E^2 Energy to Educate℠

Social responsibility is one of Constellation's core foundational values. We believe that providing quality educational opportunities and career development are among the most important tools to help communities succeed in the long term. As part of our commitment to education, E^2: Energy to Educate Grants support projects that are team oriented, learning focused, hands-on demonstration projects with specific results. E^2 Energy to Educate projects enhance student understanding of the science and technology needed to address energy issues, and reach and inspire students to think differently about energy.

2018 E2 Energy to Educate – Highlights

- **20 projects awarded more than $450,000, reaching more than 18,000 students nationwide**
  - Student projects include solar car competitions, fuel cell technology, wind power and learning energy concepts via an interactive gaming platform.

2018 E^2 Energy to Educate – Awardees

Albany State University

Albany, GA

At least 100-150 middle and high school students will be directly involved in the design of a solar powered irrigation system. The design process includes the estimation of the water pump capacity and the solar panel sufficiency to run the pump. The students will learn about the design, calculations, various constraints in the design and budget, and the selection of appropriate materials or devices. Initially, the design work will start with the estimation of daily energy demand. After that, the students will calculate the wattage size of the solar panel taking into account the average sunlight exposure data for the state of Georgia. Finally, the students will consider the power loss that occurs in the cables, wires and joints to determine the actual wattage of the solar panel for practical implementation in the field. At the end of the project for follow-up student learning and engagement, a group of students will be selected from each participating school to design a small system suitable for a classroom setting. The assembled system will be demonstrated at a local science fair competition. This project will be carried out during the spring and fall semesters with a different cohort of students from the two schools. In the summer, a solar camp will be hosted at Albany State University and all local school students will be invited to participate in the learning activities associated with the solar powered irrigation system design mentioned above. Additionally, the camp participants will be taken to a nearby solar farm for a field trip to expose the students to real-world application. The expected outcome of the project will be to motivate at least 30% more students towards choosing a solar energy related STEM career.

Cape Fear Community College
Wilmington, NC
Cape Fear Community College students will design and build two single-person solar cars which will compete in a solar car event. A set of rules and regulations are being created to make the project safe, cost effective, and achievable for community college level students. All colleges in the North Carolina Community College System are being invited to compete in this event where the team whose car completes the most laps in three hours using only solar power will be declared the winner. The event will be an opportunity to showcase the teams, colleges, and students to the media and general public.

Carnegie Mellon University
Pittsburgh, PA
The Carnegie Mellon Racing Team is a group of students that build 100% electric vehicles from the ground up each academic year. The team devotes thousands of hours to designing the vehicle using industry-level system analysis and 3D CAD software, then physically builds it once the designs have been validated. Once the vehicle is completed the team allocates time to testing and tuning the vehicle to collect data and see where improvements could be made. The team then participates in two competitions at Formula North in May and FSAE Electric in June. At these competitions our team competes in events against teams from around the world.

Clarkson University
Potsdam, NY
Food waste (FW) is a valuable resource, yet Americans discard 40 million tons in landfills annually. Anaerobic digesters easily treat FW to recover energy and produce effluent that can be used as fertilizer, as long as the food waste stream is void of contamination. Diverting FW from the solid waste stream requires a cultural change within the population so that organic waste streams of high enough quality can be generated. Through a partnership between Clarkson University and the public K-12 school in Canton NY (Canton Central School District), we will train more than 60 college students and teach more than 375 K-12 students the benefits of resource recovery (RR) and the need to reliably generate a “contaminant free” organic feedstock for RR. College students will develop and deliver classroom activities and mentor K-12 students in a newly created resource recovery program at the school. Post-consumer food waste will be collected at the school cafeteria and delivered regularly to Clarkson’s small scale anaerobic digester at the nearby farm operated by Cornell Cooperative Extension of St. Lawrence County (CCE). Workshops for teachers will generate school-wide expertise so that the program will be sustainable for years to come and will become a model for other school districts. Clarkson students will simultaneously create and implement a sister-pilot program on the Clarkson campus to supplement the feed stream to the anaerobic food digester on campus.

Coppin State University
Baltimore, MD
Depletion of fossil fuel has had a severe negative impact on the environment. Renewable energy is the solution to the over reliance on non-renewable energy such as fossil fuels. An attractive alternative to fossil fuel is the exploitation of renewable energy sources such wind, solar, hydro, biomass, geothermal and hydrogen. These energy sources do not deplete and are generally environmental friendly. The project will involve the production of biofuel from waste products.

Students will become familiar with chemical synthesis, chemical characterization, experimental data analysis and evaluation. Students will be introduced to the various generation of biofuels and how they are generated. Biofuel are important because they hold promise in battling climate change, meeting higher energy demand and safeguarding energy availability. Also, using waste products in the generation of biofuel ensures that scarce resources that would have been used for this purpose is channeled for other needs. Over 300 students from Al-Rahmah (AR), Bluford Drew Jamison STEM Academy (BDJ), Coppin Academy (CA), Coppin State University (CSU), will be enlightened on the production of biofuel, the characteristics and various applications. Students will be tutored on different generation of biofuels. They will also have the opportunity to carry out the synthesis of biofuel using different waste materials. The students will be guided by ten faculty and five staff scientists. Upon completion of the project, each student be expected to:

- Have a good understanding about the three different generations of biofuel
- Synthesize biofuel using a waste material
- Perform at least one experiment and analyze their findings
- Present their findings at STEM DAY, symposium and conferences including the science fair competition, Energy-path conference and ACS regional and national conferences

Dallas Secondary Educational Academy

Dallas, TX

All students at Dallas Academy (DA) have a diagnosed learning disability, and our students learn best from hands-on activities. Texas set new records for energy use in 2018, as July temperatures reached at least 111 degrees. Dallas Academy students are excited about the idea of building a Zero-Carbon Model Home to learn about and encourage energy conservation. From January to May 2019, 100 middle and high school students will learn as they build a zero-carbon model home. They will install smart glass, solar panels, wind turbines, magnification tubes that concentrate sunlight inside, geothermal water heating, barrel and pump rainwater collection system, bio digester grey water system, cooling drywall sheetrock, on-site, self-sustaining farm/greenhouse, a green roof, and other systems to ensure the house uses less energy than it generates. In May 2019, students will host an all-school and public event to present the zero-carbon home, explain how each aspect of the home operates, and announce the winner of the at-home energy conservation challenge with analysis of the winning strategies.

Joliet Junior College

Joliet, IL

Joliet Junior College will provide 225 female students from low-income middle/junior high schools an opportunity to expand their STEM knowledge by learning about energy, specifically solar powered and hydrocar fuel cell cars, and becoming a design engineer. Through three-day workshops, students will learn principles of basic physics, mechanics, and solar/hydro energy while also developing critical thinking and problem-solving skills. Two workshops will be offered for 2019. The first will use commercially available instruction kits to allow students, working in teams, to design their solar-powered cars, learn about solar/photovoltaic (PV) cells, troubleshoot, and prepare to test their car's functionality. In addition, girls will have the option of continuing their education in sustainable energy through a second workshop that focuses on designing Hydrocar Fuel Cell cars. Through kits they will learn how clean-energy fuel cells convert hydrogen gas to electricity and water. As an end project in both workshops, the girls will

be able to share their experience with the design process, and ultimately race their cars to determine the most successful design.

Kean University
Hillside, NJ
The project proposed would continue running a reach out program that provides workshops for 150-180 high school students and 25-30 educators to learn the basics, applications, and impacts of renewable energy through hands-on activities and software tools.
Five workshop options will be provided in the following ways:
● Solar panel workshop: participants will learn about basic PV cell concepts and test PV cells in different conditions.
● Fuel cell workshop: participants will learn about fundamentals of fuel cells and set up an experimental kit which converts solar energy to electricity using a solar panel and fuel cells.
● Home energy use workshop: participants will learn about energy efficiency concepts and measure the energy consumption used in houses and buildings which are utilizing renewable energy.
● Wind turbine workshop: participants will learn about configuration and mechanism of wind turbines and test how wind turbine efficiency changes with blades' shape.
● Life cycle assessment (LCA): participants will learn about LCA concepts, components, and standards. These participants will be taught how to use a LCA software tool to estimate environmental impacts of renewable energy at home.
The program will offer workshops at Kean University's Union campus which is located near Elizabeth, a city with many underserved communities in New Jersey. Also, the program will offer workshops at the high schools' campuses in order to reach out more communities across the New Jersey. The project is expected to promote sustainability study in high schools and therefore increase the amount of students majoring in Sustainability Science at colleges and universities.

Legends of Learning
Washington, DC
Legends of Learning leveraged a 2017 Constellation E2 Energy to Educate grant to build games for Baltimore City Public Schools to help teachers teach students about solar power, clean energy and energy storage. The games were deployed on Legends platform to students in Baltimore City in the Spring of 2018 and were extremely well received by teachers and students. Legends of Learning will leverage lessons learned and best practices, to a much broader audience in the Exelon & Constellation footprint. Legends of Learning will build three new games that cover the following topics: onsite generation, home energy data, electric vehicles and buses, vehicle charging infrastructure and energy storage.
The games will be made available for free to the school districts in perpetuity. Legends will work with the school districts and teachers to ensure fidelity of adoption of the games and usage in the classroom. We anticipate that the outcome will be increased engagement in STEM related activities and improved educational performance similar to the results of our published research with Vanderbilt University.

Mid-State Technical College
Wisconsin Rapids, WI
Project “Electric Vehicles: Pathways and Roadways” seeks to provide training opportunities on electric vehicle charging infrastructure installation for all members of our community and all levels of our educational career pathways. This project will engage the public through a set of free public presentations, electricians and electrical apprentices through electric vehicle charging infrastructure continuing education opportunities, Mid-State Technical College students enrolled in the Renewable Energy Technician Program and in the Construction Trades Technical Diploma through installation activities and local high school students and teachers through an energy literacy education program.

Rachel Carson Middle School
Herndon, VA
Our goal is to raise the necessary funds to install a grid-tied, 2.4 kW wind turbine with online data-logger on our school grounds. Just like our solar panels which have been in operation on our school's roof for more than eight years, the wind turbine will serve as a highly visible working example of capturing renewable energy for our use, as it generates pollution-free electricity for our school. The wind turbine and the data which will be available online to students will be used for science, technology, engineering and math education for all of our students for the next 20+ years. The wind turbine will also serve as a focal point of our community, a working model of an alternative energy device, which any community member can see up-close and learn more about online. All data and information will be available to anyone accessing our school's website and will be shared freely with other schools and organizations.

Rochester Institute of Technology
Rochester, NY
This project proposes to educate high school teachers and students in the area of electricity generation using fuel cells. The education program contains: (1) Online curriculum development to train high school chemistry and earth science teachers to prepare them to teach "Clean Energy/Fuel Cells for Electricity Generation"; (2) High school teachers incorporating the "Clean Energy/Fuel Cells for Electricity Generation" as a unit into their chemistry and/or earth science high school program for at least 100 students; (3) Live hands-on laboratory experiments for high school teachers; and (4) Face-to-face lab sessions for high school students during summer 2019. The experiments will include: (a) "Constructing a Hydrogen-Oxygen Fuel Cell", (b) "Electricity Generation with a Hydrogen Fuel Cell and Hydrogen Stored in a Tank", (c) "Measuring the Amount of Hydrogen Stored and Released from Chemical Compounds and Electricity Generation with a Fuel Cell", and (d) “Solar Electrolysis of Water”. The lab sessions will also be held via recorded video where students will present in a virtual lab room. The project proposes to expand the training to “New York State Clean Energy Communities”.

