House of Awakened Culture

Solar Plus Storage Feasibility Study

7325 NE Parkway, Suquamish, WA 98392

Suquamish Trust Land

Prepared by Cascadia Renewables for the Suquamish Tribe

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CASCADIA RENEWABLES

About Cascadia Renewables

Cascadia Renewables is a technical consultant based in Washington state, specializing in designing and deploying solar and storage assets. We leverage our combined decades of industry experience to support public and private entities as they pursue their clean energy goals. Our team has led regional clean energy policy initiatives focused on equality, transparency, and affordability.

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Acknowledgments

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Letter From the Field

Dear Cherrie May,

We are pleased to present the Suquamish Tribe with this study, which examines the feasibility of constructing a solar plus storage system to enhance resiliency at the House of Awakened Culture.

The purpose of this study is to convey a clear, detailed, and accurate description of the design for a potential solar plus storage system to enhance community resilience, taking into account geographical, infrastructural, economic, environmental, and social context. This report is the culmination of an extensive design project, the goals of which include:

- Understanding community needs
- Assessing trends in energy usage and conditions of the site
- Determining the optimal system size and architecture
- Assessing the benefits, challenges, and risks of proceeding with the proposed system
- Identifying next steps

FUNDED BY WASHINGTON'S CLIMATE COMMITMENT ACT

This report is supported with funding from Washington's Climate Commitment Act. The CCA supports Washington's climate action efforts by putting cap-and-invest dollars to work reducing climate pollution, creating jobs, and improving public health. Information about the CCA is available at www.climate.wa.gov.

We intend this document to concicely convey the technical aspects of the design to those with experience reading such information. It is separated into three levels of detail:

1. A high-level summary of our findings and recommended design *(found on page 5)*
2. Detailed specifications of our design and design process *(pages 6–46)*
3. An appendix of calculations and ancillary documents for cross-referencing, as well as the findings and photos from our original site visit *(found in separate PDFs)*

To determine the feasibility of a solar plus storage system, it is necessary to specify equipment, equipment locations, system design, and hourly labor/services estimates. Though we provide this high level of fidelity, please note that this feasibility study is conceptual– it is not intended for construction purposes. It supports stakeholder decision-making, fundraising efforts, and future designs. To determine the final product specifications, equipment locations, system design, and hourly cost/estimates, Cascadia Renewables recommends a thorough 3+ bid RFP process.

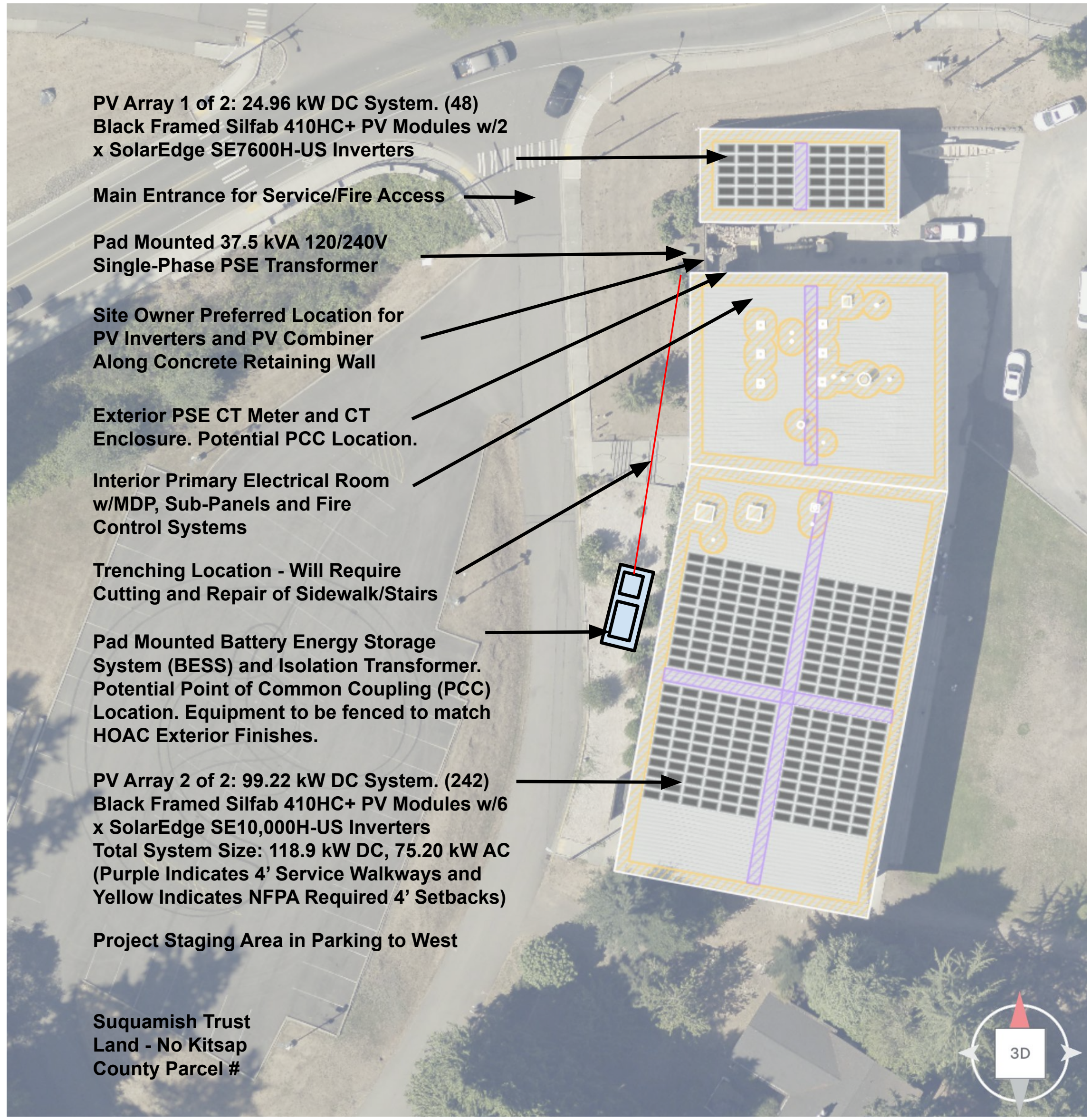
Please direct yourself to any sections appropriate and relevant to your needs. If you have questions about this report, please contact us at info@cascadiarenewables.com.

Sincerely,

Cascadia Renewables

Design Abstract

The purpose of the solar plus storage system is to provide reliable backup power, enhancing the community's resilience during outages while also facilitating energy cost savings. This system will support the House of Awakened Culture (HOAC) in the Port Madison Reservation, ensuring it remains functional as a community gathering point during emergencies, natural disasters, and prolonged utility outages. The PV layout was designed to balance visual appeal and practicality, using all-black Silfab 410 HC+ solar modules with black mounting rails to maintain the building's aesthetics. The PV system is mounted primarily on the building's standing seam metal roofs, which face west and north. The setup not only maximizes sunlight exposure but also ensures efficient energy capture. The system employs a net metered design methodology, allowing for any excess electricity generated to be sent back to the grid. The primary function of the BESS is to ensure backup power availability. The system aligns with the community's goals of achieving energy independence and resilience, while also accounting for economic and environmental benefits.



PV System Size	118.9 kW DC/75.2 kW AC
BESS Size	96 kW/526 kWh
Estimated Annual Electric Production	119,775 kWh
Estimated Percentage of Annual Consumption Offset	100%
First Year Bill Savings	$12,771.00
Period of Autonomy	June: Continuous December: 100% Demand (15 hours), 150% Demand (9.5 hours)

Design Specifications and Process

Introduction to the Site

Type of Building: Single-story wood framed community center and boathouse constructed in 2012.

Surrounding Conditions: The House of Awakended Culture is located in the heart of the Port Madison Reservation, just off of Suquamish Way NE, with a large parking area to the west and Port Madison to the east.

Typical Purpose of Site: The House of Awakened Culture is a central cultural and social space for the Suquamish Tribe. It plays an essential role in maintaining the tribe's cultural practices, serving as a venue for ceremonies, educational programs, and community events. Located on the Port Madison Indian Reservation, the HOAC draws from the historical significance of the nearby Old Man House, which was a large communal longhouse. It is positioned along the shoreline of Agate Passage, half a mile from where the Old Man House stood, symbolizing the tribe's cultural revitalization.

Emergency Function: The HOAC serves as a key location for the tribe's emergency preparedness, acting as a gathering and sheltering location, care center, and food and emergency supply distribution hub during crises.

Project Goals

In conversation with stakeholders, the community had the following goals:

- Ensure that the HOAC remains operational as a gathering point for care and coordination during emergencies.
- The community has noted an increase in short seasonal outages and is preparing for larger, more extended outages by reinforcing the site's resilience.

In service of those goals, the system was designed with the following priorities:

1. Provide backup power to the HOAC that is currently not available due to the lack of an on site generator or battery system.
2. Mitigate the impact of both short, seasonal outages and potentially larger, more prolonged grid failures.
3. Ensure the aesthetic and functional integration of the solar plus storage system matches the current architectural and aesthetic look of the facility.

4. Optimize operational costs by reducing energy and operational expenses to ensure the long-term viability of building operations.

Stakeholder Engagement

Key stakeholders included:

- Cherrie May – *Manager* – Suquamish Tribe Office of Emergency Management
- Catherine Edwards – *Executive Director* – Suquamish Tribe

Differing needs of stakeholders were voiced through the following interactions, summarized below.

Engagement Activities and Objectives:

April to September 2024: Meetings with subconsultant Michiel Zuidweg to discuss technical aspects of the project.

June 12, 2024: A meeting was conducted between Cascadia Renewables and representatives of the Suquamish Tribe. The goal of the meeting was to inform the tribe about the upcoming process and to make plans to aquire the necessary information to perfom a site analysis.

July 11, 2024: A pre-design meeting was held between Cascadia Renewables and the tribe to get an impression of the goals of the tribe and understand their concerns about the upcoming process

September 4, 2024: Members of Cascadia Renewables conducted a comprehensive site assessment with personnel from the tribe.

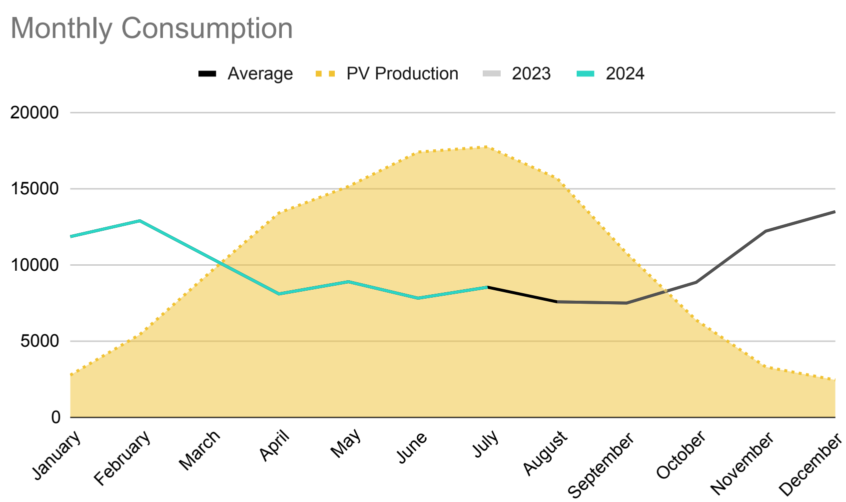
November 13 , 2024: Cascadia Renewables held a design review meeting with members of the tribe to present the in-progress conceptual design. We received feedback on the design, and responded to the concerns of the the tribe.

