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Continuing Evaluation of Undergraduate Engineering Students' Perspectives on Renewable Energy: A Two-Year Study

Mr. Hang Song, Auburn University

Dr. John T. Solomon, Tuskegee University

Dr. Solomon is a Full Professor in the Mechanical Engineering department of Tuskegee University (TU), AL. He received a Ph.D. from Florida State University (FSU) in 2010. Dr. Solomon's research interests include high-speed flow control, actuator development, experimental fluid mechanics, micro-scale flow diagnostics, and engineering education. He holds three US patents on high-frequency microactuator technologies developed for high-speed flow control applications. The National Science Foundation has supported Dr. Solomon's research through grants such as the Research Initiation Award, Excellence in Research (EiR), and Improving Undergraduate STEM Education (IUSE). He was selected as a summer faculty research fellow at NASA Jet Propulsion Laboratory, California Institute of Technology (Caltech), in 2019 and 2020.

Dr. Lauren E. Beckingham, Auburn University

Karen McNeal, Auburn University

Dr. McNeal conducts research in geoscience education investigating how people think and learn about the Earth. She conducts quantitative and qualitative methods to assess people's understanding, perceptions, and behavior about complex environmental systems. She has published 65 peer-reviewed articles and secured more than $25M in external funding.

Dr. Kelly Lazar, Clemson University

Kelly Lazar is an Assistant Professor of Engineering and Science Education at Clemson University with a joint appointment in Environmental Engineering and Earth Sciences. Her research largely focuses on recruitment and retention of STEM students through the use of experiential learning opportunities such as virtual reality, field experiences, and undergraduate research opportunities. Her education includes a B.S. in Geology from North Carolina State University, a M.S. in Geological Sciences from East Carolina University, and a Ph.D. in Geological Sciences from The Ohio State University.

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Abstract:

This study meticulously probes the evolution of engineering undergraduates' attitudes and skills related to renewable energy and sustainability over two years at two institutions in the Southeastern United States. Data were intensively collected in two phases – fall 2022 and spring 2024 – amassing over 250 initial and upwards of 200 follow-up responses. This rigorous effort culminated in over 150 complete and matched datasets subjected to detailed examination. A bespoke, five-part survey was employed to capture the complex spectrum of students' attitudes. Our analytical approach incorporated ANOVA; these results indicated minimal group variances across most survey dimensions, hence suggesting a uniformity in perceptions. Paired sample tests brought to light a minor, but statistically significant increase in sustainability-related knowledge. The educational methods employed included hands-on projects, seminars, and group assignments focused on various aspects of renewable energy and sustainability. These incremental yet impactful changes highlight the potential of precise educational strategies to effectively mold student perspectives towards sustainability. By integrating solid statistical techniques and delving into the broader educational implications, this study provides valuable insights into the refinement of a sustainability-centered engineering curricula.

***Keywords**: Climate Change, Paired Sample T-test, Attitudes & Behaviors, intervention, Sustainability*

I. INTRODUCTION AND BACKGROUND

Engineering Education and Sustainability

The evolving landscape of engineering challenges in the 21st century necessitates a paradigm shift in engineering education, steering it towards sustainability to address global environmental, social, and economic challenges. Duderstadt et al. (2007) underscore the urgency of this shift, highlighting a general lack of knowledge among engineering students about sustainable development despite its critical importance to their future roles as innovators and leaders. The need for an integrated approach to sustainability in engineering curricula is evident in the findings of Azapagic et al. (2005), who, through an international survey, exposed the gap in sustainability knowledge among engineering students. This gap underscores the imperative for curriculum development that not only educates but also empowers students to apply sustainability principles in their professional practices.

Adopting effective pedagogical approaches is paramount to instilling a deep understanding of sustainability among engineering students. Segalàs et al. (2010) provide valuable insights into how different teaching strategies affect students' learning outcomes in sustainability courses. Their research suggests that experiential learning and problem-based approaches significantly enhance students' grasp of sustainability concepts, underscoring the need for educational methods that actively engage students in learning. The transformation of engineering education to incorporate sustainability presents both challenges and opportunities. Jamieson & Lohmann (2009) articulate the importance of fostering a culture of innovation within engineering education to prepare students for a globalized society. This culture must prioritize sustainability as a core component of the curriculum to develop engineers capable of addressing the complex challenges of our times.

