The Re-Energize Undergraduate Research Program at Our Community College

Dr. Dan G. Dimitriu, San Antonio College

Dan G. Dimitriu has been practicing engineering since 1970 and taught engineering courses concurrently for more than 20 years at various institutions. In 2001, he joined San Antonio College full-time as the Coordinator of its Engineering program and in 2004 he joined also the faculty at University of Texas at San Antonio as an adjunct professor. He has been involved with several engineering societies and became a member of the Two-year College Division of ASEE in 2002. His research interests are in alternative fuels, fuel cells, plastics, and engineering education.

Mr. Klaus Bartels, San Antonio College

Klaus Bartels is an Adjunct Faculty member at San Antonio College (SAC) in both the Mathematics Department and the Physics/Engineering/Architecture Dept. He was born near Buenos Aires, Argentina and immigrated to the U.S. in 1956. He grew up and went to college in the Boston, MA area. He has a B.S.E.E. from Tufts University (1972) and an M.S.E.E. from M.I.T. (1975). He served as a Communications-Electronics Engineer/Officer in the USAF from 1975 to 1999, retiring as a colonel. He worked part time as a Flight Director at the Challenger Learning Center of San Antonio from 2000 to 2009, and has been teaching remedial math and engineering courses at SAC since 2000. He has also been involved in various engineering summer programs at SAC, including instructor for Robotics Camps for 3rd to 5th graders (2012 - 2014), instructor and coordinator for the Early Development of General Engineering program for high school students (2007 - present), and faculty adviser for Solar Undergraduate Research Programs (2011 - present). He is a faculty participant and student mentor in the 3-yr (2014 - 2017), DOE grant-funded ReEnergize renewable energy research and education partnership program.

Mr. Steven F. Lewis, William R. Sinkin Eco Centro, San Antonio College

Bio: Steven Lewis- Manager of the William R. Sinkin Eco Centro sustainability outreach center of Alamo Colleges/San Antonio College (SAC). Mr. Lewis came to San Antonio College (SAC) in 2006 after a private sector career of designing, implementing and managing workforce and sustainability training projects in developing nations. During that time, he and his wife founded the nonprofit corporation Tools for Development, which undertakes sustainable development projects in indigenous villages of Mexico. In late 2008, he presided over the initial strategy sessions for what is now the Alamo Colleges Green Initiative. He and his assistants now coordinate the many environmentally related events and activities that take place at Eco Centro, which serves as a demonstration center for solar energy use in our region. Undergraduate research projects at Eco Centro include plant growth experimentation in a containerized solar hydroponic project and comparison of worm bedding mixes used to create beneficial microorganisms through vermicomposting.

Dr. Bahram Asiabanpour, Texas State University

Dr. Bahram Asiabanpour is an Associate Professor of Manufacturing Engineering at Texas State University and a Certified Manufacturing Engineer (CMfgE). He received his Ph.D. from the Daniel J. Epstein Department of Industrial and Systems Engineering at the University of Southern California. His main research interest is Additive Manufacturing, Product Development, and Renewable Energy. Since joining Texas State, Dr. Asiabanpour has secured 27 externally funded projects from NSF, NASA, Toyota, USDA, DOE, and several local industries. He is currently the PI for the $614K grant from the DOE (2014-17), called "REENERGIZE: Recruitment and Retention of Students in STEM Programs through a Renewable Energy Research and Education Partnership with Five Minority Institutions." He was the founding Editor In Chief of the American Journal of Engineering Education (AJEE), serving between 2010 and 2014. He is currently Editor In Chief of the International Journal of Rapid Manufacturing (IJRapidM).
The Re-Energize Undergraduate Research Program at San Antonio College

Abstract

Re-Energize is a network of renewable energy education and research labs fully contained and established at each of the four member institutions. The main goal of this collaborative effort is to involve STEM students in developing and sharing effective new green technology content while imparting skills to faculty members of this network. That will strengthen their capacities and arm them with additional resources to support their efforts in recruiting and retaining students, and in particular minorities, in STEM programs offered at their institutions.