Preliminary Electrical Usage Analysis

The electrical usage analysis determines the optimal solar and battery system sizes for meeting the needs of the site. We consider this electrical analysis in tandem with information collected on site to verify installability and inform conceptual designs.

This analysis examines the community's electricity usage from July 2023 to June 2024. All available data was used for modeling since only one year of data was available. The analysis reveals seasonal variations in usage, with electricity consumption generally increasing during the winter months due to heating needs. September had the lowest electricity use, while December had the highest. There are currently no planned electrical infrastructure changes that are expected to alter the site's energy consumption or demand patterns.

Estimated Annual Electric Consumption	118,040 kWH
Seasonal Fluctuation:	80.21% fluctuation between minimum consumption in September and maximum consumption in December
Estimated Maximum Peak Demand	37.5 kVA, based on utility transformer size
98-Percentile of Consumption During a Single Day	Insufficient Data



Comprehensive Site Visit

Following the preliminary electrical analysis and an initial review of the available building plans and satellite imagery, members of the Cascadia Renewables' design team assessed the real-world conditions through a comprehensive site visit.

Roof:

Condition of the roof

Roof Quality	The standing seam metal roof is in fair condition and appears to have not been cleaned or serviced since it was originally installed. There is a significant amount of bird droppings across the entirety of the roof surface that indicates that the site will require regular maintenance and cleaning. On-site personnel stated that there are leakage issues along the valley and central roof area of the primary building. Repairs are not currently scheduled or budgeted, so the PV system installation must be laid out to avoid this area.
Roof Type	Standing Seam Metal
Roof Angle	4.8 degrees, 1/12
Roof Age	2012
Date After Which Roof Should Be Replaced	2042+

Structure:

Structure Type	The HOAC is a single-story wood framed structure with an additional single-story wood framed boathouse to the north.
Assessment of Structure Quality	The buildings appear in excellent condition with no structural improvements required.
Availability of Plans	Electrical and Structural Plans were available for review
Soil Conditions	There is landscaped areas with grass, with concrete entrance sidewalks and stairs along the west side of the HOAC, where all of the solar plus storage infrastructure will be located.

Electrical:

Service Utility	Puget Sound Energy
Main Service Type	120/240V, Single-Phase
Electrical Topology	The HOAC's electrical infrastructure is centrally located between the main building and boathouse to the north, with the main distribution panel and sub-panels located in the main electrical room at the north end of the main building.
Line Side Infrastructure	The site's single-phase, 120/240V power is fed from a 37.5 kVA, pad-mounted PSE transformer that is located just outside to the west of the fenced electrical equipment area between the main building and boathouse.
Electric Utility Hosting Capacity	Unknown
Location of Main Electrical Service	Interior main electrical room at the north end of the main building

Locations of Current Infrastructure	The PSE meter and CT enclosure are both centrally located on the north exterior wall of the main building in a fenced service area between the boathouse and main building. The main distribution panel and sub-panel 2P1 are both located in the main electrical room in the northern end of the main building, with additional sub-panels spread throughout the building. The pad-mounted PSE transformer is located just outside of the fenced service area on the west side of the buildings.
Main Transformer Rating, Voltage, and Phase	37.5 kVA, 120/240V, Single-Phase
Main Service Bus Capacity	600 A
Main Service Bus Voltage	120/240V, Single-Phase
Main OCPD Rating	600 A
Main Distribution Center Type	Panelboard

Amps Available for PV Interconnection Under 120% Rule	120 A

Generator:

Generator Brand	N/A
Generator Size	N/A
Generator Fuel Type	N/A
Generator Interconnection Method	N/A
Generator Backup Configuration	N/A

Other:

Description of Accessibility: The HOAC is centrally located in the Port Madison Reservation with easy access from Suquamish Way NE. The PV installation locations are readily accessible from the lower west and north sides with standard extension ladders onto the single-story standing seam metal roof areas where the PV will be installed. Forklift or manlift access may not be required for this site.

Description of Shading: There is limited shading on to the main HOAC roof from a grove of large evergreen trees along the south edge of the building, that can be minimized by keeping the PV installation location centrally located as proposed in this feasibility study.

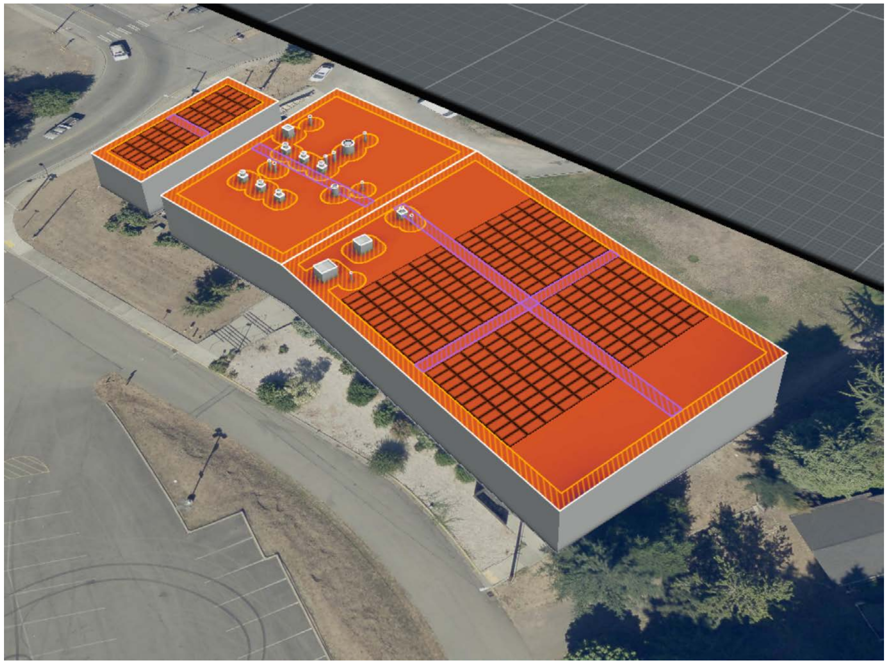
Photovoltaic (PV) System Design

Overview:

The PV array is mounted on the roof. The system is designed under net metering limitations, maximizing financial payback even though not all available space is installed with PV panels. The layout is intended to enhance visual appeal while maintaining the aesthetics of the building by using all-black Silfab 410 HC+ solar modules with black mounting rails and hardware. It positions two small rectangular arrays on the low west-facing roof of the boathouse for maximum visual impact, with the remaining modules installed in four rectangular arrays centrally located on the main building.

The PV system production was modeled using Aurora, a software that uses irradiance data, LIDAR data, and 3D models of buildings to determine PV output over the course of the day and the year.

In this report, specific products names are used. These recommendations are to be considered typical. Comparable equipment may be substituted. When making substitutions, pay attention to all technical specifications, as some products that initially appear comparable may be different in key ways.



Solar irradiance visualized across the array

Specifications:

PV System Size	118.9 kW DC, 75.2 kW AC
PV Module	Silfab SIL 410 HC+
Number of Modules	290

Estimated Annual Electric Production	119,775 kWh
Estimated Percentage of Annual Consumption Offset	100%

Total Solar Efficiency	83.0% TSRF
Number and Models of Inverters	(6) SolarEdge SE10KUS 120/240V, and (2) SolarEdge SE7600 120/240V inverters with PCS controls for integration with the BESS and PCC.
Location of Inverters	Mounted in a single row along the east-facing retaining wall within the fenced service area adjacent to the PSE meter and CT enclosure. If the space is inadequate, an electrical equipment rack could be included at the BESS pad-mount location.

Design Considerations:

Trenching, Cutting, and Wall Penetrations Trenching along the west side of the main building will be required to connect the pad-mounted BESS on the southwest side to the centrally located PV inverters, Point of Common Coupling (PCC), and interconnection location at the main distribution panel. This trenching will require the contractor to cut across and repair the main west entrance set of concrete stairs to connect the two locations. The stairs were chosen, rather than the sidewalk, due to a request by the facilities manager to coordinate the repair with other stair repairs that must be completed. There will be a limited number of wall penetrations to allow for the integration of the PCC into the existing electrical infrastructure.

Maintenance and Fire Access 4’ commercial fire setbacks will be provided on all roof locations to allow for easy maintenance and fire access.

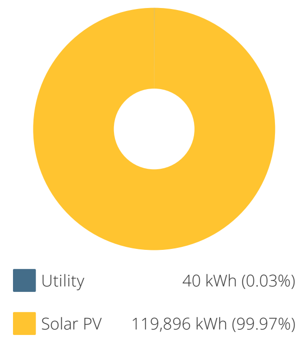
PV SYSTEM DETAILS

GENERAL INFORMATION
Facility: Meter #1
Address: 7325 NE Pkwy Suquamish WA 98392

SOLAR PV SYSTEM RATING
Power Rating: 118,900 W-DC

SOLAR PV EQUIPMENT DESCRIPTION
Solar Panels: 118.9 kW-DC Standard Modules

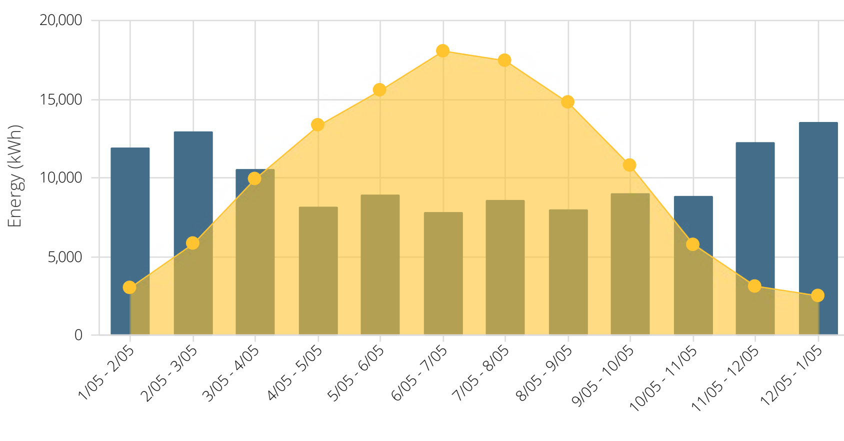
ENERGY CONSUMPTION MIX
Annual Energy Use: 119,936 kWh



SOLAR PV EQUIPMENT TYPICAL LIFESPAN
Solar Panels: Greater than 30 Years
Inverters: 15 Years

Solar PV System Cost and Incentives	
Solar PV System Cost	$331,300
Grant Amount	-$331,300
Net Solar PV System Cost	**$0**

MONTHLY ENERGY USE VS SOLAR GENERATION



Wire Run The boathouse PV array will require a short 35-40’ DC wire run to the PV inverter location adjacent to the PSE meter. The main building array will require multiple 140’ DC wire runs to the inverter location adjacent to the to the PSE meter, or multiple shorter 40-50’ wire runs if the PV inverters are co-located with the BESS.

Roof Shading There is limited shading along the south edge of the main building from a grove of evergreen trees on the south edge of the property that can be avoided by proper placement of the rooftop PV array.

Required Upgrades Prior to PV Installation The 37.5 kVA utility transformer will need to be upsized to accommodate the interconnection of the PV system and BESS.

Interconnection Method for PV The (8) SolarEdge inverters will have their 120/240V output combined in a PV combiner panel, that will feed the PV input in the Point of Common Coupling (PCC) panel that will be installed nearby with the BESS system.

