	102	.805	-.070	.281	-.628	.488
	Equal variances not assumed			-.248	97.484	.805	-.070	.282	-.629	.490
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - Changing my energy use habits is too much of an inconvenience.	Equal variances assumed	.088	.768	.391	102	.697	.068	.173	-.276	.411
	Equal variances not assumed			.388	95.973	.699	.068	.174	-.278	.413
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - My energy use habits at home are different from my energy use habits on campus.	Equal variances assumed	.004	.948	.097	102	.923	.018	.188	-.355	.391
	Equal variances not assumed			.097	97.024	.923	.018	.189	-.356	.392
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - There is not much I can do to conserve energy in my residence at Boston College.	Equal variances assumed	.073	.788	.641	102	.523	.128	.200	-.269	.526
	Equal variances not assumed			.641	98.146	.523	.128	.200	-.269	.526
For the following questions, please indicate the degree to which you agree or disagree with the statement given. - I feel morally obligated to improve my energy use habits.	Equal variances assumed	.080	.778	.908	102	.366	.134	.147	-.158	.425
	Equal variances not assumed			.930	101.668	.354	.134	.144	-.151	.419