Our two-year college is part of this network and for at least three years will develop and implement new undergraduate research projects related to green technologies. As part of this partnership with its fellow Hispanic-Serving Institutions, our college made a commitment to

1) Encourage our STEM faculty to attend Re-Energize professional development opportunities to learn and adopt green energy educational modules into our STEM curriculum over the next three years

2) Seek space to establish a "start-up green lab" on our campus with MSEIP pass through funding from the four-year institution so that faculty can conduct classroom demonstrations and our students can perform undergraduate research. This initiative is meant to diversify and continue our undergraduate research program and include our EcoCentro facility into this program

3) Promote additional related outreach and educational Re-Energize efforts to support our students and encourage them to seek successful careers in STEM and green energy-related fields and to

4) Participate in on-going evaluation and research efforts related to this program.

Undergraduate research programs at four-year institutions have been widely reported to increase retention, and our results indicate that two-year institutions can also initiate successful programs. This paper describes a work in progress and presents detailed results of the first year partnership between San Antonio College and Texas State University. Together we will develop a new direction for summer undergraduate research programs at our community college, offer recommendations, and outline future plans.
The Demand for Engineers Keeps Growing

Overall, the engineering occupations are projected to add 136,500 jobs through 2022. They will continue to be needed to design, build, test, and improve manufactured products. However, during this time, increasing employment of engineers in service industries, research and development, and consulting should generate most of the employment growth \(^1\).

The 2015 National Science Foundation’s Survey of Graduate Students and Post-doctorates in science and engineering\(^2\) found that from 2008 to 2013 STEM graduate students in the U.S. who were U.S. citizens or permanent residents rose 3.1\%. Of these, 25.8\% were Hispanic and 7.8\% were African-American.

“Finding Your Workforce: Latinos in Science, Technology, Engineering, and Math (STEM)”\(^3\) 2015 report found that between 2010 and 2013, the credentials earned by Latinos in STEM have increased by 40.74\%. Hispanics earned 9\% of all degrees and certificates awarded in 2013 for STEM.

As a minority serving institution, San Antonio College has a stated mission to attract and engage minorities on a path toward higher education. A high level of achievement in Science, Technology, Engineering, and Mathematics (STEM) education is essential if the U.S. is to maintain a leading role in aeronautics, space science, and technology. Based on the given realities, for the last fifteen years San Antonio College has been on a continuously ascending path to attract and retain more students, in particular minorities, into the STEM fields as well as striving to align its engineering program with the engineering programs offered by the surrounding area four-year institutions\(^4\),\(^5\). At the same time this college’s engineering faculty made every effort to provide the highest quality education for our students\(^6\).

Starting in 2004 with the EDGE program\(^7\), continuing with service learning programs\(^8\),\(^9\), opening in 2007 the first and only MESA (Mathematics Engineering Science Achievement) Center in Texas\(^10\), and initiating in 2010 a continuous undergraduate research program\(^11\) our college increased the number of students with a declared major in engineering from 164 in 2001 to 858 in 2014. These results prove the findings from previous studies that engaging students in authentic hands-on and interactive educational activities is essential to facilitate and enhance learning in the STEM fields. It has become clear over the past two decades that undergraduate
research experiences have consistent positive correlations with student persistence and achievement. [12], [13], [14], [15]

Our continuous growth was supported with grants from N.S.F., Department of Education, and N.A.S.A. and attracted partnerships with various four-year institutions such as University of Texas at San Antonio, Wright State University, and more recently Texas State University.

In October, 2014 Texas State University formed an initial partnership with three minority serving institutions (San Antonio College, Southwest Texas Junior College, and Costal Bend College). In the second year, a fourth minority institution partner will be added. In the third and final year, the fifth minority institution will be selected and added from among the most deserving and interested institutions. Through this partnership, called REENERGIZE, it is expected that the two-year colleges will develop their own research capabilities in renewable energy based on collaboration with Texas State [16, 17].

**Plan of Operation**

The purpose of the Re-Energize program is to establish a continuous, year-around creative research and development (R&D) and professional development (PD) ecosystem to empower institutions of higher education who prepare students in engineering and engineering technology in Central Texas to continue to do so with enhanced and focused knowledge, facilities, and student programs for the surrounding area two-year colleges. Re-Energize addresses the learning needs of faculty and students via a systems approach and aims to serve as a replicable and scalable national model.