Roof Loading and Mounting:

Mount Location	(48) PV modules will be installed on the west-facing roof of the boathouse, with the remaining (242) modules installed centrally on the west-facing main building.
PV Racking System	IronRidge XR100 with Lynx Standing Seam Clamps
PV Mounting System	Flush mounted, non-penetrating
Roof Penetrations	The system will require no roof penetrations due to the installation of the non-penetrating Lynx Standing Seam Clamps on the Snaplock Metal Roof.
Roof Loading Capacity	25.0 psf
Additional Available Roof Loading	3.0 psf
Estimated PV System Roof Loading	2.6 psf
Assessment of Whether the Roof Will Support the System	Yes

Battery Energy Storage System (BESS) Design

Specifications:

BESS Size	96 kW/526 kWh
BESS Backup Configuration	Whole Building
Peak Demand for Modeling Purposes	37.5 kVA, based on utility transformer size
Source of Peak Demand	Simulated
% of Building Demand used in Modeling	100% and 150%

Overview:

The conceptual design is based on a BESS consisting of lithium iron phosphate (LFP) battery cells, a grid-forming inverter, and a microgrid controller. This solution is intended to be containerized, pad-mounted, and located on the west side of the building, south of the entrance stairway. It is designed to support the building's energy needs during emergencies by providing backup power for extended periods. The system was modeled for various historical demand levels to assess its performance in scenarios with increased energy usage, particularly during prolonged utility outages. The modeling also considers both full and zero solar resource availability, which is critical during situations such as winter storms and heavy snowfall. By partially discharging daily to coincide with peak building demand, the BESS helps flatten the demand profile, promoting both system health and longevity. This aligns with the community's goal of maintaining reliable power

Potential BESS Location

Example of a Containerized BESS Unit

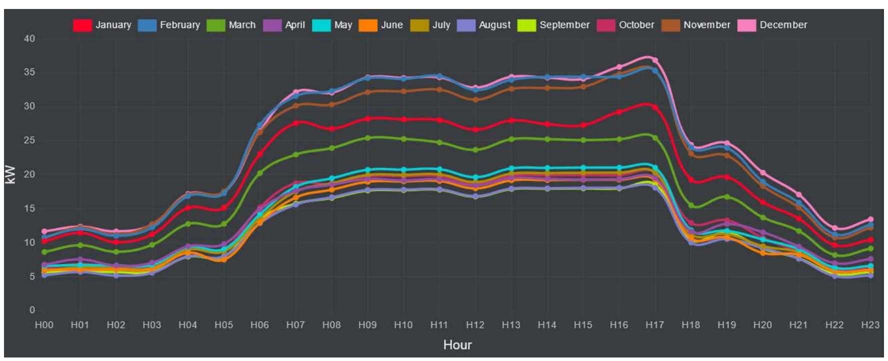
during outages, ensuring that the building can serve as a central point for care and coordination when needed.

BESS dispatch performance is modeled in a program called Xendee, which considers many sources of data, including PV production, estimated site consumption, and grid energy pricing, to optimize a BESS for a variety of desired characteristics, including resiliency and financial benefit.

Demand Modeling:

For the BESS modeling, since no interval data was available, we applied the monthly consumption data to the NREL load profile of ‘Outpatient’ to generate a daily load profile for the building. Since the building is normally closed to the public we utilized this NREL load profile as we felt it best represented the anticipated building use in an emergency.

Before constructing a system, we recommend conducting a month long meter study, collecting 1-minute interval data to identify transient peaks in demand.



Demand Curves

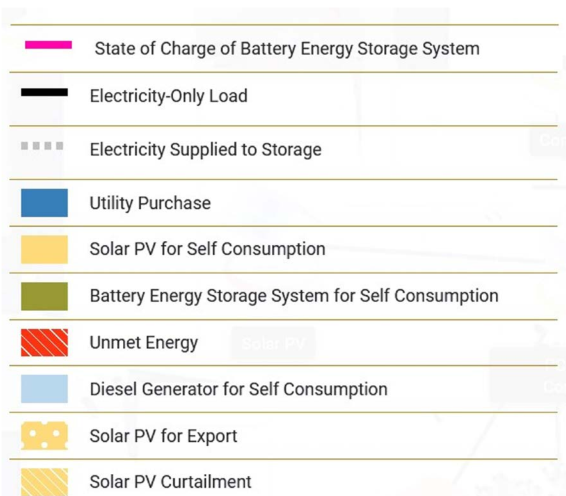
Generator Supplementation:

Though not part of a solar plus storage system, a standby generator can be a hugely beneficial complement to a BESS as it will allow a site to maintain extended autonomous operation in the winter. Additionally, a BESS complements a generator by allowing it to run less often and more efficiently than if the generator was installed alone.

Generator Recommendation	Add New Generator
Proposed Generator Size	100kW
Proposed Generator Fuel Type	Diesel
Proposed Generator Interconnection Method	via PCC with isolation contractor/motorized breaker and SEL relay
Proposed Generator Backup Configuration	Whole Building

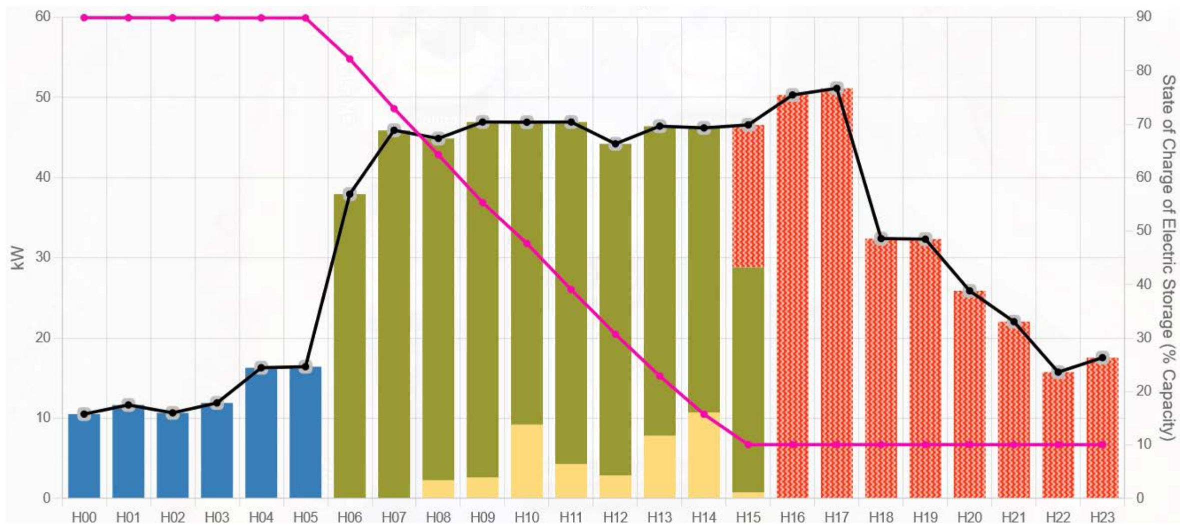
Low-PV Outage Simulation:

December Period of Autonomy	100% Demand (15 hours), 150% Demand (9.5 hours)
Daily Generator Run-time Required for Continuous Site Up-time in December	100% Demand (3.5 hrs/day), 150% Demand (6.5 hrs/day)

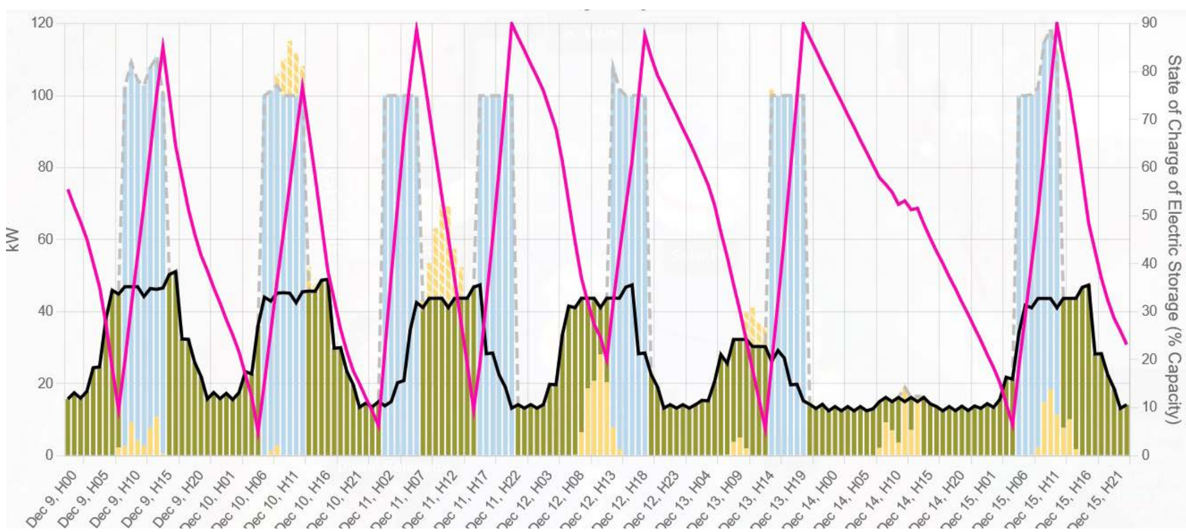


Dispatch Graph Key

December Outage Scenario Electricity Dispatch – 150% Demand No Generator



December Outage Scenario Electricity Dispatch – 150% Demand, Generator

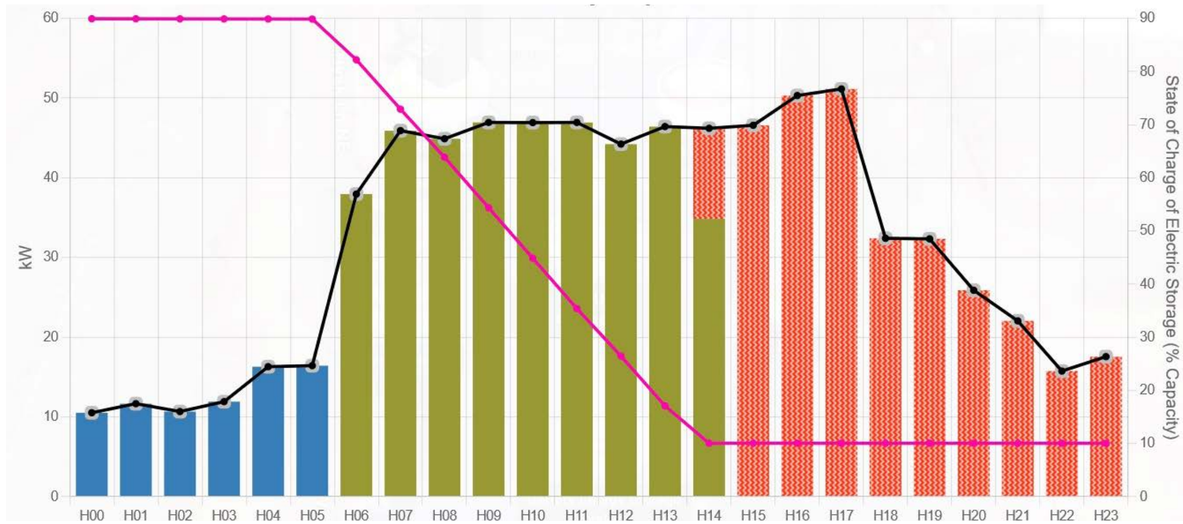


High-PV Outage Simulation:

