SPONGE Microgrids

Nemaiah Valley Case Study

Off-grid predictive control | 2024.08.09

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INTRODUCTION

The Naghtaneqed Elementary Junior Secondary School in Nemaiah Valley, British Columbia is powered by an off-grid solar system including battery storage and a diesel generator. The off-grid system was commissioned by Hakai Energy Solutions, a leading solar contractor from Cumberland, BC, in 2019.

Since commissioning, the solar system has been able to utilize roughly 66% of the solar resource available to it on an annual basis, with the remaining 34% being lost to curtailment when the batteries are fully charged.

Solar curtailment is typical in a well designed off-grid system. However, with predictive system control, there is an opportunity to reduce some of that curtailment by improving the coordination of the generator runtime with forthcoming solar availability and site demand.

Sponge Microgrids Inc has commissioned the enclosed case study to assess the impact that our predictive control solution could have on the total solar resource utilization and resultant diesel consumption and operating costs at the School.

SCOPE OF PROJECT

The primary objective of the study is to determine the amount of diesel consumption that could be offset on an annual basis from the addition of a Sponge System Optimization controller at the Naghtaneqed Elementary Junior Secondary School.

System Specifications

PV Capacity (DC)	49.9	kW
PV Capacity (AC)	50	kW
PV Tilt Angle	45	deg
Battery Storage Capacity	112	kWh
Generator Capacity	45	kW
Generator Setpoint	36	kW
Diesel Cost	2.0	$/L
Generator Cost	0.83	$/kWh
Round Trip Storage Efficiency	79	%

METHODOLOGY

Historical power flow data from the system was made available to Sponge via Hakai's remote monitoring platform. The most recent (12) months worth of data have been extracted for analysis.

Since the data available did not include the total available solar resource at the site, a 3 step modelling process was employed to develop a robust estimate of the offset potential relative to baseline, as follows:

01. **Analyze:** Extract key performance metrics from 12 month historical data

02. **Baseline:** Calibrate baseline simulation model with a new solar resource dataset and observed load data, to mimic observed controls and match observed KPIs

03. **Optimize:** Replace calibrated observed control logic with Sponge Predictive Controls to determine offset potential relative to calibrated baseline.

KPIs

Total Demand	Annual Electricity demanded by the site	Maintain
Generator Usage	Annual electrical energy demanded from Generator	Minimize
PV Usage	Annual solar energy utilized in the system	Maximize
Curtailment	Annual solar energy lost to curtailment	Minimize
Net Efficiency	Annual Ratio of total generation to total Demand	Maintain
Diesel Cost	Estimated cost of running generator	Minimize

Highlights

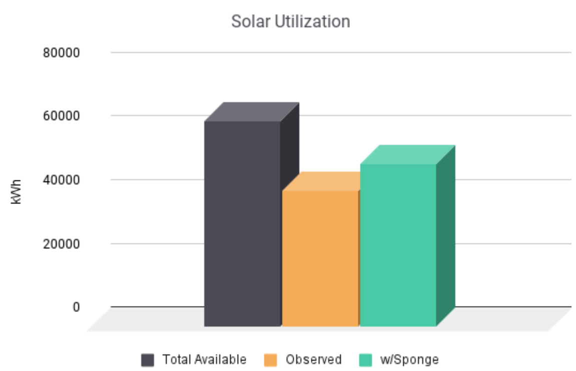
$7,134.85
Savings

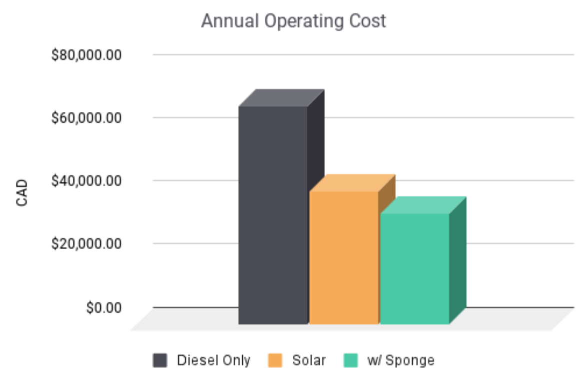
16.9% / 8596 kWh
Diesel Offset

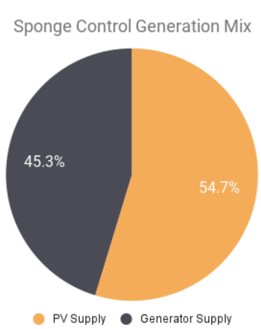
51036 kWh / 79% (up from 66%)
PV Utilization

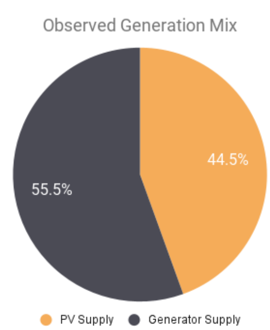
	Total Demand	Generator Usage	PV Usage	PV Curtailment	Net Efficiency	Gen Share	PV Share	Diesel Cost
Actuals	80453	50156	40180		89.06%	55.52%	44.48%	$41,629.48
Baseline	80453	50847	42504	21841	89.18%	54.47%	45.53%	$42,203.01
Optimal	83254	42251	51036	13310	89.25%	45.29%	54.71%	$35,068.16