Later, with the funds that would be available through the MSEIP – Special Project program, each of the partnering institutions will establish a replica of the research and education lab in their own facilities, which will be operated as an independent and collaborative entity within the network of institutions that is established under this grant. A meeting will be held at the end of each year to discuss and adopt lessons learned from the collaborating institutions. Faculty and administrators of all partnering institutions are interested and eager to approach both regional higher education collaboration and to provide support for students with additional and valuable skills in green technologies.
San Antonio College has an enrollment of 26,000, of which 53% are Hispanic and 6.3% are African-American, has excellent faculty who are committed to preparing their students to acquire the knowledge and skills needed for success in college and career, and has the Eco Centro facility that already initiated a strong green energy program within the community. The details of the plan of operation are as follows:

**Goal and Objectives**

The goals for San Antonio College are derived from the overall goals and objectives of the official Re-Energize program developed for all six institutions involved.

**Goal:** In the Re-Energize program, Texas State University-San Marcos (the host-hub institution) will provide training, service, and research assistance in renewable energy research and education to four faculty from San Antonio College to promote STEM programs in the form of a sustainable and attractive education and research program. San Antonio College will work with Texas State University in serving students by establishing a permanent renewable energy education and research lab that will be leveraged to support the professional development of Science, Technology, Engineering and Mathematics (STEM) faculty through a broad, inclusive set of green technologies and practices (GTP). The main goal of this collaborative effort is to share effective new GTP content and impart skills to faculty teams from these institutions in order to strengthen their capacities and arm them with additional resources to support their efforts in recruiting and retaining students in STEM programs offered at their institutions.

The objectives are as follows:

**Objective #1:** Increase the number of STEM faculty from San Antonio College with enhanced professional development experiences via the proposed trainings in green energy and sustainability topics as well as best practices in pedagogy and culturally effective instruction.

- **Activity 1.1:** Design and develop a permanent renewable energy research and education lab at the Eco Centro.
- **Activity 1.2:** Provide training workshops for the faculty, staff, and selected individuals from STEM education.
- **Activity 1.3:** Texas State will provide support, train, and partner with San Antonio College faculty to address their research and educational needs.
Activity 1.4: Texas State will host a seminar/mini-conference at Texas State at the end of each of the three years to discuss and adopt lessons learned.

Activity 1.5: Selected minority women faculty (and students as appropriate) will be invited to attend the annual Women in Science and Engineering (WISE) conference at Texas State.

Objective #2: Provide awareness, training, and financial support to attract and motivate students from the minority institutions to consider education and career opportunities in STEM.

Activity 2.1: Texas State will provide support for events at the Eco Centro for raising awareness of the many possible STEM career opportunities and recruiting students into the STEM fields.

Activity 2.2: The program will create a big brother/big sister mentorship between students in the participating institutions and industry or graduate school mentors.

Activity 2.3: Texas State will facilitate a day-long tour for the participating students to Texas State labs and facility with STEM-oriented educational and entertainment programs.

Activity 2.4: Texas State will provide research assistantship through the financial support to students in the minority institutions.

Objective #3: Design and develop a replicable renewable energy laboratory to carry out the training and hands-on activities proposed in the Re-Energize program. A replica of the lab will be established at Eco Centro to operate independently once the training is completed.

Activity 3.1: Texas State will establish a replicable renewable energy laboratory, which consists of one 100W solar panel kit that includes a solar panel, charge controller, inverter, breakers and mounting kit, and one 400W wind turbine kit that includes a charge controller, inverter, breakers and data server at the Eco Centro. These professional level kits will be great tools for teaching and research.

Activity 3.2: San Antonio College will nominate selected members of STEM faculty and encourage as well as support them to attend the designated Re-Energize professional development activities to learn and adopt green energy educational modules.

Activity 3.3: San Antonio College will utilize the funding provided by Texas State and designated for the establishment of a start-up green lab (as defined by specific parameters) and follow Texas State guidance regarding technical training and support.

