RESILIENCY FOR THE TULALIP TRIBES - UTILITY CONSIDERATIONS

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Objective

- The Tulalip Tribes have received grants to add up to 1 MWDC of solar power and 8 MWh of stored energy in a battery energy storage system (BESS)
- **This project examines the potential wholesale market value of independently owned distributed energy resources (DERs) to inform potential partnership strategies with the distribution utility SnoPUD.**

Requirements

1. **Power Flow Analysis:** Model the local distribution grid and confirm that injecting power from the microgrid will be safe and reliable—even under worst-case conditions
2. **Cost Savings Analysis:** Compare different battery sizes, explore Bonneville Power Administration (BPA) power pricing scenarios, and calculate a 10-year net present value (NPV)
3. **BESS Research and Recommendations:** Recommend different battery technologies (including size, capacity, and vendor options) that work for both everyday use and emergency backup

Power Flow Analysis

Circuit Context & Model Inputs:

- **QLC feeder** (north loop — Quil-Ceda sub **QLC 12-317B**, serving Gathering-Hall / Lushootseed) and **TUL feeder** (south loop — Tulalip sub **TUL 12-507**, serving Admin Campus / Mission Beach) form the twin circuits used in all Synergi studies.

Scenario Set-Up:

- We combine SnoPUD **winter-peak and summer-midday load taps** with the Synergi **DER library** (PV, BESS, diesel) to create worst-case studies; the two representative scenarios in the table illustrate this approach.

ID	Season	Load Condition	Expected PV	BESS Strategy*	Generator Status	Why this snapshot matters
W-1	Winter	Peak evening demand	None	Discharge to support peak load	OFF	Worst-case voltage drop & thermal loading
S-1	Summer	Quiet midday, low load	Very high	Charge with surplus PV to hold voltage	OFF	Avoid over-voltage and solar curtailment

Simulating These Scenarios in Synergi:

- Placing DERs at realistic downstream nodes
- Configure Solar as fixed-output, BESS with Volt/VAR control
- Configure load profiles to match seasonal conditions (Winter Peak, Summer Peak).
- Tracking key metrics: Voltage (Min/Max), Current, Reactive Power, and Imbalance.

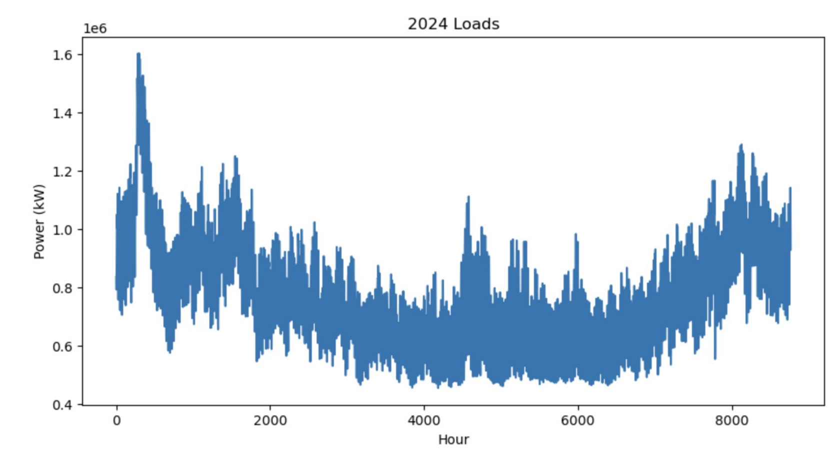
Cost Savings Analysis: Role of Market Pricing on Battery Dispatch

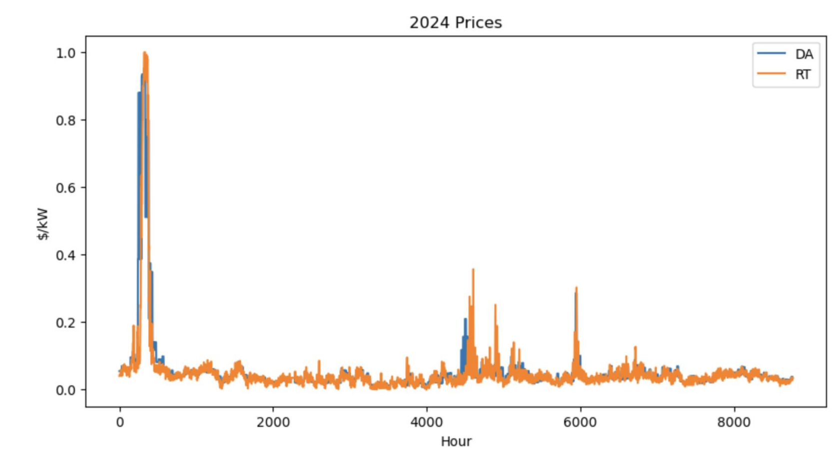
Background

- 3 tier SnoPUD power purchasing procedure: BPA Block & Slice, day-ahead (DA) market, and the real-time (RT) market.
- The Simulated Pricing Models we used to accurately reflect savings from BESS forecasting and use were 100% DA, 100% RT, and Hybrid: 75% BESS Capacity DA, 25% BESS Capacity RT.