Rowan University Foundation
Glassboro, NJ
This project will focus on educating Rowan University engineering and Glassboro area high school students on renewable energy based sustainable transportation using solar powered battery operated vehicles. As a part of the engineering clinic program at Rowan it would be a

team oriented, learning focused, hands-on project based course that would also be partnered with the College's outreach program to provide exposure to high school students to the technologically challenging problem of Green Transportation. The Formula Electric project is an interdisciplinary engineering student team from Mechanical, Electrical, Biomedical and Engineering Entrepreneurship departments.
(1) The Formula Electric Clinic will require multiple student teams to design, build and test a new electric powered vehicle over the course of two years. The teams will learn by doing frame and body design, research into ways of maximizing solar charging, superior energy storage and battery performance options, design and assemble drivetrain, steering and regenerative braking systems, as well as encompass other important aspects of electromobile engineering.
(2) Students will acquire important computational and mathematical skills such as energy efficiency analysis, CFD aerodynamic analysis, 3D CAD based stress analysis, engineering system analysis, as well as business skills like cost-benefit analysis and project management.
(3) To help develop the students' understanding of green fuels like biodiesel, green technologies like fuel cells, and enable them to measure the impact of current transportation systems on the environment. Additionally, to empower the students to see a future in the green energy/technology sector and inspire them to go for a career in this field.
(4) Provide educators with the relevant student data based on their experiences with the design, fabrication and testing process, interactions with their peers and teachers while conceptualizing and iterating upon ideas, and thereby helping to supplement the renewable energy program at Rowan University.
(5) Engage our outreach resource network to educate the K-12 students in electric vehicles technologies by adopting a fun, hands-on approach to illustrate the fundamental concepts of energy generation, energy conversion, energy storage and electric motors.

Solar One
New York, NY
Solar One's Green Design Lab™ (GDL) program is an award-winning K-12 environmental education program and curriculum, developed in partnership with the NYC Department of Education (NYC DOE). The GDL uses the school community as both a laboratory for learning and a tool for environmental change: through the program, students, teachers, and school staff learn about STEM subjects, environmental literacy, and promoting sustainable behaviors, while developing as environmental stewards and preparing for careers in the green economy. Our advanced high school level curriculum, called "CleanTech," addresses the needs of a wide range of high school classes from general education to vocational to advanced placement. Over the past eight years, the GDL has become the "go-to" energy and solar education program for the NYC DOE. Since its inception, our program has reached over 20,000 students, 3,300 teachers and 1,000 schools.

The Londonderry School
Harrisburg, PA
The Londonderry School is a non-profit green school (with an LEED certified building) situated on 14 acres of woodland in the city of Harrisburg, PA. Sustainability and the stewardship of the earth are fundamental components of education at Londonderry, especially in the areas of science, technology, engineering, and math. Students plant, tend, and harvest their own organic gardens, plan and implement zero waste lunches, design, build, and use their own compost bins, and design and build award-winning wind turbines. This project would allow for an expansion of

these efforts, essentially taking STEM education at Londonderry to the next level by funding the creation of a student-designed and -built entirely off the grid classroom. This classroom will be used to teach students about green engineering, solar and mechanical energy generation, and the practical actualization of STEM. It will also serve as the centerpiece of green education at Londonderry for students enrolled during the day, in afterschool, and in our many summer camps, and, hopefully (through community outreach), the wider community of students in the Harrisburg area, be they cyber, home, or traditionally schooled.

The Science and Math Investigative Learning Experiences

Kingston, RI

This project will support the implementation of a year-long 32-week curriculum for nine middle school SMILE clubs. The curriculum includes hands-on STEM learning activities and field-trips. The project also supports the Middle School Engineering Challenge held at the University of Rhode Island (URI) for 180 middle school students in March 2019. In preparation for the Challenge Weekend, SMILE students participate in 8-10 weeks of pre-activities in their clubs to learn about the science needed to address energy storage and waste issues. Students will learn about the various resources available to harness energy from (wind, tides, landfills, methane, etc.). Students will also learn and work with recharging batteries, and production of hydrogen from excess electricity produced by wind and how other energy storage systems work. They will also discuss ideas proposing other solutions to storing excess energy. During the challenge weekend, students will work on an engineering project to build a functioning model wind turbine. This project teaches students about energy and wind, renewable vs. nonrenewable energy sources, measuring and calculating wind power, wind turbine structures, and generators to produce electricity.

The Works: Ohio Center for History, Art & Technology

Newark, OH

The Works: Ohio Center for History, Art and Technology (The Works) and Denison University will collaborate to present a new Zero Waste Energy Challenge at an annual STEM competition called STEMfest at The Works. Teams of middle and high school students will take on the challenge of investigating compost reactors as a sustainable source of heat energy. Teams will present their solutions at STEMfest at The Works in February 2019, where they will have opportunities to win trophies, academic scholarships, and paid internships in STEM fields. The Zero Waste Energy Challenge will engage approximately 385 middle and high school students representing 25 rural and city schools in east central Ohio. The program will challenge student teams to generate an effective form of heat-energy from a home-made compost reactor, and to design a creative and practical way that compost energy could be used to replace or reduce current energy usage and/or waste.

Trustees of the Smith College

Northampton, MA

A significant campus wide decarbonization effort is well underway at Smith College, an all-women's undergraduate liberal arts institution located in New England. At Smith, leaders are cultivated by providing them with an entire campus as their classroom. From developing categorical methods to estimate campus wide heating energy losses with no metered data, to developing carbon proxy tax strategies to incorporate in to capital projects, students push the

boundaries of the institution to successfully promote innovational change.
During the summer of 2019, test boreholes will be drilled on campus for engineering design purposes related to the generation of a District Energy Master Plan. This project leverages those boreholes to heat and cool the Smith Field House, currently consuming fuel oil. Significant modifications will be made to a suite of courses offered at Smith across a wide range of disciplines. This demonstration project will be a central element to the campus-wide themed year on Climate Change in 2019-2020. Outreach opportunities will be expanded to incorporate this demonstration project through K-5 after school programs as well as intensive summer programs for high school women interested in STEM.

University of Memphis
Memphis, TN
In order for future leaders to most effectively and efficiently solve tomorrow's greatest energy challenges, our future leaders should be cognizant of all technologies at their disposal. Hence, there is a need to strategically expose and educate students on emerging, promising, less well-known technologies such as thermoelectrics (TEs) which uses heat to generate electricity and electricity to transfer heat. It has the potential to significantly reduce our dependence on fossil fuels and can drive technology innovation because TEs will help engineers visualize new and better solutions to the world's energy problems.
This project seeks to recruit and persuade 20 undeclared college students to pursue degrees in Science, Technology, Engineering and Mathematics (STEM) through engagement in a workshop and outreach experience. They will be educated on TEs and alternative energy sources, and then, they will be trained to educate local-area middle school and high school teachers on TEs as an alternative energy source – with teachers being provided with TEs materials to demonstrate TEs to their students. Selected student teams from local-area middle and high schools will be invited to participate in a TEs contest on Engineering Day at the University of Memphis.
More than 400 students will witness how TEs is applied in the real world via 1) demonstrations and lab exercises that convert waste heat to electricity and 2) demonstrations that use electricity to transfer heat. While exposure is the sole focus for students in grades seven through twelve, college students will obtain a fundamental understanding of TEs and basic energy-related concepts and will be assessed for understanding. The amount of funds needed for this project is $49,983.00, which includes university overhead, PI salary, part of one graduate student's time, and parts/materials costs. The scope of work will include hardware design, testing and verification; parts sourcing, ordering and assembly; instruction development; recruiting and training.

University of the Sciences
Philadelphia, PA
This project will enable a Renewable Energy-themed Summer Physics Camp for Middle School Girls, known as Physics Wonder Girls. Two elite cohorts of 15 rising 8th and 9th graders from diverse backgrounds are selected, on the basis of recommendations, grades and a personal essay, from a pool of top-performing students nominated by their science teachers. Mentored by the PI and an undergraduate STEM crew, the cohort will work in teams as they undergo an intensive week of project-building, experiments and demonstrations focusing on renewable energies: solar and wind energies, including their physical basis, generation, storage, transmission, and application, as well comparisons between conventional and organic solar cells. Campers will be treated to physics-based games, research lab tours, and inspiring STEM

career talks by women scientists and engineers from the private sector and academia. The camp will end with a capstone Community Energy Show by the newly-minted Energy Girl Ambassadors who will perform their favorite energy demonstrations to a roomful of family, teachers and friends. For even broader impact, the girls will participate in community energy outreach at the annual Philadelphia Science Carnival, which is visited by over 70,000 where they will explain and lead renewable energy-based demonstrations and interactive, hands-on activities that will excite and stimulate interest in renewable energy. Finally, the energy equipment and materials will be used during the regular semesters to catalyze and energize energy-based undergraduate research at the University of the Sciences.

2017 E2 Energy to Educate – Highlights

- **17 projects awarded more than $400,000, reaching over 27,000 students nationwide**
- Student projects include solar car competitions, fuel cell technology, wind power and learning energy concepts via an interactive gaming platform.

2017 E2 Energy to Educate – Awardees

Albany State University
Albany, GA
At least 100-150 middle and high school students will be directly involved in the design of a "green" system where a water reservoir will be used to store energy instead of a rechargeable battery. During the day time, a water pump, operated by a solar panel, will lift water to a certain height and store in a reservoir and in the night time the potential energy of the water will be used to generate electricity with a hydroelectric generator. The discharged water will be collected and lifted again in the day time. School students will learn about design calculations, various constraints in design and budget, and selection of proper materials or devices. Initially, the design work will start with the estimation of daily energy demand. After that, student will calculate the amount of water to be lifted, design the reservoir size, determine the capacity of a DC water pump and finally the wattage size of solar panel that will run the pump. At the end of the project, a group of students will be selected from each participating school and will be asked to design a small system to follow up student learning and engagement. Project Director will check design calculations and purchase required supplies. Students will assemble all components under the supervision of Project Director. The assembled system will be demonstrated at the local science fair for competition. The expected outcome of the project will be to motivate at least 30% more students towards choosing a solar energy related STEM career.

Baltimore Polytechnic Institute Foundation
Baltimore, MD
As part of the Renewable Energy Curriculum, Constellation would provide funding for a Hydrogen as Energy Storage Project. The Renewable Energy course has approximately 150 (5 classes of 30) senior students enrolled every year, AP Chemistry has 32 students, and Chemistry II for Engineers has approximately 160 students. The Renewable energy class would design and assemble the equipment necessary to separate and store the hydrogen, this will take a

minimum of 3-6 months. Each stage of the design and testing stages would involve the Chemistry classes mentioned above. Each year we could disassemble so the next class could assemble, therefore the project can be extended over 3-5 years minimum. It will also be designed to be portable if there are renovations to the building or roof or a need to move the equipment.

Coppin State University
Baltimore, MD
Students will be introduced to concepts associated with renewable energy including basic education in fuel cell technology:. Students will learn the principle of operation of fuel cell and be involved in the fabrication of the fuel cells

Fuel Cells in Renewable energy systems: Predominant use of fossil fuel is unappealing due to environmental concerns and depleting fossil fuel. Fuel cells are valuable renewable energy sources as they do not cause any pollution. Students will be exposed to different types of fuel cells namely: Alkali fuel cells, Molten carbonate fuel cells, Phosphoric Acid fuels cells, Proton Exchange Fuel Cells and Solid Oxide Fuel cells. Renewable energy sources for transportation will likely replace fossil fuel sources in the not distant future.
The project will seek STEM careers --
1. Develop an infrastructure of renewable energy (solar, wind, geothermal etc.) education among college and high school students
2. Develop STEM education for the next generation students from Baltimore area high school thru a series of renewable energy program
3. Develop a workface for existing and emerging green energy technology base US industries or companies
4. Bring the high-pay jobs of green energy technology to college and high school students
5. Encourage the use of renewable energy by the US industries or companies

Green Street Academy
Baltimore, MD
The project aims to utilize solar energy to power a food computer system aimed at mitigating issues associated with access to fresh fruits and vegetables. Both hydroponic and aquaponic farming methods are superior to traditional soil farming methods because they require less space and water, however, because these methods also largely rely on electrical power (and artificial grow lights for indoor systems), research shows that these methods may not be sustainable in a real-world system. We will expand current class curriculum to include an additional design element in which students will plan and create a full room-sized "Food Computer" that will hold enough produce to feed the entire high school for one meal per month using the skills that they learn in building smaller, tabletop Food Computers. In order to mirror a real world indoor garden, students will calculate their indoor farm's theoretical energy needs, and compare these calculations to the actual energy needs and costs over the course of three months. During this analysis period, we will expand our Sustainability Unit to cover solar-powered energy and other renewable energy sources and discuss how we can implement some of these solutions so that our indoor Food Computer farm can provide a proof-of --concept model for sustainable solutions that can feed larger populations in Baltimore City communities. At the conclusion of the project, Green Street Academy will have a food production center,

powered by solar energy, that allows the enterprise to be economically self-sustaining.