Activity 3.4: San Antonio College agreed to participate in on-going evaluation and research efforts related to this program.
Results of the First Year (1 Oct 14 to 30 Sep 15)

Objective 3, Activity 3.2:
Three STEM faculty (two engineering and one environmental) attended a weeklong training seminar at Texas State University from 18 to 22 May 2015. Texas State faculty and industry representatives provided a detailed overview of the Re-Energize program including partner institution responsibilities, as well as instruction on sustainable/renewable energy systems and demonstrations of solar, wind, and rainwater catchment systems. Texas State also provided a tour of their engineering/manufacturing lab facilities. At the end of the week, San Antonio College faculty developed proposed educational modules/activities for use in classrooms to improve student awareness and learning in sustainability and renewable energy systems. Activities planned included a sustainable home team project for San Antonio College’s Introduction to Engineering course and renewable energy application problems to be used in quizzes, tests, or as homework in engineering or mathematics classes.

Figure 1 - Additional equipment allows STEM students to conduct research on the level of plant nutrition found in our worm compost

Objective 3, Activity 3.3
The Re-Energize grant has paved the way for San Antonio College to significantly expand the
scope of its undergraduate research projects. In addition to acquiring the equipment for a solar hydroponic project, the year-one funding made it possible to acquire equipment that will enhance the ongoing vermicompost and soil enrichment research project. A team of STEM students have worked on that project for three years, but recent addition of new equipment and a dedicated lab will make it possible to elevate the sophistication of the undergraduate research. The vermicompost project links to the solar hydroponic project because one of the liquid nutrient mixes will include worm castings generated at our worm farm, which now houses about a million worms.

Equipment is now on hand to launch research projects in the realms of water quality and air quality. These are both major issues of concern for our local community and community support for both projects is likely to be forthcoming. Expansion of the vermicomposting project and into the water/air quality realms promises to expand involvement of non-engineering STEM students who would like to approach research from biological or chemical perspectives. The advent of a dedicated environmental research lab coupled with greater involvement of our student researchers gives the undergraduate learning experience a practical hands-on dimension that contributes to greater student engagement.

Figure 2 - New environmental lab equipment facilitates water and air quality research
Objective #3, Activity 3.1 and 3.3
Rather than limit the participation of stem students to monitoring installed equipment, staff and faculty at San Antonio College added a functional component to the solar project which involves supplying power to a solar hydroponic project located on the grounds of the William R. Sinkin Eco Centro. During the first year of the Re-Energize project, STEM students at San Antonio College took on a daunting project launch. From the beginning, the group decided that they would go well beyond the original energy generation and monitoring scope of the grant by adding a research component involving the design and assembly of a solar hydroponic project in a shipping container located at the William R. Sinkin Eco Centro facility. With assistance and input from faculty, staff and researchers at San Antonio College and several other institution of higher education in the United States and Europe, they designed a containerized vertical agriculture system that will primarily be powered by solar energy.

![Image](image.jpg)

**Figure 3 - Students prepare to mount REENERGIZE solar panels with vertical hydroponic rack in the background**

The solar hydroponic problem focuses on reducing energy consumption associated with lighting and climate controls found in commonly accepted hydroponic projects. The heavy energy load leave them heavily dependent on energy drawn from electrical grids. In addition, cost of grid-
supplied energy undermines the cost competitiveness of greenhouse-grown leafy greens and vegetables.

Through the adoption of multiple insulation layers, low-wattage LED grow lights, and efficient pumps, the solar hydroponic system developed by the STEM student team aims at dramatically reducing grid dependence by reducing the overall electrical load of the system. In addition, our vertical agriculture strategy adapted for use in a 40’ shipping container maximized production per square foot. The containerized agriculture system using controlled-spectrum LED lighting in a vertical agriculture layout will improve yields of leafy greens relative to conventional in-ground growing methods while reducing water and energy consumption. The late-December 2015 meeting with hydroponic researcher Amanda Lewis of Vageningen University in the Netherlands adds a new dimension to the project by exposing out STEM students to the world’s most advanced and successful hydroponic strategies, some of which could be incorporated into the implementation phase of this project in years two and three.

