

## **Where Political Affiliation and Sustainability Meet: A Study of Undergraduate Engineering Students' Career Choices**

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### **Abstract**

Sustainability is becoming increasingly important in various industries, and engineers have a crucial role to play in designing and implementing sustainable solutions. We explored in this study whether students' sustainability-related career choices are associated with their political affiliation. For this study, the CLIMATE survey [11] is used to collect data from 96 research institutions all over the USA. The survey data includes 3766 undergraduate students' responses from diverse engineering majors. For this study, we focused on one survey question: "Which of these topics, if any, do you hope to directly address in your career?". The question consists of 10 sustainability-related career choices - energy, disease, poverty and distribution of wealth and resources, climate change, terrorism and war, water supply, food availability, opportunities for future generations, opportunities for women and/or minorities, and environmental degradation. Pearson's chi-squared test is used to compare the responses from students with different political affiliations. There are significant political affiliation differences in students' sustainability-related career outcomes. Students with Republican political affiliations are more interested in addressing terrorism and war whereas students with independent political affiliations are more interested in addressing energy supply and demand. Students who have democratic political affiliation are more interested in the rest of the eight sustainability-related career choices. Overall, among the students, Democrats affiliated are more interested in solving sustainability issues compared to Republicans affiliated. As early as in their undergraduate engineering period, students' political affiliations may impact their inclination towards promoting sustainability outcomes in their professional pursuits, as suggested by our findings.

### **Introduction**

Engineering students should consider choosing sustainability career choices, as they present a unique chance to effect positive change in both society and the environment [1]. By pursuing a career in sustainability, engineering students can work towards creating a more sustainable future for themselves and future generations. Moreover, sustainability jobs are expected to grow in demand in the coming years, providing engineering students with a promising career path [2]. As a result, there is a growing demand for engineers who can design and implement sustainable solutions in various industries.

Many studies have explored various factors that influence the career intentions of undergraduate engineering students concerning sustainability. These studies suggest that students' personal values, educational experiences, and career opportunities play a critical role in shaping their sustainability-related career choices. Students who are passionate about environmental and social justice may be more likely to seek out careers that align with their values [3]. Besides, by taking sustainability-focused courses, attending conferences, and participating in extracurricular activities related to sustainability [3], students can learn about the challenges facing our planet and the various ways that engineers can help mitigate them. A study conducted by the National Academy of Engineering (NAE) found that undergraduate engineering students who participated in sustainability-focused service-learning projects were more likely to pursue careers in sustainability-related fields [4]. Career opportunities are another important factor that influences

sustainability-related career choices among engineering students. As the demand for sustainable solutions increases, more job opportunities are emerging in fields such as green building design, renewable energy, and sustainable transportation. Students who are aware of these job opportunities may be more likely to pursue careers in these fields. For example, a study by the National Science Foundation (NSF) found that students who were exposed to green job opportunities through internships and other work experiences were more likely to pursue careers in sustainability-related fields [5]. However, little is known about how political affiliations may influence undergraduate engineering students' career choices related to sustainability.

Political affiliations may have a significant impact on future career choices related to sustainability for engineering students. Some students may prioritize environmental protection and sustainability as core values, driven by their political associations. Such students may prefer career paths that align with their values, such as working in renewable energy, environmental policy, or sustainable engineering. Overall, individuals who prioritize sustainability may choose careers that align with their values and views on environmental issues and seek out opportunities to make a positive impact in their communities and beyond. This study aims to investigate the extent to which political affiliations are associated with undergraduate engineering students' sustainability-related career choices.