Bielefeldt & Canney (2016) offer a longitudinal perspective on the evolution of engineering students' attitudes towards social responsibility, a key component of sustainability. Their study illustrates the positive impact of targeted educational interventions on students' perceptions and attitudes, suggesting that sustained exposure to sustainability concepts throughout their education can cultivate a generation of socially responsible engineers. Gamage et al. (2022) argue for the pivotal role of higher education, and specifically engineering education, in driving societal progress towards sustainability. By embedding sustainability into the engineering curriculum, educators can equip students with the knowledge, skills, and values necessary to contribute to a sustainable future.

Undergraduate Reform in Engineering Education

The evolution of engineering education towards integrating sustainability and preparing students for the complexities of modern engineering roles is an imperative shift recognized across academic and industrial spheres (Queiruga-Dios et al., 2021). This transformation is driven by the growing demand for engineers who are not only technically adept but also possess a broad understanding of the environmental, societal, and ethical implications of engineering projects (de Vere et al., 2009; McGinn, 2018). A key aspect of this educational reform is the emphasis on interdisciplinary learning and the application of knowledge to real-world problems, fostering a generation of engineers equipped to tackle global challenges with innovative and sustainable solutions (Jamieson & Lohmann, 2009; Froyd, Wankat, & Smith, 2012).

Pedagogical innovations, such as project-based learning (PBL) and service-learning, have been pivotal in promoting active engagement and deeper understanding of engineering principles among students (Servant-Miklos & Kolmos, 2022; Queiruga-Dios et al., 2021; Sukackė et al., 2022). These methods emphasize learning through doing, encouraging students to apply theoretical knowledge in practical settings, thus enhancing their problem-solving skills, creativity, and motivation to learn (Asbjornsen, 2015). The shift towards such dynamic learning environments not only aligns with the evolving expectations of the engineering profession but also bridges the gap between academic preparation and industry requirements, ensuring that graduates are well-prepared for their future roles in the workforce (Prince & Felder, 2006; Dym et al., 2005).

II. APPROACH

Theoretical Approaches for Engineering Education & Sustainability Survey Sections

In the realm of engineering education, integrating sustainability requires a multifaceted approach that encompasses technical knowledge and fosters an understanding of environmental, economic, and social dimensions (Gagnon, 2009; Boarin & Martinez-Molina, 2022; Rao et al., 2013). Our survey design was informed by several key theoretical frameworks to assess students' knowledge, attitudes, and behaviors towards sustainability.

Knowledge Section (S1): Constructivism and systems thinking guided the development of questions assessing students' understanding of sustainability as an interconnected system. These theories emphasize active learning, problem-solving, and critical thinking skills, encouraging students to construct their own understanding of sustainability concepts (Anthony, 1996; Cattaneo, 2017; Grabinger & Dunlap, 1995).

Attitude Section (S2): Socio-technical systems theory and transformational learning theory shaped questions probing students' beliefs and values regarding sustainability. These theories help to understand the interdependence of social and technical systems and the importance of critical reflection in shaping attitudes towards sustainability (Smith, 2007; Gordon et al., 2022; Gelles et al., 2021).

Behavior Section (S3): Social Cognitive Theory (Bandura, 1986) and transformational learning theory informed questions assessing how students' understanding of sustainability influences their behaviors. These theories emphasize the role of self-efficacy and critical reflection in driving behavioral change towards more sustainable practices.

Abilities Section (S4 & S5): Questions in these sections evaluated students' confidence in performing tasks related to sustainable engineering and their ability to integrate technical knowledge with societal needs. Systems thinking and socio-technical systems theory were instrumental in shaping these questions, highlighting the need for holistic problem-solving and sustainable engineering solutions.

By aligning the theoretical approaches with the specific focus of each survey section, we aimed to ensure the relevance and coherence of our assessment tools. This alignment provides a clearer framework for understanding the survey results and reflects the complexity and interconnectedness of sustainability in engineering education.