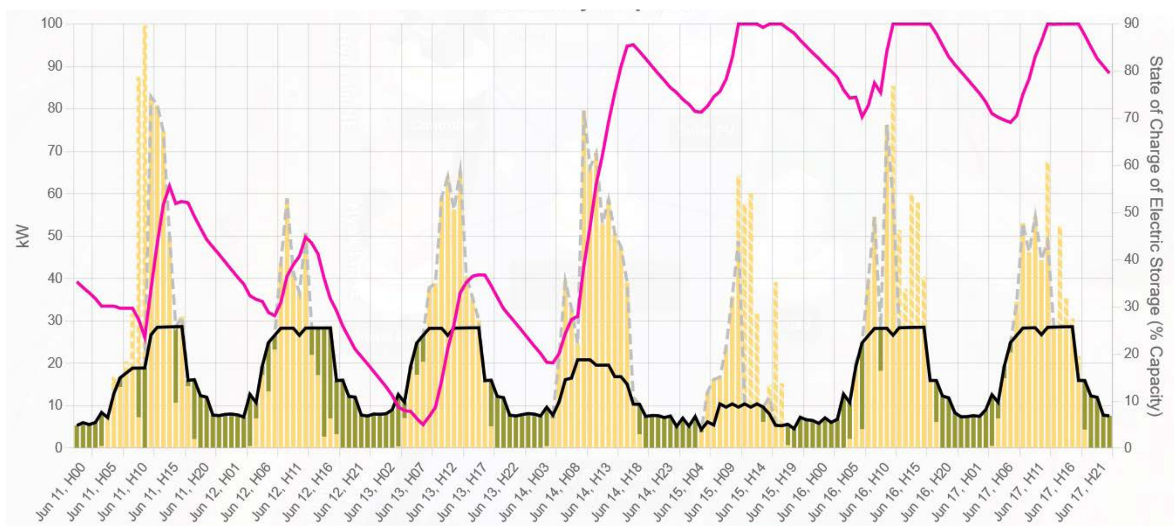
June Period of Autonomy	Continuous
Daily Generator Runtime Required for Continuous Site Uptime in June	0 hrs/day

In operation, the period of autonomy of the BESS and estimated daily generator runtime will depend on numerous factors, including available solar resources, BESS state of charge, and building loads during an outage. A change in any of these factors will impact these estimates.

December Outage Scenario Electricity Dispatch – 150% Demand, No PV



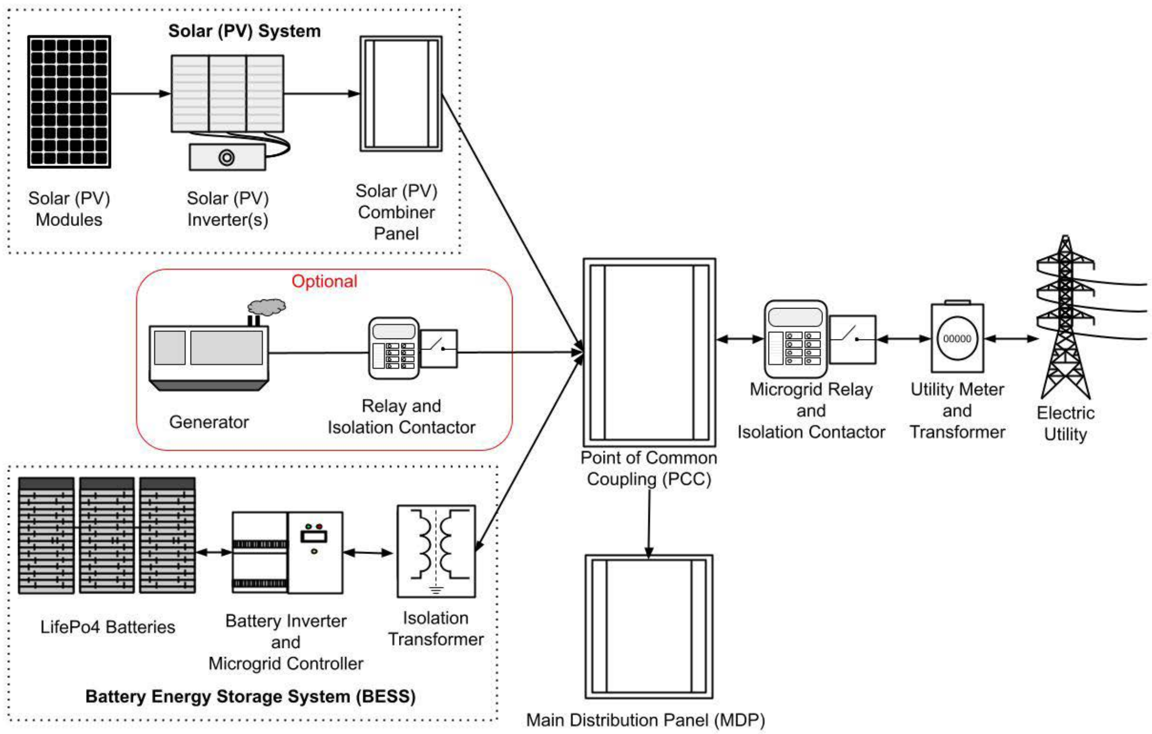
June Outage Scenario Electricity Dispatch – 150% Demand, No Generator



Interconnection

Topology:

The Suquamish Tribe's House of Awakened Culture's (HOAC) power supply consists of a 600A, 120/240V single phase incoming service from a 37.5kVA PSE pad-mounted transformer. The existing 600A-rated main distribution panel (MDP) is not suitable for the point-of-common coupling (PCC) of the microgrid system due to a lack of spare breaker space at the capacity required by the BESS and PV systems. Our conceptual design utilizes a new 600A PCC electrical panel and main service disconnect mounted on the exterior of the building adjacent to the utility meter. The PCC combines the incoming utility feed, BESS, and PV system and feeds the MDP. Prior to landing in the PCC, PV inverter output circuits are combined in a new 400A PV Combiner Panel mounted on the exterior of the concrete wall between the main building and the boat barn, adjacent to the PV inverters. Between the PCC and the utility meter would be a PSE required distributed generation system disconnect, which also serves as the service disconnect for the building. The PCC includes a microgrid interconnect device (MID), which consists of a 600A rated motor controlled breaker and a SEL751 relay. The MID device automatically isolates the PCC from the utility during an outage, allowing the PV system and BESS to supply power to the MDP. If desired, a standby generator could be added to the system and interconnected into the PCC via a grid isolation contractor/motorized breaker controlled by the microgrid control system to provide grid isolation from the generator until the system moves into island mode during a utility outage. This system utilizes an Energy Management System to ensure that the distributed energy resources are dispatched efficiently and that the capacity of the electrical equipment bussing is never exceeded.



Simplified single line diagram of the conceptual system showing the topology of its interconnection.

This configuration meets the goals of enabling the Suquamish Tribe by enabling the HOAC's electrical loads to remain powered during seasonal outages, natural disasters, and prolonged utility outages. This allows the building to serve as a gathering point for care and coordination during emergencies. The interconnection is a crucial element that affects the project's feasibility, budget, and timeline. Cascadia Renewables recommends that an electrical engineer verify the final system design before implementation.

Locations of New Infrastructure:

PV inverters and PV Combiner panel mounted on a custom built rack on the east facing concrete wall between main building and the boat barn.

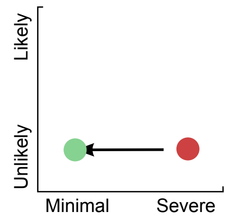
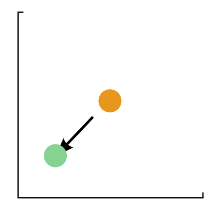
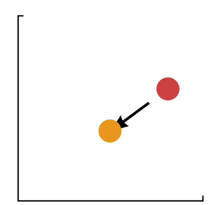
Pad Mounted BESS location south of the main building entrance on the west side of the building.

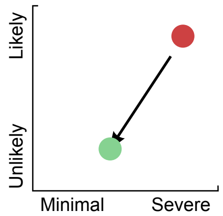
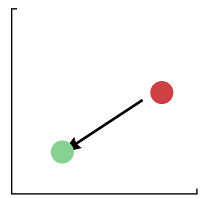
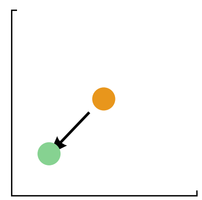
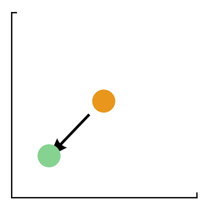
New exterior PCC electrical panel, located near the existing meter and PSE disconnect on the exterior of the main building.

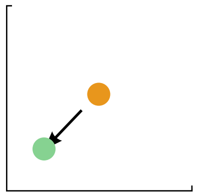
PSE Generation Knifeblade Disconnect adjacent to PV and BESS Generation Combiner Panel.

Project Risks

Developing a solar plus storage system comes with uncertainties, from incomplete information and market fluctuation. This feasibility study aims to mitigate some risks while identifying how others might be addressed. Risks have varying levels of severity and likelihood, which can be reduced by varying degrees through the proposed mitigation strategies.

Risk	Impact	Mitigation	Risk Before and After Mitigation
Incomplete or inaccessible online utility grid hosting/ outage data	Potential for larger projects to be sized beyond the grid hosting capacity, triggering very expensive grid upgrades and potentially rendering the project infeasible.	Ensure that large-scale projects (500kW+) do not proceed to final design, engineering, financing, or procurement prior to confirmation from the utility that the project falls within grid hosting capacity. In some instances, this may require a grid study at the expense of the client.	
Construction projects often encounter unforeseen challenges, including site-specific conditions, environmental constraints, and permitting issues.	Delays in project timelines, increased costs, potential legal disputes, and strained relationships with stakeholders.	Regular site assessments, proactive stakeholder engagement, and a robust project management approach can help identify and address potential hurdles early. Engage in thorough due diligence before finalizing a contractor to ensure they are sufficiently qualified and experienced to take on a complex solar plus storage project. Ensure that contracts have clear clauses regarding delays, with penalties or incentives for timely completion.	
Geopolitical events can impact supply chains, project financing, and overall project feasibility.	Disruption in material or equipment delivery, increased costs, potential project cancellation, or delays due to financing issues.	Diversifying supply chains, monitoring global events closely, and having contingency plans in place can help navigate these challenges. Consider insurance or hedging options that protect against geopolitical risks.	

Risk	Impact	Mitigation	Risk Before and After Mitigation
The industry can experience shortages in critical equipment due to high demand or manufacturing constraints.	Project delays, the potential need for equipment substitutions leading to design modifications, and increased costs.	Seek contractors with established relationships with multiple suppliers, who maintain a strategic inventory and who monitor industry trends to anticipate shortages. Consider contracts allowing equipment substitution or alternative solutions in case of shortages.	
The availability and cost of skilled labor can fluctuate based on market conditions.	Delays in project timelines, potential compromise in work quality, and increased labor costs.	Consider prioritizing contractors with a strong track record of workforce management and training or with established partnerships with local training institutions. Ensure contracts have provisions for labor continuity and quality assurance. Consider the timeline of construction and allowance for longer construction periods or delaying construction until more workforce development for the large-scale solar plus storage industry has occurred.	
Detailed engineering and site-specific surveys may reveal conditions or requirements that impact cost and timeline.	Potential redesign requirements, increased costs, and project delays.	Engage experienced engineering firms, conduct thorough preliminary surveys, and allocate resources for potential additional studies. Consider engaging independent third-party reviewers for critical project milestones. Allocate a portion of the budget for potential additional studies or modifications.	
Prices for materials, equipment, and services can be subject to market volatility.	Unpredictable project costs, potential financial strain, and challenges in budgeting and forecasting.	Negotiate fixed-price or capped-price contracts where possible. Maintain a contingency budget for unexpected price fluctuations and ensure transparency in cost adjustments.	

Risk	Impact	Mitigation	Risk Before and After Mitigation
Point of PV interconnection lacks sufficient capacity to accommodate PV backfeed.	Potential for costly/time-consuming electrical upgrades that derail project budget and timeline.	Engage an electrical engineer to verify all proposed points of interconnection prior to final system design and bid solicitation.	

