

## **ETHR-ENRG Smart Solar Project Kits**

**Ms. Danielle S. Washington, North Carolina Agricultural and Technical State University**

Danielle Washington is a first year graduate student majoring in Information Technology at North Carolina A&T State University. Danielle obtained her Bachelor of Science in Electronics/Computer Systems Engineering Technology from North Carolina A&T State University as well. She also obtained an Associate of Applied Science in Electrical/Electronics Engineering Technology from Guilford Technical Community College. She is a very perseverant, ambitious and analytical individual.

**Mr. Tony D. Martin Jr.**

**Dr. Evelyn Sowells-Boone, North Carolina Agricultural and Technical State University**

Dr. Evelyn R. Sowells-Boone is an associate professor in the Computer Systems Technology department at North Carolina A&T State University's College of Science and Technology. Prior to joining the School of Technology faculty, she held position at U.S. Department of Energy, N.C. A&T's Division of Research and College of Engineering. Dr. Sowells earned a Ph.D. in Electrical Engineering from North Carolina A&T State University's College of Engineering. She also holds a M.S. and B.S in Computer Science with a concentration in software engineering from the same university. Her primary research interests are in the areas of efficient digital systems design and STEM education. As a result of her work, she has numerous peer reviewed journal and conference publications. She recently authored a book entitled "Low Power Self-Timed Size Optimization for an Input Data Distribution," which explores innovative techniques to reduce power consumption for portable electronic devices. She was recently awarded the 2016 Chair's award for Rookie Researcher of the year in the Computer System Technology department. Dr. Sowells is the lead investigator of the Females in Technology (FiT) summer boot camp grant project for academically gifted low income rising senior and junior high girls for recruitment into the technology degree areas. She is also the co-PI of the Aggie STEM Minority Male Maker grant project focused on early exposure to technology to stimulate interest in technology of middle school minority males. Evelyn is not only outstanding in teaching and research, but also in service. She recently received the 2013 Chair's Award for Outstanding Service in the Department of Computer System Technology and is a member of Upsilon Phi Epsilon, Computer Science Honor Society, American Society of Engineering Education's Electronic Technology and Women in Engineering Divisions, and American Association of University Women.

## ETHR-ENRG: Smart Solar Project Kits

Danielle Washington  
*College of Science and Technology*  
*NCA&T: Information Technology*  
*Graduate Student*  
Greensboro, United States  
dswashin@aggies.ncat.edu

Corey Wooten  
*College of Science and Technology*  
*NCA&T: Electronics Technology*  
*Graduate*  
Greensboro, United States  
ccwooten@aggies.ncat.edu

Tony Martin  
*College of Science and Technology*  
*NCA&T: Industrial Engineering*  
*Graduate Student*  
Greensboro, United States  
tdmart1@aggies.ncat.edu

Michael Farabee  
*College of Science and Technology*  
*NCA&T: Electronics Technology*  
*Graduate*  
Greensboro, United States  
mmfarabe@aggies.ncat.edu

**Abstract**— We present the design, development, and implementation of user-friendly lesson plans that provide high-level explanations of solar energy concepts. The project kits will be available in novice, intermediate, and advanced difficulty levels. We have chosen this project because although solar energy is growing in both popularity and efficiency, there are very few educational programs or resources available to students to provide them with the knowledge and skills required to understand, develop, and implement solar power. Our Smart Solar Project Kits will educate up and coming generations on the benefits of solar energy using an exciting, tactical, and educational approach. We will explain the functions, processes, and uses of solar panels using detailed imagery and fundamental guidelines, and provide essential sources of subject matter while building knowledgeable skill sets in correlation with clean energy practices. The novice, intermediate, and advanced level project kits, how they were developed, and how they work will be presented in a Poster Presentation.