Groundwork Hudson Valley
Yonkers, NY
This project ties directly into the approach we take at our two STEM education centers, which explore energy, waste and recycling across interconnected and observable technological systems. The main goals and objectives of this project are:
1. To strengthen a highly effective STEM education program that serves more than 3,000 students (K-12) each year and teach 7,000 visitors overall at the Science Barge and Ecohouse, reinforcing critical themes of energy flow, recycling, and waste recapture.
2. To incorporate bio-digester technology into the overall program through a design project involving undergraduate and graduate students from Mercy College, along with high-school students from Yonkers, that will yield 4-6 scalable bio-digester systems, with associated signage and teaching tools.
3. To strengthen our partnership with Mercy College and their sustainability projects, providing mentoring opportunities in STEM fields for low-income, minority youth.
4. To provide the public with the opportunity to understand bio-digester technology, while giving them the tools they need to build their own systems at home.

Joliet Junior College Foundation
Joliet, IL
Joliet will provide 230 female students from low-income middle schools an opportunity to learn about energy, specifically solar powered cars by becoming a design engineer, and also 20 middle school instructors a workshop to continue the training throughout the school year. Joliet Junior College's solar-powered car program is a valuable STEM (science, technology, engineering and math) hands-on learning experience. Students will learn principles of basic physics, mechanics, and solar energy while also developing critical thinking and problem-solving skills. Through the use of commercially available instruction kits, students will work in teams to design their solar-powered cars, learn about solar/photovoltaic (PV) cells, troubleshoot, and prepare to test their car's functionality. As part of the learning process, the girls will be able to experiment with gear drive and pulley drive systems to determine which produces the fastest solar car. In addition, they will test different solar cell positions to determine which is most effective. Even though the girls will be learning through the use of a kit, it will provide flexibility and creativity for them to build and test their own design. As an end project, the girls will be able to share their experience with the design process, and ultimately race their cars to determine the most successful design.

Kean University
Union, NJ
The project will host workshops for 120-150 high school students and 30 educators in order to introduce basics, applications, and impacts of renewable energy through hands-on activities and software tools. Five workshop options will be provided in the following ways:
1. Solar panel workshop: participants will learn about basic PV cell concepts and test PV cells in different conditions.
2. Fuel cell workshop: participants will learn about fundamentals of fuel cells and set up an experimental kit which converts solar energy to electricity using a solar panel and fuel cells.
3. Home energy use workshop: participants will learn about energy efficiency concepts and

measure the energy consumption used in houses and buildings which are utilizing renewable energy.
4. Wind turbine workshop: participants will learn about configuration and mechanism of wind turbines and test how wind turbine efficiency changes with blades' shape.
5. Life cycle assessment (LCA): participants will learn about LCA concepts, components, and standards. These participants will be taught how to use a LCA software tool to estimate environmental impacts of renewable energy in homes.
The project is expected to promote sustainability study in high schools and therefore increase the amount of students majoring in Sustainability Science at colleges and universities.

Legends of Learning Inc.
Washington, D.C
Legends of Learning will help Baltimore City Public Schools leverage its technological resources to increase student engagement and academic performance. Through the use of a game-based learning platform, students will learn about innovative energy strategies through playing online games, interacting with simulations, and conquering assessment questions. A new curriculum on the topics of The Future of Energy (cars, vehicles, trucks and infrastructure) and Transportation and Battery Technology will be created to align to current Maryland science standards. The new partnership will allow teachers to transform their classrooms through game-based learning tools that are backed by ongoing research. Teachers will have access to student data to assess a student's content mastery. In addition to giving students exposure to new innovations in energy, this partnership will achieve meaningful impact by increasing academic performance in a way that is measurable and profound for all learners.

Mid-State Technical College Foundation Inc
Wisconsin Rapids, WI
Project "Driving on Sunshine" seeks to demonstrate that pairing renewable energy generation with electric vehicle charging stations not only allows for a common infrastructure but provides for a sustainable energy source for transportation. With Central Wisconsin being the hub of interstate interchange from north and south as well as east and west; it only makes sense to invest in charging stations that could ultimately have a greater impact on our economy from outside the district as well as within our district.
In Central Wisconsin, there are two critical gaps. One is the availability of public electric vehicle charging stations the other are the tools necessary to train and educate about this technology. Our community is an electric vehicle charging desert. The nearest public charging station is 56 miles away to the north and 109 miles to the south. This charging station would serve as a bridge across the state.

The basic components of the project include:
1. Centralize a public electric vehicle charging station at the Mid-State Technical College campus in Wisconsin Rapids to fill the electric vehicle charging station void in Central Wisconsin.
2. Demonstrate how renewable energy can be used to provide the additional power load from electric vehicle charging.
3. Educate the community on electric vehicles and solar power generation.
4. Assist in the education and curriculum development for middle and high school electric vehicle instruction.

Regents of the University of Michigan

Ann Arbor, MI

The University of Michigan Solar Car Team has upheld a strong tradition of excellence; with 9 national championship titles, 5 top-three finishes at Worlds, and one international title under our belt, we are North America's #1 team. Every two years, a new project cycle begins, and we design, build, and race a new solar-powered vehicle that challenges the limits of electric vehicle technology and champions the promise of sustainable energy.

This project cycle is our most exciting and high-stakes one yet, because our 14th vehicle, Novum--Latin for "new thing" and root of the word "innovate"--is pushing solar technology and our students' minds like no solar car has before. In Novum, we did a "new thing" and built a car that breaks from previous solar car design convention, which dictates favoring maximization of solar array area at the expense of car size and thus, at the expense of aerodynamics. We chose to "innovate," designing a smaller, more aerodynamic car with a smaller array area comprised of far more efficient solar cells. Novum is a risk, but by our calculations, our race time will lower significantly, and this small car will pay off in a big way. We believe Novum can win us our first World Solar Challenge title and can defend our long-standing American Solar Challenge title.

Rochester Institute of Technology

Rochester, NY

A partnership was developed with the RIT's K-12 program to educate high school teachers and students in the area of electricity generation using fuel cells. The education program contains: (1) Online curriculum development to train high school chemistry and earth science teachers to prepare them to teach "Clean Energy/Fuel Cells for Electricity Generation"; (2) High school teachers incorporating the "Clean Energy/Fuel Cells for Electricity Generation" as a unit into their chemistry and/or earth science high school program for at least 100 students; (3) Live hands-on laboratory experiments for high school teachers; and (4) two weeklong summer camps for high school students at RIT. The experiments will include: (a) "Constructing a Hydrogen-Oxygen Fuel Cell", (b) "Electricity Generation with a Hydrogen Fuel Cell and Hydrogen Stored in a Tank", and (c) "Measuring the Amount of Hydrogen Stored and Released from Chemical Compounds and Electricity Generation with a Fuel Cell." The lab sessions will also be held via recorded video where students will present in a virtual lab room.

Saint Francis University

Loretto, PA

Renewable energy topics are typical in both K-12 and college level curriculum, however, how many students have ever stepped inside a solar powered classroom? Or touched a wind turbine blade? Or physically seen how different types of insulation effect energy efficiency? With the new SFU tiny mobile classroom, now they can! The new classroom is a mobile active learning space that utilizes a 1.56 kW solar photovoltaic system, biomass heating, energy efficiency techniques, a wind energy demo, and sustainable building practices. The transportable feature of the classroom allows us to provide hands-on experience with renewable energy and energy efficiency technologies to communities statewide. With support from the E2Energy to Educate grant, the SFU Institute for Energy will tour the state of Pennsylvania with the mobile power lab and offer exciting, experiential energy education to a broad and diverse audience.

Solar Car Team at the University of Virginia
Charlottesville, VA
The Solar Car Team at the University of Virginia aims to build a fully solar-powered vehicle to compete in the cross-country, American Solar Challenge 2018 race. We also aim to provide a holistic, experiential learning platform to students across all majors and backgrounds at UVA. The Team is entirely student-run and provides opportunities to gain first-hand experiences through real-world situations -- from the design of the car to its production and financing. By developing a solar-powered vehicle, we are engaging university students to think about sustainable options to augment today's gasoline-powered vehicles. In addition, our regular, weekly workshops and rigorous project have enabled us to build a team that will last for generations of UVA students to come.

Solar One
New York, NY
Solar One 's Green Design Lab™ (GDL) program is an award-winning K-12 environmental education program and curriculum, developed in partnership with the NYC Department of Education (NYC DOE), and is the only curricular blueprint of its kind that utilizes the school building as both a laboratory for learning and a tool for environmental change. GDL was created with two objectives in mind: increasing environmental literacy and promoting sustainable behaviors, while creating environmental stewards and preparing students for careers in the green economy. GDL's professional development training helps teachers improve their STEM teaching, integrate GDL into their day-to-day teaching, and amplifies the impact of our curriculum and program on students; all while ensuring the sustainability and longevity of the program.

Through funding from Constellation, we expect to reach 700 teachers through professional development training during the 2017-2018 school year and that each teacher trained will reach 25-30 students with information and activities from our curriculum. As a result, we estimate that approximately 17,000 students will be reached by the program.

St. John Fisher College
Rochester, NY
This project will develop a Waste-to-Energy (W2E) education unit that directly correlates with New York state science core curriculum and learning standards and pilot the unit in Rochester city, suburban, and rural middle schools. The unit will include hands-on activities related to waste-to-energy topics for an entire class of students, background information for the teachers on topics of sustainable energy, zero waste and biofuels, detailed lesson plans and procedures for inquiry based activities, a student activity book and assessment activities including when to administer the assessments. In the pilot year, the W2E unit will reach to at least 250 students from Rochester suburban middle schools and up to 300 students in the Rochester City School District, a district that serves a highly diverse, high need, under-served student population. The W2E unit will be made available to schools through a public organization, BOCES (Board of Cooperative Educational Services), which provides shared educational programs and services to school districts across large geographic regions of NY State. Since resources are shared between different BOCES and they refurbish and maintain the science kits, this model will provide the opportunity for our W2E unit to be marketed for use in hundreds of classrooms across the state for many years to come.

Strategic Energy Innovations
San Rafael, CA
The Strategic Energy Innovations Green Transportation Design Project challenges students to address transportation needs through alternative, sustainable solutions including biomass, solar, electric vehicles, and fuel cell technology. Students participating in the project will develop an understanding of current transportation systems and analyze the environmental impact of traditional personal transportation vehicles. Students will then complete at least one hands-on design project, such as, making biodiesel, constructing a solar model car, or creating hydrogen fuel through an electrolysis lab. Through the project, students will build STEM skills and apply them to their designs.

University of Maryland Baltimore Foundation
Baltimore, MD
An understanding of renewable energy will be a crucial part of scientific literacy for the future. When the middle school students in the UMB CURE Scholars Program reach adulthood, many of them will be commuting from solar energy powered homes in electric, biomass, and/or solar energy fueled cars. 100 students in the UMB CURE Scholars Program will explore solar energy and its applications in homes and transportation during the summer enrichment camp. Students will harness energy from the sun using photovoltaic (PV) cells (solar panels) and learn how semiconductors in PV cells generate electricity to power a house and a car. Students will build solar- and battery-powered cars using PV cells, gears, pulleys, DC electric motors, and balsa wood. Students will experiment with different designs, configurations, and calculations to determine the most efficient use of solar energy to power the car for a racing competition. Students will also explore the use of PV cells to power a house through a partnership with Constellation and SolarCity. The use of energy storage systems including batteries, supercapacitors, and flywheels will be explored to investigate how the solar-powered car and house can store electricity until it is needed.

University of Pittsburgh
Pittsburgh, PA
The project titled Constellation Community Energy "Inventor-Labs" will revolve around existing innovation themes (Energy in Transportation, Backyard Generation and, Zero Waste).

Specifically, we want to see student energy prototypes translated into the community by enabling them to create high fidelity prototypes and teaching them to examine their technologies with their peers and in their communities. To do this we will again engage our network of resources and partners so that K-12 student teams are able to build with university engineering students. The program will continue to focus on hands-on student team learning of fundamental science and engineering concepts by synthesizing our energy curriculum around Energy "Inventor-labs.
Our vision is that upon completion of our extra-curricular programs student teams will be able to celebrate their successes within their communities.

As for our teacher engagement we will continue to host a new cohort of 20 teachers at our 2-day "Teach the Teacher" program at the University of Pittsburgh's Mascaro Center for Sustainable Innovation and strengthen existing relationships with K-12 teachers throughout Western PA. We are genuinely motivated by the desire to broaden the impact of Energy

Inventor labs to long-term interactions with students and teachers throughout their academic formation, from K-College.