There is a growing body of research that suggests that political affiliation can influence how people view and respond to sustainability issues [6] - [7]. In general, people who identify as liberal are more likely to be concerned about sustainability issues and to support policies that address these issues, while people who identify as conservative are less likely to be concerned about sustainability issues and to support policies that address these issues [8]. There is a mounting partisan gap in Americans' views on climate change, with Republicans becoming increasingly skeptical of the issue. From a National Survey, authors [7] found that Republicans are more likely than Democrats to believe that climate change is not a serious problem. They found that Democrats were more likely to support policies to address climate change, such as cap-and-trade programs and renewable energy subsidies, while Republicans were less likely to support these policies. The study is supported by [9]. They found that Democrats are very inclined to support policies aimed at reducing carbon emissions. The partisan gap on climate change is likely to make it more difficult to address the issue through public policy. Another study by [10] examined the factors that influenced public concern over climate change in the United States from 2002 to 2010, including the influence of political affiliation. They found that conservative and industry-funded organizations were more likely to deny the existence of climate change and oppose policies to address it, while progressive and environmental organizations were more likely to support climate action. So, political affiliation is an important factor in shaping attitudes toward climate change and support for policies to address it. However, little research has been done to examine the potential influence of political affiliations on undergraduate engineering students' sustainability-related career choices.

This study seeks to fill this gap by analyzing data from a CLIMATE survey [11] of undergraduate engineering students from 96 universities in the United States. The survey includes questions about students' political affiliations and sustainability-related career aspirations. By examining the association between political affiliations and sustainability-related career choices among undergraduate engineering students, this study aims to contribute to our

understanding of the factors that shape the next generation of engineers' attitudes and career aspirations related to sustainability.

## **Research Question**

The present study addresses the research question, "To what extent, if any, are political affiliations associated with undergraduate engineering students' sustainability-related career choices?" The objective of this research endeavor is to gain a deeper comprehension of how students' inclination towards sustainability topics varies according to their political affiliations. The outcomes further shed light on the trajectory that engineering students undertake as they transition into industry, as well as highlight the sustainability subjects that garner the most resonance among them, concerning their political orientations.

## **Methods**

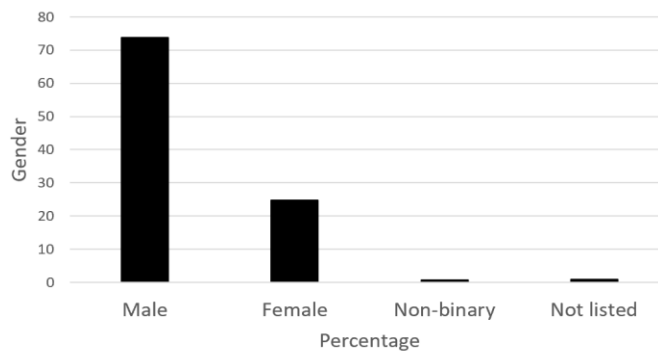
The study investigates whether political affiliation has any association with sustainability-related career choices among undergraduate engineering students by leveraging the CLIMATE survey [11]. The survey was intended for students who were about to enter the workforce, specifically those in their final senior design or capstone course. The survey was developed using a combination of previously conducted national surveys and newly created questions that were categorized into five sections: (1) career goals, (2) college experiences, (3) about themselves, (4) people and planet, and (5) demographic information. For this study, we focused on two questions: sustainability-related career choices (question five) in the career goals section, and political affiliation (question 32) in the demographic section. Question five asked participants, "Which of these topics, if any, do you aspire to directly address in your career?" Notably, question five featured 10 distinct sustainability-related career choices. On the political front, question 32 prompted participants with the query, "Generally speaking, do you identify yourself as a Republican, a Democrat, an Independent, or something else?" Here, students were asked to articulate their political affiliation by selecting one of these four available options: Republican, Democrat, Independent, or Other. We leveraged a nonparametric test to analyze the data since both of the variables are categorical.