Cost Savings Analysis using REopt

- REopt: scheduling and optimization software used to assist in planning and designing distributed energy systems.
  - Find life cycle cost savings of the project for the course of 10 years
  - Produce graphs of BESS dispatch: charge/discharge of battery based on rates and loads
- Graphs below display the loads (left) and DA/RT prices (right) over the course of 2024.

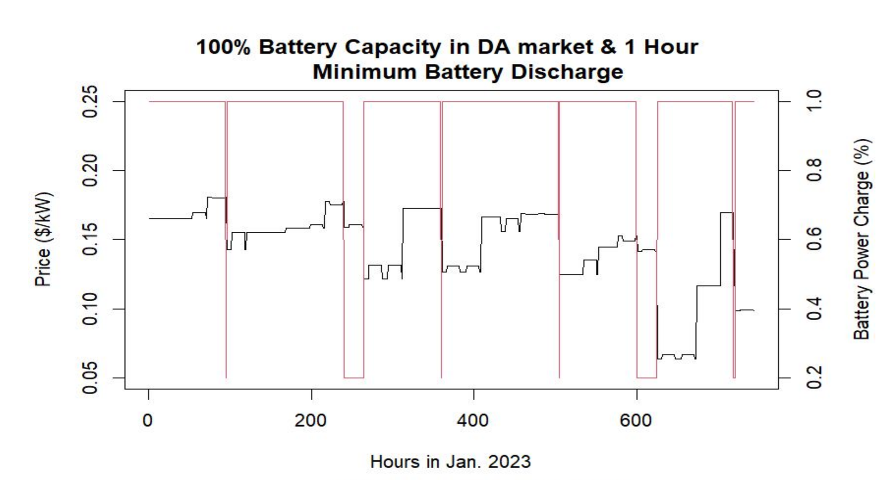


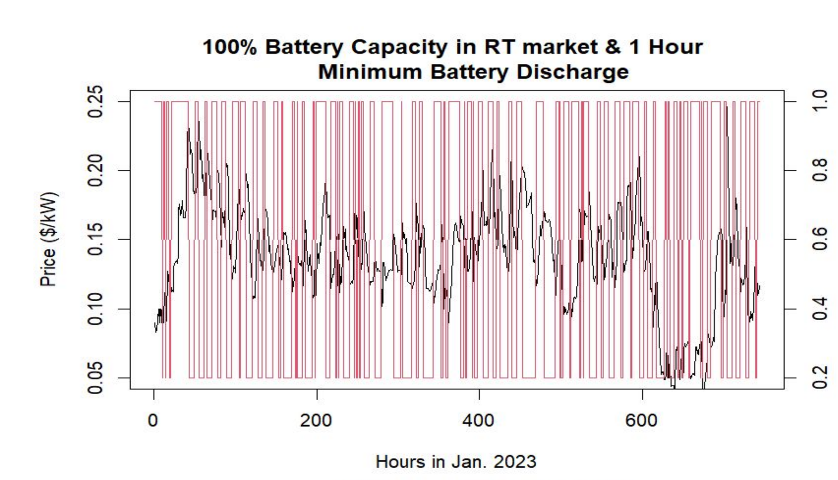


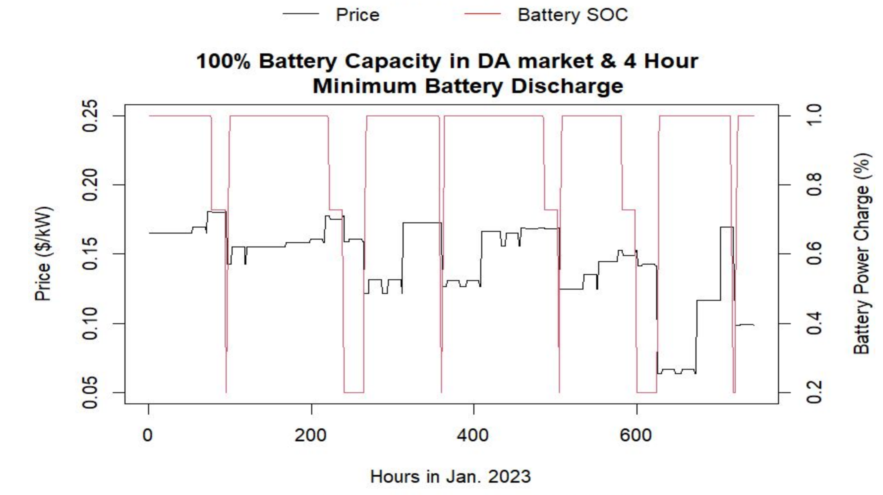
Scenario	1 hour discharge	2 hour discharge	4 hour discharge
100% DA	$327,674	$327,687	$313,772
100% RT	$1,114,667	$1,023,203	$875,871
75% DA/25% RT Hybrid	$524,423	$501,566	$454,297
Recommended battery power	6.75 MW	4.0 MW	2.0 MW

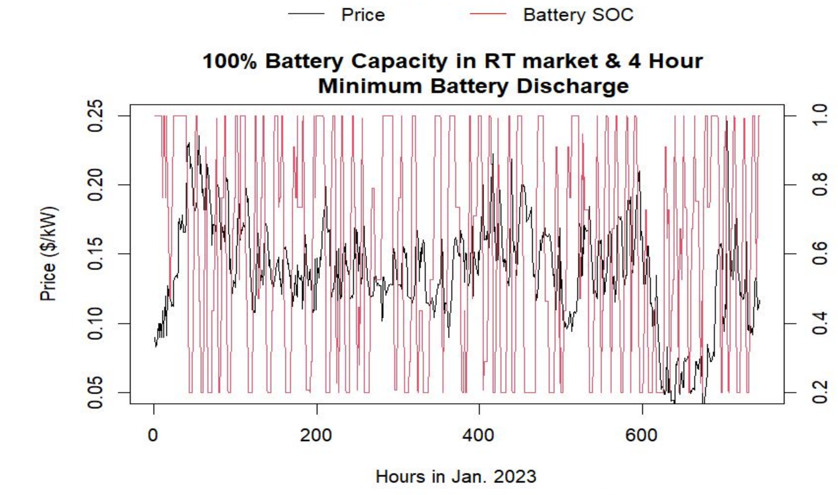
REopt's estimated NPV using an 8 MW battery over a 10 year lifetime, based on 2023's DA and RT market data and electrical load, while varying battery usage and applications

- Graphs below display optimal battery dispatch over the SnoPUD provided rates in January 2023 for a minimum battery discharge of 1 hour (top 2 graphs) and 4 hours (bottom 2 graphs)









BESS: Economics & Parameter Analysis

Research and Literature Survey:

- Consulted with Nathan Washburn from SoundGrid Partners on BESS parameters and economical considerations.

Identified Use Cases of BESS:

1. Energy Arbitrage/Shifting
2. Resiliency
3. Load Leveling and Congestion Relief

Analyzed Different Battery Durations:

	2-hour BESS ($/kWh)	**4-hour BESS ($/kWh)**	**8-hour BESS ($ / kWh)**
Costs: O&M:	Cheapest CAPEX: 1,325.924 O&M: 29.48	Compensation in markets CAPEX: 2159.143 O&M: 49.595	Most Expensive CAPEX: 3,827.98 O&M: 89.826
Rated Power:	4 MW	2 MW	1 MW
Power Restraints:	Can provide up to 4 MW in an hour, for approximately 2 hours with little drop	Provides a middle range in terms of length with one 2 MW provided an hour, not intended for long term durations	Great for longer term outages, however with a max of 1 MW per hour, not used for fast discharge
Utility Use:	Optimal for Arbitrage and High Cost Savings, but requires accurate forecasting	Discharge during a longer time window and cover peak hours Multiple cycles a day	Fewer cycles a day

Compared various BESS Materials:

- Lithium Iron Phosphate (LFP): utilizes an Iron Phosphate cathode, increasing energy density from standard industry values of Lithium systems.
- Nickel Manganese Cobalt (NMC): utilizes a high energy density for a shorter period of time, with LFP providing a lower power for a longer time.
- LFP batteries are considered safer due to a limit of heavy metal contamination, with a lower cost due to high levels of manufacturing.

Identified Concerns:

- Cell Degradation over a 10 yr depreciation period.
- Instrumentation and Controls - low level metering can fault system.

Future Work and Acknowledgments

- Analyze Power Flow with N-1 Contingencies
- Run Parametric Studies for Optimal Solar Dispatch

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