Research Questions:

1. Impact of Active Learning Approaches: How are active learning strategies and hands-on curricular implementations in engineering classrooms related to changes observed in undergraduate engineering students' responses in a six-section pre-post sustainability survey and their open-ended feedback?
2. Comparative Analysis Across Disciplines: How do the pre-post sustainability survey results differ among students from different engineering majors, and what relationships do these differences suggest about the disciplinary approaches to sustainability education?
3. Relationships Influencing Survey Performance: Which specific factors are most strongly related to students' performance improvements in the pre-post sustainability survey, and how do these relationships shed light on the underlying mechanisms of learning and attitude change towards sustainability concepts within engineering education?

III. METHODS

In this study, we employed a mixed-methods approach to examine the impact of educational interventions on undergraduate engineering students' perspectives on renewable energy and sustainability. The research methodology encompassed quantitative data collection through a structured survey, as well as qualitative insights gathered from student feedback and classroom observations. The survey instrument was designed to assess various dimensions of students' attitudes, knowledge, behavioral intentions, and perceived abilities related to sustainability. To ensure the validity and reliability of the survey, it underwent rigorous expert review and pilot testing. The educational interventions included in the study comprised group projects, seminars, and hands-on experimental activities, all aimed at enhancing students' understanding and engagement with renewable energy concepts. Data analysis involved statistical techniques such as Analysis of Variance (ANOVA) and paired sample t-tests to identify significant changes in student responses over time. By integrating these diverse methods, the study aimed to provide a holistic understanding of the effectiveness of sustainability education in engineering programs.

Population

The study's population consisted of undergraduate engineering students enrolled in specific courses at institution A and institution B over four semesters. At Institution A, students were from the course CIVL 3230 Introduction to Environmental Engineering. At institution B, the courses involved were MENG 425 Renewable Energy in the spring semester and MENG 313 Fluid Mechanics and MENG 418 Heating, Ventilation and Air Conditioning (HVAC) in the fall semester. The initial pre-survey phase garnered responses from 132 participants, with 83 students from Institution A and 49 from institution B. The gender distribution showed a higher participation rate among males, with 96 male students compared to 34 female students. Notably, 14 participants opted out of allowing their data to be used, highlighting our commitment to ethical research practices and individual consent. In the post-survey phase, the total number of participants decreased slightly to 92, with a balanced representation from both institutions (45 from Institution A and 47 from institution B). The gender distribution remained skewed towards males, with 65 male and 27 female participants. Additionally, 9 responses were not authorized for use in this phase.

Importantly, the survey successfully collected paired pre- and post-responses from 84 individuals. This paired data provides a robust foundation for longitudinal analysis, allowing for direct comparison and deeper insight into changes in students' perceptions and understanding of sustainability in engineering. The comprehensive dataset from these two distinguished institutions offers a nuanced view of the educational impact over time, particularly regarding the effectiveness of our intervention in shaping students' knowledge and attitudes towards sustainability and renewable energy.

Study Timeline and Survey Administration

The study spanned four semesters, each corresponding to an academic term at both Institution A and Institution B. The timing of the surveys was carefully coordinated with the academic calendar of each institution to ensure consistency and relevance. The pre-surveys were administered approximately one week after the start of the new semester. This timing was chosen to allow students to settle into their courses while ensuring that their initial responses reflected their baseline knowledge and attitudes before significant exposure to the course content and interventions. Following the pre-surveys, the educational interventions, which included group development, experimental projects, and seminars, were implemented throughout the duration of the courses. These activities were designed to engage students in hands-on learning and to deepen their understanding of sustainability and renewable energy concepts. The post-surveys were administered approximately two to three weeks before the final exams, varying slightly between Institution A and Institution B due to differences in their academic calendars. This timing ensured that students had sufficient exposure to the interventions and course material while allowing for data collection before the end-of-semester activities.By aligning the survey administration with the start and end of the courses and accounting for the differences in academic calendars, we aimed to capture the impact of the educational interventions on students' perspectives and learning outcomes in a consistent and meaningful manner.

