Exploring Renewable Energy Education

Oral LaFleur

Industrial Technology Department
College of Science and Technology

Abstract

Texas Southern University College of Science and Technology's involvement in renewable energy has been on the upsurge since 1994. The growth of the program has been tremendous and now includes many projects involving renewable energy, energy efficiency and the Renewable Energy and Environmental Protection (REEP) Academy. Staff, faculty and students have made optimal contributions to these research efforts and are committed to demonstrating and informing others about renewable energy technologies.

Together, high school and college interns in the REEP academy are given the opportunity to practice what they learn in their prospective programs during the three weeks of the REEP Academy. Traveling around the United States during the last week of the program, some students are exposed to many different types of renewable energy technology at the wind farms in Austin and West Texas, in Colorado at the National Renewable Energy Laboratory and to Washington, DC to the capital to meet with energy policy makers. There is also the solar installation that takes place in South Africa where REEP students and college students learn first hand about the practical use of renewable energy technology.

Renewable energy is a fast emerging technology and students and staff working in the Photovoltaic Research and Demonstration Laboratory are dedicated to structuring programs to meet the growing demands of the REEP Academy. Ultimately, the development of the REEP Academy in the College of Science and Technology has been one of the greatest contributions to the growth and use of the Photovoltaic Research and Demonstration Laboratory.

This paper demonstrates the progress and contributions made by the Texas Southern University's Renewable Energy and Environmental Protection (REEP) Academy and the Photovoltaic Research and Demonstration Laboratory to educating high school and college students as well as the community.

INTRODUCTION

Today's bankers may argue this fact: It is without any doubt that the formula for yielding high Return on Investment (ROI) is an investment in education. Countries with highly successful industrialized economies invest heavily in their higher educational systems. Successful economies have recognized the importance of research and development (R&D) to the

corresponding health of their economies. Thus, the importance of investing in education stands poised for embrace all over the world.
The technological innovations we now enjoy were borne of meticulous work in the laboratories of the world. In Houston, Texas, many United States corporations, national laboratories, state and federal agencies, and private foundations have recognized the importance of investing in education to secure a healthy energy future. High school and college students are getting an opportunity to study and experience several aspects of technologies that deals with renewable energy and environmental issues from field exercises, classroom, research and development to installation and testing of renewable energy electrical systems. Texas Southern University (TSU), through its College of Science and Technology, conducts an educational program called the Renewable Energy and Environmental Protection (REEP) Academy for six consecutive years. With this program, TSU is attempting to take R&D from the labs into the disadvantaged communities of the world.

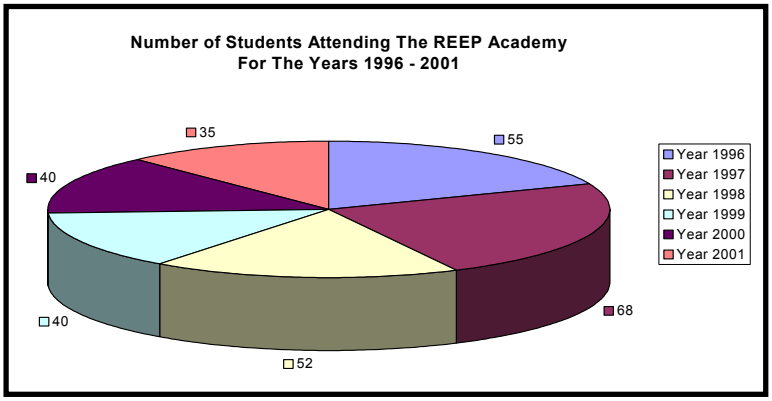

Figure 1: Indication of number of students who attended The REEP Academy in the past Years

OBJECTIVE

The Renewable Energy and Environmental Protection (REEP) Academy is a comprehensive educational outreach program that seeks to create a lasting interest in mathematics, science and technology among youth from low and moderate-income households, and transform that interest into the pursuit of higher education. Evidence points to the lack of minority student participation in math and science curriculums. The REEP program addresses this lack by encouraging students to stay in school and proceed to college. Immersing the students in the academic and social collegiate environment mitigates freshman year anxiety and provides a practical segue from high school to college. The strategy is to recruit from Texas' inner city high schools minority and low-income students with a demonstrated ability and interest in science and technology. As a result, a high percentage of student graduating through the Academy have chosen a technical field of study at the college of their choice.

