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## Solar PV - Equipping the Future

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Messiah University is a Christian university of the liberal and applied arts and sciences. Our mission is to educate men and women toward maturity of intellect, character and Christian faith in preparation for lives of service, leadership and reconciliation in church and society.

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## 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. In recent history we began constructing a Solar lab to equip future teams with more of the experience and knowledge we have gained from previous systems we've designed.

This poster describes the steps performed to design a solar lab at Messiah College, explains the current layout chosen for the system, and what progress we've accomplished in the past year.



Figure 1: The Solar PV Team in Winter 2019

## Our Partners

The Solar PV has had many partners in previous years including LLM, TCZ, and EBI. Unlike in past years this year our main focus has not been in building a specific solar PV system but in creating an educational one at Messiah College. This system will exist to benefit our future teams so that we can continue to serve our previous partners and future partners with fuller and better knowledge of PV systems.

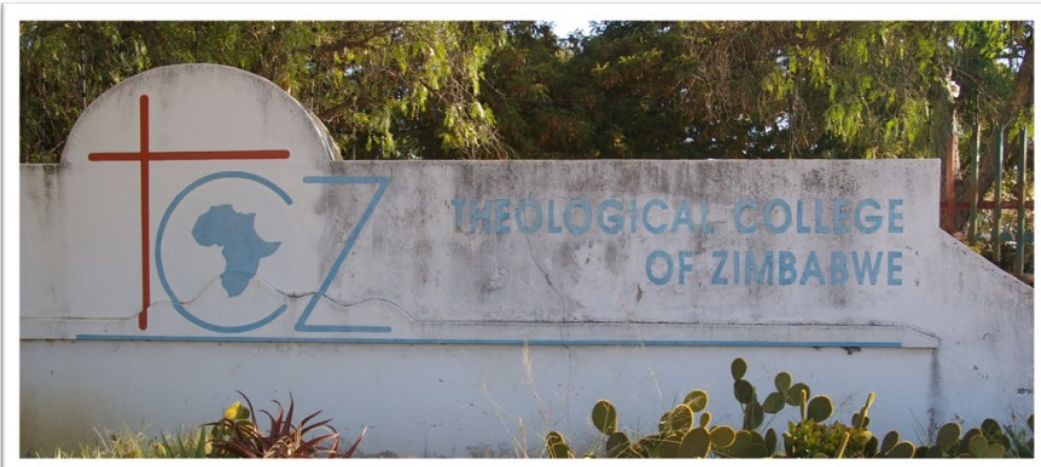


Figure 2: TCZ welcome sign



Figure 3: The Solar PV Team at LLM, Kenya

## Messiah College Solar PV Lab

The Solar Lab at Messiah College is a fully capable solar PV system which has two main uses. The first of which is to educate new team members about the different parts of solar PV systems which have been installed at client locations. Many of the parts in the Solar Lab have been used at actual Solar PV install locations. The second use of the Solar Lab is for the experimentation of new designs or layouts or for testing how new components may interact with the already existing system.

The Solar Lab is a 1.6kW system with a battery backup, dual charge controllers, dual pure sine wave inverters, and one modified sine wave inverter. The panels for the system are mounted between Frey Hall and Bittner Beach. There are eight total panels split between two pole mounts. The wiring from the panels then follows underground conduits before entering into the project space in Frey 70 and over to the control panel.

The Solar Lab can be rearranged to match a number of different configurations for experimentation and simulation of system installs. Both charge controllers can be used independently or in a master slave configuration in order to expand battery storage capability. Dual charge controllers also allows us to test independent battery strings

The batteries for the system can also be re-arranged for flexibility and for experimentation. There are currently four AGM and four Gel batteries, but the wiring layout can be altered easily by accessing the battery box located directly below the control panel.

On the control panel we have three separate inverters. Two of the inverters are the same pure sine wave unit, while the last one is a modified sine wave inverter. The pure sine inverters are the same model Solar PV has installed before at client locations. They can be wired in a master slave configuration, an independent configuration, or a grid-tied configuration.