In compliance with the Re-Energize grant, STEM students are also playing an important role in installing a separate two-panel solar energy monitoring system that will feed data to Texas State University. That data will be compiled and evaluated relative to data provided by the other three partner colleges/universities in the Re-Energize program. Equipment comprising the laboratory’s solar output monitoring component were mounted at the William R. Sinkin Eco Centro facility during a joint work session involving faculty and graduates of Texas State University as well as faculty, staff and students of San Antonio College held on 16 October 2015.

The final stage of installation is scheduled for January, 2016 upon the arrival of an eGauge energy display system and updated weather station. At that time the coordinated energy output of the grant will be in full operation. STEM students at San Antonio College have played an active role in the installation of the solar energy output system to date and will participate in the installation of the remaining components. Since the electrical equipment box for the solar component will be located outdoors, students have developed a plan for weatherizing the box which is currently vulnerable to water penetration during rainstorms. Once the initial installation phase of the solar energy output equipment is complete, STEM students will monitor output and periodically check to ensure that data is being transmitted to Texas State University as stipulated by the Re-Energize grant.
By the end of the second year of the Re-Energize grant, the solar energy output component will be in full operation. In addition, the first stage of leafy green production in the solar hydroponic containers will be operational. Research will be underway focusing on several variables in hydroponic food production. The variables include light spectrum and liquid nutrient mixes. In support of the Re-Energize grant, several strategies for minimizing dependence on the electrical grid and maximizing our reliance on solar energy will be employed. Rather than assemble the 400-Watt wind energy kit mentioned in the Re-Energize grant, our college opted for refurbishing a higher-capacity wind generation system donated by Microsoft. The system had multiple years of use prior to donation and was not operational upon arrival. STEM students in the renewable energy degree program at San Antonio College’s sister college (St. Philip’s College) refurbished the wind generation component and the system awaits installation pending the availability of funding for the support structure.

Objective 3, Activity 3.4:
On September 18, 2015 San Antonio College provided Re-Energize surveys completed by 68 STEM students to Texas State. These surveys provided demographic information, interest and
opinions on STEM careers, and attitudes towards green energy and sustainability. In addition, San Antonio College recruited 21 STEM students (18 male, 3 female) as volunteer participants in the Re-Energize program, including 16 minority students (13 Hispanic, 3 African-American). Ten of these students along with the three San Antonio College STEM faculty attended the end of year one Re-Energize seminar hosted by Texas State where all institutions provided up-to-date status of their Re-Energize activities (see Appendix I). In addition, students were given a tour of Texas State engineering/manufacturing lab facilities. San Antonio College also formed 8 mentor-mentee pair relationships between STEM faculty and STEM students in Year 1. Inspired by the ideas generated by Re-Energize project a team of eight engineering and chemistry students along with two faculty members worked together in the summer of 2015 to convert a worn-out gas utility cart scheduled to be salvaged into a solar-electric vehicle. The solar cart summer undergraduate research project was funded through a National Science Foundation Louis Stokes Alliances for Minority Participation CIMA Alliance grant along with donations from Alamo Colleges. The solar cart design includes four 12-volt batteries, two 230-watt photovoltaic (solar) panels (one on a slide mount), and a four horsepower, 48-volt DC electric motor. It will be used by the San Antonio College MESA Center at various school events to showcase renewable energy technology and to increase students’ interest in STEM careers as well as the Re-Energize program.

During Year 2 of the Re-Energize program a team of more than 20 energetic engineering students (mostly Hispanic) from San Antonio College with the assistance of Texas State University students will design, build and test a hydrogen fuel cell prototype vehicle in order to compete in the prestigious Shell Eco-Marathon Americas tournament (shell.com/ecomarathon) in Detroit in April, 2016. Winners in this tournament are determined by the vehicles that travel the furthest using the least amount of fuel/energy. This complex and difficult undergraduate research project challenges students to design and build the most energy-efficient vehicle possible. This project is expected to be a showcase activity for the Re-Energize program and has generated more interest and participation by SAC STEM students than any previous undergraduate research project.
Conclusions