Survey Structure Question Structure

In response to the request for more detailed information on the survey questions used to assess students' knowledge and attitudes towards sustainability and renewable energy, it's important to note that the survey was carefully crafted based on the framework developed in our in-review paper, "Developing a Broad Measure of Undergraduate Students' Sustainability and Renewable-Energy Knowledge and Perspectives" (Song et al., in review, AJEE). This paper outlines the theoretical underpinnings and methodological considerations that informed the survey's design.

The survey comprises five distinct sections, each designed to evaluate a broad spectrum of knowledge and perspectives on environmental sustainability and renewable energy. The structure and content of the survey were informed by established theoretical frameworks and previous research to ensure a comprehensive assessment of students' understanding and attitudes.

Section 1: Knowledge Assessment (S1)

This section employed a series of multiple-choice questions aimed at assessing students' foundational understanding of renewable energy and environmental protection concepts. The questions were consistent across the pre- and post-survey phases, with slight modifications in phrasing or numerical values where applicable to maintain the integrity of the evaluation and allow for a direct comparison of knowledge acquisition (Anthony, 1996; Cattaneo, 2017; Grabinger & Dunlap, 1995).

Sections 2-5: Attitudes, Behaviors, Career Decisions, and Abilities

These sections delved into students' attitudes towards renewable energy (S2), their behavioral intentions (S3), factors influencing their career decisions (S4), and self-assessed abilities relevant to sustainability (S5). Likert-type scales and open-ended questions were employed to capture nuanced views and facilitate a comprehensive analysis of the impact of educational interventions on students' perspectives and preparedness for engaging with sustainability (Smith, 2007; Gordon et al., 2022; Gelles et al., 2021; Swaim et al., 2014; Brunstein et al., 2021; Yu et al., 2023; Barelli, 2017; Seleur, 2012; Dlouhá et al., 2019).

To further validate engagement with the survey content and to prevent rote responses, an attention check question (e.g., "What is 2+2?") was included.

Comprehensive Assessment Approach

This approach to survey design allowed us to capture a wide array of data points, from baseline knowledge to shifts in attitudes and behaviors towards sustainability. The survey, validated and reviewed by experts, encompassed a wide spectrum of constructs, providing a comprehensive tool to guide educational strategies and curricular development aimed at fostering sustainability competencies among future engineers.

IV. INTERVENTION

Class Intervention

The course intervention designed to enhance undergraduate engineering students' comprehension and practical skills in renewable energy applications involves a dynamic, hands-on approach through group assignments, seminars, and experimental projects. By dividing students into groups and assigning them seminars alongside experimental projects related to renewable energy, the curriculum aims to foster a deeper understanding and hands-on experience with renewable energy technologies. These projects, utilizing scaled models from the Horizon Energy Box™, cover a broad spectrum of renewable energy sources, including solar, wind, hydrogen fuel cells, saltwater fuel cells, biofuels, the thermoelectric effect, and mechanical energy conversion to electrical energy via supercapacitors. Each project is meticulously crafted to not only introduce students to the theoretical aspects of these renewable sources but also to immerse them in the practical challenges of harnessing such energies efficiently. Through assembling models, conducting varied experiments, data collection and analysis, and presenting their findings, students are expected to develop a comprehensive grasp of the operational principles and potential applications of these renewable energy technologies.

Moreover, the intervention strategically emphasizes the critical importance of renewable energy in addressing contemporary energy challenges and environmental sustainability. For instance, projects like the solar-powered model car, wind turbine optimization, and biofuel electricity generation are designed not only to impart technical knowledge but also to cultivate a sense of environmental stewardship and innovation among students. The inclusion of cutting-edge technologies such as hydrogen and saltwater fuel cells aims to acquaint students with the future of energy generation and storage, encouraging them to consider careers in these emerging fields. By engaging in these experimental projects, students not only enhance their technical and analytical skills but also their ability to work collaboratively, solve complex problems, and communicate their findings effectively. This comprehensive educational approach serves not just to educate but also to inspire the next generation of engineers to contribute to the development of sustainable, renewable energy solutions, aligning with the global imperative for cleaner and more sustainable energy sources.