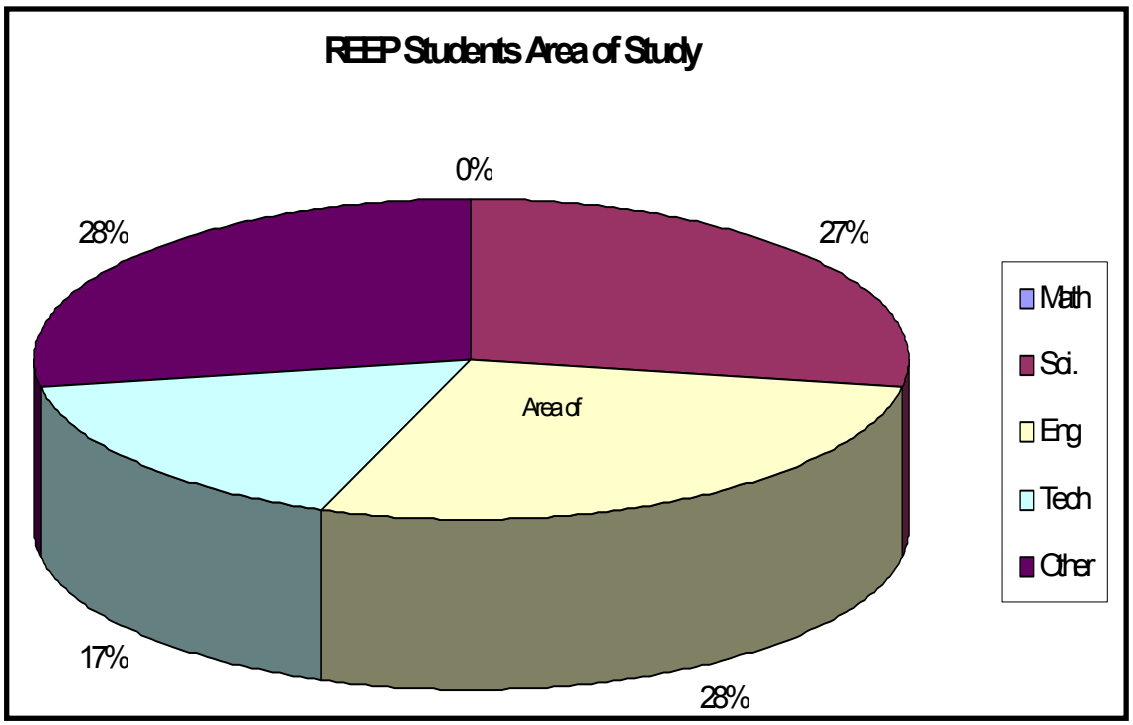

Figure 2: Indicate area of study selected by students

PROGRAM ACTIVITIES

Activities of the REEP Academy are administered through the College of Science and Technology, which houses a Photovoltaic Research and Demonstration Laboratory. For several years, the Photovoltaic Laboratory has been used as a designated training site for college student participating in the National Renewable Energy Laboratory (NREL) PV Research Associate Program. During the summer, both the REEP and college student to complete lab exercises in renewable energy and environmental activities uses the Photovoltaic Research and Demonstration Laboratory.

REEP's academic focus is to promote the awareness and development of renewable energy technologies and environmental management programs. REEP educates students through an intensive, college-preparatory curriculum of hands-on projects and demonstrations of renewable energy sources such as solar and wind power. In addition, the program introduces the students to the need for energy conservation and environmental protection, and encourages them to seek creative solutions shows the overwhelming potential of the Academy's effectiveness to inspire.