The main goal in Year 1 of this collaborative effort is to involve STEM students in developing and sharing effective new green technology content while also imparting skills to faculty members of this network. After a slow start due to countless administrative adjustments between multiple institutions the project ramped up quickly with equipment acquisitions, faculty training, student recruiting, and research team formation and project execution. San Antonio College has been successful in meeting the Year 1 objectives of the Re-Energize program and is well-positioned for executing Year 2. All participants are united in strengthening their capacities and arming themselves with additional resources to support efforts to increase recruitment and retention of students, especially minorities and females, in STEM programs offered at their institutions.
References


4. Forging Stronger Ties between Community Colleges and Four Year Universities, by Dan G. Dimitriu and Jerry O’Connor, ASEE Conference, Salt Lake City, UT, June 2004

5. Community Colleges Can Help Universities During ABET Accreditation Efforts, by Dan G. Dimitriu and Jerry O’Connor, ASEE Conference, Louisville, KY, June 2010

6. The Need for a Quality Control System for Community College Engineering Education, by Dan G. Dimitriu and Jerry O’Connor, ASEE Conference, Honolulu, Hawaii, June 2007


8. Introduction of Service Learning in a Freshman Engineering Course, by Dan G. Dimitriu and Jerry O’Connor, ASEE Conference, Pittsburgh, PA, June 2008


10. The Five Years Evolution of a MESA Program, by Dan G. Dimitriu and Jerry O’Connor, ASEE Conference, Atlanta, GA, June 2013

11. Initiation of an Undergraduate Research Program, by Dan G. Dimitriu and Jerry O’Connor, ASEE Conference, San Antonio, TX, June 2012


17. Reenergize project website: http://reenergize.engineering.txstate.edu/
Appendix I

San Antonio College Re-Energize Project, Year 1 Results and Year 2 Proposals, PowerPoint Presentation by Steven Lewis, Dan Dimitriu, and Klaus Bartels, September 18, 2015

REENERGIZE
Solar Hydroponic Project
William R. Sinkin Eco Centro
San Antonio College

Steven Lewis
486-0417 (office)
454-8632 (cell)
1802 North Main Avenue
San Antonio, TX 78212

Dan Dimitriu
and
Klaus Bartels
San Antonio College

San Antonio College REENERGIZE Mentor – Mentee Pairs

<table>
<thead>
<tr>
<th>Mentor</th>
<th>Title and Department</th>
<th>No. of Mentees</th>
<th>Gender/Race/Ethnicity</th>
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<tbody>
<tr>
<td>Dr. Dan Dimitriu</td>
<td>Engineering Coordinator, Physics, Physics/Engineering/Architecture Dept.</td>
<td>1</td>
<td>Male/Caucasian/Hispanic</td>
</tr>
<tr>
<td>Steven Lewis</td>
<td>Director, Eco Centro</td>
<td>4</td>
<td>3 Males/Caucasian/Hispanic</td>
</tr>
<tr>
<td>Klaus Bartels</td>
<td>Adjunct Faculty, Math Dept. and Physics/Engineering/Architecture Dept.</td>
<td>1</td>
<td>Male/Caucasian/Hispanic</td>
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<tr>
<td>Gustavo Valdez</td>
<td>Adjunct Faculty, Math Dept.</td>
<td>1</td>
<td>Male/African-American</td>
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San Antonio College REENERGIZE
Student Participant Demographics

Total Students: 21

Gender: 18 male, 3 female

Minorities: 17
  ◦ 13 Hispanic – 11 male, 1 female
  ◦ 3 African-American male
  ◦ 1 Asian-American female

Majors: 18 Engineering, 1 General Science
  1 Horticulture, 1 Undeclared

SAC REENERGIZE
Activities Embedded in Classes

<table>
<thead>
<tr>
<th>Activity</th>
<th>Courses</th>
<th>Students per semester</th>
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<tbody>
<tr>
<td>Sustainable Home Team Project</td>
<td>ENGR 1291 – Introduction to Engineering</td>
<td>70 – 75</td>
</tr>
<tr>
<td>Renewable Energy Application</td>
<td>MATH 0310 – Introduction to Algebra</td>
<td>30</td>
</tr>
<tr>
<td>Renewable Energy Quiz or Test</td>
<td>ENGR 1291 – Introduction to Engineering</td>
<td>70 - 75</td>
</tr>
<tr>
<td>Problem</td>
<td></td>
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</tbody>
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SAC REENERGIZE
CAMPUS & COMMUNITY INFO SESSIONS

