Solar Photovoltaic System For the Ekuphileni Bible Institute

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Introduction

The Solar PV team (Fig. 1) designs and installs solar photovoltaic systems in developing countries where power is either unreliable or non-existent. Lack of reliable electricity significantly hinders the mission of our clients and, in the case of our current client, prevents them from furthering their education and safely storing food for extended periods of time.

This poster describes the steps performed to design a solar PV system for the Ekuphileni Bible Institute in Zimbabwe, and explains the current layout chosen for the system.

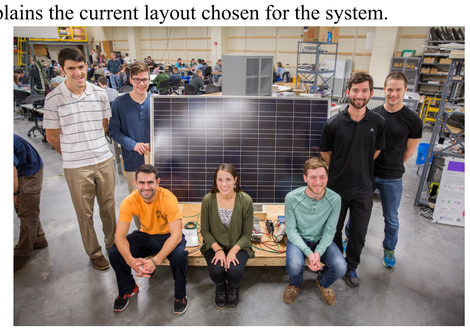

Figure 1: The Solar PV team in Spring 2017

Client

The Ekuphileni Bible Institute (Fig. 3, 4, & 7) is located in Mtshabezi, Zimbabwe (Fig. 2). The local electric grid, relying largely on hydropower, has grown increasingly unreliable due to droughts, and often shuts off unexpectedly, remaining off for an unknown amount of time—sometimes for up to a week. This has interrupted refrigeration, causing several hundred dollars worth of food to be lost, and continues to hinder their ability to pursue their educational mission. To mitigate their energy concerns, our team has designed a solar photovoltaic system to power EBI's library and fridge. An installation trip is scheduled for May 2017.

Figure 2: EBI Location in Africa

Figure 3: EBI Campus Layout

Design Steps

In order to design a viable Solar PV System, certain steps were followed. These are outlined below:

♦ First, the size of the system was decided by analyzing power usage. The faculty at EBI provided a list of equipment they wanted powered, such as computers in the library (Figure 4). This information was used to perform a load analysis in order to calculate the required energy production the system would need to meet, measured in kilowatt-hours per day (kWh/day) .

Figure 4: Computer lab

♦ Next, the specific electrical components (Figure 5) were selected. This included solar panels, batteries, an inverter, a charge controller, a MATE, etc. The role of each component is outlined below in the context of the whole system:

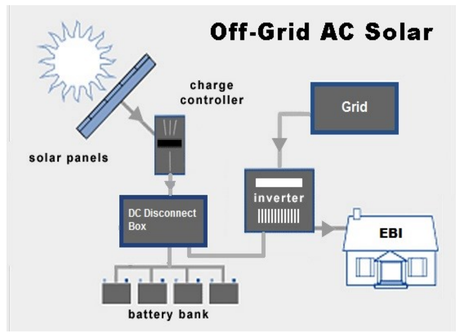

Figure 5: Diagram of a Simple Off-Grid Solar Installation

♦ The panels take energy from the sun and convert it to electricity. The wattage of the panels was chosen based on how long the batteries take to charge.

♦ Batteries store energy from the panels for later use when the sun is not out or when the loads require more power than is being produced by the panels alone. Batteries were chosen based on the load (determined earlier).

♦ The charge controller monitors the energy that is going from the panels to the batteries. It was selected based on the solar panels and batteries that are being used.

♦ The inverter converts the DC electricity from the panels and batteries into AC for appliances to be powered. The inverter was chosen based on the loads and the battery bank voltage.

♦ A MATE (not shown in Figure 4) will also be included in EBI's system. The MATE controls and monitors the system as a whole, managing the other components.

Funding for the Ekuphileni Bible Institute's System

While solar provides a tremendous opportunity for EBI's energy crisis, solar equipment is expensive, making funding the system the primary challenge to implementation. Fortunately, over the summer of 2016, the Solar team received a generous donation of $20,000 towards the EBI project. This has provided for a tremendous portion of the overall cost of the system. However, additional funds are still required to be fully funded. A crowd-funding effort with the goal of raising $7,000 has been launched on EBI's behalf, in hopes of raising the final funds needed. This will run until the team departs in May.

System Layout

Once the components were chosen, the system layout needed to be designed. Fifteen 305 watt solar panels will be placed on the library roof, where they will be in direct sunlight. This was determined by conducting a shade analysis which accounts for shading from nearby trees and other objects at all times of the year. A roof analysis was also conducted to ensure the library roof will be strong enough to support the weight of the solar panels. Solar panels will be secured to the roof with a mounting system constructed out of lightweight aluminum. The remaining electrical components will be housed on top of a battery box with eight batteries in EBI's library where they will be protected from weather and theft.

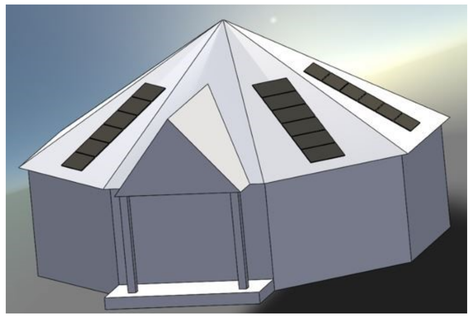

Figure 6: Panel layout on library roof

Figure 7: The library at EBI

Conclusions

With a growing power crisis in Zimbabwe, solar has become one of the most viable options for reliable electricity. Now that a system is designed and ready for installation, we look forward to providing the power needed for the students and faculty at EBI to further their education and continue in their mission of sharing God's love with the world.

Acknowledgements

We greatly appreciate Friends of TCZ and Rebekah Basinger's assistance in raising funds for the EBI installation, as well as Messiah College's grant office. In addition, we appreciate Katie Piette's efforts in filming and editing our team video. Also, we would like to thank Mr. Mark Brill, Mr. Nathan Charles, Mr. Erik Weenink, Mr. Bob Hentz, Mr. Glen Pierce, Dr. Randy Fish, and Dr. Michael Robinson (project advisor) for their advice and support. The other members of Solar PV—Scott Kerstetter, and Josiah Peck —must also be acknowledged for their hard work and commitment to the project's vision this past year.

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