*Keywords:* solar energy, project kits, novice, intermediate, advanced, smart solar LED emergency bag light, smart solar USB wired/wireless mobile device, smart solar ultraviolet rainwater purification system, educational program

## I. INTRODUCTION

Ultimately, we want to prepare young people for an imminent and fast-approaching future involving clean energy. Although solar energy has spiked in popularity in recent years, there is much more progress to be made within the United States' renewables industry. We are living and raising future generations in an age of growing climate concerns developing alongside technological advancements that are moving at an unprecedented rate. We believe by associating the practices and technicalities of renewable energy with fun, interesting hands-on projects, and resources, we are provided the ability to educate these generations on one of the most essential and beneficial skills that will most assuredly be sought after in future years.

When we embarked upon this journey we had no idea what challenges and/or learning experiences we would encounter. We went through multiple phases before we were able to come up with designs

we felt would be essential to the outcome we wanted and the learning experience we wanted to provide. We had issues with the consistency of the sunlight charging our devices adequately for functionality, so we had to figure out the best materials for what we needed and our location. Location plays a big part in the development of any device that will use solar power. The more sunlight the solar panels have access to, the more efficient the device will charge and function. We had an assortment of solar panels to figure out the best fit. We did multiple tests and calculations to figure out the right voltages, currents, wattage, and whether or not we needed to add any type of device for resistance to our designs or would they suffice without the use of resistance or if they needed a device for assistance with keeping a charge. Some of the materials we thought would be best for our design initially, eventually we cut them from the design later. Some of the original designs we had consisted of resistors, charge controllers, and diodes. After much thought and consideration of all the details of our design and its functionality, we came up with three designs. We have a Smart Solar LED Emergency Bag Light as our novice model, a Smart Solar USB Wired/Wireless Mobile Device Charger, and a Smart Solar Ultraviolet Rainwater Purification System.

## II. MODEL DEVELOPMENTS

Project kits contain all the parts and components required for the construction of the related solar energy project. The project kits are offered in Novice, Intermediate, and Advanced models.

Every model will have an instruction manual and a construction kit. The materials are supplied individually, and the kits will be prepped on-demand to guarantee all users will have the necessary parts and equipment to build their devices.

### A. *Novice Model: ETHR-ENRG Smart Solar LED Emergency Bag Light*

The Smart Solar LED Emergency Bag Light will store energy from sunlight gathered during the day and assist the user in finding items they need from their bags or purses when in a dimly lit room or dark area. This model requires the following parts:

- (1) 5-volt/220-mA solar panel
- Clear/White 20-watt LED circuit lights
- Pre-split Electrical Wires

- (1) Miniature Project breadboard
- Soldering and testing equipment

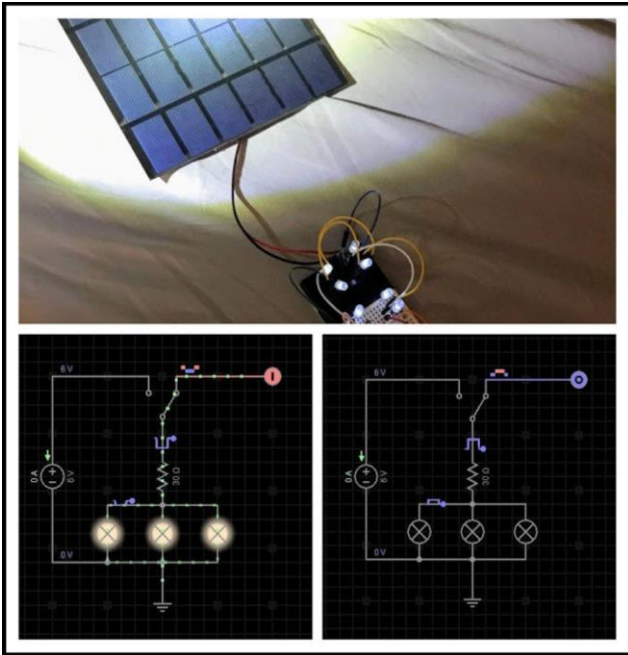


Figure 1: ETHR-ENRG Smart Solar LED Emergency Bag Light With Circuitry Design

The design above is wired using a 5-volt solar panel with the soldered on positive (red) and negative (black) wires connected to a miniature project breadboard and respectively being wired to the cathode and anode leads of the LED lights.