V. Results

Table 1: Paired Samples Statistics

This table presents the paired samples statistics, including the mean, standard deviation, and standard error mean for each survey section before and after the intervention. The data provide insight into the changes in students' responses over the course of the study.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PreS1	0.65	83	0.40	0.04
	PostS1	0.77	83	0.20	0.02
Pair 2	PreS2	4.49	83	0.87	0.10
	PostS2	4.49	83	0.86	0.09
Pair 3	PreS3	4.39	83	0.95	0.10
	PostS3	4.37	83	0.92	0.10
Pair 4	PreS4	5.68	83	0.57	0.06
	PostS4	5.77	83	0.67	0.07
Pair 5	PreS5	5.00	83	0.75	0.08
	PostS5	4.86	83	0.76	0.08

Table 2: Paired Samples Correlations

Table 2 showcases the correlations between pre- and post-survey scores for each section, indicating the relationship between initial and follow-up responses.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PreS1 & PostS1	83	0.19	0.09
Pair 2	PreS2 & PostS2	83	0.19	0.08

Pair 3	PreS3 & PostS3	83	0.17	0.12
Pair 4	PreS4 & PostS4	83	-0.01	0.98
Pair 5	PreS5 & PostS5	83	0.20	0.08

Table 3: Paired Samples Test Results

Table 3 provides the results of the paired samples t-test, highlighting the mean differences, standard deviations, and significance levels for each survey section. This analysis helps to identify statistically significant changes in student responses.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	PreS1 - PostS1	-0.12	0.42	0.05	-0.21	-0.03	-2.66	82	0.01
Pair 2	PreS2 - PostS2	0.00	1.10	0.12	-0.24	0.24	0.02	82	0.99
Pair 3	PreS3 - PostS3	-0.04	1.21	0.13	-0.30	0.23	-0.27	82	0.79
Pair 4	PreS4 - PostS4	-0.09	0.88	0.10	-0.28	0.10	-0.93	82	0.36
Pair 5	PreS5 - PostS5	0.15	0.96	0.1	-0.06	0.35	1.38	82	0.17

The paired sample t-test results provide insights into the changes in the survey sections' scores from the pre- to post-intervention phase. Here's a summary of the analysis for each pair:

Pair 1 (PreS1 - PostS1):

There's a statistically significant increase in the mean score from the pre-survey (M=0.6460, SD=0.40079) to the post-survey (M=0.7681, SD=0.20740), t(82) = -2.675, p = 0.009. This suggests that the intervention had a significant positive impact on the scores for Section 1.

Pair 2 (PreS2 - PostS2):

There's no significant change in the mean scores for Section 2 from the pre-survey (M=4.4899, SD=0.87228) to the post-survey (M=4.4880, SD=0.86049), t(82) = 0.016, p = 0.987. This indicates that the intervention did not have a statistically significant impact on the scores for this section.

Pair 3 (PreS3 - PostS3):

There's also no significant change in Section 3's mean scores from pre (M=4.3317, SD=0.95488) to post (M=4.3673, SD=0.91948), t(82) = -0.269, p = 0.788.

Pair 4 (PreS4 - PostS4):
No significant change is observed in Section 4's mean scores from pre (M=5.6790, SD=0.56833) to post (M=5.7693, SD=0.67441), t(82) = -0.931, p = 0.355.

Pair 5 (PreS5 - PostS5):
A slight, but not statistically significant, increase is noted in the mean scores for Section 5 from pre (M=5.0052, SD=0.75292) to post (M=4.8599, SD=0.75973), t(82) = 1.380, p = 0.171.

The correlations between pre- and post-scores for each section were generally low, with none reaching statistical significance at the $p < .05$ level. This indicates that there is no strong relationship between the pre-scores and the post-scores, suggesting that the changes observed are not consistent across all students.

