

Feasibility of Solar Power at Calvin University

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Project Overview

Calvin University is facing the need to upgrade its energy infrastructure, with many systems having several decades of service. The need to upgrade provides an unprecedented opportunity to replace CO2-emitting technology with greener options. Calvin's Climate Commitment highlights the need to be carbon neutral by 2057. The Vice President for Finance & Chief Financial Officer at Calvin University, Dirk Pruis, tasked the ENGR 333 class to explore the question: *What should be the design of a Calvin Solar Farm?* The project looked at four different options including ground mounting off campus, ground mounting on campus, carpark mounting, and rooftop mounting. We had help from the PHYS-133 and ENGR 327 classes to further analysis.

Objectives

- Calculate the Solar energy efficiency applied to Calvin University
- Explore locations on campus and off campus for Solar arrays
- Establish the type and model of Solar panel and Inverter to be used in each configuration
- Determine financial expenses and savings of implementing the Solar panel system
- Investigate how the Solar farm(s) will integrate into existing electric grid

Acknowledgements

We would like to thank Professor Matthew Heun, Mr. Dirk Pruis, Professor Larry Molnar, Mr. Chuck Holwerda, Professor Leonard De Rooy, Greg Oliver (Agathon Solar), Jennifer Ambrose, and all students in ENGR 333, ENGR 327, and PHYS 131.

Analysis

Ground Mounting off Campus

The team analyzed the property owned by Calvin, Flat Iron Lake Preserve. The site was chosen for its characteristics: clear, flat terrain, which is highly suitable for solar panel installations. The team selected the TOPBiHiKu7, Canadian Solar, 690-720W. The number of panels that can be allocated is 7,803 along the prairie and side of the research house found in the property.

Ground Mounting on Campus

The areas to put solar panels were selected based on land geometry, size, solar irradiance, land use, potential challenges and surveys. These areas are the Cross-Country track forest, Phi Chi Field, Devos Field, Preserve Prairie, Hampshire property and Lake Drive Entrance. The total amount of panels is 9,836 solar panels using the TOPBiHiKu7, Canadian Solar, 690-720W.

Carpark Mounting (Parking Lots)

The team identified 14 parking lots, divided into 6 projects, that could sufficiently house Car Park style solar structures. These parking lots are found along Calvin campus, which are Lots 1, 2, 3, 4, 5, 6, 8, 11, 13, 14, 15, 16, 17, and 19. The total amount of panels allocated across all parking lots is 9,883 using the panel brand Tiger NEO72HL4-V, 605 W.

Rooftop Mounting

The team identified six roofs for the Calvin University Solar Array, which are the Venema Aquatic Center, North Hall, Devos Communication Center, Prince Conference Center, Hiemenga Hall, Hekman Library, and Van Noord Arena. The total amount of panels to put in these roofs is 4,792 using the Silfab SIL-430 QD DCA, 430 W.



Figure 1. ENGR 333 section B students.

Conclusions

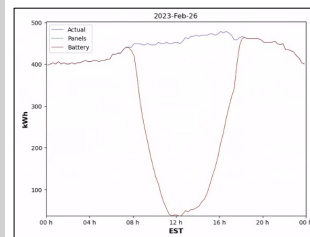
The analysis was done by calculating the energy efficiency each site could generate with relation to the 30-year ROI as well as the payback period (see Figure 4) in years to make the optimal decision for Calvin's Campus Solar Farm. It is composed of a combination of rooftop and ground mounted on campus solar panels. The sites on campus ground mounted are the seminary fields and the lake drive lawn, both having a payback period of 14 years and 36% ROI. The rooftop used for the solar farm are the aquatic center, Van Noord Arena, Hiemenga Hall/Hekman Library, Devos Communication Center, and the Prince Conference Center. The rooftops have a 12-year payback period and an average of 42% ROI.

Key References

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Henderson, Michael. "Pole Mount Design and Quoting Tool - MT Solar AutoDesigner." *MT Solar*, 15 Oct. 2024, www.mtsolar.us/autodesigner/. Accessed 19 Nov. 2024.

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LEFT: Figure 2. Total energy used by Calvin University on a sample day.

Power Analysis

RIGHT: Figure 3. The monthly consumption of electricity for Calvin University; comparing total, peak, and off peak

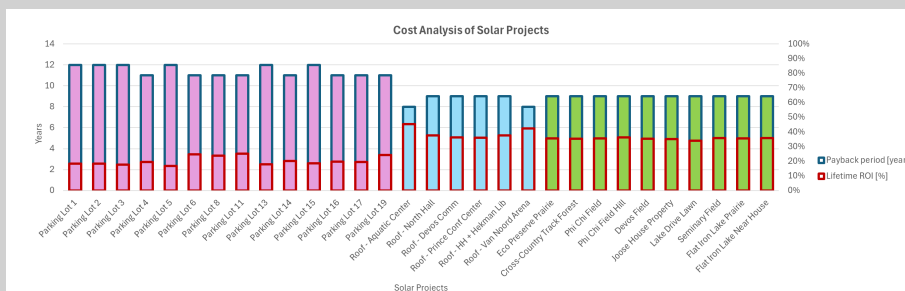
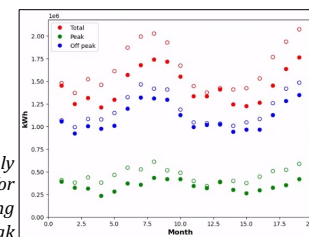


Figure 4. Cost analysis of parking Lots, roofs, and ground mounted.