## ***Participants***

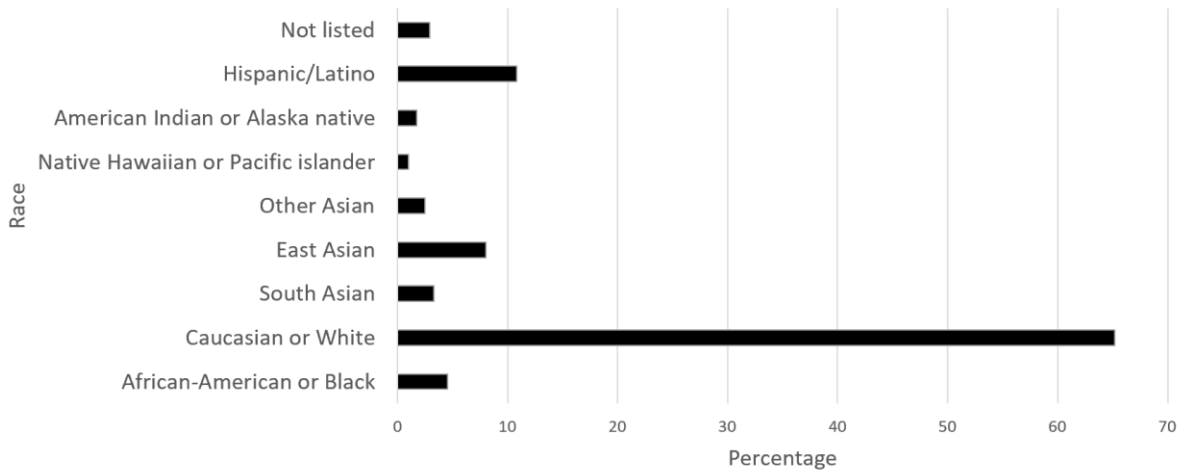
The CLIMATE survey [11] was administered to 3766 senior students of 96 schools from 18 distinct engineering departments, who were chosen to be a representative sample of the student body in their majors and demographic traits. A stratified random list of universities with ABET-accredited engineering programs was compiled, separating them into small (<5400), medium (5400–14,800), and large institutions (>14,800) based on overall undergraduate enrollment, ensuring that the sample was representative of varying sizes of institutions [18]. The initial point of contact for each institution was made by engineering department heads. Subsequently, capstone instructors were requested to distribute the survey to their students after being contacted by the department head. Eighty-three capstone instructors consented to distribute the surveys in their respective classes, with no incentives provided to the students or instructors. Paper surveys were mailed to capstone instructors, accompanied by instructions for distribution during their courses. Students were informed that the survey was not part of their course, and they would not

receive class credit or any type of grade for completing it. The survey was conducted anonymously. As shown in Figure 1(a) among the respondents, 2777 identified as male (73.76%), 932 identified as female (24.75%), 24 identified as non-binary (0.64%), and 32 chose not to disclose their gender (0.85%).

Additionally, the survey asked the students to disclose their self-identified races or ethnicities, and the results are shown in Figure 1(b). Among the respondents, a majority self-identified as Caucasian or White, with the second-largest cohort identifying as Hispanic/Latino. While East Asians and South Asians were also represented in the responses, their numbers were comparatively smaller than those of the aforementioned ethnicities. The fraction of respondents identifying as Native Hawaiian or Pacific Islander was modest, with an even lesser proportion identifying as American Indians or Alaska Natives. Additionally, a minor percentage of respondents refrained from disclosing their racial or ethnic identity.



(a)



(b)

Figure 1: Demographics of participants (a) gender diversity in percentage, (b) race diversity in percentage.

### ***Instrument***

Through Qualtrics, the survey was delivered electronically during class. Students voluntarily chose to participate in the survey. Students' career objectives, college experiences, opinions

about engineering, and demographic data were all questioned in this study. In this essay, we mainly analyzed students' answers to the query, "Which of these topics, if any, do you hope to directly address in your career?" Energy (supply or demand), disease, poverty and resource distribution, terrorism and conflict, water supply, food availability, possibilities for the next generation, an opportunity for women and minorities, and environmental degradation were the topics that were listed in the survey. There were only two possible responses to this query: yes or no.