V. CONCLUSIONS:

In conclusion, the intervention appears to have had a statistically significant effect only on Section 1, with no significant changes observed in the other sections. This could imply that the intervention was effective in improving a specific subset of knowledge or skills assessed in Section 1 but did not impact the broader range of topics covered in other sections. The reasons could be that a semester long course is not adequate to significantly change attitudes or career plans of this population, although additional reasons for this could be manifold and warrant further investigation to understand the differential impacts of the intervention on various aspects of students' learning and attitudes towards sustainability and renewable energy. The results presented here represent the preliminary findings from the initial year of a longitudinal study stretching over a three-year period. This first phase, encompassing data from Fall 2021 through Spring 2022, offers an early glimpse into the evolving understanding and perspectives of undergraduate engineering students in the realm of sustainability and renewable energy. As we continue to collect and analyze data throughout the duration of this project, we anticipate developing a more comprehensive understanding of the educational impacts and trends. The insights from this study are intended to contribute to the broader dialogue on engineering education reform, particularly as it pertains to integrating principles of sustainability into the curriculum.It is important to note that the findings at this stage are foundational. They will serve as a benchmark against which we will compare subsequent data collected in the remaining years of the project. Our goal is to identify patterns, shifts, and educational outcomes that emerge over time, as students are repeatedly exposed to active learning environments and hands-on curricular interventions. We acknowledge the limitations inherent in interpreting data from a single academic year and recognize the value of longitudinal analysis in providing a richer, more nuanced narrative. By the time of the ASEE conference in June, we aim to deliver more definitive answers and in-depth insights, as we will have had the opportunity to observe and evaluate the survey data across multiple academic cycles. In conclusion, while the current discussion is necessarily tentative, it lays the groundwork for future analyses. Our ongoing research will continue to probe the depths of how experiential learning in sustainability can shape the competencies, attitudes, and career trajectories of tomorrow's engineers.

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Appendix

The full set of survey items, meticulously designed to gauge undergraduate students' knowledge of and attitudes toward environmental protection, is detailed within this study. For a curated selection of questions that were incorporated into the final survey instrument, please refer to Table 1.

Introduction Part 1: Understanding of the fundamentals of environmental protection and renewal energy knowledge.

Please mark the correct answer. There is only 1 correct answer (Correct Answers are highlighted)

Questions	A	B	C	D
Mark the sustainable (renewable) energy source(s):	Solar energy	Natural Gas	Petroleum	Carbon
2. Which is not the sustainable (renewable) energy source:	Oil	Wind	Biomass	Hydropower
From which source most of the electricity in the U.S. is generated?	By burning oil, coal, and wood	With nuclear power	Through solar energy	hydro-electric power plants
Wind flows from ________ pressure area to _________ pressure area.	high, high	high, low	low, high	low, low
Of the following, which would be considered living in the most environmentally sustainable way?	Recycling all recyclable packaging	Reducing consumption of all products	Buying products labeled "eco" or "green"	Buying the newest products available

Which of the following is the most commonly used definition of sustainable development?	Creating a government welfare system that ensures universal access to education, health care, and social services	Setting aside resources for preservation, never to be used	Meeting the needs of the present without compromising the ability of future generations to meet their own needs	Building a neighborhood that is both socio-demographically and economically diverse
……. is the most common cause of pollution of streams, rivers, and oceans	Dumping of garbage by cities	Surface water running off yards, city ,streets paved lots, and farm fields	Trash washed into the ocean from beaches, or	Waste dumped by factories?
8. Humans can be exposed to environmental contamination through which of the following pathways:	Bioaccumulation in food chains	Atmospheric aerosols	Aqueous transport	All of the above
Which of these is the major contributor to world pollution?	Commercial resources	Non-Commercial Resources	Renewable Resources	Nuclear Energy
10. What percent of global electricity generation is considered renewable?	45%	30%	25%	20%
What is solar radiation?	Energy radiated from the sun in all directions	Energy radiated from Earth in all directions	Radiation travelling in space	Energy radiated from sun that travels in ether

Compared to people in many developing countries, North Americans use about	5 times as much energy	15 times as much energy	30 times as much energy	50 times as much energy
Which of the following affects the amount of solar radiation received by a location or water body?	Shape of the water body	Time at night	Altitude and latitude	Rotational speed of Earth
In our country, the most widely used energy resource is	Oil	Natural Gas	Coal	Solar
Which of the statements is correct about Solar Energy?	It is a renewable and conventional source of energy	It is a non-renewable and non-conventional source of energy	It is a renewable and non-conventional source of energy	It is a non-renewable source of energy
What are the potential effects of global climate change?	Loss of habitats	Less severe weather	Loss of ozone layer	Decrease in sea level
What do you think is the main cause of global climate change or the warming of the planet Earth?	more carbon emissions	sunlight radiating more strongly through ozone hole	increased volcanic activity	increase in oxygen in the atmosphere