2016 E2 Energy to Educate – Highlights

- **17 projects awarded nearly $400,000, reaching over 35,000 students nationwide**
- Student projects include installing and studying luminescent solar concentrators, building and racing electric vehicles, designing wind turbines, scientific testing of fuel cells, and evaluation of energy storage technologies

2016 E2 Energy to Educate – Awardees

Albany State University
Albany, GA
At least 100-150 middle and high school students will be engaged in design and construction of a battery charging device with solar energy. The charged battery will be used to run a rechargeable battery operated vehicle. As solar energy will be used as energy source to drive the vehicle, the vehicle can be termed as "Green vehicle" which will be the part of future "Green Transportation". In this project, school students will learn about design calculations, various constraints in design and budget, and selection of proper materials or devices for construction. Initially, the project will start with a design of a charger with high power level (300 Watts). At the end of the project, to ensure sustainability, a group of students will be selected from each participating school and will be asked to dsegin a charger with lower power level (<100 watts). Students will assembles all components and compete in science fair competitions. The expected outcome of the project will be to motivate at least 30% of the student participants towards choosing a solar energy related STEM career.

Allegheny College
Meadville, PA
There is an increasing emphasis on developing local food economies both nationally and internationally. This project explores the use of recoverable and otherwise waste energy sources to power and heat a small-scale demonstration greenhouse. This project will use innovative heating and photovoltaic systems to maintain a microclimate within the greenhouse for year round food production. The roof of the greenhouse will be composed of luminescent solar concentrators (LCSs), a novel photovoltaic technology that can generate electricity from “wasted” light. The panels capture and convert unusable wavelengths into electricity while allowing photosynthetically active light to reach the plants below. Additional systems will be powered by pelletized switchgrass and recovered oil. All systems will be monitored so that energy production and consumption can be assessed by students through established educational programs. Once the greenhouse has been fitted with the technologies to generate power and heat from recoverable and waste energy sources, it will be used as a demonstration laboratory and educational tool to teach hundreds of students and serve as a model for the potential application of these technologies elsewhere on or off campus.

Carnegie Mellon University

Pittsburgh, PA

The Carnegie Mellon Racing Team is a group of students that build 100% electric vehicles from the ground up each academic year. Carnegie Mellon Racing promotes excellence in engineering as it encompasses all aspects of industry engineering including research, design, manufacturing, testing, developing, marketing, management and finances. Our Electric Race Car project takes students out of the classroom and allows them to apply textbook theories to real work experiences. The team devotes thousands of hours to designing the vehicle using industry-level system analysis and 3D CAD software, then physically builds it once the designs have been validated. Once the vehicle is completed the team allocates time to testing and tuning the vehicle to collect data and see where improvements could be made. The team then participates in two competitions at Formula Hybrid in April and FSAE Electric in June. At these competitions the team competes in events against teams from both the United States and Europe.

Challenger Center for Space Science Education

Washington, DC

Challenger Center will create an 8-hour program that introduces early high school students to energy science and careers. The program will include an overview of energy science, including topics relevant to the energy in Transportation, Backyard Generation, and Zero Waste focal areas. The program will also include a hands-on, team-based research challenge, an introduction to energy careers, and an opportunity to interact with energy professionals. In 2017, Challenger Center will design and pilot this program with at least 100 students in Washington, DC. Then, we will share this program with our network of 43 Challenger Learning Centers in the U.S. and internationally, who deliver high quality STEM programming to more than 250,000 students annually. We also have over 20 communities actively working to establish a Challenger Learning Center that are seeking programs like this to engage students and teachers during the multi-year process of opening a Center.

Coppin State University

Baltimore, MD

There has been an exponential growth in the generation of renewable energy from sources such as Wind and Sun. However, production of energy from these unconventional sources is not continuous: The wind does not blow and the sun does not shine all the time at particular place. The use of energy storage and charge devices is therefore paramount for renewable energy applications such as in transportation. Two hundred forty (240) students form Blueford Jamison STEM Academy (BDJ), Carver Vocational Technical High School, Al-Rahmah High School (ARH) and Coppin Academy High School will be coached by ten faculty, one post-doctoral researcher, one research technician and 30 students at the Coppin State University (CSU) Natural Sciences and Center for Nanotechnology on energy storage and charging system technologies and how they can be utilized in an environmentally friendly solar light rail. Students will receive hands on training and become acquainted with the energy storage, rapid charging devices and the construction of a makeshift solar light rail. The above mentioned faculty, staff and students will mentor students as undertake projects and explore career opportunities in renewable energy technologies.

East Carolina University

Greenville, NC

This project will educate and inspire students on the significance and societal benefits of sustainability and renewable energy in the preservation of environment and natural resources through a hands-on solar technology project. Approximately 150 East Carolina University Students from the College of Engineering and Technology (CET) will partner with Lucille W. Gorham Intergenerational Community Center (IGCC) to develop and deploy renewable energy sustainable systems with a goal to build a net zero energy facility.

Joliet Junior College Foundation

Joilet, IL

Girls Leading the Charge will provide 250 minority and under-represented female students from low-income middle schools an opportunity to learn about energy, specifically solar powered cars, by becoming a design engineer. Joliet Junior College's (JJC) solar-powered car program is a valuable STEM hands-on learning experience. Students will learn principles of basic physics, mechanics, and solar energy while also developing critical thinking and problem-solving skills. The free course will be held afterschool in the spring and fall, and during the summer. The highpoint of the Girls Leading the Charge project will be the building of the commercially available solar-powered car instructional kits. Using the kits, students will work in teams to design solar-powered cars, learn about solar/photovoltaic (PV) cells, troubleshoot, and prepare to test their car's functionality. As part of the learning process, the students will be able to experiment with gear drive and pulley drive systems to determine which produces the fastest solar car. In addition, students will test different solar cell positions to determine which is most effective. Even though the students will be learning through the use of a kit, it will provide flexibility and creativity for them to build and test their own design. As a final project, the students will share their experience with the design process with each other and local business and technology professionals, and ultimately race their cars to determine the most successful design.

Kean University

Union, NJ

The project will provide workshops where 310 high school students and 20 high school educators will learn about basics, application, and impacts of renewable energy through hands-on activities and software tools. Four workshops will be provided:

- Solar panel workshop
- Fuel cell workshop
- Home energy use workshop
- Life cycle

All workshops and activities will be offered during the week of Earth Day 2017, in order to celebrate the Earth Day and promote sustainability study in high schools. The project is also expected to increase the amount of students majoring in Sustainability Science at colleges and universities.

Klein Independent School District

Spring, TX

This project will provide solar energy panels and components for a mobile classroom that supports over 20,000 students throughout the district. and 12,000 additional community members each year. The panels will be placed on top of the trailer, and wired for proper energy storage and distribution. The purpose of the mobile classroom is to promote STEM careers. The trainer of the classroom will show students how solar energy can be used to support the energy needs of basic things inside a car, home, or commercial building. The second part of this project will provide learning kits that contain materials for hands on energy-based lab experiments. Students will research the advantages and disadvantages of different forms of energy. Students will discover the impact of energy sources on society and the environment. Students will discover the practical applications and value of alternative energy sources in transportation, home, and commercial use. Approximately 10,000 thousand students in Elementary, Intermediate and High Schools will benefit from these experiments each year. Twelve kits will be purchased along with twelve hydrogen fuel cell refilling stations. The kits will be shared with 44 schools in our district. The kits target specific standards in the Texas curriculum that will benefit students at all levels.

Mid-State Technical College Foundation

Wisconsin Rapids, WI

Project "Distributed Education: Power to the People" seeks to bring renewable energy training directly to the community through a shared mobile renewable energy classroom and education platform. This grant emphasizes equal access to renewable energy equipment; solar for all. This project will meet the following objectives.

•Make renewable energy education accessible.
• Provide classroom hands-on tools and curriculum to provide a greater understanding of energy production and distribution
• Inspire students to consider careers within the renewable energy industry
• Provide incentive for 10 students to enroll in the MSTC Renewable Energy program
• Reach 10% of regional high school and middle school students and inspire their intellectual scientific curiosity in energy technology

Nueva Esperanza Academy Charter School

Philadelphia, PA

Esperanza Academy Charter School, which serves 1,400 predominately low-income Latino students in North Philadelphia, will offer 7th- and 8th-grade science and engineering classes a unique opportunity to experiment with the energy infrastructure of the future. Students will work in teams to build model alternative-energy vehicles and to test the efficiency of their designs. They also will develop the charging infrastructure to fuel their vehicles and will compare the effectiveness of various energy storage methods. Finally, students will consider how their experimental systems might contribute to the construction of a more reliable energy grid. Our primary goal for the 21st Century Energy Innovation Lab program is to get low-income Latino middle school students excited about STEM fields, where Latinos are currently only 2% of the workforce nationally.

Penn State Wind Energy Club
University Park, PA
Penn State's Wind Energy Club is motivated to inspire secondary school students to pursue STEM and renewable energy careers while also teaching them about the energy that is present in their own backyards and being renewed on a daily basis. They propose to construct an interactive, portable wind turbine to encourage high school students to learn more about wind energy while also exploring novel science, engineering and math concepts! With the help of the E2 Energy to Educate Grant, Penn State's Wind Energy Club will be designing, testing, and manufacturing a portable wind turbine designed to educate secondary school students on the power in the wind available in their own school yard. The previous experiences the team has with designing and building a fully operational wind turbine for the Department of Energy Collegiate Wind Competition will be brought to bear into the design of the current system. The proposed project has two components: the development of the turbine itself and the design of interactive, educational activities for secondary school students to participate in.

Rochester Institute of Technology
Rochester, NY
RIT's K-12 Education for Electricity Generation Using Fuel Cells program is designed to take what we know about the importance of alternative and clean energy resources, and make that knowledge a part of curriculum. This program has two goals: 1.) To conduct workshops for high school teachers that address how to bring issues of global warming, the need for clean energy, and the changing technology of fuel cells to their classrooms.
2.) To conduct a summer program for students in grades 7-12 to expose them to new technology in energy, allow them to conduct experiments in this field, and to increase their overall knowledge of and interest in alternative clean energies. The program consists of teacher workshops and student summer programs that include lectures, hands-on experiments, and laboratory tours all devoted to subjects like solar power, hydrogen fuel cells, environmental sustainability, and how all of this is improved through the study of the various sciences.

Solar One
New York, NY
Solar One's Green Design Lab™ (GDL) program is an award-winning K-12 environmental education program and curriculum, developed in partnership with the NYC Department of Education (NYC DOE), and is the only curricular blueprint of its kind that utilizes the school building as both a laboratory for learning and a tool for environmental change. As part of our Green Design Lab programming, Solar One will deliver a "backyard generation" unit, over 6 weeks, to 6 classes at the East Village Community School. Up to 25 students will be in each class, and thus the program will reach 150 students. The lessons and activities will focus on energy, PV solar and battery storage. During the 2015-2016 school year, we reached 295 teachers and more than 200 students through the NYC Solar and NYS K-Solar programs.

Southern Illinois University East St Louis
East St Louis, IL
Students will participate in weekly hands-on project-based units designed to increase critical thinking skills, build their interest in energy careers, and teach them team work and the thrill of

cooperative competitive. The program will be implemented using an evidence-based renewable energy curriculum developed by the SIUE STEM Center supplemented by guest speakers and workplace learning opportunities with the National Corn-to-Ethanol Research Center (NCERC) at SIUE. East St. Louis Zero Waste Challenge will target middle and high school students from SIUE's Upward Bound Program. Upward Bound serves low-income first generation college students from Greater East St. Louis region school districts (East St. Louis District 189, Brooklyn United District 188, and Cahokia Unified School District 187, East St. Louis Charter High School and Madison School District). The project targets a community that is severely disadvantaged in STEM, with the goal of narrowing the achievement gap and providing enhanced opportunities in STEM for minority students. The project will enhance our science, technology, engineering and math (STEM) programming with an energy education curriculum for 825 middle and high school students, project based learning and a competition aimed at eliminated waste in East St. Louis.