Logistical and Financial Analysis

Hurdles Presented by Existing Conditions

Below are construction challenges and setbacks that could arise while implementing this conceptual design and potential mitigation strategies for them. Overcoming certain hurdles may create additional expenses, while other hurdles necessitate further validation of the final design before incurring significant costs.

Proximity to saltwater may prematurely degrade system components

Due to the site's location near a body of saltwater, salt mist may collect on the PV modules, solar/PV inverters, and BESS system, which could prematurely degrade the externally mounted system components.

Mitigation Strategy 1: The contractor must verify that the warranties of all installed products are not negated by their proximity to salt water. This is particularly important with the BESS system, where the battery cells may have separate, more restrictive warranties than the manufacturer's battery enclosure warranty.

Mitigation Strategy 2: A regular system maintenance schedule to clean the solar modules, racking system, and equipment enclosures every six to 12 months should be employed. Internal BESS maintenance reviews to look for signs of corrosion are required to maintain the effectiveness of the system.

Limited support functionality of the BESS during long-term emergencies without generator support

The conceptual BESS is designed to provide resilience and backup emergency support for 72+ hours during a summer outage, down to approximately 15 hours during a winter outage at 100% of historical demand and 9.5 hours at 150% of historical demand. While the summer autonomy provided by this system offers a high level of resilience for the Tribe, if a large-scale emergency or natural disaster occured in the winter, causing a multi-week power outage, this system would not provide long term support to the community without careful battery and energy use management.

Mitigation Strategy 1: Adding a generator with a high-capacity on site fuel storage system that can be integrated with the BESS would dramatically extend the long-term backup period.

Mitigation Strategy 2: Suggested manual load reduction strategies should be followed closely to maximize BESS run-times.

Mitigation Strategy 3: Develop load reduction strategies based upon the season and weather conditions when the long-term emergency occurs, with a focus on greater reduction strategies during winter months or snow/rain events that may reduce the PV system production.

BESS installation location will be in close proximity to areas that are accessible and/or visible

For safety reasons the BESS system will need to be housed in a substantial outdoor metal enclosure at the location shown on the feasibility study's site plan. This is in a highly visible, high usage zone, and may impact the aesthetics or assesibility of this area.

Mitigation Strategy 1: An alternative location may be available and coordinated with the installing contractor at the time of final design. Additional costs may arise from this change.

Mitigation Strategy 2: Additional fencing may be installed to mitigate visibility and access to the BESS system. Electrical and property setbacks must be followed.

Fire Control Systems may activate during a power outage

Reviews of installed BESS systems show that some building Fire Control Systems may activate temporarily when the power goes out and the change from grid to battery power is occuring due to the millisecond delay.

Roof repairs and cleaning should be completed prior to the PV installation

On-site staff indicated that there were multiple roof leaks and roof issues in/near the valley of the main building roof and around the rooftop equipment, and the roofs of both buildings do not appear to have been cleaned since it was installed in 2012

Mitigation Strategy 1: The PV system design on the main building has been configured to avoid roof sections where roof repairs will be needed.

Mitigation Strategy 2: A full pressure washing/cleaning of the roofs should be completed prior to the PV installation.

The pad mounted 37.5 kVA, 120/240V PSE transformer is undersized for the site

The 37.5 kVA transformer is undersized for the necessary PV system and BESS capacity in order to meet the resiliency goals of the community.

Mitigation Strategy 1: Utilize the electrical engineering report for the system and work with PSE to increase the size of the utility transformer supplying the building.

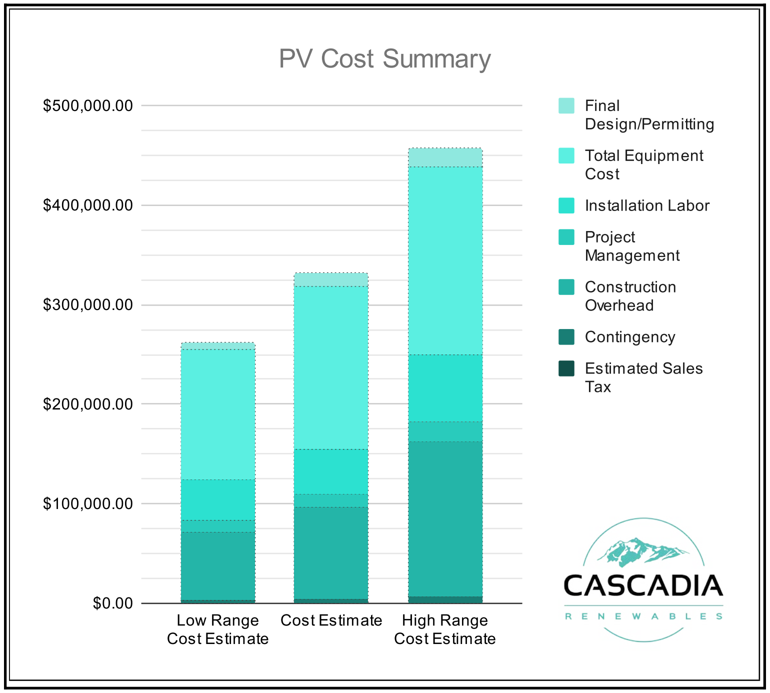
Mitigation Strategy 2: Reduce the PV and BESS capacity to allow system interconnection with the existing transformer. Note that this will have a significant impact on the resiliency benefits provided by the system.

System Budget

Cascadia Renewables included current Davis Bacon prevailing wage rates, contractor direct pricing, permitting, and consulting/engineering fees to determine the conceptual system pricing. The labor rates and equipment pricing used in the provided budgetary information are relevant to and compliant with local, regional, and federal grant programs to give the applicant access to an array of funding opportunities. The estimated installation cost excludes any required architectural or structural improvements, Department of Archeology and Historic Preservation (DAHP) permit, the internal organizational cost of procurement, and administration. This cost estimate also excludes future storytelling and community engagement efforts.

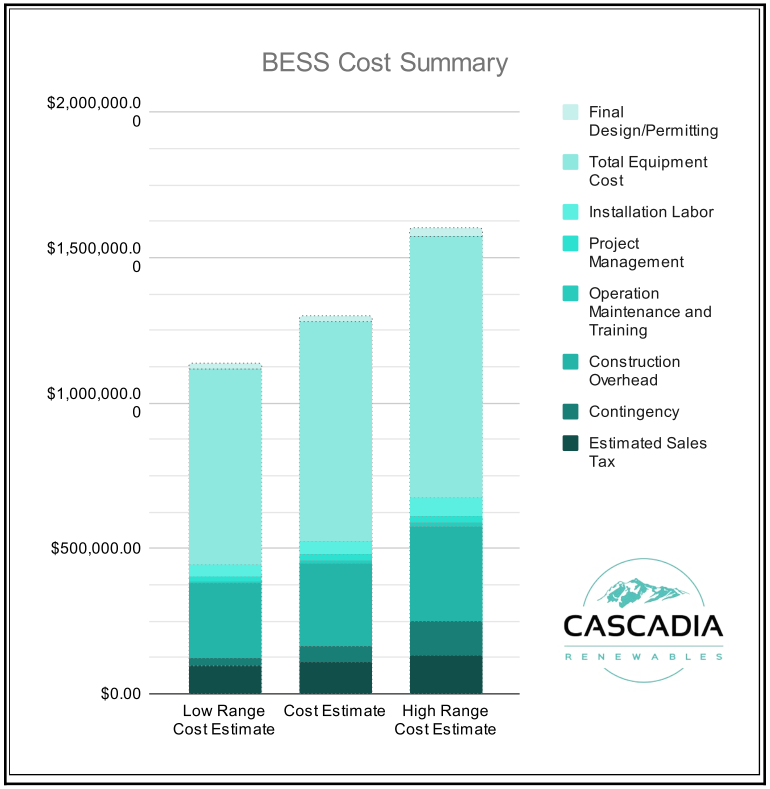
We advise applicants to consider these budget items separately and designate suitable resources for each. The cost estimate provided is based on market conditions, availability of labor, and equipment costs at the time of writing.

Since it is a well-established and competitive market, there is limited opportunity to reduce these costs further. The projected increase in the demand for BESS projects over the coming years may outpace the current supply. This may inflate equipment costs in the short term, which we reflect in our estimated budget. Final pricing may vary based on the chosen installation partner, final engineered solution, on-site soil, and geotech studies, which are not available within the scope of this feasibility study. We recommend establishing a comprehensive 3+ bid RFP process that encourages contractor participation, value engineering, and competitive pricing. We recommend periodic system price updates during the project development and construction.

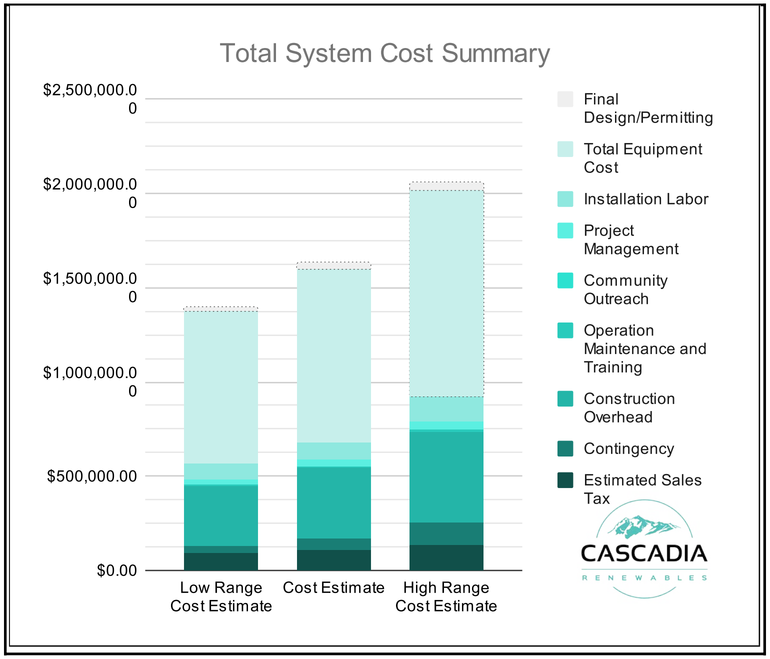


PV - COST SUMMARY

Total Costs	Low Range Cost Estimate	Cost Estimate	High Range Cost Estimate
Final Design/Permitting	$6,250.00	**$12,500.00**	$18,750.00
Total Equipment Cost	$131,200.00	**$164,000.00**	$188,600.00
Installation Labor	$40,680.00	**$45,200.00**	$67,800.00
Project Management	$11,880.00	**$13,200.00**	$19,800.00
Community Outreach	TBD By Applicant	**TBD By Applicant**	TBD By Applicant
Operation Maintenance and Training	TBD By Applicant	**TBD By Applicant**	TBD By Applicant
Construction Overhead	$68,550.00	**$91,400.00**	$155,380.00
Contingency	$3,500.00	**$5,000.00**	$7,000.00
Estimated Sales Tax	$0.00	**$0.00**	$0.00
Total PV System Cost Estimate	**$262,060.00**	**$331,300.00**	**$457,330.00**
Cost/Watt ($/w)	**$2.20**	**$2.79**	**$3.85**