18. State your agreement with the following statements.

- We should use renewable energy even though it will increase power fees
- I have an extensive understanding of renewable energy
- Environmental protection is much more important than economic development
- I agree with garbage sorting, even though it makes it more inconvenient for me
- We should use energy sources that can replace fossil fuels
- Use of recyclable or biodegradable materials and renewable energy sources can solve environmental challenges
- The condition of the environment will play an increasingly important role in the ' 'nation's economic future
- Private companies should train their employees to consider/solve environmental problems and integrate sustainability in their day-by-day tasks
- Government agencies should support environmental education programs for adults
- The United States should promote the development of renewable energy
- When humans interfere with nature, they often have disastrous consequences
- If all human activities do not change, we will soon experience a major environmental disaster
- It is important to limit our use of energy
- Green energy alternatives should be supported by the public
- Wind and solar will become key players in meeting energy demands
- Laws and regulations for environmental protection have gone too far
- I will still trust in nuclear power after all the nuclear leaks happened
- Even though hydropower stations may affect the survival of terrestrial plants and impact their living environment, I still think the government should build more hydropower stations
- I understand and trust photovoltaic power generation

What is 2+2? (item used for validation as attention check)

Introduction Part 3: Your habits and willingness in regard to the renewal energy usage.
In this part your will be asking your habits or your willingness to do the below behaviors.

19 I would like to do these behaviors to reduce the greenhouse gas emissions on our Earth.

- Turn off lights and appliances when not in use
- Driving less and using other forms of transportation
- Buy green energy from utility provider
- Using energy-efficient bulbs
- Consume less food/clothes or things I do not really need
- Buy a fuel-efficient car
- Turn off electronic devices that are not being used
- Actively search for products that are more energy efficient
- Encourage friends or family to be more energy efficient
- Participate in carpooling

- Install solar panels on my home

20. Please take a moment to think about your typical energy usage habits, how often in **one week** period do you do each of the following?

- Turn off electric appliances when not in use
- Actively search for products that are more energy efficient
- Turn off all lights and appliances before leaving a room
- Encourage friends or family to be more energy efficient
- Participate in carpooling
- Choose to travel without a car (e.g., walk, bike, public transport, etc.)
- Change the setting on my thermostat to be lower in winter and higher in summer

Introduction Part 4: Importance of certain factors to your career decision.

21. Please score the importance of the below factors to your career decision.

- Job location
- Salary
- Type of Industry
- The company's reputation and culture
- The company's workplace is environmentally friendly
- The company has sustainability initiatives
- The company promotes a work-life balance
- The company has a friendly atmosphere
- This company allows employees to work remote

22. Please mark your agreement with the following statement (put 1-6 where, 1= Strongly disagree, 2= Slightly disagree, 3= Disagree,, 4=Slightly agree, 5=Agree, and 6= Strongly agree, 7=I do not understand this statement)

- I am confident in my ability to recognize/identify a system
- I am confident in my ability to understand a system with multiple parts
- I am confident in my understanding of cause-effect relationships
- I am confident in my ability to evaluate knowledge from different disciplines
- I am confident in my ability to understand methods from other disciplines
- I am confident in my ability to communicate with people in other disciplines
- I am confident in my ability to recognize when changes in my approach need to occur
- I am confident in my ability to predict possible outcomes of a problem
- I am confident in my ability to deal with risks and changes
- I am confident in my ability to think deeply about important ideas
- I am confident in my ability to apply important information to a variety of real-world situations
- I am confident in my ability to apply complex problem-solving skills
- I am confident in working with others to solve problems
- I am confident I have the skills to communicate with others

- I am confident I can deal with interpersonal conflicts when they arise
- I am confident I am able to communicate effectively to a range of audiences
- I am confident I am able to use communication technologies
- I am confident that I possess the capability to evaluate information in the media
- I am confident I am able to cope with uncertainties involved in a particular task
- I am confident that I am able to cope with various demands on my time
- I am confident I can cope with multiple stressors