University of Maryland

College Park, MD

The U.S. Department of Energy Solar Decathlon challenges collegiate teams to design, build and operate solar-powered houses that are cost-effective, energy-efficient and attractive. The 2017 Solar Decathlon will take place October 5th through 15th, 2017, in Denver, Colorado. Teams are challenged to demonstrate the best blend of affordability, consumer appeal, and design excellence with optimal energy production and maximum efficiency. An anticipated 90,000 visitors will attend the competition, providing high visibility as teams showcase the most innovative and cutting edge in energy-efficient, sustainable technology. University of Maryland College Park's last entry, in 2011, was awarded first place.

University of Pittsburgh

Pittsburgh, PA

Over 700 students from Pittsburgh's universities (University of Pittsburgh, Robert Morris University), local schools and summer programs will be engaged in an innovative hands-on Energy curriculum that revolves around teams of students designing and building energy technology prototypes. Building upon successful outreach programs enabled by the Mascaro Center for Sustainable Innovation seed grant, the curriculum will focus on student learning of fundamental science and engineering concepts by synthesizing our energy curriculum around Energy "Inventor-labs". Student-teams will embark on a 3-tiered Design-Build Energy challenge by inventing prototypes that demonstrate

- Energy Generation and Conversion (Tier 1)
- Increased Energy Efficiency (Tier 2)
- Sustainable Energy Technology (Tier 3)

Upon completion of the 3-tiered challenge student teams then select an energy design problem of their choice. These final projects will culminate in a design expo in the Summer of 2015 and December 2015 where student teams and prototypes from all schools and programs will be showcased and celebrated at a public event at the universities. While two "teach the teacher" sessions will occur in the summer as part of a continuing education program to reach an additional 500 students, the ultimate goal is to catalyze the creation of a team-oriented, learning focused, hands-on spaces and culture in our classrooms that will attract support and further the Energy to Educate goals long after the completion of the project. An essential element is that the rapid prototyping and physical modeling of energy technologies will require

students to practice high-level thinking (e.g. analysis, synthesis, evaluation) while building a culture geared toward Energy tech innovation.

2015 E2 Energy to Educate – Highlights

- **13 projects awarded $382,000, reaching over 18,000 students nationwide**
- Energy efficiency analysis, using the school building itself as a laboratory
- Investigating photovoltaic solar conversion efficiency and fuel cells
- Demand response of small to medium load appliances using wireless smart plug technology
- Student ambassadorship of energy efficiency, electric vehicles, and alternative technologies leveraging design and investigative experience

2015 E2 Energy to Educate – Awardees

Albany State University
Albany, GA
550 middle grade students from 3 local schools will learn about solar energy:

- Students will learn about resistors, series/parallel circuits, voltage polarity, soldering, voltage measurement, current measurement, multimeter use and electronic breadboard connections.
- Students will measure solar cell voltage and current, and calculate output power of cell. Student will also learn how to determine solar cell parameters (short circuit current and open circuit voltage) and calculate cell efficiency. Student will also know how to measure solar cell output voltage and current data wirelessly with a blue tooth enabled iPAD.
- Students will assemble commercially available solar car and homes and observe their functionality. The student will then address several technical issues that arise in solar cell operation such as drop in solar cell's output voltage when connected to an external load, advantage and disadvantage of series and parallel operation of two or more cells together.

An additional undergraduate student will research nano technology-based high efficiency solar energy. Goals of the project will be measured by an external evaluator and student presentations at an energy conference.

Carnegie Mellon University
Pittsburgh, PA
The Carnegie Mellon Racing Team is a group of students that build 100% electric vehicles from the ground up each academic year. Carnegie Mellon Racing promotes excellence in engineering as it encompasses all aspects of industry engineering including research, design, manufacturing, testing, developing, marketing, management and finances. Our Electric Race Car project takes students out of the classroom and allows them to apply textbook theories to real work experiences. The team devotes thousands of hours to designing the vehicle using industry-level system analysis and 3D CAD software, then physically builds it once the designs have been validated. Once the vehicle is completed the team allocates time to testing and tuning the vehicle to collect data and see where improvements could be made. The team then participates in two competitions at Formula Hybrid in April and FSAE Electric in June. At these competitions the team competes in events against teams from both the United States and Europe.

Center for Robust Decision Making

Chicago, IL

Energy science and technologies have huge impacts on the global environment and economy, as well as our everyday lives. However, these topics are largely unaddressed in schools and colleges. This leaves the next generation of students unequipped to tackle the energy challenges of the future. At the University of Chicago Center for Robust Decision Making on Climate and Energy Policy (RDCEP), we offer programs that provide students with an intuitive understanding of the energy system. One of our key educational programs engages high school students in the development of a library of interactive energy demonstrations. Through a fun, hands-on approach, these demonstrations illustrate fundamental concepts, including Energy Generation, Energy Conversion, Electric Motors, Alternate Sources of Energy, and the Smart Grid.

Coppin State University

Baltimore, MD

The Coppin State University Science and Technology Center will provide opportunities for 375 high school students to explore how photovoltaic energy and dye sensitized solar cells are developed and applied to the real world.

- Eight faculty members and 50 students at the Coppin State University (CSU) Department of Natural Sciences and Center for Nanotechnology will conduct research on photovoltaic energy and dye sensitized solar cells.
- CSU faculty and students will mentor and expose 375 high schools students from Coppin Academy High School (CAHS), Bluford Drew Jemison STEM Academy (BDJ), Carver Vocational and Technical High School (Carver), Frederick Douglass High School, and Maryland Academy of Technology and Health Science Charter School (MATHS) students to innovative research on photovoltaic energy and dye sensitized solar cells. The 5 partnered high schools are located within a one miles radius of University.
- This summer over 200 scientists and science students from the USA and five other countries participated in the two day symposium on sustainable energy. Thesymposium will include interactive presentations and workshops by researchers and scientists with the goal of empowering and inspiring high school students about careers in the energy industries.

Mid-State Technical College Foundation

Wisconsin Rapids, WI

Incourage Community Foundation of Wisconsin Rapids, Wisconsin facilitates a business/education collaborative STEM (Science, Technology, Engineering & Math) initiative with participation from ten regional businesses, six community organizations, and six local school systems as well as the local technical college, Mid-State Technical College.

Project "Building Energy Education Pathways" or BEEP, has resulted in an increase in enrollment in the MSTC Renewable Education program. Each participating high school and middle school receives energy curriculum and instruction, and use of state of the art tools to assess renewable energy potential and options. Photovoltaic systems are used as an actual demonstration unit for STEM courses.

The basic components to the program include:

• Expansion of educational solar photovoltaic installations at the three area middle schools

• Providing high school students with scholarships for the Mid-State Renewable Energy program.
• Expansion of energy education curriculum from the MSTC Renewable Energy program into high school and middle schools.
• "Solar Olympics" for all schools with the similar solar photovoltaic installations to use the equipment and knowledge from shared curriculum in competition to determine which school can generate the most energy

Northside Education Foundation
San Antonio, TX
The Construction Careers Academy Parade of Homes is an ambitious capstone program, now in its third year, that challenges 12th grade students to demonstrate their design and construction skills while developing the teamwork, project management, and financial skills that are required for success in today's workforce. The program involves a year-long build competition in which four teams of students from across the school's four focus areas will partner with industry and faculty advisers to design and construct fully functional micro-homes. The final products, which will be fully inhabitable and portable, will include electrical, HVAC, welding, and plumbing components.

This program will expand the scope of the Parade of Homes to challenge students to incorporate 'off the grid' features into their designs and supply, at minimum, half of their house's electricity with photovoltaic systems. 3 teams will be challenged to construct homes that are grid tied, but supply at minimum 50% of their electricity from solar sources. The 4th team will be challenged to construct a fully-off grid home that garners all of its power from solar sources.

Nova Southeastern University

San Antonio, TX

This project focuses on educating students on the sciences and technologies of new energy solutions (e.g. biofuels and dye-sensitized solar cells). This will be accomplished in three ways: a) by educating 450 of NSU's undergraduate science students in STEM (especially in the areas of chemistry and physics) in the laboratories and the classroom, b) by providing STEM outreach programs for 400 high school students in the South Florida tri-county area (Miami-Dade, Broward, and Palm Beach Counties) and c) by educating 400 undergraduate students and the NSU community about clean energy technologies through energy sustainability lecture series.

The objectives are to:

- Educate and engage undergraduate and high school students in emerging clean renewable energy technologies.
- Actively involve undergraduate and high school students in collecting and analyzing data on energy specific topics.
- Increase students' understanding of clean renewable energy technologies and inspire them to think critically about the various production methods for clean energy
- Develop undergraduate and high school students' abilities to take responsibility for energy challenges and solutions of today and tomorrow.
- Inspire a culturally and intellectually diverse student population to pursue STEM careers in chemical and physical sciences.
- Encourage teaching, learning, and training to a large diverse and underrepresented student population in South Florida as next generation scientists.

Rochester Institute of Technology

Rochester, NY

RIT's K-12 Education for Electricity Generation Using Fuel Cells program is designed to take what we know about the importance of alternative and clean energy resources, and make that knowledge a part of curriculum. This program has two goals: 1.) To conduct workshops for high school teachers that address how to bring issues of global warming, the need for clean energy, and the changing technology of fuel cells to their classrooms.

2.) To conduct a summer program for students in grades 7-12 to expose them to new technology in energy, allow them to conduct experiments in this field, and to increase their overall knowledge of and interest in alternative clean energies. The program consists of teacher workshops and student summer programs that include lectures, hands-on experiments, and laboratory tours all devoted to subjects like solar power, hydrogen fuel cells, environmental sustainability, and how all of this is improved through the study of the various sciences.

Science and Math Investigative Learning Experiences Program

Kingston , RI

Seven middle school clubs will participate in a 32 week curriculum, which includes hands-on activities and science and career oriented field-trips. The project also supports the Middle School Engineering Challenge held at the University of Rhode Island (URI) for 140 middle school students in March 2016. In preparation for the Challenge Weekend, students participate in 8-10 weeks of pre-activities in their clubs to learn about the science needed to address energy issues and about the various engineering disciplines involved in energy. They experiment with properties of air, build anenometers to measure wind speed, design wind turbine blades,

determine their efficiency in producing electrical power through mathematical calculations and actual testing, and learn about gears and gear ratios. At the Challenge Weekend, students will work on an engineering project to build a functioning model wind turbine. This project teaches students about energy and wind, renewable vs. nonrenewable energy sources, measuring and calculating wind power, wind turbine structures, and generators to produce electricity.

This project will teach students the fundamentals of wind turbines including: an introduction to energy and wind, renewable vs. nonrenewable energy sources, measuring and calculating wind power, wind turbine structures, and generators to produce electricity. To reinforce club activities, students will go on field-trips to visit wind turbines in action and meet with industry professionals in the field. Site visits include a wind turbine located in North Kingstown, Narragansett Bay Commission, and offshore wind farm companies Cape Wind and Deep Water Wind, as well as a visit to Navatek in South Kingstown where students can test their wind turbines in a wind tunnel.

Solar One
New York, NY
Developed in partnership with the New York City Department of Education (NYC DOE), Solar One's Green Design Lab™ (GDL) is a hands-on sustainability curriculum and program aimed at greening urban schools. Adaptable for grades K-12, GDL utilizes the school building as both a laboratory for learning and a tool for environmental change. Its mission is to enhance students' environmental literacy and science, technology, engineering and math (STEM) skills, while promoting behavioral change in the direction of energy efficiency and healthier, greener urban spaces. GDL teaches students to transform their school environments, cultivate environmental stewardship in their communities, and gain valuable skills for career pathways in the growing green industries. Solar One directly delivers the advanced high school version of the Green Design Lab™, called CleanTech, in NYC schools as well as expanding the Sustainable Schools Network (SSN), our alternative delivery model, to reach new schools.

Strategic Energy Innovations
San Rafael, CA
The School Zero Net Energy (ZNE) Design project challenges Bay Area high school students to redesign their school to produce as much energy as it uses. Students conduct a school-wide energy audit to identify opportunities for energy efficiency improvements and behavioral energy conservation. Then, students design a solar array on the rooftop of their school. Student create a School Zero Net Energy Design Proposal that integrates energy efficiency, energy conservation actions, and renewable energy into their school designs. Students acquire technical career skills in energy auditing, including measuring power use with a watt meter, determining lighting levels with light meters, and calculating energy savings by transitioning to energy efficient appliances, lighting, and mechanical systems. Students also learn how to calculate the environmental benefit and cost of renewable energy systems, through assessing the financial feasibility and payback for a solar installation at their school. The School Zero Net Energy Design project empowers students to become energy leaders in their community, through the creation, implementation, and presentation of plans for creating a zero net energy campus to their district decision-makers.