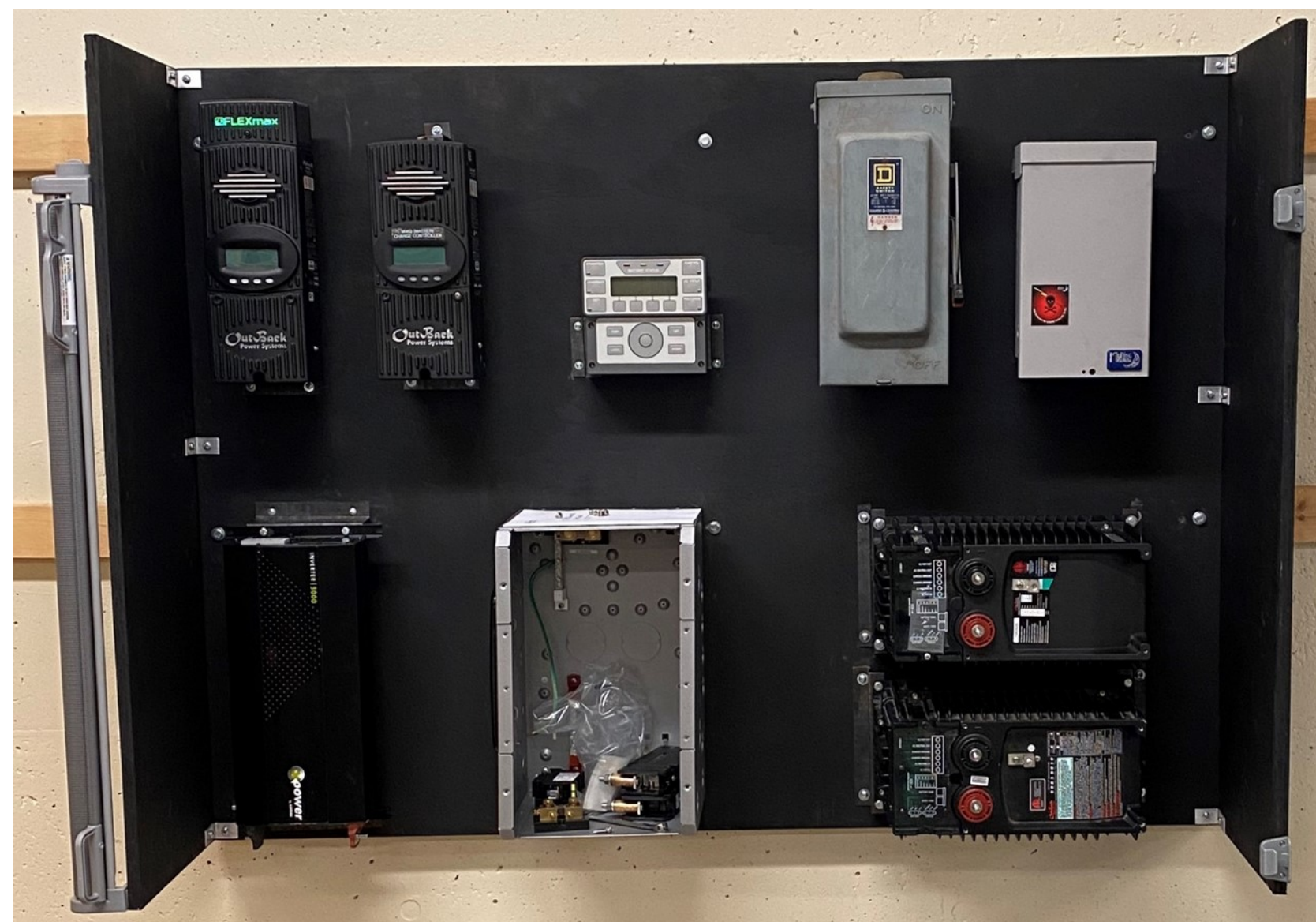


Figure 4: Current Layout of the Solar Lab control Panel

## Solar Curriculum

To utilize this solar lab well. The solar team has been working on writing a series of labs that can be utilized in the future to teach new student team members and get them up to speed on how Solar PV systems work. The some parts of this curriculum have been written and are currently being revised. The rest of this curriculum will be written between the end of the semester and in the fall next year. Figure 6 shows the full list of topics to be discussed in the solar curriculum.