BESS - COST SUMMARY			
Total Costs	**Low Range Cost Estimate**	**Cost Estimate**	**High Range Cost Estimate**
Final Design/Permitting	$17,850.00	**$21,000.00**	$24,150.00
Total Equipment Cost	$675,720.00	**$750,800.00**	$900,960.00
Installation Labor	$41,310.00	**$48,600.00**	$63,180.00
Project Management	$15,840.00	**$19,800.00**	$23,760.00
Community Outreach	**TBD By Applicant**	**TBD By Applicant**	**TBD By Applicant**
Operation Maintenance and Training	$7,000.00	**$10,000.00**	$14,000.00
Construction Overhead	$255,060.00	**$283,400.00**	$325,910.00
Contingency	$28,350.00	**$56,700.00**	$113,400.00
Estimated Sales Tax	$95,783.96	**$109,507.60**	$134,813.12
Total BESS System Cost Estimate	**$1,136,913.96**	**$1,299,807.60**	**$1,600,173.12**
Cost/Kilowatt Hour ($/kWh)	**$2,161.43**	**$2,471.12**	**$3,042.15**



Total System - COST SUMMARY

Total Costs	Low Range Cost Estimate	Cost Estimate	High Range Cost Estimate
Final Design/Permitting	$24,100.00	**$33,500.00**	$42,900.00
Total Equipment Cost	$806,920.00	**$914,800.00**	$1,089,560.00
Installation Labor	$81,990.00	**$93,800.00**	$130,980.00
Project Management	$27,720.00	**$33,000.00**	$43,560.00
Community Outreach	$0.00	**$0.00**	$0.00
Operation Maintenance and Training	$7,000.00	**$10,000.00**	$14,000.00
Construction Overhead	$323,610.00	**$374,800.00**	$481,290.00
Contingency	$31,850.00	**$61,700.00**	$120,400.00
Estimated Sales Tax	$95,783.96	**$109,507.60**	$134,813.12
Total System Cost Estimate	**$1,398,973.96**	**$1,631,107.60**	**$2,057,503.12**

Economic Benefit

This is a detailed breakdown of the cash flow of the system. Please note that this breakdown does not include the cost of operations and maintenance, as that cost is challenging to predict. Cascadia Renewables does not want to offset the confidence we otherwise have in these financial estimates by overshadowing our conclusions with less reliable data. To that effect, Cascadia Renewables recommends requesting an estimate for annual operations and maintenance as part of the contractor selection RFP.

Assumptions and Key Financial Metrics

IRR - Term	10.2%	Net Present Value	$193,143	Payback Period	1.0 Years
ROI	35.6%	PV Degradation Rate	0.56%	Discount Rate	5.0%
Energy Cost Escalation Rate	3.0%	Federal Income Tax Rate	0.0%	State Income Tax Rate	0.0%
Total Project Costs	$1,631,108				

Years	Project Costs	Electric Bill Savings	Grant Amount	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	-$1,631,108	-	-	-	-$1,631,108	-$1,631,108
1	-	$12,771	$1,631,108	119,895	$1,643,879	$12,771
2	-	$13,124	-	119,224	$13,124	$25,895
3	-	$13,487	-	118,553	$13,487	$39,382
4	-	$13,859	-	117,881	$13,859	$53,241
5	-	$14,242	-	117,210	$14,242	$67,483
6	-	$14,635	-	116,538	$14,635	$82,119
7	-	$15,040	-	115,867	$15,040	$97,158
8	-	$15,455	-	115,195	$15,455	$112,613
9	-	$15,881	-	114,524	$15,881	$128,495
10	-	$16,320	-	113,853	$16,320	$144,814
11	-	$16,770	-	113,181	$16,770	$161,584
12	-	$17,232	-	112,510	$17,232	$178,816
13	-	$17,708	-	111,838	$17,708	$196,524
14	-	$18,196	-	111,167	$18,196	$214,720
15	-	$18,697	-	110,496	$18,697	$233,417
16	-	$19,583	-	109,824	$19,583	$253,001
17	-	$20,047	-	109,153	$20,047	$273,048
18	-	$20,522	-	108,481	$20,522	$293,570
19	-	$21,007	-	107,810	$21,007	$314,577
20	-	$21,502	-	107,139	$21,502	$336,079
21	-	$22,008	-	106,467	$22,008	$358,087
22	-	$22,526	-	105,796	$22,526	$380,613
23	-	$23,054	-	105,124	$23,054	$403,667
24	-	$23,594	-	104,453	$23,594	$427,262
25	-	$24,146	-	103,781	$24,146	$451,407
26	-	$24,709	-	103,110	$24,709	$476,117
27	-	$25,285	-	102,439	$25,285	$501,402
28	-	$25,873	-	101,767	$25,873	$527,274
29	-	$26,473	-	101,096	$26,473	$553,747
30	-	$27,086	-	100,424	$27,086	$580,834
Totals:	-$1,631,108	$580,834	$1,631,108	3,304,796	$580,834	-

Maintenance Considerations

An operations and maintenance plan should be enacted by internal personell or an external contractor. When designing this plan, consider the following:

- The PV system will require regular annual or bi-annual PV module cleaning to remove any built-up debris in order to maintain the peak system performance and maximum BESS charging capabilities. The maintenance schedule will vary depending upon the site conditions, frequency of rain events, and build up of season debris such as fall leaves or needles.
- The BESS will require regular maintenance to maintain it’s equipment warranty and ensure proper system functionality. The required maintenance steps and frequency will be defined by the equipment manufacturer but typically include servicing the BESS HVAC and fire protection systems, internal/external visual inspections, loose connections check, and a functional battery test on an annual basis.

Community Benefit

The House of Awakened Culture serves as a key gathering point for the community during emergencies. It functions as a central hub for care and coordination, supporting resilience efforts against short-term power outages and preparing for more extended grid failures. The solar plus storage system being implemented will provide backup power, integrating seamlessly with the existing aesthetic and architectural features of the facility, thus preserving its visual and functional integrity. Additionally, this site supports the community's long-term goals of lowering operational costs by reducing energy expenses, which helps sustain building operations over time.

The community of Suquamish has a 51% state percentile for flood risk, which heightens the need for resilient infrastructure. A solar plus storage system can play a pivotal role in maintaining power during such emergencies, reinforcing the community as it faces these environmental challenges.

The Southwestern Suquamish area is home to approximately 4,446 people, with 1,823 households, covering a geographic span of 7.15 square miles. The state percentiles show that 23% of the population is over 64 years old, indicating a need for consistent health and emergency services in cases of prolonged outages. This demographic condition influences the community's need for a stable and reliable power source.

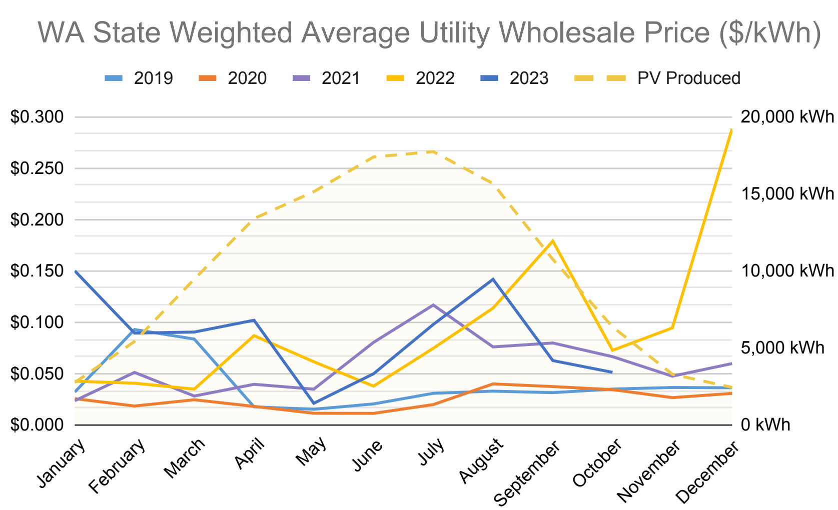
There are no other large facilities set up to provide auxiliary mass care in case of a disaster, making the continued operation of HOAC during an emergency especially important for the health and safety of the surrounding community.

By specifying local contractors and utilizing union labor and apprenticeship programs, the workforce local to the area can be trained. This increases the local capacity to develop future resiliency projects.

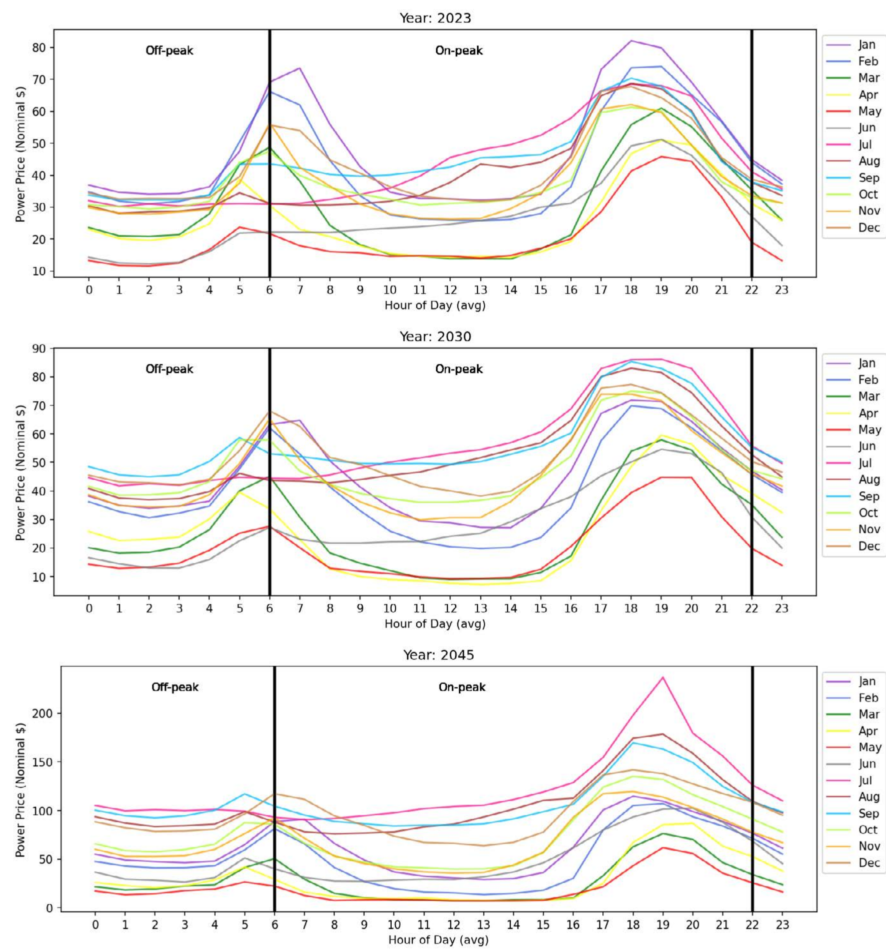
Over the warrantied lifetime of the PV array, the system will offset 1,879 lbs of carbon, equivalent to planting 28,176 trees.

Grid Benefit

At a national level, the US electric grid is one of the world's largest and most complex machines, with aging infrastructure facing increased demand due to the electrification of transportation and buildings, population growth, and migration. Distributed Energy Resources (DERs) play a crucial role in strengthening existing grid infrastructure and moving toward a more equitable and sustainable electric grid. Washington State has historically relied on hydroelectric power to balance energy demand. However, climate change is reducing snowpack and our available hydro resources, making it necessary to explore alternative options. Regional electricity prices, represented in the middle Columbia WA State Weighted Average Wholesale Price graph below, have been increasingly volatile during late summer afternoons. The largest investor-owned utility (IOU) in WA, PSE, anticipates that this price volatility will increase in coming years (see graph below). In Washington State, solar generation can help address the energy shortfall during summers, and energy storage can provide balancing services and further reduce demand during peak periods.