University of Maryland Baltimore County

Baltimore, MD

For an effective adaptation and percolation of the demand response model, green building applications must be efficient at the device level, which is dependent upon the fine-grained determination of power consumption across different, consumer-grade appliances. Evaluating such efficiency is performed through non-intrusive load monitoring (NILM); however, a key challenge in deploying the NILM algorithm is that such involves disaggregating the energy consumption of an appliance from the aggregate power measurement, as well as modeling and incorporating usage-based prediction. In practice, deploying smart plug based NILM and load-disaggregating algorithms using appliances is often difficult or impossible due to the shortage of labeled, real power consumption data for the respective appliances. The proposed project will provide students the opportunity to make a judicial choice from a variety of commercially available smart plugs from different vendors and spin-offs in this area and then utilize smart plugs for monitoring and reducing energy consumption of appliances. Specifically, interdisciplinary teams of students will first do a feasibility study of recommending the most reliable and cost-effective smart plugs available off-the-shelf and subsequently use these devices to analyze and determine which appliances use the most energy and track the amount used individually. The broader implication of this project is that such findings will provide insight into developing best practices for carbon footprint reduction, as well as promoting the need for greater environmental sustainability. Additionally, hundreds of undergraduate students will gain significant research experience by collaborating with faculty mentors in using energy management technology to further investigate the energy consumption patterns of human communities.

University of Pittsburgh

Pittsburgh, PA

Over 700 students from Pittsburgh's universities (University of Pittsburgh, Robert Morris University), local schools and summer programs will be engaged in an innovative hands-on Energy curriculum that revolves around teams of students designing and building energy technology prototypes. Building upon successful outreach programs enabled by the Mascaro Center for Sustainable Innovation seed grant, the curriculum will focus on student learning of fundamental science and engineering concepts by synthesizing our energy curriculum around Energy "Inventor-labs". Student-teams will embark on a 3-tiered Design-Build Energy challenge by inventing prototypes that demonstrate

- Energy Generation and Conversion (Tier 1)
- Increased Energy Efficiency (Tier 2)
- Sustainable Energy Technology (Tier 3)

Upon completion of the 3-tiered challenge student teams then select an energy design problem of their choice. These final projects will culminate in a design expo in the Summer of 2015 and December 2015 where student teams and prototypes from all schools and programs will be showcased and celebrated at a public event at the universities. While two "teach the teacher" sessions will occur in the summer as part of a continuing education program to reach an additional 500 students, the ultimate goal is to catalyze the creation of a team-oriented, learning focused, hands-on spaces and culture in our classrooms that will attract support and further the Energy to Educate goals long after the completion of the project. An essential element is that the rapid prototyping and physical modeling of energy technologies will require students to practice high-level thinking (e.g. analysis, synthesis, evaluation) while building a culture geared toward Energy tech innovation.

2014 E2 Energy to Educate – Highlights

- **11 projects awarded $340,000, reaching over 7,000 students nationwide**
- Energy efficiency analysis, using the school building itself as a laboratory
- Investigating photovoltaic solar conversion efficiency, hands-on solar installation and model solar car competition
- Demand response of small to medium load appliances using wireless smart plug technology
- Student ambassadorship of energy efficiency, electric vehicles, and alternative technologies leveraging design and investigative experience

2014 E2 Energy to Educate – Awardees

Albany State University
Albany, GA
490 middle grade students from 3 local schools will learn about solar energy:

- Students will learn about resistors, series/parallel circuits, voltage polarity, soldering, voltage measurement, current measurement, multimeter use and electronic breadboard connections.
- Students will measure solar cell voltage and current, and calculate output power of cell. Student will also learn how to determine solar cell parameters (short circuit current and open circuit voltage) and calculate cell efficiency. Student will also know how to measure solar cell output voltage and current data wirelessly with a blue tooth enabled iPAD.
- Students will assemble commercially available solar car and homes and observe their functionality. The student will then address several technical issues that arise in solar cell operation such as drop in solar cell's output voltage when connected to an external load, advantage and disadvantage of series and parallel operation of two or more cells together.

Three undergraduate students will research nano technology-based high efficiency solar energy. Goals of the project will be measured by an external evaluator and student presentations at an energy conference.

Carnegie Mellon University
Pittsburgh, PA
The Carnegie Mellon Racing Team is a group of students that build 100% electric vehicles from the ground up each academic year. The team devotes thousands of hours to designing the vehicle using industry-level system analysis and 3D CAD software, then physically builds it once the designs have been validated. Once the vehicle is completed the team allocates time to testing and tuning the vehicle to collect data and see where improvements could be made. The team then participates in two competitions at Formula Hybrid in April and FSAE Electric in June. At these competitions the team competes in events against teams from both the United States and Europe.

Carnegie Mellon Racing promotes excellence in engineering as it encompasses all aspects of industry engineering including research, design, manufacturing, testing, developing, marketing, management and finances. Our Electric Race Car project takes students out of the classroom

and allows them to apply textbook theories to real work experiences. Our goal for this year is to win both Competitions we compete in - securing a 1st Place electric vehicle in only our second year. The timeline looking forward targets our first competition of April 27th, 2014 as the culmination of over a year's worth of development.

Coppin State University

Baltimore, MD

The Coppin State University Science and Technology Center will provide opportunities for 200 high school students to explore how photovoltaic energy and dye sensitized solar cells are developed and applied to the real world.

- Five faculty members and 5 students at the Coppin State University (CSU) Department of Natural Sciences and Center for Nanotechnology will conduct research on photovoltaic energy and dye sensitized solar cells.
- CSU faculty and students will mentor and expose 200 high schools students from Coppin Academy High School (CAHS), Bluford Drew Jemison STEM Academy (BDJ), Carver Vocational and Technical High School (Carver), Frederick Douglass High School, and Maryland Academy of Technology and Health Science Charter School (MATHS) students to innovative research on photovoltaic energy and dye sensitized solar cells. The 5 partnered high schools are located within a one miles radius of University.
- Coppin faculty members and students will mentor 50 high school students (10 from each school) as they design solar energy science projects that will be featured at the CSU 3rd International Symposium on Innovation of Science, Nanotechnology, Human Health and Environment for a Global Society.
- This summer over 200 scientists and science students from the USA and five other countries participated in the two day symposium on sustainable energy. The 2015 symposium will include interactive presentations and workshops by researchers and scientists with the goal of empowering and inspiring high school students about careers in the energy industries.

Green Street Academy

Baltimore, MD

Green Street Academy (GSA), Living Classrooms Foundation (LCF) - including both Commodore John Rogers (CJR) the Crossroads School (TCS) - and The Baltimore Leadership School for Young Women (BLSYW) seek to launch an extension of the National Science Foundation-supported middle school program first launched in Baltimore in 2012 that was created at North Carolina State University, and focuses on new electric vehicle (EV) and photovoltaic (PV) technologies emerging into the marketplace. The after-school program, facilitated by GSA, LCF, and BLSYW staff, is based on national science, math, and technology standards and promotes a team-oriented, learning-focused, hands-on EV and PV demonstration project with specific results: a spring 2015 GSA, LCF and BLSYW EV racing competition. Overall, the program will advance student and public understanding of what makes some EV and PV technologies succeed and others fail. Topics covered will include: Solar Technology, Distributed Generation, Electrical Vehicles and Energy Storage. Wide Angle Youth Media (WAYM) of Baltimore will provide videography of the student design and competition.

International Center For Sustainable Development

Baltimore, MD

The Baltimore-Washington Electric Vehicle Initiative (BEVI) launched an electric vehicle internship, education and community outreach program in 2012, and has continued this program through to the present, with critical funding from the Constellation Energy to Educate program. In 2012 the interns focused on social media outreach. In 2013 the interns designed and launched the MarylandEV website (www.marylandEV.org) to serve as an EV education hub in Maryland. In 2014 the students focused on improving the Maryland EV website, and focused on getting EVs into Maryland fleets. We propose to build on all of these developments to date by continuing the multi-disciplinary EV education and community outreach program in partnership with Baltimore area institutions of higher education (MICA, Johns Hopkins, UMBC and Towson University at a minimum), with a specific target of combining EV education with electric vehicle body design and 3D printing for actual electric go-cart style race competitions to be held at the end of the summer program in August 2015.

Mid-State Technical College Foundation

Wisconsin Rapids, WI

Incourage Community Foundation of Wisconsin Rapids, Wisconsin facilitates a business/education collaborative STEM (Science, Technology, Engineering & Math) initiative with participation from ten regional business, six community organizations, and five local school systems and, Mid-State Technical College (MSTC).

Project CLEAN Future builds upon the success of the 2013 Central Wisconsin Energy Education Collaboration project funded by Constellation. The 2013 project enabled an array of solar panels to be installed at four local high schools, advancement of knowledge and understanding of energy issues by approximately 10% of the students enrolled in the high schools and teacher continuing education for ten area teachers.

Project CLEAN Future will bring additional tools to teachers for education and monitoring of energy into the classroom, extend the reach of the energy curriculum to the local middle schools, bring another high school (Pittsville) into the collaboration with installation of a photovoltaic system, continue to leverage MSTC's resources and those of the Wisconsin K-12 Energy Education program (KEEP), development of a platform for on-going collaboration among school systems, and expand technology with the installation of solar thermal in an existing school supported greenhouse.

Approximately 363 students from five high schools and middle schools will gain knowledge and understanding of energy, production, conservation, and related issues directly. It is expected an additional 600 students will benefit through continued education of high school teachers through the University of Wisconsin -- Stevens Point, KEEP curriculum.

Pocono Environmental Education Center - PEEC

Dingmans Ferry, PA

The Renewable Energy Lab at PEEC engages 250 middle and/or high school students and 25 educators in an EE program focusing on renewable energy systems. The students and teachers will live in the renovated cabins during their EE program at PEEC and in the process use, monitor and compare the different technologies.

The pilot project focuses on the recent and on-going energy efficient retrofits of 10 'cabins' on PEEC's campus. PEEC's 21st Century Sustainability campaign called for PEEC to, wherever possible, modify its existing structures to create working models of renewable energy alternatives for hands-on teaching. Ten of PEEC's existing 1950's 'Honeymoon Haven' cabins are being renovated with state of the art green building products and renewable energy efficient systems including: solar thermal, Photo Voltaic solar, passive solar, vertical axis wind turbine and a ground-source heat pump.

This project creates a-one-of-a-kind functional laboratory for renewables, with various working renewable energy systems in place in one location. It is an incubator for sustainable design, a local, state, regional, national showcase and destination venue that promotes an established, well-known and respected environmental education center and aligns with the Academic Learning Standards (PA, NY, NJ) in Science, Technology, Engineering, Math, Ecology, Sustainability and more grades 4-12.

Rochester Institute of Technology
Rochester, NY
A partnership between RIT's School of Chemistry and Materials Science, and RIT's Office of K-12 programs is formed to develop education for high school teachers and students in the area of electricity generation using fuel cells. The education program contains: (1) RIT Curriculum Development to design and train high school Chemistry and Earth Science teachers to prepare them to teach "Clean energy/fuel cells for electricity generation"; (2) High School Teachers incorporating the "Clean energy/fuel cells for electricity generation" as a unit into their Chemistry and Earth Science High School program for at least 100 students; and (3) Hands-on Laboratory Experiments for High School teachers and students during a Summer Camp Workshop at RIT. The experiments will include: (a) "Constructing a Hydrogen - Oxygen Fuel Cell", and (b) "Measuring the Amount of Hydrogen Stored and Released from Chemical Compounds with a Fuel Cell". Both live lab sessions at RIT and online sessions will be held via recorded video where students will be present in a virtual lab room.