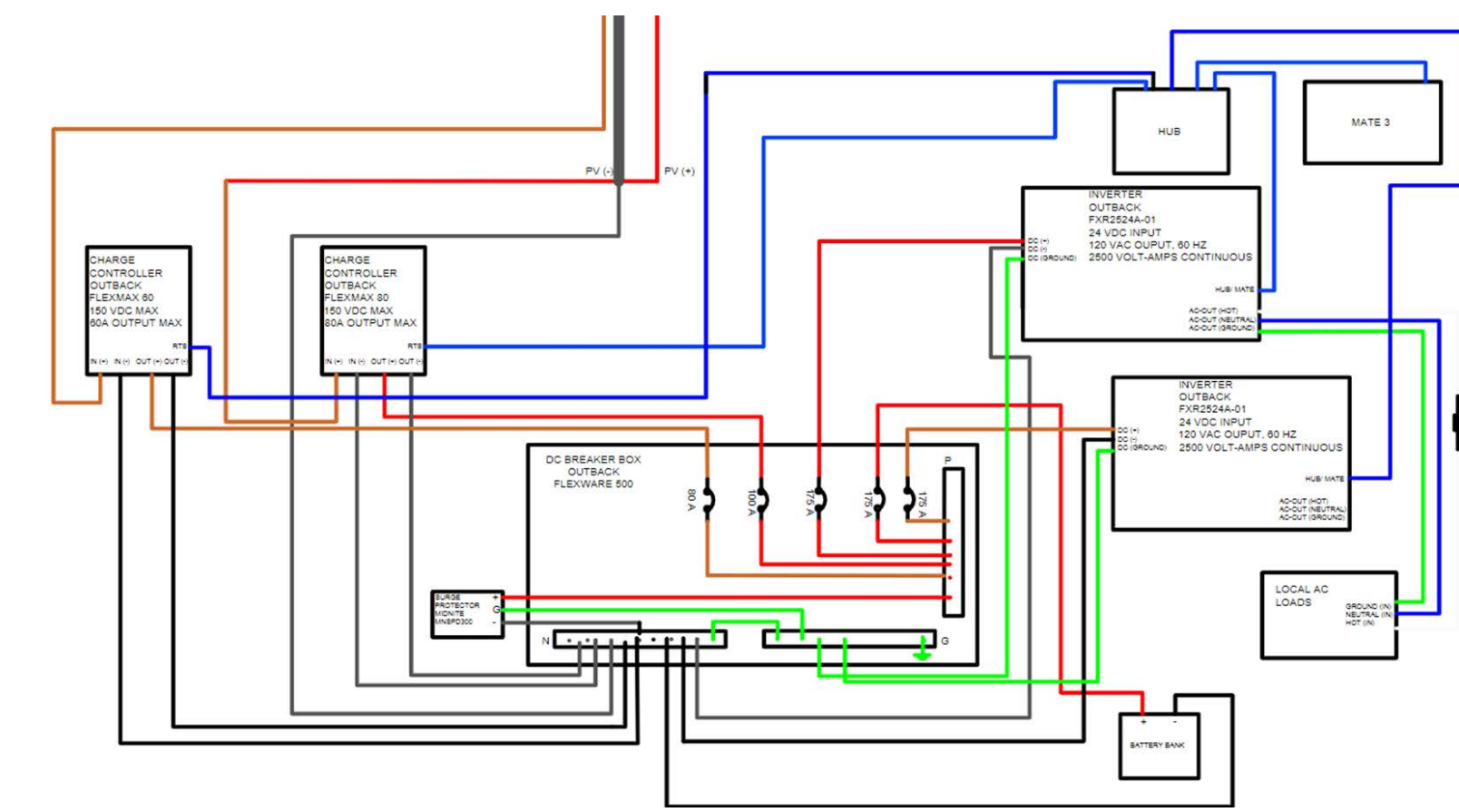


Figure 5: Wiring Diagram for the Solar Lab

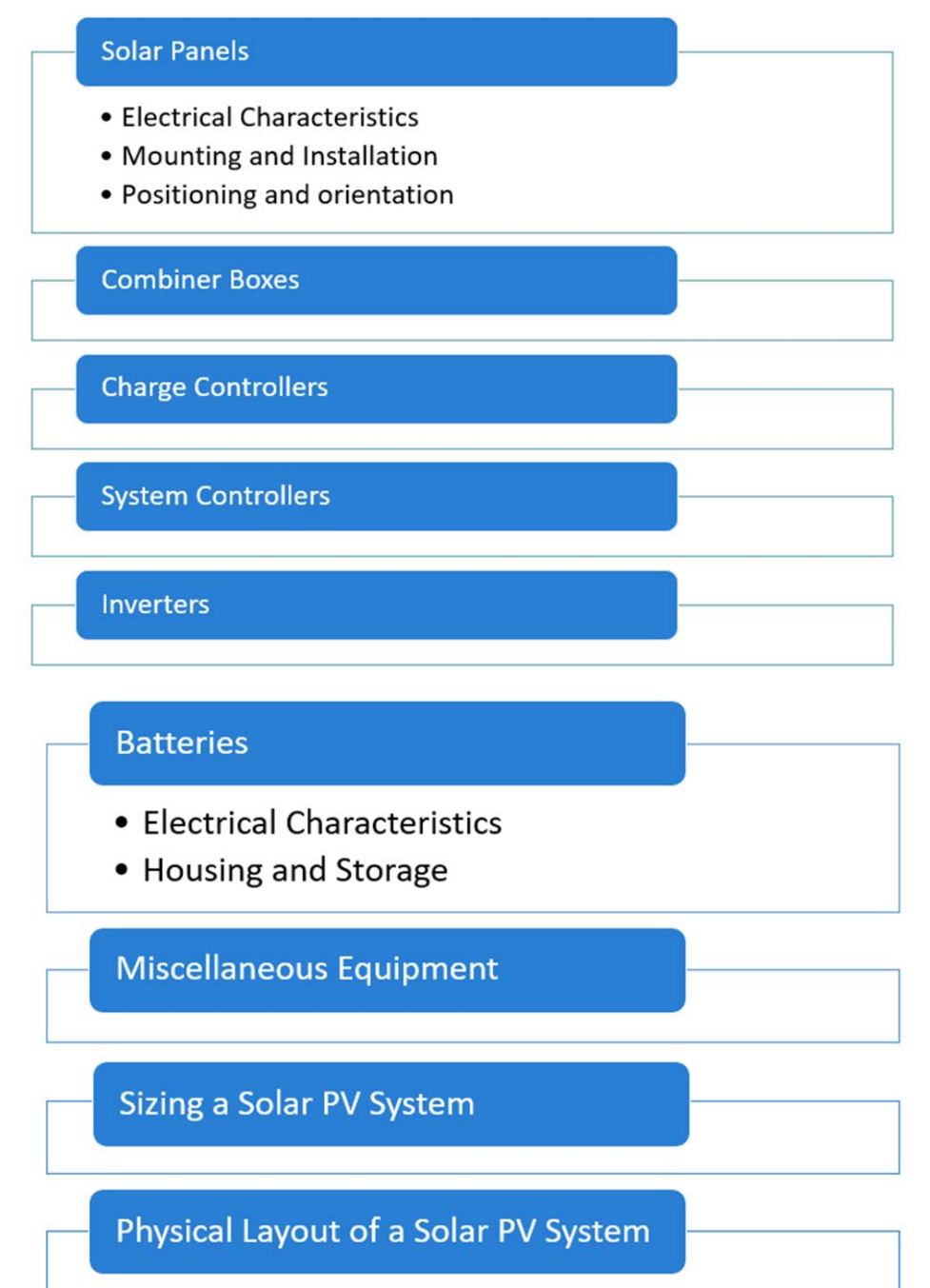


Figure 6: Lab Modules for the Solar Curriculum

## Conclusions

The Solar PV team looks forward to completing the final installation of the Solar Lab and completing the training document. Both will be valuable resources for new team members as well as prototyping new client installs in the future.

## Acknowledgements

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