<table>
<thead>
<tr>
<th>Activity</th>
<th>Presentation Type</th>
<th>Number Served Year 1</th>
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<tr>
<td>Project explanation to students</td>
<td>On-site proof of concept description</td>
<td>120</td>
</tr>
<tr>
<td>Project overview to eco Centro visitors from the campus and surrounding community</td>
<td>Classroom descriptions coupled with area tours</td>
<td>30</td>
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</tbody>
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SAC REENERGIZE
Student Surveys

<table>
<thead>
<tr>
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<th>Students Completing Surveys</th>
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<tbody>
<tr>
<td>RE-1</td>
<td>69</td>
</tr>
<tr>
<td>RE-2</td>
<td>68</td>
</tr>
<tr>
<td>RE-3</td>
<td>68</td>
</tr>
<tr>
<td>RE-5</td>
<td>TBD – Will take after 20 hrs. of research completed</td>
</tr>
</tbody>
</table>
SAC REENERGIZE
Other STEM Outreach Activities Toward Minority and Female Minority Students

ReEnergize Students will participate in outreach events informing the campus and urban community through events such as:

- MESAable at Welcome Back Days – every Fall and Spring Semester
- MESA Center Colloquium (campus) – Fall Semester – student’s disseminate research
- STEMulate (campus) – in September and February
- Alongside Eco-Centro for:
  - SACtacular – Fall Community Event
  - Earth Day – Spring Community Event
- CORE 4 STEM family day – Community Event sponsored by San Antonio College and the Hispanic Chamber of Commerce – every October
- ReEnergize students could contact faculty and schedule classroom visits

REENERGIZE YEAR 1 PROJECT

Solar Hydroponic System
# LAND IN FARMS

<table>
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<tr>
<th></th>
<th>2007</th>
<th>2012</th>
<th>% Change</th>
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<td>Land in farms</td>
<td>14,972,789</td>
<td>14,748,107</td>
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<tr>
<td>Total cropland</td>
<td>7,609,210</td>
<td>7,526,742</td>
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<tr>
<td>Cropland harvested</td>
<td>4,387,169</td>
<td>4,342,904</td>
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<tr>
<td>Woodland</td>
<td>1,988,322</td>
<td>2,139,141</td>
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<tr>
<td>Permanent pasture</td>
<td>4,775,287</td>
<td>4,518,550</td>
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</tr>
<tr>
<td>Other land</td>
<td>599,970</td>
<td>563,674</td>
<td>-6.0</td>
</tr>
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Weighted average source distance miles traveled from farm to table by food type:

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<th>Produce Type</th>
<th>Locally grown W ASD (miles)</th>
<th>Conventional Source Estimation W ASD (miles)</th>
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<tr>
<td>Apples</td>
<td>61</td>
<td>1,726</td>
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<tr>
<td>Beans</td>
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<td>1,313</td>
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<tr>
<td>Broccoli</td>
<td>20</td>
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<tr>
<td>Cabbage</td>
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<td>710</td>
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<tr>
<td>Carrots</td>
<td>27</td>
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<tr>
<td>Corn, Sweet</td>
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<tr>
<td>Garlic</td>
<td>31</td>
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<tr>
<td>Lettuce</td>
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<tr>
<td>Onions</td>
<td>35</td>
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<tr>
<td>Peppers</td>
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<td>1,589</td>
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<tr>
<td>Potatoes</td>
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<td>1,155</td>
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<tr>
<td>Pumpkins</td>
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<td>311</td>
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<td>Spinach</td>
<td>36</td>
<td>1,815</td>
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<tr>
<td>Squash</td>
<td>52</td>
<td>1,277</td>
</tr>
<tr>
<td>Strawberries</td>
<td>56</td>
<td>1,830</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>60</td>
<td>1,569</td>
</tr>
<tr>
<td><strong>W ASD - for all produce</strong></td>
<td>56</td>
<td>1,494</td>
</tr>
<tr>
<td><strong>Sum of all WASDs</strong></td>
<td>716</td>
<td>25,301</td>
</tr>
</tbody>
</table>