Solar One
New York, NY
Developed in partnership with the New York City Department of Education (NYC DOE), Solar One's Green Design Lab™ (GDL) is a hands-on sustainability curriculum and program aimed at greening urban schools. Adaptable for grades K-12, GDL utilizes the school building as both a laboratory for learning and a tool for environmental change. Its mission is to enhance students' environmental literacy and science, technology, engineering and math (STEM) skills, while promoting behavioral change in the direction of energy efficiency and healthier, greener urban spaces. GDL teaches students to transform their school environments, cultivate environmental stewardship in their communities, and gain valuable skills for career pathways in the growing green industries. In 2014-2015, Solar One will directly deliver the advanced high school version of the Green Design Lab™, called CleanTech, in at least eight NYC schools. Pending funding, we hope to also reach an additional six NYC middle and elementary schools with direct delivery of the Green Design Lab™. We will continue to expand the Sustainable Schools Network (SSN), our alternative delivery model, to reach 40-50 new schools.

University of Maryland Baltimore County

Baltimore, MD

For an effective adaptation and percolation of the demand response model, green building applications must be efficient at the device level, which is dependent upon the fine-grained determination of power consumption across different, consumer-grade appliances. Evaluating such efficiency is performed through non-intrusive load monitoring (NILM); however, a key challenge in deploying the NILM algorithm is that such involves disaggregating the energy consumption of an appliance from the aggregate power measurement, as well as modeling and incorporating usage-based prediction. In practice, deploying smart plug based NILM and load-disaggregating algorithms using appliances is often difficult or impossible due to the shortage of labeled, real power consumption data for the respective appliances. The proposed project will provide students the opportunity to make a judicial choice from a variety of commercially available smart plugs from different vendors and spin-offs in this area and then utilize smart plugs for monitoring and reducing energy consumption of appliances. Specifically, interdisciplinary teams of students will first do a feasibility study of recommending the most reliable and cost-effective smart plugs available off-the-shelf and subsequently use these devices to analyze and determine which appliances use the most energy and track the amount used individually. The broader implication of this project is that such findings will provide insight into developing best practices for carbon footprint reduction, as well as promoting the need for greater environmental sustainability. Additionally, hundreds of undergraduate students will gain significant research experience by collaborating with faculty mentors in using energy management technology to further investigate the energy consumption patterns of human communities.

University of Pittsburgh

Pittsburgh, PA

Over 700 students from Pittsburgh's universities (University of Pittsburgh, Robert Morris University), local schools and summer programs will be engaged in an innovative hands-on Energy curriculum that revolves around teams of students designing and building energy technology prototypes. Building upon successful outreach programs enabled by the Mascaro Center for Sustainable Innovation seed grant, the curriculum will focus on student learning of fundamental science and engineering concepts by synthesizing our energy curriculum around Energy "Inventor-labs". Student-teams will embark on a 3-tiered Design-Build Energy challenge by inventing prototypes that demonstrate

- Energy Generation and Conversion (Tier 1)
- Increased Energy Efficiency (Tier 2)
- Sustainable Energy Technology (Tier 3)

Upon completion of the 3-tiered challenge student teams then select an energy design problem of their choice. These final projects will culminate in a design expo in the Summer of 2015 and December 2015 where student teams and prototypes from all schools and programs will be showcased and celebrated at a public event at the universities. While two "teach the teacher" sessions will occur in the summer as part of a continuing education program to reach an additional 500 students, the ultimate goal is to catalyze the creation of a team-oriented, learning focused, hands-on spaces and culture in our classrooms that will attract support and further the Energy to Educate goals long after the completion of the project. An essential element is that the rapid prototyping and physical modeling of energy technologies will require

students to practice high-level thinking (e.g. analysis, synthesis, evaluation) while building a culture geared toward Energy tech innovation.

2013 E2 Energy to Educate – Highlights

- **10 projects awarded $310,000, reaching over 21,000 students nationwide**
- Energy efficiency analysis, using the school building itself as a laboratory
- Investigating photovoltaic solar conversion efficiency, hands-on solar installation and model solar car competition
- Demand response of small to medium load appliances using wireless smart plug technology
- Student ambassadorship of energy efficiency, electric vehicles, and alternative technologies leveraging design and investigative experience

2013 E2 Energy to Educate – Awardees

Baltimore Polytechnic Institute
Maryland
180 students will be involved in making a classroom solely dependent on a renewable energy-solar. Students will learn from hands on projects in conjunction with a new Renewable Energy Curriculum written in cooperation with the Department of Energy. Many renewable energy activities are integrated throughout the curriculum, the most important being progressive solar energy installation. Students will conceive, design and install all facets of the project with the advice of an industry expert and under the supervision of school faculty. Students will learn the science and engineering of the technology in the classroom, then test and measure in the lab, and finally measure the efficiency of the comparable commercial equipment in the school building.

Coppin State University
Maryland
120 students from Coppin State University and Coppin Academy will explore new energy technologies including quantum dot solar cells and nanotechnology. Student will explore how these technologies are developed and applied and what makes them succeed while others fail. Researchers and engineers in solar technology industry will mentor students as they design projects and explore career opportunities in solar technology. At the completion of the project, students will have a better understanding of solar energy technologies as measured by pre-test and post-test, design of solar cell with greater efficiency and presentation of project resu lts at energy conferences.

Evergreen Heritage Foundation
Maryland
Over 1,100 high school and college students will experience in hands-on learning opportunities in energy science and technology through creating 1) a 200 square-foot Energy Learning Station that will be used by hundreds of students annually and 2) an energy-efficient architectural design for a new 2500 square-foot Evergreen Energy Education (E3) EHC classroom facility that will provide a functioning example of green energy solutions. Students will identify and evaluate

energy resources, investigate renewable energy technology alternatives, conduct energy audits at their schools, and assess renewable energy solutions already in use at local high school and college facilities. The buildings will demonstrate and allow students to evaluate renewable and other energy-saving solutions, including an energy "dashboard" that will enable students and visitors to monitor energy usage and efficiency.

Farleigh Dickinson University
New Jersey
550 students from various New Jersey high schools will participate in a conference on Global Sustainability and Renewable Energy. The 2014 Global Leadership and Sustainability Challenge is a partnership between academic centers at Fairleigh Dickinson University and local educational partner, Student Global Ambassador Project (SGAP). The conference will bring together students, teachers and administrators at Fairleigh Dickinson campuses for hands on projects in Global Sustainability and Renewable Energy (Spring 2014), followed by second session on Social Entrepreneurship (Fall 2014). The program will culminate in the participating students creating social venture ideas/proposals, a selection of which will be entered into FDU's annual Business Ideas Competition that will have a Social Entrepreneurship category for the Spring 2015 season.

Green Street Academy
Maryland
Green Street Academy and the Living Classrooms Crossroads School will partner to take the Green Street Racers competition to the next level. Building from a successful Baltimore pilot of a National Science Foundation-supported middle school program, the two schools will team up to engage 400 students on a program that focuses on new electric vehicle (EV) and photovoltaic (PV) technologies now emerging into the marketplace. The after-school program is based on national science, math, and technology standards and promotes a team-oriented, hands-on demonstration project with specific results: a spring 2012 EV racing competition. The program will advance student understanding of what makes some technologies succeed and others fail, while fostering teamwork among middle school students toward a common goal. Topics covered include: Solar Technology, Distributed Generation, Electrical Vehicles and Energy Storage.

International Center for Sustainable Development - Baltimore-Washington Electric Vehicle Institute
Maryland
Baltimore-Washington Electric Vehicle Initiative (BEVI) will engage a youth service corps of high school and college students focused on electric vehicle education. These interns target community outreach and impact in energy and the environment for Maryland EV ready jurisdictions. BEVI works to improve and grow electric vehicle outreach and education in collaboration with the University of Maryland at College Park Energy Research Center, Johns Hopkins University, Maryland Institute College of Arts, and the University of Maryland Baltimore County. Elements include a Statewide EV education and outreach website at 'www.MarylandEV.org', related social media campaigns designed by students, and social entrepreneurship business plans related to electric vehicles in the region, ultimately reaching 4,500 students.

Mid-State Technical College Foundation
Wisconsin

189 area students at four participating high schools will learn energy generation, use, and conservation. Mid-State Technical College's Renewable Energy program faculty will provide energy efficiency curriculum and instruction to evaluate the energy efficiency of their facility using modern scientific methods and curriculum. Students will utilize state of the art energy efficiency diagnostic tools, such as infrared cameras and blower door systems, to assess their facility energy efficiency. Based on their education and application of tools, students will then design a 2-4kW photovoltaic system for their high school. The system will be used hence forth as an actual demonstration unit for STEM courses. Through a partnership with the Wisconsin K-12 Energy Education Program (KEEP), teachers will participate in continuing education courses to further reach an additional 600 students.

Rochester Museum
New York
10,000 school-age youth will be engaged in the process of invention as it relates to energy production and consumption, and learn about careers within these fields through hands-on design-and-build challenges in RMSC's new Inventor Center exhibit. The Inventor Center will consist of a series of participatory stations designed to scaffold the inventive process into accessible parts. The experience is a combination maker/engineering-challenge space where visitors are invited to engage in design and build challenges based on authentic problems faced by industry/academics.

Solar One
New York
Developed by Solar One, the Green Design Lab (GDL) is a hands-on sustainability curriculum aimed at greening urban schools. GDL utilizes the school building as both a laboratory for learning and a tool for environmental change to enhance student environmental literacy and science, technology, engineering and math (STEM) skills while promoting behavioral change in the direction of energy efficiency and healthier, greener urban spaces. The Green Design Lab will teach 4,500 students to reduce energy consumption in their school buildings, cultivate environmental stewardship in their communities, and gain valuable skills for career pathways in the growing industries of Clean Tech, Energy Efficiency, Green Design and Construction, and Renewable Power.

University of Maryland Baltimore County
Maryland
200 students will engage in a competition to develop new interactive demand response technologies. The challenge the students will address is informed 'localized' optimization of large numbers of low-to-medium load appliances, which currently aren’t managed by commercially available demand response technologies, and consume approximately 50%' of a commercial building's energy consumption. By using new emerging 'smart plugs' which embed a micro-controller and low-power communication device, power consumption will be monitored and the data will be communicated wirelessly. Students will benchmark power consumption data to build a dynamic catalog, and develop a web-based portal for visualizing detailed historical and real time energy consumption. Ultimately, these systems will make energy consumption visible and actionable. Further, students will investigatemotivational practices to convince individual consumers to reduce their energy footprints.

2012 E2 Energy to Educate – Highlights

- **10 projects to be awarded $337,265, reaching 14,000 students nationwide**
- Hands-on wind turbine design, electric vehicle, and solar vessel competitions
- Renewable energy and energy efficiency analysis, using the school building itself as a laboratory
- Investigating photovoltaic solar conversion efficiency, hybrid solar/wind generators, and comparative renewable energy
- Student entrepreneurship bridging the science of energy and the mechanics of business
- Student ambassadorship of energy efficiency, electric vehicles, and alternative technologies leveraging design and investigative experience

2012 E2 Energy to Educate – Awardees

Allegan County Community Foundation
Michigan
223 students will explore, collect and analyze data and communicate findings about two alternative energy technologies -- Hybrid (solar/wind) Generator and Solar Water Heater. This is an expansion of the existing Electrical Systems and Renewable Energy Program of the Allegan County Area Technical & Education Center. Each piece of equipment will be installed and monitored in the Center's Renewable Energy Voltage Village (REVV) and placed on a mobile demonstration cart for use in awareness presentations in student programs and public forums. Partners include the Allegan County Community Foundation and Sepstar (Hybrid Generator manufacturer).

The Boston Education Development Foundation Inc
Massachusetts
The Be The Change: Youth Green Jobs Energy Audit Training Program engages twenty urban high school students in Boston Public Schools in high-quality, replicable, energy education and leadership training as well as funds the implementation of student-led energy efficiency projects. The Program provides teens with a paid summer green job that prepares and requires them to conduct energy audit walk-throughs in the fall at their school, and also builds leadership skills enabling them to expand their impact by bringing energy lessons to at least 200 other students, parents, and teachers. In addition to completing their summer job, participating youth must commit to: forming a green team at their respective schools with at least 15 other students, conducting an energy audit at their school, creating an energy action plan based on the findings of the audit, and hosting an Energy Fair to report their findings and recommendations to their community. Upon completion of these deliverables, each student team will receive $3,000 to fund at least one high impact energy savings project identified in their audit report.