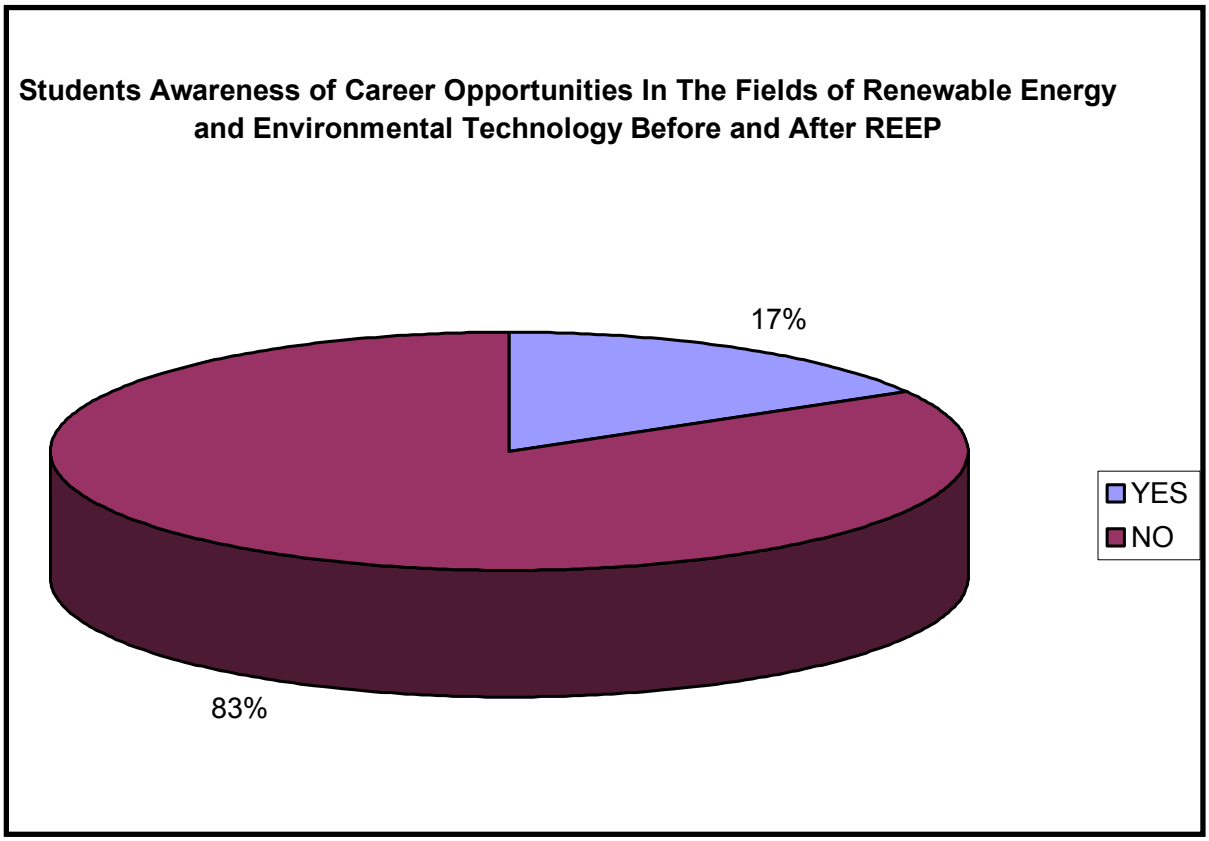

Figure 3: Indicates Awareness

CURRICULUM

The curriculum of the REEP Academy is presented through abbreviated courses from the TSU College of Science and Technology's curriculum; technical seminars on renewable energy, energy-efficiency, pollution prevention and assessment, and natural resource conservation, laboratory activities, and field exercises. Student's options are specific college-preparatory courses taken during the Academy, similar to college course selection. These options include: Introduction to Physics, Light and Electricity, Introduction to Electronic Engineering Technology, Engineering Mathematical Concepts, Airway Science Flight Simulation, Introduction to Computer Aided Drafting, Environmental Science, Introduction to Transportation Technologies and Introduction to Materials and Heat Transfer. University faculty teaches the courses. Because the REEP Academy seeks to academically prepare and develop students for careers in industry, government, business and education, and specifically, to make them proficient in the application of basic sciences and technologies, industry experts are invited to conduct technical seminars on renewable energy and environmental issues. Professionals in business, government and education give presentations and workshops to identify and develop leadership skills. Filed trips further enhance the REEP Academy to accentuate success stories in the minority community, such as banks, and local businesses.

Thus, Figure 4 indicates the influence of the REEP program on the choices of careers REEP students opted after attending the REEP Academy.