Monthly production of the system vs average wholesale energy pricing. Coincidence of high production to high pricing is financially beneficial.



Daily price volatility by month for the years 2023, 2030, and 2045.

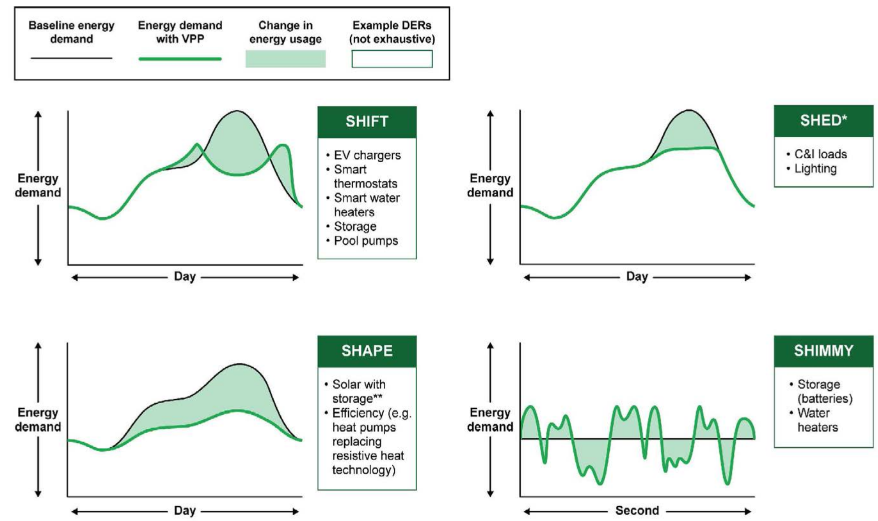
CASCADIA RENEWABLES

The US Department of Energy's September 2023 report titled "The Pathway To Commercial Liftoff: Virtual Power Plants" suggests integrating solar panels, battery storage, and micro-grid projects to optimize energy resource usage and manage grid stability. Virtual Power Plants (VPPs) and networked energy storage solutions are cost-effective alternatives to natural gas peaker plants, offering substantial benefits and low costs. The report highlights the importance of adopting innovative technologies to meet the growing energy demand sustainably and cost-effectively. Ultimately, strengthening the grid benefits the entire community. This project can play a part in improving regional energy infrastructure by reducing energy demand and providing grid-balancing services.

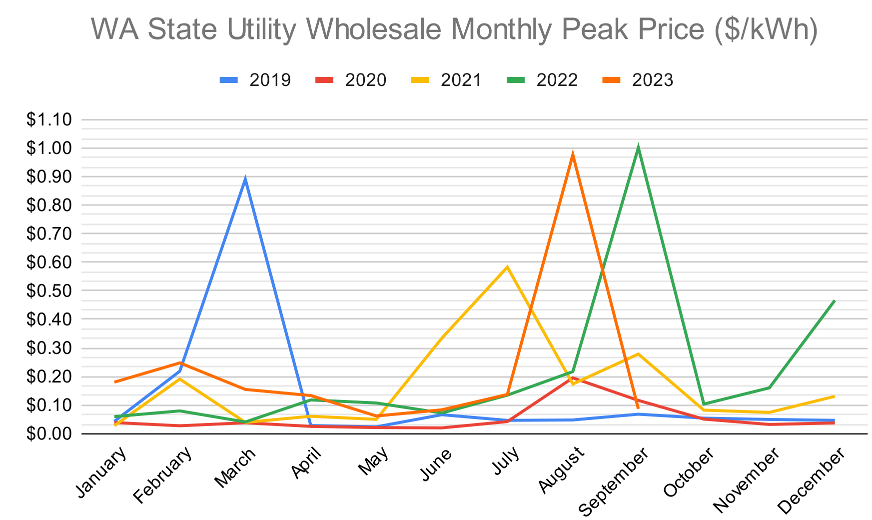
Energy pricing can serve as an effective method for utilities to encourage efficient energy dispatch from flexible resources such as solar and storage. A well-optimized system can use stored energy during high-demand periods, contributing to grid stability and economic efficiency. By implementing an appropriate demand response program, unused BESS capacity can be deployed to reduce peak demand across the service territory on a grid scale. This section aims to evaluate the potential benefits of the conceptual system in terms of reducing demand, exporting energy, and providing grid-balancing services.

PSE does not currently have a demand response program, so we have conducted optimizations to showcase the maximum demand reduction on-site while ensuring battery cell longevity.

To illustrate the effects that the conceptual system could have on the site's demand, we have simulated the conceptual system with a model of predicted consumption patterns. These charts depict the days on which the peak demand for December is predicted to occur, according to our simulation



Illustrations of the various ways DERs can influence demand. "Shape" (bottom left) is the most likely result of a solar plus storage system. Graphs by the US Department of Energy.

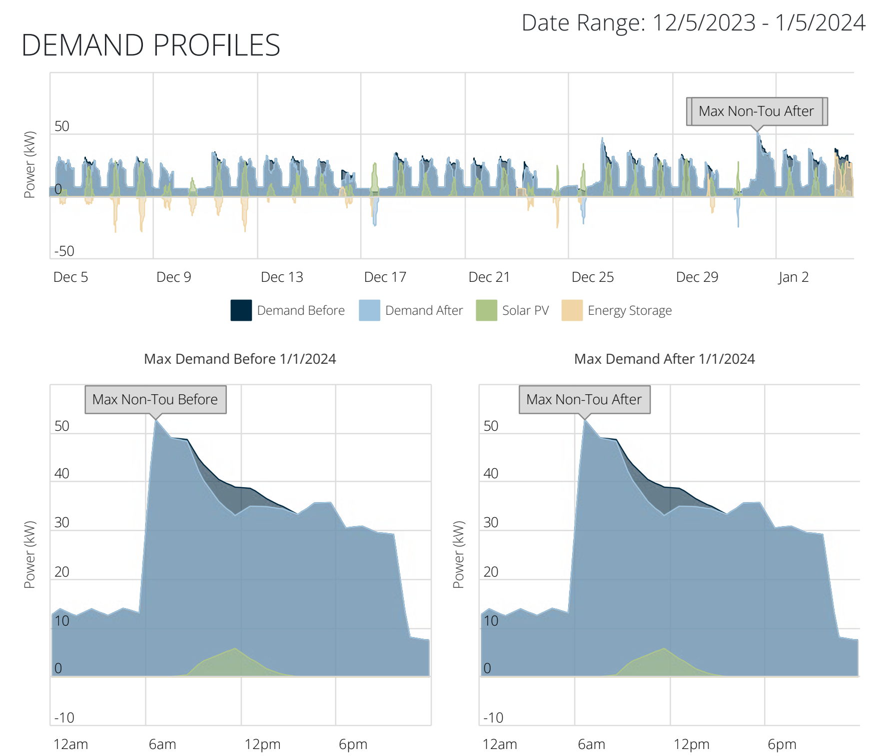


The highest wholesale costs can be mitigated by dispatching unused BESS capacity, given appropriate programs.

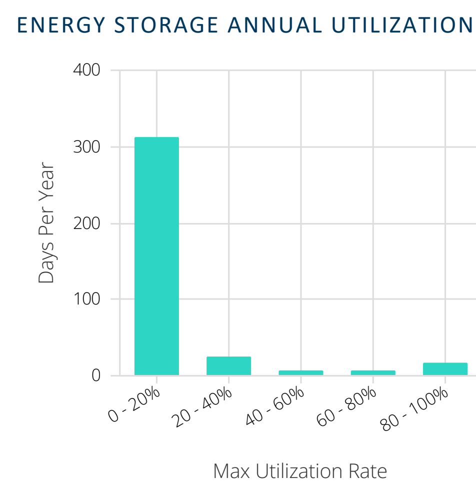
of the conceptual system. The demand of the site before accounting for the system is shown in dark blue, while the demand that would result from its implementation is shown in light blue. The difference between the demand before and the demand after is the sum of the PV generation (shown in green) and the BESS's flow (shown in yellow). The chart on the left displays the day of maximum historical demand, while the chart on the right displays the day of maximum simulated demand accounting for the effects of the conceptual system. The appendix provides the same series of charts relevant to each month throughout the year. Note that any smoothing or demand reduction on site represents a reduced burden on the local grid.

To promote system health and longetivity, the BESS should be configured to partially discharge each day. This discharge can be coordinated with times of peak building demand, which will reduce and flatten the demand profile of the building. However, there is no direct economic benefit to this peak demand reduction since the utility rate schedule does not include demand charges.

The bar chart shows how many days each quintile of the BESS is used for on-site demand management throughout the year. It is worth noting that increased utilization of the BESS could result in a faster degradation rate.



Above: Dispatch graphs showing the effects of the conceptual solar plus storage system on peak demand for the month of December.



Left: Histogram of the distribution of BESS utilization over a year.

Permitting and Utility Agreements

If this project proceeds to installation, it will be the responsibility of the installer to verify the relevant authorities having jurisdiction (AHJs) and ensure all necessary permits and agreements are in place. As it pertains to this conceptual design, Cascadia Renewables has identified the following AHJs and has documented our interactions to date.

L&I - Electrical Permitting:

The conceptual PV system and BESS design will require electrical permitting and a possible plan review from the Washington Department of Labor & Industries to verify that they meet all current WAC and NEC code reviews. Code revisions may occur in the NEC and WAC and will need to be verified during the final system design.

Puget Sound Energy - Interconnection:

The conceptual PV system is designed to align with Puget Sound Energy's standard interconnection rules, with a capacity of 100kW AC or less per customer meter. This classification ensures the system adheres to the established approval procedures for Net Metering. To proceed, a Schedule 150 Application and Agreement for Interconnection, Net Metering, and Production must be submitted.

