



E² Energy to EducateSM

As part of our commitment to education, E²: Energy to Educate Grants support projects that are team oriented, learning focused, hands-on demonstration projects with specific results. E² 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.

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. The 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.

Mid-State Technical College Foundation

Wisconsin Rapids, WI

Incorporate 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 anemometers 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.



E² Energy to EducateSM

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, E²: Energy to Educate Grants support projects that are team oriented, learning focused, hands-on demonstration projects with specific results. E² 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.

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

Encourage 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.

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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)
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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.



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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 results 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 investigate motivational practices to convince individual consumers to reduce their energy footprints.



E² Energy to EducateSM

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, E²: Energy to Educate Grants support projects that are team oriented, learning focused, hands-on demonstration projects with specific results. E² 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.

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 results 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 project, but they discuss their career experiences with 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 power -- 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 E² : Energy to Educate Award Winners

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E² Energy to Educate – 2011 Highlights

- 14 E² Energy to Educate 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
- Design-build challenge to construct an electric vehicle charging station for cold-weather climates
- Leveraging energy exhibits on smart grid, solar, wind, and power choices to identify classroom projects and specific actions in local schools

2011 E² 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 E² Energy to Educate Awards

Social responsibility is one of Constellation Energy's core foundational values. We believe that providing quality educational opportunities and career development are among the most important tools to help communities succeed long term. E² Energy to Educate Grants were awarded to projects that reach and inspire students to think differently about energy, and that aligned with at least one of three focus areas: the basic science and engineering needed to address energy challenges; new energy technologies entering the marketplace; and the expanding role of information technology in how we efficiently manage and use energy.

The E² Energy to Educate grant program was launched in 2010, and a total of \$350,000 was awarded to 10 projects in communities where Constellation Energy does business. Collectively, the grant awards will reach more than 26,000 students nationwide. The awards will support a variety of initiatives, ranging from a project to evaluate the viability of wind energy at local schools to designing and building a solar-powered house that produces as much energy as it uses.

E² : 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.