### ***Data Analysis***

Due to the binary nature of the question's response—either yes or no— Pearson's chi-square test was conducted in terms of comparing responses from students who identify with different political affiliations on each aspect of this question. This test was chosen because it assesses the likelihood that any observed difference between sets resulted from chance and is applicable to categorical data; in our case political affiliation and sustainability-related career choices. Specifically, the test is used to evaluate the null hypothesis that these two variables are independent versus the alternative hypothesis that they are dependent. The alpha value is 0.05 to control the type-I error. After performing the analysis, we checked the assumptions. To check the categorical data assumption, we ensured that the data were categorical in nature. In this case, political affiliation and career choice are both categorical variables. For this CLIMATE survey, the sample was randomly selected from the population of interest, hence it meets the random sample assumption. If the sample was not random, then the results may not be generalizable to the population of interest. The observations in the sample were independent of each other. This means that each observation is not influenced by any of the other observations in the sample. Hence, the independence assumption is met. Furthermore, we checked that each cell of the contingency table had an expected count of at least 5 which fulfills the sample size assumption.

### ***Limitations***

The CLIMATE survey used in this study only includes 10 pre-defined career choices for students, and the question regarding sustainability-related career choices is binary. As a result, the survey may not capture the full range of students' preferences, and students who do not select the specific option are recorded as a "no" response. To improve upon this limitation, future research may consider using a Likert scale with multiple response options ranging from "Strongly disagree" to "Strongly agree" to provide more nuanced information about students' preferences. Additionally, the survey only includes one question about students' political affiliations and does not collect information on how active they are in practicing their political beliefs. Therefore, further research is needed to explore these factors and their potential influence on students' sustainability-related career choices.

### **Results**

We performed chi-square tests to compare the frequency of desired sustainability-related career choices among students with different political affiliations. Table 1 presents the results of the test, including both significant and non-significant findings to provide a comprehensive overview of our results. Additionally, we calculated the effect size, Cramer's V, to determine the practical

significance of our significant findings. We considered a value of 0.10 to indicate a small effect, 0.30 to indicate a medium effect, and 0.50 to indicate a large effect [12].

Table 1 displays the results of the association of the differences in political affiliations with students' sustainability-related career outcome choices. The sample consists of undergraduate students who identify as Republican, Democrat, Independent, or Other, and the analysis explores whether there are differences in career choices across these groups. The results are presented as a percentage of agreement among students with different political affiliations for each career choice.

**Table 1:** Association of differences in political affiliations with students' sustainability-related career choices

Sustainability-related career choices	Percent Agreement				Chi-square	p-value	Effect size
	Republican	Democrat	Independent	Other			
Energy	24.3	28.1	<b>28.7</b>	19	13.689	<b>.003**</b>	.06
Disease	20.4	<b>32.9</b>	30.1	16.6	11.155	<b>.010**</b>	.05
Poverty	11.1	<b>37.3</b>	32.5	19.1	<b>111.27</b>	<b>&lt; .001***</b>	<b>.17</b>
Climate change	13.7	<b>39.7</b>	31.3	15.3	<b>211.43</b>	<b>&lt; .001***</b>	<b>.24</b>
Terrorism and War	<b>35.8</b>	17.7	28.6	17.8	49.927	<b>&lt; .001***</b>	.12
Water supply	21.3	<b>32.3</b>	28.6	17.8	35.482	<b>&lt; .001***</b>	.10
Food availability	18.6	<b>30.7</b>	29.3	21.4	26.009	<b>&lt; .001***</b>	.08
Opportunities for future generations	24.9	<b>30.0</b>	28.0	17.2	6.7856	.079	.04
Opportunities for women and minorities	14.3	<b>44.0</b>	25.0	16.8	<b>200.42</b>	<b>&lt; .001***</b>	<b>.23</b>
Environmental degradation	18.7	<b>33.6</b>	31.5	16.2	86.429	<b>&lt; .001***</b>	<b>.15</b>

Note: \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

We found that there are significant differences in students' sustainability-related career choices across different political affiliations based on the results of percentage agreement. Based on the data from Table 1, students affiliated with Democrats are comparatively more interested in addressing sustainability issues and are likely to choose careers related to poverty, disease, environmental degradation, climate change, water supply, food availability, opportunities for future generations, and opportunities for women and minorities, while Republicans are more likely to choose careers related to terrorism and war. These differences in career choices suggest that political beliefs play a role in shaping students' interests and priorities when it comes to sustainability-related issues.

