Constellation
An Exelon Company

E² Energy to Educate℠

As part of our commitment to education, E² Energy to Educate grant awards support projects that are team oriented, hands-on 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.

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 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 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.