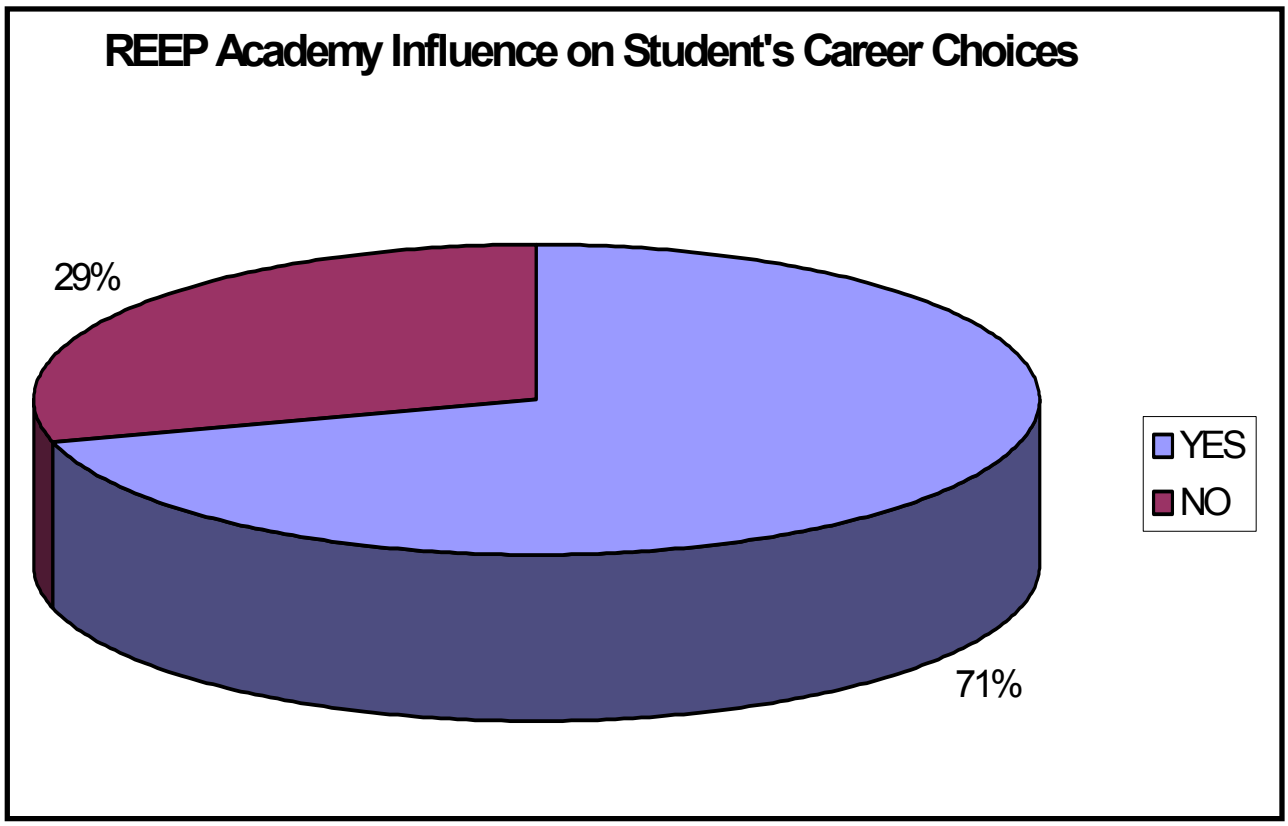

Figure 4: REEP influence on students' indicator

FIELD PROJECTS

In addition to the classroom instruction, seminars, and local field trips, REEP students travel domestically and internationally to experience real-time applications of renewable energy. Each year according to interest expressed on their application and seniority in the program, student participants are divided into four groups, three groups for domestic travel and one international.

The domestic trips are designed to expose the students to governmental issues regarding renewable energy and environmental protection by visiting and participating in energy policy dialogues at the Department of Energy in Washington DC.

Figure 5: REEP Students and staff with Congresswoman Sheila Jackson Lee in Washington DC

Secondly, one of the premier educational sights for REEP students' activities is the National Renewable Energy Laboratory in Golden, Colorado where the world's leading scientists and experts introduce students to renewable energy technology through additional courses and field exercises.

Figure 6: Field Exercises at the National Renewable Energy Laboratory in Golden, Colorado.

The third aspect of the domestic trip includes the students traveling to West Texas for the annual field trip involving wind technology. This trip includes a visit to the Alternative Energy Institute (AEI) at West Texas A&M University where they learn about renewable energy projects in other schools and ultimately a visit to Big Springs and Lubbock, Texas where a toured of the windmill farm and the American Wind Power Center is conducted. Field trips and facility tours of energy and environmental facilities are scheduled to show careers that are available in these fields.

Figure 7: REEP Students on a Field Excursion at the Alternative Energy Institute in West Texas

INTERNATIONAL ACTIVITIES

For many years, selected students participating in the REEP Academy along with staff members have traveled to South Africa. The purpose of the trip is to assist with developmental projects and participate in South Africa's Rural Electrification program by installing solar systems in rural communities. Through education and cultural awareness, REEP South Africa works with villages and rural communities to determine areas in need of improvement, and when feasible, implements sustainable solutions to their infrastructural and developmental needs in conjunction with local technikons and universities, governments, and utilities. Additionally, the REEP program provides funds for international exchange students to receive photovoltaic, solar thermal energy systems, and other technical training at TSU for implementation in South African rural communities.

