

IEEE EDS HUMANITARIAN GRANT REPORT FOR THE OFF-GRID SOLAR SCHOOL AND SMARTBOX PROJECT IN THE MAASAI TRIBAL VILLAGE OF EMPASH, KENYA

By STEPHEN PARKE



The school building with solar panels in the village of Empash

Education is a most formidable tool in transforming our world. Education brings fulfillment, reduces poverty, increases chances for a healthy life, empowers women, and promotes peace. But, more than 72 million children around the world remain unschooled. The Sub-Saharan region of Africa, particularly the disenfranchised Maasai children of Kenya and Tanzania, are severely affected due to lack of access to water, electric power, teachers, curricula, computers, and internet.

Wilson Kamau, PhD Materials Engineering, founder of non-profit toEnable.org, grew up in Mukurwe, a village outside of Thika Town in Central Kenya. It has 500 people, 2000 cows, and 6000 goats. Wilson was fortunate to receive outside help to complete primary school and then high school, where he caught the vision to become a chemist. He found generous support to attend Africa Nazarene University in Nairobi and then Northwest Nazarene University in Boise, ID, graduating with a Chemistry degree. He went on to graduate school at University of Nevada, Reno and persevered to receive a PhD in Materials Engineering. He now works for a major US engineering company! With his wife Rebecca, he has founded the non-profit toEnable.org to bring basic human needs (clean water, food, power, etc) and primary and high school education to the village of Empash. In 2019, Dr. Kamau reached out to his alma mater, NNU, to request the help of interdisciplinary design teams of senior engineering students to design a modular, classroom building that could be assembled in a simple manner in remote sites, like the village of Empash, off-road and off-grid. This classroom is replicable, using locally available materials and talent.

Two consecutive years of "Firm Foundation" student teams designed the modular classroom for 40 primary school students and delivered their PE-reviewed building plans to the local Empash construction team. This involved developing new lightweight masonry wall panels made of "Aircrete." (although traditional stone was ultimately used) ToEnable funded the construction, and the first two adjacent modular classrooms were completed July-October 2022. Dr. Kamau also requested NNU's



SmartBox and Solar Power system installed in the village of Empash

Kenya Energy “Kenergy” student team to design a 10kWh per day off-grid solar power system for this new school. It is capable of charging 20 cell phones, 20 laptops, LED lights, a small medicine fridge, and a novel off-grid, off-internet classroom learning system known as SmartBox. Our team worked with Idaho-based, off-grid solar company Inergy to design a safe, robust, simple to maintain system for the Empash School. This university-industry collaboration placed state-of-the-art solar equipment in one of the neediest and most practical locations on earth in a very short time.

Without any internet connection to the Cloud, the tera-bytes-sized SSD RACHEL server inside the SmartBox delivers a vast collection of curated content for K-12 education, distributed through the classrooms and village wirelessly with a WiFi router to 20 chromebooks (two students on each) and other laptop or cellphone users in the community. The 20 chromebooks, server, router, and teaching data projector are recharged nightly (in 4 hours) from the solar power system, then run on battery power the entire school day. SmartBox has extensive interactive educational resources including Wikipedia, Khan Academy, African Storybook Project, 1000’s of reading books, e-textbooks, History of Women Leaders in Africa, languages, videos, animations, art & music, and two audio headsets per laptop, for quiet team learning in the classroom. Lack of qualified teachers is a serious problem in remote areas, but students can learn on SmartBox, even in the absence of enough qualified teachers. It is also a powerful learning resource for the teachers themselves. The SmartBox and its tech equipment are all housed in a strong, wheeled Pelican Case that is securely locked nightly inside a steel security cage alongside the Solar Battery Stack.

Box helped that school to rise to the top in Liberia on the West African Examination Council (WAEC) high school graduation exam. In 2014, the school only had a 23% grad rate. In 2017, they jumped to a 88% grad rate! The Empash Primary School in Maasailand is the first school in Kenya to receive SmartBox. Hands-on training was held for the Empash teachers both before and during our weeklong install visit to Empash in mid-October 2022. Some of the teachers trained had never used a computer/laptop in their life! Now they are proficient enough to teach their primary school children how to use them.

Dr. Stephen Parke, NNU Engineering Professor and IEEE EDS Humanitarian Council member led a team of 12 NNU students to Africa Nazarene University near Nairobi, Kenya from August-December 2022 to study alongside their fellow Kenyan students. 16-23 October, Dr. Parke and this NNU student team along with Dr. Kamau and his ToEnable team, traveled six hours by 4WD to transport, install, and train teachers on this new Solar Power and SmartBox system in the newly completed Empash School.



Children with chromebooks in the classroom

NNU Engineering traveled a few years ago to a rural off-grid school in Liberia to install a SmartBox, along with SmartBox creator Gary Friesen, from Innovative Education Inc. (IEI). In three years of use in that setting, Smart-



NNU Engineering student volunteer training Empash teachers on SmartBox chromebook system



Volunteers from NNU, Boise

At the end of this week, the entire village and school children came out to celebrate the opening of this new, modern primary school. There were speeches, dances, singing, food, and much thanksgiving in prayer for this huge change wrought in this small village. There are now 66 students enrolled in this new school, with 100 more

on a waiting list. There is no doubt that this school will produce many more Dr. Wilson's and Dr. Rebecca's in the future. Thanks to IEEE EDS Humanitarian Council for their generous \$16,000 grant to help begin the transformation of these students' lives for this village of Empash and surrounding ones.
