E^2 Energy to Educate℠

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.

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.