Design of a solar powered water pumping system for Living Love Ministries in Ol Kalou, Kenya

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Living Love Ministries

SOLAR PV

Our Team

The solar photovoltaics (PV) team (Fig. 1) designs and installs solar panel systems in developing countries where power is either unreliable or non-existent. By providing a solar water pump, we will enable expansion at the Living Love Ministries (LLM) Children's Home in Ol Kalou, Kenya, allowing LLM to care for more orphaned children.

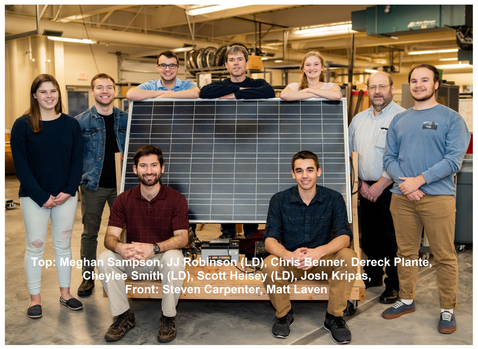

Figure 1: The Solar PV Team in Spring 2019

Our Partners

The LLM Home (Fig. 2) in Ol Kalou, Kenya provides food, clothing, and education at a nearby Christian school to 36 orphaned children. Goals for the Home include a new primary school and less reliance on outside agents. A reliable water supply will assist these goals. Stanley Earth (Fig.3) has partnered with us to provide a pump, motor, and controller, plus backups for each component. Stanley Earth supports sustainable agriculture with solar pumping systems.

Figure 2: LLM's Children

STANLEY Earth

Figure 3: Stanley Earth Logo

Our Partner's Need

LLM Children's Home currently relies on a diesel generator and pump to supply water to their campus. This impedes campus growth. We are partnering with Stanley Earth to install a solar water pump that will lower cost and increasing water output for both domestic use and irrigation, thus enabling ministry expansion.

Design Methodology

- Seek to size the system to match the measured well output capacity of 12,000 L/day.
- Accommodate a total budget of $15,000, with $6,000-7,000 allocated to solar.
- Model daily power production and water flow. Assume that power production is a bell curve. Data from Stanley Earth shows that flow from the pump is linearly proportional to the solar power.

  For a cost-effective 265 W panel, the maximum number of panels based on the voltage rating of the controller will supply 10,000L on an average sun-day. Since this is below the well output capacity, use the maximum of 26 panels.

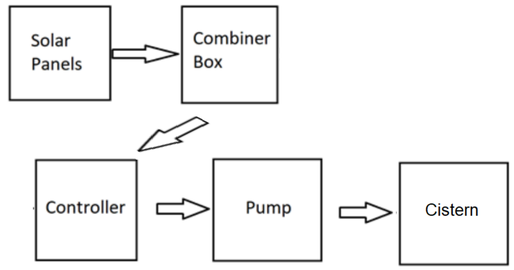

Figure 4: LLM Solar Water Pumping Block Diagram

- Size components and wiring based on the voltage and current supplied by the system. Fig. 4 provides a top level block diagram of the system. Components include: panel mounting, wiring, disconnect switches, combiner box, fuses, conduit, etc.
- Select an in-country solar equipment distributor. The Center for Alternative Technologies (CAT) was chosen for their competitive pricing and service last year.

Figure 5: Panels on Roof of Pamoja Hall—Summer 2018

- Mount panels on Pamoja Hall for security. This is where the team installed panels last year (Fig. 5).
- House the pump controller near to the borehole.
- The system provides domestic plus irrigation water. On bad sun days, the system will still supply enough water for domestic use, but less for irrigation. This is not a problem, since bad sun days tend to be rainy days.

System Layout

Twenty-six 265 watt solar panels will be placed on the roof of Pamoja Hall to form a 6.89kW array (Fig. 6). The panels will be wired in two strings of thirteen panels. LLM is near the equator, so panels may be placed on either side of the roof for equivalent energy production. However, the building is oriented northwest to southeast, so half of the panels are shaded by the peak of the roof during the first and last hours of the day. Therefore, half of the panels are placed on each side of the roof to extend the water-pumping hours. Wiring will run from Pamoja Hall to the controller at the borehole (Fig. 7). The pump will run to a partially underground cistern. (Fig. 8).

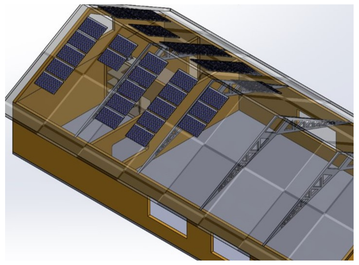

Figure 6: Panel Layout on Pamoja Hall

Figure 7: In-Between Building Wiring Plan

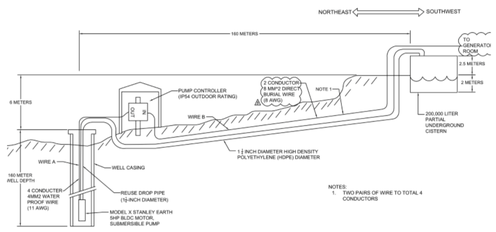

Figure 8: Side view of bore hole and pump setup

Conclusions

The team travels to Kenya in May-June 2019 to install a solar water pumping system and interact with LLM staff, children and families. The Collaboratory is pleased to provide ongoing support for LLM's mission to share the Good News about Jesus with orphans.

Acknowledgements

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