Students affiliated with independent political beliefs are significantly more likely to address energy (supply/demand) related issues ( $\chi^2 = 13.689$ ;  $p < .01$ ; 28.7%). On the other hand, students affiliated with Republicans are significantly more interested in addressing terrorism and war issues ( $\chi^2 = 49.927$ ;  $p < .001$ ; 35.8%). Students with Democratic political affiliation are significantly more interested in addressing a lot of sustainability issues such as poverty ( $\chi^2 = 111.27$ ;  $p < .001$ ; 37.3%), disease ( $\chi^2 = 11.155$ ;  $p < .01$ ; 32.9%), environmental degradation ( $\chi^2 = 86.429$ ;  $p < .001$ ; 33.6%), climate change ( $\chi^2 = 211.43$ ;  $p < .001$ ; 39.7%), water supply ( $\chi^2 = 35.482$ ;  $p < .001$ ; 32.3%), food availability ( $\chi^2 = 26.009$ ;  $p < .001$ ; 30.7%), and opportunities for women and minorities ( $\chi^2 = 200.42$ ;  $p < .001$ ; 44%) in their careers compared to students affiliated with Republicans, Independent, and other political parties. Among these career outcomes, Democrat-affiliated students are more significantly interested in solving issues such as climate change ( $\chi^2 = 211.43$ ;  $p < .001$ ), opportunities for women and minorities ( $\chi^2 = 200.42$ ;  $p < .001$ ), and poverty ( $\chi^2 = 111.27$ ;  $p < .001$ ) compared to other sustainability-related issues.

We also calculated Cramer's V to identify the strength of the association between political affiliations and career choices. It ranges from 0 to 1, with higher values indicating a stronger association. In other words, larger effect sizes indicate stronger associations between the variables, while smaller effect sizes indicate weaker associations. The effect sizes range from 0.04 to 0.24. The largest effect size is observed for the relationship between political affiliations and concerns about climate change, with a value of 0.24. This indicates a moderate association between political affiliations and concerns about climate change. The effect size for opportunities for women and minorities is also relatively large (0.23), indicating a moderate association between political affiliations and concerns about opportunities for women and minorities. The effect size for poverty is 0.17, indicating a moderate association between political affiliations and concerns about poverty. The effect sizes for the other variables range from weak to moderate, with values ranging from 0.04 to 0.15. Although we have statistically significant results, their practical significance is weak to moderate. These findings suggest that political beliefs are an important factor in whether they're interested in sustainability which in turn shapes students' sustainability-related career outcome expectations. This has significant implications for the development of sustainability-related education and training programs.

## **Discussion**

Our findings provide initial insights into the potential influence that political affiliations can have on the inclination of undergraduate engineering students towards pursuing specific sustainability objectives in their future professional pursuits, even at an advanced stage in their academic trajectory. The study has uncovered significant disparities in the specific sustainability-oriented issues that students with diverse political affiliations aspire to address in their future professional endeavors. Students affiliated with the Democratic party exhibited a greater level of interest in resolving a majority of the sustainability-related challenges, with the exception of energy, terrorism, and war. Republican-affiliated students displayed a greater inclination towards addressing terrorism and war issues whereas students with independent political affiliation expressed a heightened interest in contributing towards resolving energy-related issues. We observed significant differences in undergraduate engineering students' motivations in addressing sustainability-related issues with the exception of opportunities for future generations. These findings are consistent with previous research that has indicated a relationship between



political ideology and environmental attitudes [6] – [9]. Therefore, our results suggest that political affiliation influences the degree to which students are inclined toward pursuing sustainability goals in their future professional trajectories. Hence, educators and policymakers should be aware of how political beliefs and affiliations may influence students' attitudes and career aspirations related to sustainability. It may be important to design educational programs and policies that address these issues and promote sustainability-related career opportunities for students from diverse political backgrounds.