RESULTS



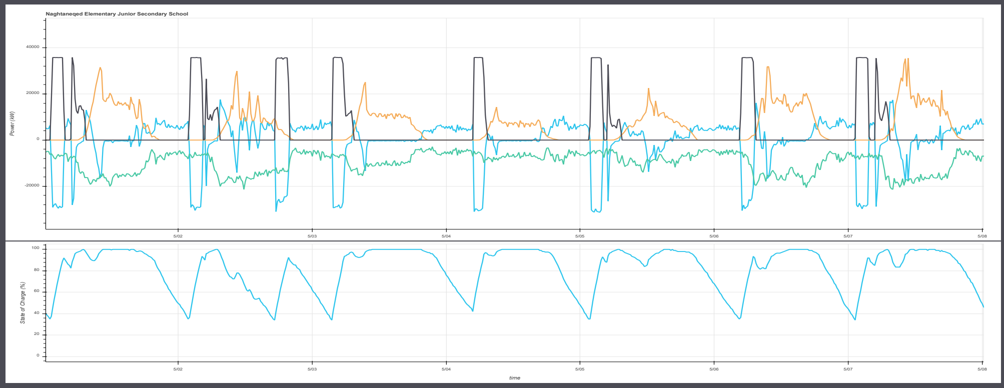






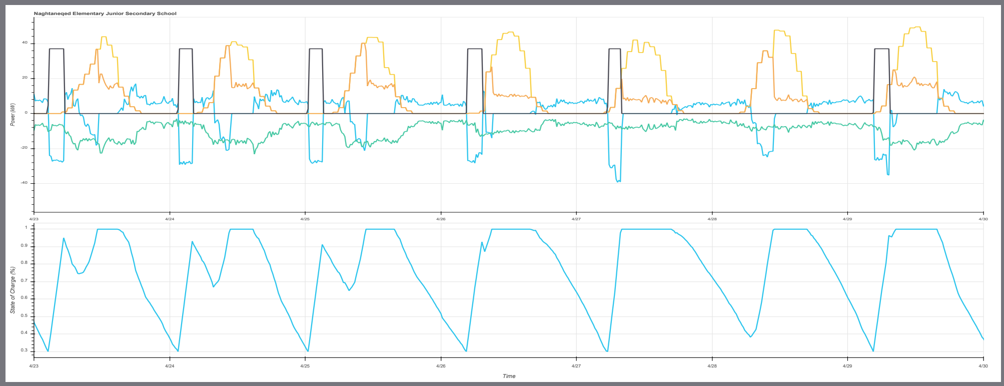
Sample Time Series Data For Each

Observed



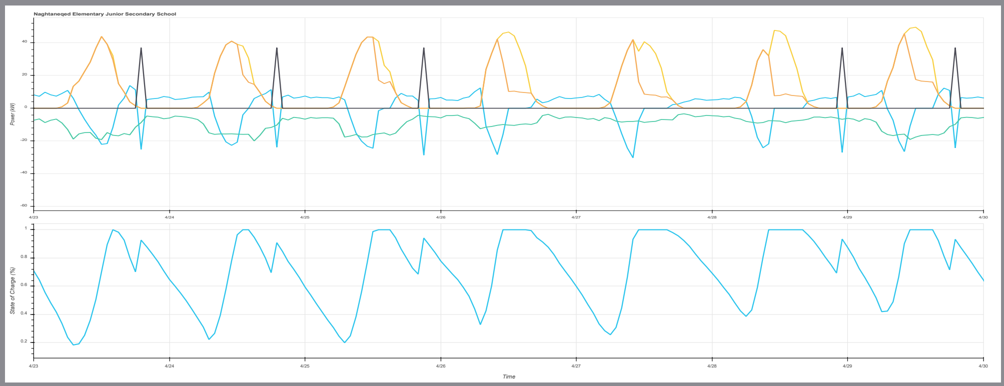
Notes - In the historical data, the sub-optimal timing of generator firing can be easily observed. Commonly, the battery discharges overnight, reaching a generator cut-in state of charge in the early morning. At this point, the generator kicks on, charging the battery until it's cut-out point of 95%. At this point, when the sun is rising, and the battery is full, solar utilization is limited to the load of the facility and any excess is curtailed, leading to excess diesel consumption.

Baseline



Notes - The baseline simulation has been calibrated to mirror the performance of the historical data. As can be observed below, the timing of generator firing, state of charge profile and resultant curtailment exhibit similar trends.

Optimal



Notes - In the predictive control simulation, forecasted demand and solar resource are evaluated by the controller on an ongoing basis to determine when to run the generator. The controller seeks to run the generator during time periods that minimize the impact on solar curtailment. This approach commonly shifts the generator runtime from the morning to the evening, allowing the battery sufficient capacity to discharge overnight to a state of charge in the morning that is compatible with the solar resource.