Source: United States Department of Agriculture
Major advantage in land utilization

Major advantage in water consumption

Disadvantage in energy consumption

Shipping container used for solar hydroponic project prior to starting
Supplies trickle in

Engineering students begin assembly of first hydroponic unit
The project’s tubing sits on partially completed rack

The horizontal hydroponic stand assembled
The vertical hydroponic stand assembled with first tube in place

New panels from Mr. Solar available for the project
Our goal is to collaborate with San Antonio’s pioneering vertical agriculture company (Local Sprout) to develop an improved and less costly containerized hydroponic system incorporating solar energy.

PROJECT COLLABORATION

- TEXAS STATE UNIVERSITY
- ST. PHILIP’S COLLEGE
  Alamo Colleges
- LOCAL SPROUT
  San Antonio
- REENERGIZE TEAM
  San Antonio College
  Alamo Colleges
- WAGENINGEN UNIVERSITY
  The Netherlands
- SOUTHWEST RESEARCH INSTITUTE
  San Antonio
**SAC REENERGIZE** Related Activity

**SOL GO ARV Undergraduate Research Project**
(Solar Go Alternative Resources Vehicle)

**Goal:** Convert gas utility cart into a solar-electric vehicle that will showcase alternative energy technology and increase students' interest in STEM careers.

**Team Composition:**
- Mechanical Team: 4 students, 1 faculty advisor
- Electrical Team: 4 students, 1 faculty advisor

**Major Components:**
- Two 230 W rooftop solar panels (one slides out)
- 48V, 4 HP DC electric motor with belt drive
- Four 40AH 12V sealed lead acid batteries
- Original frame, suspension, brakes, steering, & differential

**Project Dates:** 8 Jun 2015 to 16 Sep 2015

**Funding:** NSF Louis Stokes Alliance for Minority Participation Grant (Award #1095001)

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**SAC Year 2 REENERGIZE Research Project**

**Solar Hydroponics – Phase II**

**Goal:** To put both horizontal and vertical hydroponic tubing systems into full operation for the production of leafy greens and experiment with low-energy grow light systems drawing upon solar energy.

**Team Composition:**
- Faculty Advisor (1)
- On-Site Coordinator (1)
- Students (4)

**Major Objectives:**
- Optimize use of solar energy as a power source
- Achieve optimal lighting conditions for production of leafy greens
- Demonstrate production cost viability for locally produced leafy greens

**Major Components:**
- Four REENERGIZE solar panels backed up by 135-roof mounted panels at Eco Centro
- Racks of horizontally and vertically mounted hydroponic channels
- Multiple climate control devices/systems to achieve temperature stability

**Total Projected Cost:** $5,000 (student stipends funded by REENERGIZE grant and faculty event stipend)

**Schedule:** Ongoing with year 2 readjustment of student team scheduled for October 2015
SACyR 2 REENERGIZE Research Project
Hydrogen Fuel Cell Prototype Vehicle

**Goal:** Design, construct, and test a highly efficient hydrogen fuel cell-powered prototype vehicle that will compete honorably in the prestigious Shell Eco-Marathon in April 2016

**Team Composition:**
- Faculty Advisors (1 Project, 1 Mechanical, 1 Electrical, 1 Business)
- Mechanical Team (5 students)
- Electrical Team (5 students)

**Design Objectives:**
- Extremely low fuel consumption (maximum mpg)
- Lightweight and Aerodynamic
- Reliable and Durable (when driven approx. 6 mi. on Detroit streets)

**Major Components (proposed):**
- 500 W, 18V PEM hydrogen fuel cell
- Lightweight, aerodynamic body and frame; bicycle wheels
- Two 150 W DC electric motors

**Total Projected Cost:** $35,000 est. (partially funded by REENERGIZE grant)

**Notes:** Project dependent on successful fundraising. TX State technical advice welcomed.

eGauge data display in operation

Solar PV and wind energy trainer
Promote global warming...
Prevent global warming!

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Telephone: 486-0712 or 486-1874
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https://www.facebook.com/EcoCentro