The findings of the study can contribute to advancing the United Nations' Sustainable Development Goals (SDGs) [13] by providing insights into how to encourage more engineering students to pursue careers that promote sustainable and resilient infrastructure and technological innovation. The United Nations' SDGs provide a framework for addressing global challenges. It consists of a set of 17 goals that were adopted by all United Nations Member States in 2015 [14]. The goals are a call to action to end poverty, protect the planet, and ensure prosperity for all. The sustainability-related career choice options in the survey were from the SDGs. The study found that there is a significant association between political affiliation and sustainability-related career choices, with Democrat-affiliated students being more likely to choose sustainability-related careers than Republican-affiliated students. Based on the findings, policymakers and educators can target outreach efforts to those groups to increase interest in sustainable engineering careers. Additionally, the study's results can be used to inform the development of educational programs and initiatives that promote sustainability in engineering education. By understanding the factors that influence students' career choices related to sustainability, educators can design curricula and provide resources that highlight the importance of sustainable engineering practices and encourage students to pursue careers that align with SDGs.

Our findings illuminate the intricate interplay between political affiliations and the sustainability aspirations of undergraduate engineering students, offering valuable insights when viewed through the lens of social identity theory [15]. According to this theoretical framework [15], individuals categorize themselves into social groups based on shared attributes, and these group affiliations shape their perceptions and behaviors. In the context of our study, political affiliations serve as a form of social identity, influencing students' inclinations toward specific sustainability objectives. The observed disparities align with the notion that individuals within a particular political group may be guided by shared values and priorities, impacting their professional aspirations in the realm of sustainability. This theoretical perspective [15] emphasizes the role of social identity in shaping attitudes and motivations, providing a nuanced understanding for educators and policymakers seeking to address the complex relationship between political affiliations and career choices in the field of engineering and sustainability.

Since students' political affiliation is associated with their sustainability career choices, we need to build politically fluent engineers to address the complex challenges facing the environment and create sustainable solutions. Politically fluent engineers are not only proficient in their technical skills but also have the knowledge, skills, and abilities to navigate the complex political and social landscape in which they operate [16]. They are equipped with the necessary skills to identify and analyze the ethical, social, and environmental implications of their work and engage in effective communication and collaboration with stakeholders from different disciplines and backgrounds to create sustainable and socially responsible solutions. Engineering educators can

promote political fluency by integrating political content into engineering courses, fostering critical reflection and dialogue, and creating opportunities for students to engage in real-world problem-solving. By doing so, engineering students can become more politically aware and effective agents of change.

In addition to political affiliation, there are a number of other factors that can influence engineering students' career choices. These factors include gender [17], college experiences [18], personal values [19], career opportunities [20], the perceived value of sustainability-related careers [4], etc. It is important to consider other factors when making decisions about a career in sustainability. In future work, we will include these factors to get a holistic view of how they influence students' sustainability-related career choices. With careful planning and preparation, engineering students can make a significant contribution to addressing the sustainability challenges facing the world.

## **Conclusion**

Our findings indicate significant disparities in sustainability-related career choices among students with varying political affiliations. Specifically, we observed a higher level of interest in addressing sustainability-related challenges among Democratic-affiliated students compared to their Republican counterparts. Our results suggest that political affiliation may have an impact on the students' inclination towards promoting sustainability outcomes in their future professional pursuits, even during their undergraduate engineering period. Therefore, creating a learning environment that fosters an interest in sustainability-related challenges, regardless of political affiliation, is essential. Such efforts can contribute to a more sustainable future.

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