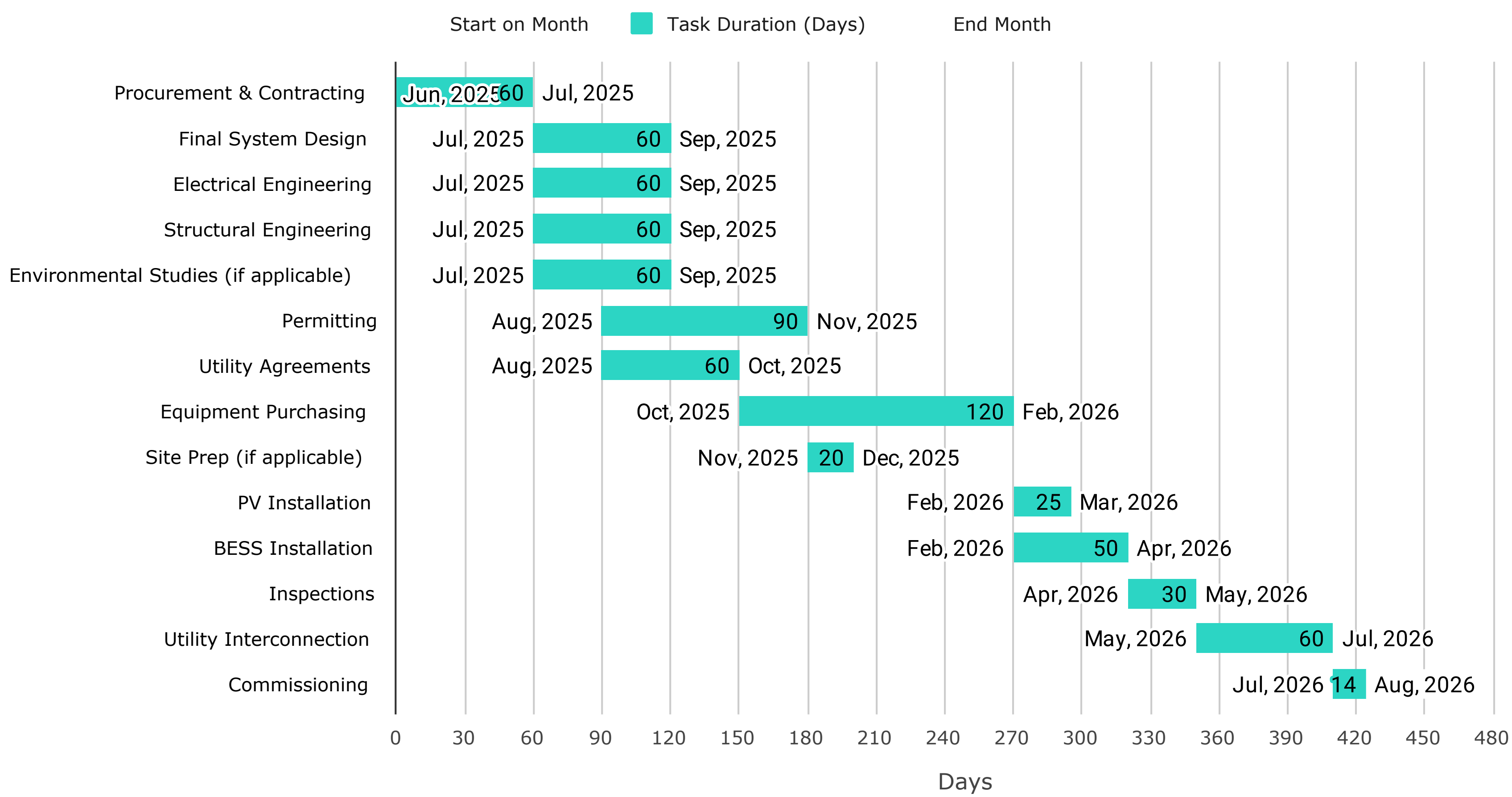
Suquamish Tribe Department of Community Development Building and Fire Permitting:

Trust properties owned by the Suquamish Tribe and Tribal families are subject to Federal land use requirements. Additional information is available at 360-598-3311, #9, #5.

Per Shenowah Purser, DCD Administrative Assistant at the Suquamish Tribe, "The Suquamish Tribe does not issue permits, and the county will not issue building permits for tribal-owned properties on the reservation."

Project pr building specific questions should be directed to Joe Bethea, the Suquamish Tribe's Maintenance Director at jbethea@suquamish.nsn.us.

Schedule


Start on Month
Task Duration (Days)
End Month
Procurement & Contracting
Jun, 2025
60
Jul, 2025
Final System Design
Jul, 2025
60
Sep, 2025
Electrical Engineering
Jul, 2025
60
Sep, 2025
Structural Engineering
Jul, 2025
60
Sep, 2025
Environmental Studies (if applicable)
Jul, 2025
60
Sep, 2025
Permitting
Aug, 2025
90
Nov, 2025
Utility Agreements
Aug, 2025
60
Oct, 2025
Equipment Purchasing
Oct, 2025
120
Feb, 2026
Site Prep (if applicable)
Nov, 2025
20
Dec, 2025
PV Installation
Feb, 2026
25
Mar, 2026
BESS Installation
Feb, 2026
50
Apr, 2026
Inspections
Apr, 2026
30
May, 2026
Utility Interconnection
May, 2026
60
Jul, 2026
Commissioning
Jul, 2026
14
Aug, 2026
0 30 60 90 120 150 180 210 240 270 300 330 360 390 420 450 480
Days

Summary of Feasibility and Next Steps

Installing a solar plus storage system at the Suquamish Tribe's House of Awakened Culture offers several resilience benefits. This system is designed to provide backup power during power outages, allowing the building to remain operational for up to 72+ hours in summer and around 15 hours in winter assuming 100% of historical demand. The resilience aspect of this system is particularly beneficial for emergency situations when the building can serve as a critical gathering point for the community.

In winter months, when the demand is higher, and solar production may be limited, a generator can be used to provide long-term autonomy. A proposed generator with a capacity of 100 kVA could be added to charge the BESS, ensuring continuous power for an extended generator.

The solar plus storage system can significantly improve energy resilience by offering a dependable backup power source for emergencies and extending autonomy through generator support.

Next Steps:

- Evaluate and approve the available space and proposed locations for the pad-mounted BESS, PV Inverters, and associated electrical equipment.
- Consider funding pathways and potential grant writing efforts.
- Reach out to PSE to inquire about the project scope and associated costs for a utility transformer upgrade.
- If a transformer upgrade is undertaken, update Cascadia Renewables if there is any change in the service voltage.
- If successful in grant requests and negotiations, construct project.

Additional Reference Information

General Site Information

Managing Organization	Suquamish Tribe
Site Address	7325 NE Parkway, Suquamish, WA 98392
Parcel Number	Suquamish Trust Land
Organization Contact	Cherrie May
Organization Contact Phone Number	360-394-8507 (Office)
Organization Contact Email	cmay@suquamish.nsn.us

Utility Information

Service Electric Utility	Puget Sound Energy
Electric Utility Meter Number	#X157288532
Electric Utility Tariff Structure	Schedule 24
Electric Utility Hosting Capacity	Unknown

Minimum Equipment Recommendations

The conceptual system has been designed assuming specific named products. These choices are based on the current market, and the named equipment may not be the best choice for the project or may not be available at the time of hypothetical construction. When evaluating bids, we recommend considering the following criteria to be the acceptable minimums.

PV Modules:

Warranty: Minimum of 12 years for the product, extending to 25 years, covering parts and labor.

Performance Guarantee: A linear performance warranty that guarantees at least 86% of nominal power rating after 25 years.

Manufacturing Standards: Modules should be Tier 1 qualified, preferably assembled in the USA.

Cell Type: Monocrystalline cells.

Frame and Weight: Anodized aluminum frame with an average system weight not exceeding 2.6 pounds per square foot (psf).

Certifications: Compliance with UL 1703/UL 61730; PID Resistance (IEC 62804); Salt Mist (IEC 61730) when PV system is within 2 kilometers of shoreline; and Fire Classification matching that of the existing roof.

PV Inverters:

Efficiency and Warranty: Minimum efficiency of 96%, with a 10-year limited warranty, extendable up to 5-15 years.

Compliance and Compatibility: Must comply with IEEE 1547/UL1741SB standards; suitable for output voltages of 120/240V Single-Phase, 120/208V 3-Phase, or 277/480V 3-Phase as dictated by the BESS design and existing electrical infrastructure; FCC Part 15 Class A; SunSpec Modbus Compliant.

Safety Features: UL1699B; NEC 2020 Rapid Shutdown Compliant; Ground Fault Detection and Interruption, AC and DC Surge Protection

PV Monitoring:

Monitoring Level: Module-level monitoring

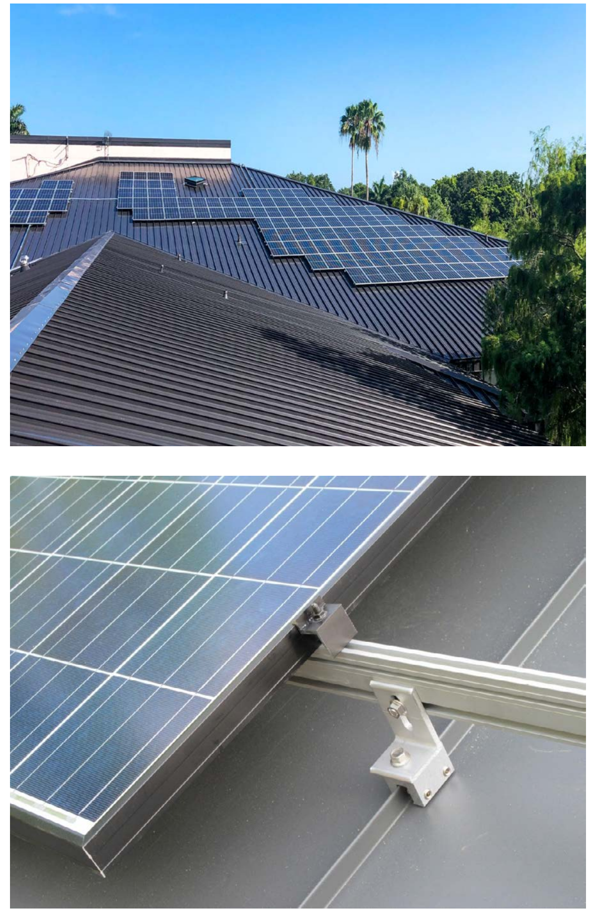
Connectivity: Connection options should include hard-wired Ethernet, Wi-Fi, or a cellular connection.

User Interface: A web-based portal accessible to customers, displaying real-time and historical data on PV power, energy production, system alerts, and module status.

Mounting System:

Warranty and Design: A minimum of a 25-year manufacturer warranty. The mounting system design should be suitable for the specific roof type and capable of withstanding local wind, seismic, and snow loading requirements.

Compatibility with Roof Materials: For standing seam metal roofs, use non-penetrating clamps. The mounting system must comply with UL2703 and local building codes, as well as maintain the roof's warranty and fire classification.



Examples of Mounting Systems for Standing Seam Metal Roofs.

BESS Specifications:

Warranty: Minimum 10-year manufacturer's warranty with 5-10-year warranty extension options.

Standards Compliance: Must comply with UL 9540 and UL 9540A for safety. Must adhere to NFPA 855 standards for installation and safety.

Battery Chemistry: Lithium Iron Phosphate (LFP/LiFePO4) is preferred for its stability, safety, and longevity.

Compatibility: Should be compatible with a range of third-party inverters and microgrid control systems. Should include generator compatibility and black start capability.

Enclosure Rating: A minimum NEMA 3R rating is required for outdoor installations to ensure protection against weather elements. If the system is to be installed near salt water, the enclosure must be suitable for the environment, and warranties must not be voided.

Fire Suppression: Active chemical fire suppression and exterior ventilation is recommended for all indoor and outdoor installations.

Battery Heating/ Cooling Equipment: Integrated HVAC or alternate active temperature control system to maintain ideal battery operating conditions and temperature.

Country of Origin: Must meet any specific country of origin requirements as per the funding source's guidelines.

Energy Capacity and Power Output: Specified based on the project's energy storage needs, considering peak demand shaving, load leveling, and backup power requirements.

Multimodal BESS Inverter: Should have the following listings and certifications, including but not limited to: UL 1741SB, IEEE 1547, IEEE 519, NEMA 3R Enclosure, Minimum efficiency of 95% with a minimum 10-year limited warranty, extendable up to 5-15 years

Efficiency and Performance: High round-trip efficiency and low degradation rate over the system's operational life.

Safety Features: Advanced Battery Management System (BMS) for monitoring cell voltage, temperature, state of charge, and overall system health. Overcharge, deep discharge, overcurrent, and short-circuit protection.

Scalability: Ability to scale up the system with additional energy storage modules or integrate with existing renewable energy systems.

Installation Flexibility: Suitable for various installation environments, including ground mount, rooftop, or integrated within existing infrastructure.

Maintenance: Low maintenance requirements, with remote monitoring and diagnostics capabilities.

Microgrid Controller:

Functionality: Highly recommended to include a microgrid controller for advanced management capabilities.

Integration: Should offer interoperability with third-party Virtual Power Plant (VPP) providers.

Features: Capable of real-time monitoring, demand response, load management, and predictive analytics.

User Interface: Intuitive, user-friendly interface for system management and data visualization.

Grid Support: Ability to monitor grid voltage and frequency to initiate power quality correction measures using distributed energy assets when needed.