### B. Intermediate Model: ETHR-ENRG Smart Solar USB Wired/Wireless Mobile Device Charger

The Smart Solar USB Wired/Wireless Mobile Device Charger will consist of multiple USB ports for efficient device charging during hours of consistent sunlight. This model requires the following parts: [2]

- (3) 5-volt/60-mA Solar Panels in parallel
- (1) 9-volt Battery Backup or Equivalent 1.5-volt AA Batteries (8)
- (1) Miniature Project breadboard
- Pre-split Electrical Wires
- Soldering and testing equipment

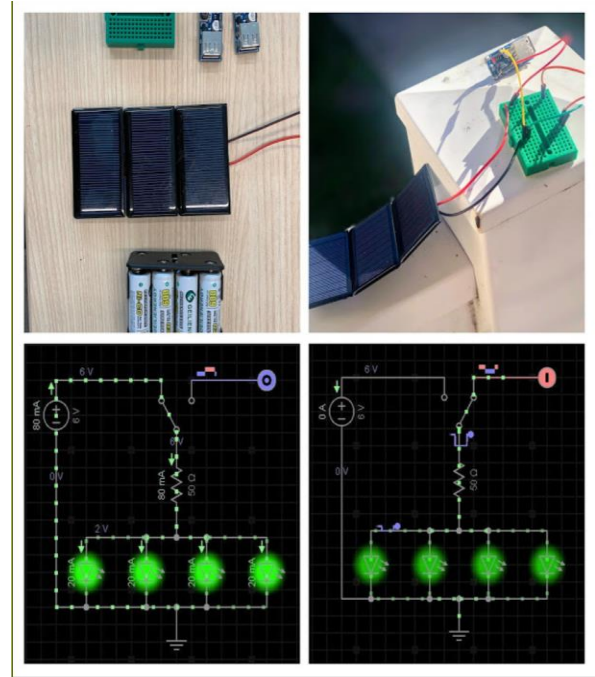


Figure 2: ETHR-ENRG Smart Solar USB Wired Mobile Device Charger With Circuitry Design

The design above is wired using the 3 solar panels in parallel with the positive and negative wires connected to a miniature project breadboard, with positive and negative wires from the breadboard respectively being soldered to the USB chip's positive and negative terminals. The battery backup is also wired in with the circuit on the miniature project breadboard.



Figure 3: ETHR-ENRG Smart Solar USB Wireless Mobile Device Charger.

The design above is wired almost exactly like the wired mobile device charger above. The only

difference is there is no miniature project breadboard or battery backup. Everything is directly connected (wired and/or soldered) together, but there is no alternative source of power without the solar panels being charged with sunlight.

*C. Advanced Model: ETHR-ENRG Smart Solar Ultraviolet Rainwater Purification System*

The Smart Solar Emergency Ultraviolet Rainwater Purification System will collect rainwater on rainy days and store the water in a safe compartment.

On sunny days, the solar panel will collect energy from the sunlight to power the system and begin the purification process. This model requires the following parts:

- (1) 12-volt/330-mA Solar Panel
- (1) 9-volt Battery Backup
- 2 Liter Specimen Container
- Pre-split Electrical Wires
- 5-ft Ultraviolet LED String Lights
- Soldering and testing equipment