Butte Community College Foundation
California
Butte College and GRID Alternatives, will facilitate hands-on and student-led research, product development, and community engagement focusing on locally abundant sources for renewable energy technologies: rice hulls and solar resources. Through Rice and Solar as Energy Alternatives(RSEA): What Do Rice Hulls and Solar Energy Have in Common?, Butte College Mathematics Engineering Science Achievement Program (MESA) students, who are working on a

professional career path in the sciences, will work in project teams to present research methods and outcomes in various academic and professional forums. Over 2400 students, faculty, and community members at large will benefit and better understand energy alternatives including what rice byproducts and solar energy have in common.

Carnegie Mellon University
Pennsylvania
Carnegie Mellon Solar Splash is an undergraduate organization that designs, builds, and races solar-electric boats. Students from across the Pittsburgh campus collaborate to solve challenging problems including hull-design, power management, and propulsion. The organization is heavily involved in the promotion of renewable energy to the surrounding community through exhibits and demonstrations. An immediate impact can be made on the future through the work that we are accomplishing, as we introduce students to the possibilities of solar-power. We are building not only boats, but we are building people too.

Coppin State University
Maryland
225 students from Bluford Drew Jemison STEM Academy and Coppin State University will explore new energy technologies including nanocrystalline solar cell, silicon solar cells, multi-junction solar cells, and nanotechnology. Student will explore how these technologies are developed and applied and what makes them succeed while others fail. Researchers and engineers in solar technology industry will mentor students as they design projects and explore career opportunities in solar technology. At the completion of the project, students will have a better understanding of solar energy technologies as measured by pre-test and post-test, design of solar cell with greater efficiency and presentation of project resu lts at energy conference.

International Center for Sustainable Development - Baltimore-Washington Electric Vehicle Institute
Maryland
Baltimore-Washington Electric Vehicle Initiative (BEVI) will engage a youth service corps of 200 high school and college students focused on electric vehicle education. These interns target community outreach and impact in energy and the environment for Maryland EV ready jurisdictions. BEVI works to improve and grow electric vehicle outreach and education in collaboration with the University of Maryland at College Park Energy Research Center, Johns Hopkins University, Maryland Institute College of Arts, and the University of Maryland Baltimore County. Elements include a Statewide EV education and outreach website at 'www.MarylandEV.org', related social media campaigns designed by students, and social entrepreneurship business plans related to electric vehicles in the region.

Network for Teaching Entrepreneurship

Maryland

In partnership with NFTE Baltimore and Maryland MESA, Baltimore City Public Schools, and Morgan State University, 125 students are being introduced to an innovative way to learn both about business and energy through the NFTE Business of Energy Project. The NFTE Business Energy Project involves the development of FAET Energy Saver, a service business that will use alternative sources of energy to charge electronic devices. This device will enable students and teachers to charge their electronic devices through use of Wind/Solar energy. Through this unique program students grasp both the concepts of business and science of energy as well as the mechanics of business and entrepreneurship.

Solar One

New York

Developed by Solar One, the Green Design Lab (GDL) is a hands-on sustainability curriculum aimed at greening urban schools. GDL utilizes the school building as both a laboratory for learning and a tool for environmental change to enhance student environmental literacy and science, technology, engineering and math (STEM) skills while promoting behavioral change in the direction of energy efficiency and healthier, greener urban spaces. The Green Design Lab will teach 4,000 students to reduce energy consumption in their school buildings, cultivate environmental stewardship in their communities, and gain valuable skills for career pathways in the growing industries of Clean Tech, Energy Efficiency, Green Design and Construction, and Renewable Power.

University Of Rhode Island Foundation on behalf of The SMILE Program

Rhode Island

The SMILE Program 2013 High School Engineering Challenge Weekend will bring together 120 high school students from six Rhode Island school districts. The project involves advanced science and math hands-on and problem solving activities, a campus tour, and college admission information. Groups of SMILE students will build and test a model of a solar car. Working in teams, students will all be given the same materials to build their solar cars, consisting of a solar cell and motor that will be used by all participating. The remainder of the vehicle the students' own design and will be made from other material. The engineering challenge provides a fun and exciting meaningful experiential experience that will increase student knowledge about alternative sources of clean energy, energy technologies, and how the choice of different energy sources impacts the environment. 50 industry mentors not only help to guide students as they work on an engineering pro ject, but they discuss their career experiences wit h the high school students.

Women of Wind Energy

Maryland

The WoWE/KidWind Student Design Challenge 2013 will train 60 teachers in the science, technology, and hands-on classroom applications of wind pofwer -- impacting over 5,000 students around Maryland and Pennsylvania. Up to 300 of these students will go on to compete in a hands-on wind turbine design competition in these two regions. The winning teams of these competitions will be invited and supported to compete in the National KidWind Challenge in Chicago, IL. The program reaches into the classroom with the integration of wind energy concepts, knowledge, equipment, and curriculum.

2011 Energy to Educate –Highlights

- **14 projects awarded over $500,000, reaching nearly 26,000 students nationwide**
- Hands-on wind turbine design, electric vehicle, and solar vehicle competitions
- Design of educational kiosks with real-time data and display of grid-tied solar array
- Renewable energy and LEED design, using the school building itself as a laboratory
- Investigating EV battery design, energy storage, hybrid and plug-in powertrain design and control, and photovoltaic solar conversion efficiency
- Examination of own actions, to explore the interactions and causal effects of behaviors and the energy supply chain

2011 E^2 Energy to Educate Awardees

Coppin State University
Maryland
200 college and high-school students will explore the properties of solar cell and investigate how nanomaterials are used to increase the solar conversion efficiency of solar cells. Students will design, simulate and fabricate new solar cells performance using organic materials, and investigate efficiency improvements with hands-on experimental approach.

Frostburg State University
Maryland
700 K-12 and college students in Western Maryland and 100 community members interested in renewable energy will learn the operation of solar PV, wind, solar thermal, and geothermal energy supply systems as well as electrical and thermal energy storage in a sustainable smart building through hands-on installation and implementation, on-site presentations and web based interface.

Green Mountain College Solar Plug-In Design
Vermont
110 college students will participate in a design build challenge to construct an electric vehicle charging station for cold-weather climates. The project will demonstrate the use of solar for vehicle charging and active and passive solar thermal strategies to create a heated environment for vehicle charging, thus enhancing their performance and addressing cold weather climate challenges. Additionally, 1,280 fourth and fifth grade students from the local schools will visit the completed station and receive standards-based on-line science and environment curriculum materials that relate to the project.

Green Street Academy
Maryland
Green Street Academy and Baltimore Electric Vehicle Institute will launch the Baltimore pilot of a National Science Foundation-supported middle school program, that focuses on new electric vehicle (EV) and photovoltaic (PV) technologies now emerging into the marketplace. The after-school program is based on national science, math, and technology standards and promotes a team-oriented, hands-on demonstration project with specific results: a spring 2012 EV racing competition. The program will advance student understanding of what makes some technologies succeed and others fail, while fostering teamwork among middle school students toward a common goal. Topics covered include: Solar Technology, Distributed Generation, Electrical Vehicles and Energy Storage.

Husky Research and Bloomsburg University
Pennsylvania
10,000 students and community members will benefit from an educational kiosk featuring interactive web applications designed by university students and faculty to monitor a grid-tied solar array, a solar tracker, and the energy used by campus buildings.

National Academy Foundation Green Student Design Project
California
300 Academy of Engineering students will design and present plans for a LEED-certified addition to their school or other local building to a panel of industry experts. This team-based student project is the culminating activity of 'Green Design', an integrated unit that aligns multiple courses and is taught by a team of teachers across engineering and core academic classes.

Network for Teaching Entrepreneurship
Maryland
125 students will learn how to design, create and build windmills that produce power and electricity to participate in the Maryland MESA Wind Energy Challenge. Students will then write a business plan, raise seed capital and develop a business at their school to sell the energy produced.

Northside Education School District Green Careers
Texas
900 students in the Northside Independent School District will participate in hands-on projects with solar and wind energy training workstations, developing knowledge and skills needed for future careers in clean energy. Programming develops a pipeline beginning in middle school through college to support development of green construction and careers.

Rochester Museum and Science Center
New York
Approximately 1,000 students will achieve a deep understanding of energy production and consumption and how to make better energy choices in conjunction with the ENERGIZE it! Exhibit. The exhibit covers topics including smart grid, solar, wind, and power choices. To take the ENERGIZE it! Exhibit back to their own classrooms, an educator toolkit will include teacher lesson plans, hands-on activities, demonstrations and experiments and culminating major community project or activity.

Solar One Green Design Lab
New York
5,000 students will directly benefit from The Green Design Lab (GDL), a curricular blueprint for student-led K-12 school greening projects, based on a simple concept to use the school building - where students spend six+ hours per day - as a laboratory for learning about sustainability. GDL climate change, sustainability, renewable energy, green design and technology, and their role in greening their school while building Science, Technology, Engineering and Math (STEM) skills. GDL is a partnership between Solar One, the NYC Department of Education (NYC DOE), and NYC public schools.

University of California Irvine Energy Causality Project
California
300 students will work in interdisciplinary teams to learn about energy technologies, the environmental impacts of various energy systems, and how these systems relate to their own lives. Students will create causation relationships through on-line tool and create videos to look at their own actions, to explore the interactions and causal effects of behaviors and the energy supply chain.

University of Michigan Dearborn Engineering
Michigan
120 undergraduate students will gain hands-on laboratory and design experience with key energy technologies used in electric vehicles including: (1) battery design and energy storage, (2) power electronics and management, (3) thermal management, (4) battery system control and management and (5) hybrid/plugin powertrain design and control. Students will leverage the research and designs to compete against peers in national and international competitions.

William Marsh Rice University Solar Car Team
Texas
200 students will participate in the Eco-Marathon and several other competitions. The Solar Car Team has developed a preliminary design and budget for the vehicle, including the research and design of major vehicle components such as the powertrain, batteries and photovoltaic array. The team will finalize the design, develop CAD drawings, order materials and construct the vehicle by mid March in time for testing and a public unveiling before the Shell Eco-Marathon competition in April.

Women of Wind Energy
Maryland and Pennsylvania
5,000 students will benefit from teacher training focused on the science, technology, and hands-on classroom applications of wind power. 300 of the students will go on to compete in a hands-on wind turbine design competition in each region.

2010 Energy to Educate Awardees

Albright Foundation: POWER – Partnership Organizing Wind Education & Research
Maryland
175 students will participate in an applied science investigation to evaluate whether a wind turbine at two schools would produce enough energy to meet the power needs of the respective schools, including wind power measurement, analysis of energy that can be generated from a kilowatt-scale wind turbine, and cost analysis.

Baltimore City School Sustainability Challenge
Maryland
19,500 students Baltimore City Public School students will be given energy conservation and sustainability information, with 30 schools participating in energy conservation and sustainability projects – including evaluation and comparison of energy usage.

Butte Community College Foundation – Sustainability Education

California
3,000 students will learn through an interactive site incorporating solar energy, hot water systems, and energy efficiency and retrofit practices.

Conrad Foundation – Spirit of Innovation Awards: *Clean Energy*
National
Up to 250 students from states including CA, FL, NY, OH, TX, VA, and DC will participate in the Clean Energy Challenge, through partnerships including the National Science Teachers Association.

Eckerd University – Installation of Novel Solar Technology
Florida
500 students will learn about innovative solar design and technologies for distributed electrification, including data monitoring and a real-time data feed.

Innovative Technology Action Group – Girls Exploring Tomorrow's Technology
Pennsylvania
350 girls will participate in event providing hands-on activities and exposure to careers in the technical and clean energy sectors, with various partners including the Smart Energy Initiative of Southeastern Pennsylvania.

KIPP Baltimore
Maryland
130 students will learn about environmental impact, alternative energy and hybrid-electric technologies through activities based learning, in partnership with UMBC Sherman Scholar Fellows and the Maryland Department of Transportation.

Morgan State University – Innovative Energy Production and Pre-College Outreach
Maryland
140 engineering students and 50 pre-college students will participate in focused projects, including advanced instrumentation design, fossil fuel combustor designs, and solar technology applications- in partnership with C.P. Crane Power Plant.

Mount St. Mary's University – Alternative Energy Education Pavilion
Maryland
2,500 students will participate in hands-on, interactive exhibits that will demonstrate how solar and wind energy technologies work, including data from nearby solar arrays.

University of Maryland College Park- Watershed Solar Decathlon Project
Maryland
200 students will collaborate to design, build, and operate a cost-effective, energy efficient, and affordable home for the national DOE solar decathlon competition.