Jamestown S’Klallam Tribe - Community Resiliency Center
Microgrid Design
Students: Vanessa Affandy, Aimee Phung, Cody Young

Objective
- The Jamestown S’Klallam Tribe wants to implement a microgrid system on their social and community services building (SCS). The Tribe is currently being supplied by a local utility, with a backup diesel generator for outages.
- A microgrid system would increase the duration of backup power during a power outage, while reducing the tribe’s carbon footprint and their overall dependency on non-tribal entities to promote tribal sovereignty.
- Our project is a feasibility study on the design and economics of the microgrid.

Requirements
The requirements of the project include:
- Preserve the appearance of tribal architecture and artwork in the design process for solar panel and battery locations.
- Support critical loads for at least 7 days in the occurrence of an emergency or long-term power outage.
- Reduce the carbon footprint of the SCS building.

Renewable Energy Research

Hydro power
- Due to the tribes reliance on nearby streams and their advocating for ecological wellness, we have decided to not implement hydropower into our design as this could damage the nearby ecosystems they are reliant upon.
- Additionally, the marine energy map indicates a dearth of wave power within the designated areas.

Solar Power
- As you can see based on the graphic from the global solar atlas, this location has a higher PV potential than nearby locations. Meaning out best choice out of the available choices is solar power.

Load Data Analysis

Hourly Load Profile Model
Shown in Figure 2, our findings reveal that the SCS building exhibits a distinct hourly energy consumption pattern:
- Winter months: ≈20 kW, peaks at ≈40 kW
- Summer months: ≈8 kW, peaks at ≈20 kW

Microgrid Sizing
Through the simulations of our system utilizing HOMER, with the potential PV sizes, employing a 21 kW/230 kWh battery:
- Accommodates typical load
- Reduces daily peak load
- Diesel generator only operates in the case of a one-week-long winter outage

Implementation; Site Selection and Generation

Load Analysis
The depicted plot (Fig. 1) demonstrates a discernible surge in the building’s load during the winter months, while the observed characteristics and numerical values remain relatively consistent across the years, undeterred by:
- Weekend vs. weekday operations
- The COVID-19 pandemic

It is inferred that the building’s equipment operation has been consistent, meaning heating and cooling are the main variables in the load.

Results - Design cases and System Scheduling

- Outages at critical load (40% of total load)
- Case 1: 48 kW PV System, 125 kW Generator, no Battery
- Case 2: 48 kW PV System, 125 kW Generator and a 21 kW/230 kWh battery system
- Case 3: 20 kW PV System, 125 kW Generator and a 21 kW/230 kWh battery system

Results - Economics
The table below compares the economics of two PV system sizes (at full load during a typical year) that will be considered for the tribe's microgrid:

<table>
<thead>
<tr>
<th>System Size</th>
<th>% Grant Funded</th>
<th>LOCE (real)</th>
<th>NPV (25 yrs)</th>
<th>Net Savings (yr 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 kW</td>
<td>0%</td>
<td>133.84</td>
<td>-764,934</td>
<td>2,176</td>
</tr>
<tr>
<td>48 kW</td>
<td>10%</td>
<td>166.91</td>
<td>-759,163</td>
<td>4,293</td>
</tr>
</tbody>
</table>

Conclusions, Future Work and References

Conclusions:
- We recommend that the Tribe selects Case 2: 48 kW PV System with a 21 kW/230 kWh battery system.
- The system will provide the most resiliency for the cost but still falls under all requirements for the microgrid given by the Tribe’s representative.
- Future work on this system will include a detailed work given high frequency data collected from the SCS building.
- Measurement of angle of roofs and land where PV panels will be installed for detailed solar report.
- Discussion with utilities to utilize system to grid connection.

References

A special thank you to our sponsor, advisers, and mentors!