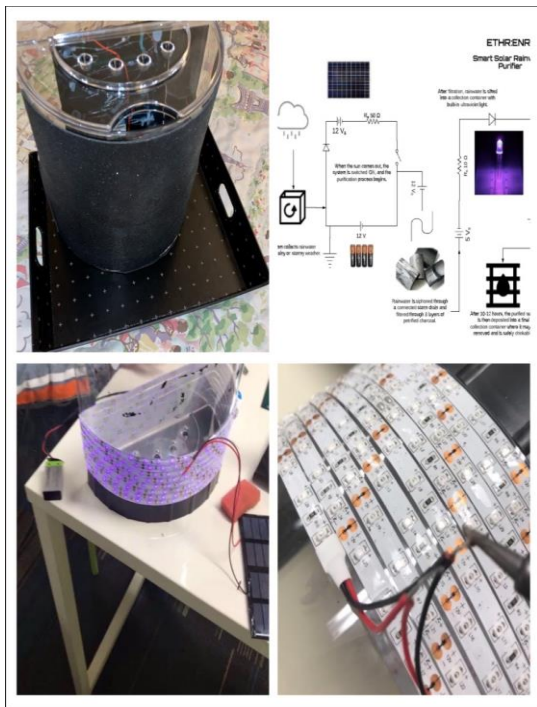


Figure 4: ETHR-ENRG Smart Solar Rainwater Purification System With Circuitry Design

The design above is wired using a 12-volt solar panel with the soldered on positive and negative wires directly soldered to the positive and negative wires on the string of ultraviolet lights and the battery backup is spliced with the other end of the wires from the string of ultraviolet lights and

taped off with electrical tape to prevent exposure and possible harm.

III. THINGS WE LEARNED

“Solar energy is tricky, but once you understand it, there are endless possibilities to create new opportunities and ideas for innovation.”

-Danielle Washington

“I can now not only explain solar energy and power in a confident, educated manner, but I can also make educated decisions on the power ratings required for many solar jobs and projects.”

-Corey Wooten

“I learned how to stay positive, and input my personal thoughts as well as receive different viewpoints, and perspectives from each group member. We learned how to maneuver through trials and errors to complete and present [the project].”

-Tony Martin

“I’ve learned the basic minimum requirements it takes to physically construct an electronic device using solar power.”

-Michael Farabee

IV. CLOSING STATEMENT

With the advancement of solar energy, we are confident our Solar Energy Project Kits will be beneficial to those who want to learn more about solar energy and its benefits. The future is solar!

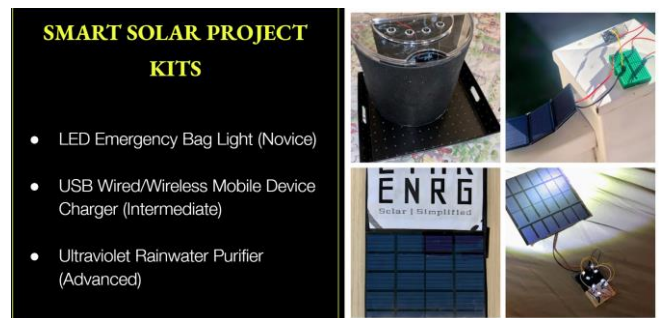


Figure 5: ETHR-ENRG Smart Solar Novice, Intermediate, and Advanced Project Kits



Figure 6: We Are ETHR-ENRG!

## REFERENCES

- [1] 2017, [https://www.youtube.com/watch?v=anX3cJ\\_Yo\\_M&feature=youtu.be](https://www.youtube.com/watch?v=anX3cJ_Yo_M&feature=youtu.be). Accessed 13 Aug 2017.
- [2] 2017, <https://www.youtube.com/watch?v=Uq8IrtL0MXU&t=33s>. Accessed 7 Feb 2017.
- [3] Day, Laura. "12V Solar Panel Guide For Beginners | Solar Alliance". *Solaralliance.Org*, 2018, <https://www.solaralliance.org/12v-solar-panel-guide/>. Accessed 18 Jan 2018.



Figure 7: ETHR-ENRG Smart Solar Novice, Intermediate, and Advanced Project Kits Assembled And Working Properly