REEP students conduct a survey of random households to determine the demographics and developmental status of the community and their environmental concern. Although it is beyond the scope of this paper to present a detailed analysis of this survey, the most widely express concern is that of safe drinking water. The table below is a test sample of the rural community drinking survey conducted by REEP students, as part of their environmental education.

Table 1: Water survey results

Chemical	Tap Water	Rain Water
Free Chlorine [1]	0.15	-0-
Total Chlorine [1]	-0-	-0-
Copper [1]	-0-	-0-
Hardness [1]	31 ppm	Negligible
Soluble Iron [1]	-0-	-0-
Total Iron [1]	-0-	-0-
pH [1]	7.6	7.6
Nitrates [2]	LO	LO
Lead [2]	LO	LO

All levels of chemicals tested were within acceptable range.
Test Medium: [1] LaMotte Drinking Water Test Kit
[2] ReflexMeter Test Strips

Since the beginning of the REEP Academy's visit to South Africa, students have participated in four installations of PV systems in villages with no source of electricity. The first installation was a 100-watt DC system designed to supply electricity to four 18-watt fluorescent lights. Students tested their knowledge gained in the classroom by connecting the two 50-watt panels in series to supply a 24-volt system.

Figure 8: REEP Students and Staff installing the 100-Watt Solar Electric System in South Africa

The second installation consisted of a two-pronged endeavor. The first part was the installation, which included the PV panels and frame assembly, solar panel wiring and pole mounting, cable mounting, hole digging, installing, and wiring the light and pull switches. The second part was teaching and empowering the women in the village to build and use solar cookers. On this trip, REEP students demonstrated their knowledge of renewable energy technology by participating in a teaching experiment in a rural village in South Africa.

Figure 9: REEP Students Demonstrate Solar Cooker

Figure 10: REEP Students Installing Solar Panel

The third installation was the introduction of a new technology to South Africa and the world. For the first time students in the REEP Academy installed a battery free solar refrigerator, which was a new research technology between NASA and Texas Southern University. This system is a project that will allow personnel at Texas Southern Photovoltaic Research and Demonstration Laboratory to measure the usage and performance of a refrigerator that runs directly from power generated by solar panels without batteries. Students were divided into groups to install the refrigerator. A group worked on building the wooden frame, while another group wired the solar panels in parallel for a 12-volt system for solar refrigerator. In addition, a group was responsible for setting up the refrigerator in the home and bolting the panels to the roof.

Figure 11: Installing Solar Panels on Roof

Figure 12: Setting up Solar Refrigerator

A data logger is connected to the solar refrigerator that will collect data to be analyzed by the College of Science and Technology to determine if this type of technology will work for homes in remote areas around the world without electricity.

The fourth installation, took place in a pre-school rather than a residential dwelling as in previous visits. The installation team consisted of five REEP students, four college interns, four students from the Eastern Cape Technikon, which is in South Africa, a local technician from the South African utility company (ESKOM), and a Photovoltaic staff engineer from the University of Texas @ El Paso. The system installed consisted of two 12 Volt 35 watt PV modules, a charge controller / voltage regulator, two 20 Watt compact fluorescent tubes, and a 90 ampere hour deep cycle battery.

Figure 13: Installing Solar Electric System on the Roof of a Pre-School in South Africa

SUMMARY AND CONCLUSION

The REEP Academy is a natural product of the combined missions of Texas Southern University and the College of Science and Technology. TSU's urban community, its predominantly African-American student body, and its ethnically diverse faculty make it uniquely qualified to address the educational needs of minority and inner city students in renewable energy and environmental technology.

The College of Science and Technology seeks to equip students with a proficiency in applied sciences and technology and the REEP Academy is designed to benefit from both entities. It is designed to channel inner city minorities into higher education and careers in math, science, engineering and technology by introducing them to applications of renewable energy and environmental management studies. The expertise of the TSU College of Science and Technology is ideally suited to the academic focus and the socioeconomic status of the students

of the REEP Academy. The TSU REEP Academy instills in high school students a lifelong commitment to scholastic achievement beyond school walls. For years to come, REEP students will be the fuel that powers renewable energy research and development and environmental technology.

REEP is an invaluable instrument to train future generations to meet the challenges for renewable energy and environmental education.

ACKNOLDGMENTS

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- TXU Electric.

ORAL LaFLEUR
Mr. LaFleur currently serves as the Director of the Photovoltaic Research and Demonstration Laboratory and in the College of Science and Technology at Texas Southern University. He has been in the renewable energy industry over ten (10) years. Over the years, he has fostered a productive and coordinated research profile on PV in schools and industries. Through his work, renewable energy research and educational projects have been developed and implemented in the United States, Mexico and South Africa.