



## **Appalachian State University Boone, North Carolina Energy**

### **SCHOOL**

Public, 4-year, approximately 17,000 students. Boone, North Carolina.

### **ABSTRACT**

Appalachian State University is committed to the idea of learning by doing. This case study looks at a project that involved students from inception to application of a renewable energy project at a working laboratory. Students in the Department of Technology and Environmental Design assessed the opportunity for implementing renewable energy at the Sustainable Development Teaching and Research Farm (also referred to as the Blackburn-Vannoy property). The farm consumes approximately 10,000 kWh per year. Students from the Appalachian State University Renewable Energy Initiative (REI) designed, installed and funded a \$45,000 renewable energy project consisting of two photovoltaic and solar thermal systems. These systems are projected to offset approximately 90% of the Blackburn-Vannoy Farm's energy demand. These systems are used as hands-on educational labs and provide valuable research opportunities.

### **GOALS AND OUTCOMES**

#### **Goals**

Appalachian students involved in this project initially recognized an educational farm, Blackburn-Vannoy Farm, was using large amounts of non-renewably generated electricity on a site with great solar potential. Initial project goals were to secure funding for, design, purchase, and install solar renewable energy systems which would significantly reduce the farm's carbon footprint.

The Blackburn-Vannoy Farm attracts students and visitors from many different degrees and walks of life. The notion that a wide variety of people will witness and interact with these real-life renewable energy systems was an attractive goal for the students involved. Due to the innovative technology used on site, these systems provide opportunities for student research.

#### **Accomplishments and Outcomes**

A 3.8 kW roof-mounted photovoltaic system was funded, designed, purchased, and installed by students. This system was mounted on the roof of a detached garage next to the main residence located on the farm. The system is currently making electricity, however an inspection from the local utility is required before the system is successfully connected to the grid and offsetting the farm's electricity. This system is designed to produce approximately 3,500 kilowatt hours of electricity annually.

A 1.5 kW pole-mounted photovoltaic system was funded, designed, purchased, and installed by students. This system is located next to a barn on the farm and will offset electricity used by the barn. This system is ready to produce electricity but is awaiting interconnection approval from the local utility. This system is designed to produce approximately 1,500 kilowatt hours of electricity annually.

An evacuated tube solar thermal system was funded, designed, purchased, and installed by students. Water heating is the main energy consumer on the farm. The newly installed evacuated tube system with 120-gallon tank is providing nearly all of the residence's hot water needs.

The three systems were designed to provide 90% of the farm's energy demand through clean and renewable energy and assist in carbon emissions reductions. Further student research into each system's production will quantify emissions reductions and energy supply. The students who created this project hope their work will be carried on by future research and will inspire new renewable energy projects.

### **Challenges and Responses**

Due to insurance reasons, students did not install every component of the renewable energy systems themselves. For example, connecting the system wiring to a utility meter had to be performed by a licensed electrician and the steel pole used to mount one of the systems was installed by the university's Physical Plant Department. These issues were resolved by requesting help from the appropriate university department. Improving student and administration relationships and communication will aid in resolving similar issues faced in a similar project.

When designing and installing a grid-tied photovoltaic system knowledge of local interconnection and net metering guidelines facilitates the interconnection process. Currently, both of the photovoltaic systems are awaiting inspection by the local utility to permit interconnection with the utility grid.

### **Campus Climate Action: Your School's Carbon Footprint**

The main objective of this project is to offset the non-renewable energy used by the Blackburn-Vannoy Farm with the application of renewable energy systems. Electricity distributed to this farm by the local utility is generated by burning of non-renewable fuels (coal, nuclear and natural gas). Not to mention the environmentally hazardous manners in which coal and natural gas are extracted, the burning of these fossil fuels release numerous toxic substances and greenhouse gases which directly endanger life on this planet. With the implementation of solar renewable energy systems, nearly 90% of this farm's non-renewable energy demand will be offset by electricity generated in an environmentally responsible and safe manner.

Appalachian has conducted four greenhouse gas emissions inventories. The next iteration will account for greenhouse gas offset directly from this project. The next inventory will be conducted in spring of 2013 and account for emissions from fiscal year 2012 (July 2011 – June 2012).

