“SHEAR” GENIUS SOLAR FROM NORTH CAROLINA STATE UNIVERSITY

NC STATE UNIVERSITY

Team: David Clinkscales, Andrew Duncan, Madison Foley, Jennifer Robson, Jenna Swartz, Jakob Triemstra, Gabe Williams, Helen Ye
Mentors: Mesut Baran, PhD, Ken Dulaney, Len White, PhD

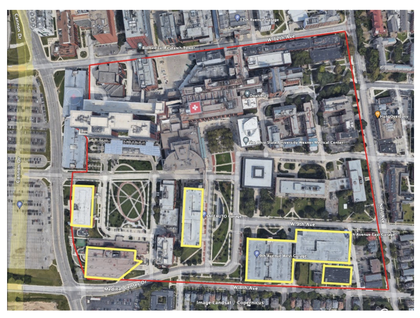
Introduction

Sponsored by the US Department of Energy, the Solar District Cup is a collegiate design competition that challenges multidisciplinary student teams to design and model a solar plus storage system for a campus or urban district use case. Teams assume the role of a developer and evaluate permitting, power purchase rates, sustainability plans, and power systems engineering. The use case assigned to the NC State team focused resiliency for the Medical Campus at Ohio State University. Our solution included rooftop solar plus an agrivoltaic installation at a nearby research farm that incorporated sheep grazing, a "shear" genius idea.

U.S. DEPARTMENT OF ENERGY
SOLAR DISTRICT CUP
COLLEGIATE DESIGN COMPETITION

System Design

After selecting potential sites, the team decided to use single axis tracking on the ground mount systems along with bifacial panels to maximize kwh production. Locations on the medical campus were limited to parking garages and buildings not under planned renovations and included a mix of monofacial and bifacial panels. The team used System Advisor Model to simulate the bifacial panels and Aurora Solar for the monofacial.



Final system design was 2.16 MW with estimated annual production of 2.92 MWh.

Financial Analysis

OSU purchases electricity at the transmission level at a very low rate. For our system design, investor returns originate from a power purchase agreement, the federal investment tax credit, and the modified accelerated cost recovery system. However, the system does not break even until nearly 20 years.

Our team also decided against installing a battery for financial reasons. Hospitals already have backup generation rules that require onsite liquid fuel storage. Therefore with the focus on system resiliency, a battery would only serve to extend the available fuel supply since it cannot be specifically used for hospital resiliency.

Results

- 2.16 MW total PV generating 2.92 MWh/year
- Did not recommend battery installation due to high cost for resiliency benefit.
- Avoided overvoltage issues, considered multiple zoning and permitting restrictions.
- We won third place in the OSU Use Case Division!

Development Plan

Agrivoltaics were an emphasis for this use case so we relied on recommendations from the American Solar Grazing Association in selecting sheep. This plan also evaluated zoning restrictions, flood plains, fire codes, glare impacts on the Hospital helipads, and all permitting requirements. The team evaluated construction risks and weather delays. Our project Gantt chart included a staged construction approach over 9 months.

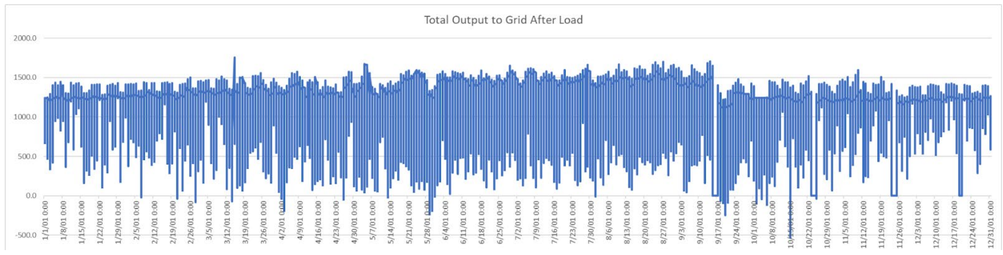
Appreciation

The team would like to thank NREL for supporting the competition, competition sponsor Aurora Solar and HeatSpring, our mentors from NC State, Southern Energy Management, Energy Intelligence Partners, and the FREEDM Systems Center at NC State.

FREEDM SYSTEMS CENTER

Distribution Impact

Potential overvoltage on high PV, low load days was the main concern. The image at right demonstrates the low risk. The team recommended smart inverters to clip production as needed.



Download Poster Here

Scan this code to view the poster in the app!