### **Commentary and Reflection**

When constructing a similar project it is beneficial to utilize the knowledge of your peers, especially faculty, staff, classmates, and colleagues. This project was successful by the assistance of the university and the technical, as well as moral support of peers.

This project began from students who felt their efforts could positively impact a situation. In the beginning stages of a project this outlook proves to be a motivator and improves the chances of success. Using this motivation, the students fully committed to achieve their goal. It was dedication and a belief in the worth of their work that sustained the group when roadblocks got in their way.

## ENGAGEMENT AND SUPPORT

### Leaders and Supporters

**Sebastian Brundage**, graduate student in Appalachian's Department of Technology and Environmental Design and student member of the REI, first recognized the opportunity for renewable energy at the Blackburn-Vannoy Farm and proposed the project to the REI.

**Dr. Dennis Scanlin**, professor of Photovoltaic System Design and Construction, approved Sebastian Brundage and **Renee Blacken**, graduate student, to design the two photovoltaic systems as final class projects. The knowledge and skills required to design these systems were learned from the teachings of Dr. Scanlin. **Chris Guttenberg**, graduate student and assistant to Dr. Scanlin, also offered tremendous support and technical advice throughout this project.

**Dr. Brian Raichle**, professor of Solar Thermal Energy Technology, approved **Chris Pike**, graduate student, to design the solar thermal water heating system as a class project. Sebastian Brundage and **Landon Abernethy**, graduate student, assisted with the design and implementation of this system. Dr. Raichle provided these students with the knowledge and skills to apply solar thermal technology in a real world setting.

The Blackburn-Vannoy Farm Committee offered assistance and guidance in every stage of this project.

### Funding and Resources

The project was funded by the Appalachian State University Renewable Energy Initiative. The REI is a seven student committee with faculty and staff advisors which is responsible for allocating money towards the application of renewable energy on campus. The funds allocated in this process are raised by a self-imposed fee included in every student's tuition. There is an approval process for proposed renewable energy projects. The three renewable energy systems were approved for funding by the REI and received \$45,000. Equipment and tools from Appalachian's Department of Technology and Environmental Design were graciously offered to assist in the design and installation of these systems.



### Education and Community Outreach

Throughout the project, students were informed of its progress and given the opportunity to gain hands-on experience by assisting in the installation process. Several students in the Photovoltaic System Design and Construction course participated in the installation and gained valuable hands-on experience.

The Blackburn-Vannoy Farm receives a significant amount of traffic, whether it is students, faculty, or visitors. This traffic allows a large and varied group of people to witness and interact with renewable energy systems. During the installation of the 3.8 kW photovoltaic system and the solar thermal water heating system, educational and interactive presentations were given to students and visitors of the farm. Visitors, students, and residents of the farm have all expressed their appreciation for and interest in the new renewable energy systems and how they produce clean energy.

Each of the three renewable energy systems will also provide research opportunities for students. Through research, students will gain experiential knowledge of these technologies which will prepare them for the industry. Currently, there is a need to verify the calculated energy production of each system and emissions offset potential.

## **CONTACT INFORMATION**

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## **MORE ABOUT YOUR SCHOOL**

### **Campus Sustainability History**

Sustainability is more than an initiative at Appalachian State University- it is a way of life that is becoming increasingly ingrained into the campus community's individual and institutional decision-making. Appalachian has a rich history of commitment to sustainable practices. Besides having the nation's oldest, recognized Sustainable Development (1991) and Appropriate Technology (1984) academic programs, Appalachian rethinks common practices and implements state of the art technologies related to energy production and energy conservation on campus. The Office of Sustainability was created in 2009. Since its inception, the university has made tremendous strides toward the overarching goal of carbon neutrality. A 50-plus member Sustainability Council was developed to help guide university operations into more sustainable practices. For the sixth year in a row, SIERRA magazine is releasing its annual ranking of the nation's "Coolest Schools," and this year Appalachian has moved into the No. 10 spot. Appalachian recently received a Gold rating in the Sustainability Tracking, Assessment and Rating System (STARS®). For more information about sustainability at Appalachian, visit the university sustainability website at [www.sustain.appstate.edu](http://www.sustain.appstate.edu).

Image Credit: Chris Pike

