SPONGE Microgrids

Project A

Proposal
Off-grid Predictive Control

2024.10.04

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Project Background

The sample project facility is powered by an off-grid solar system including battery storage and a diesel generator. The off-grid system was originally commissioned by our trusted installation partner in 2021.

Since the solar install, the system has been able to utilize roughly 57% of the solar resource available to it on an annual basis, with the remaining 43% being lost to curtailment when the batteries are fully charged.

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

Sponge Microgrids Inc has developed the enclosed proposal to assess the impact that our predictive control solution could have on solar utilization, diesel consumption, operating costs at the facility.

About Sponge

Sponge Microgrids Inc is leading innovator in predictive control for renewable energy systems based in Ontario, Canada. We have developed cutting-edge forecasting and optimization solutions that monitor, predict and enhance the performance of renewable energy systems, both off-grid and grid-tied.

Our technology is patent pending and has been deployed at numerous active projects across Canada.

Jeremy Lytle, MASc
CEO

Bas de Bruijne, MSc
CTO

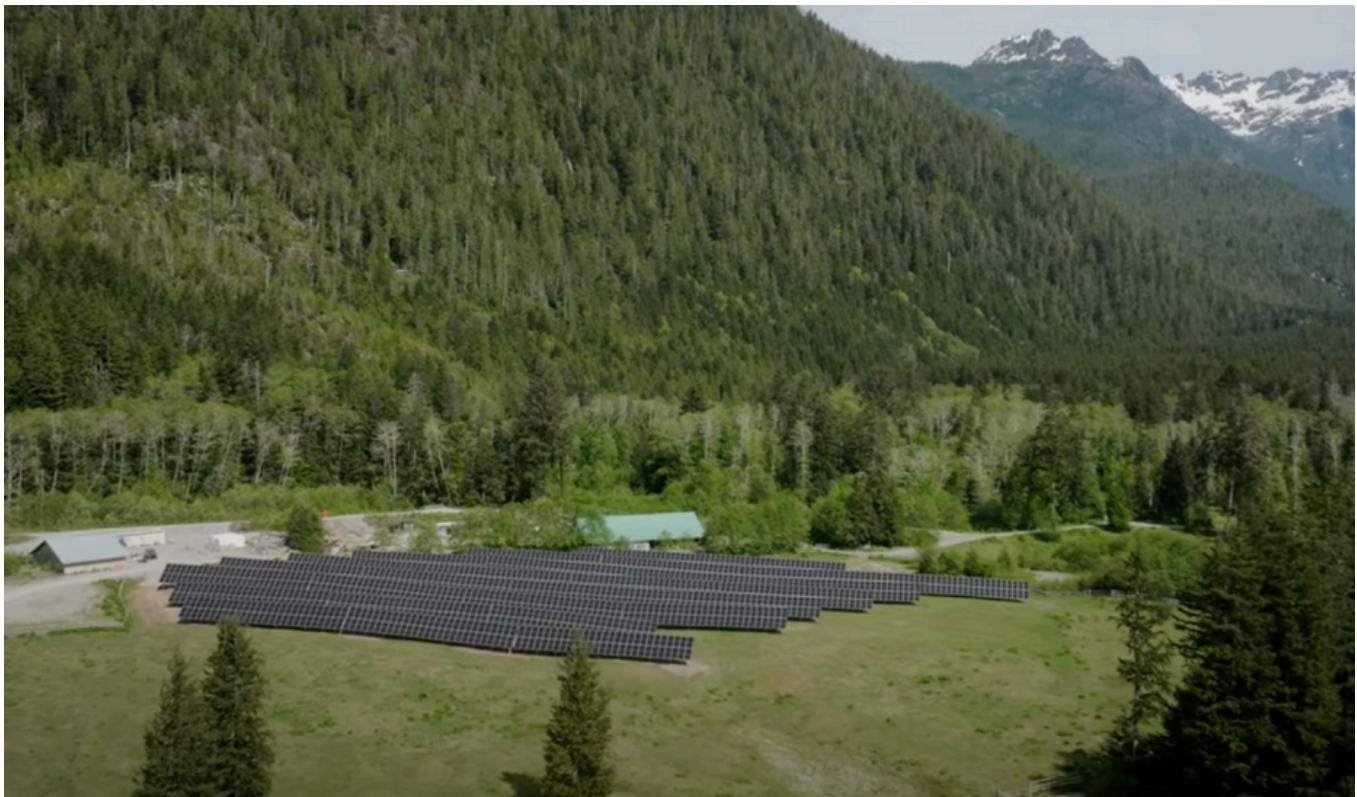
INTRODUCTION

SPECS & SCOPE

In order to indicate the potential value that Sponge controls can provide to the Project Facility, we've included a brief assessment of the application of our algorithms to the historical performance data from the facility. The primary objective of this assessment is to determine the amount of diesel consumption that could be offset on an annual basis from the addition of a Sponge predictive control solution.

System Specifications

PV Capacity (DC)	150	kW
PV Capacity (AC)	132	kW
PV TIlt Angle	Various	deg
Battery Storage Capacity	210	kWh
Battery Power Capacity	180	kW
Round Trip Storage Efficiency	80	%
Generator Capacity	72	kW
Generator Setpoint	58	kW
Diesel Cost	2.0	CA$/L
Generator Levelized Cost	1.14	CA$/kWh



METHODOLOGY

Historical power flow data from the system was made available to Sponge via the installer's remote monitoring platform. The most recent (12) months worth of data have been extracted for analysis, covering the period of Oct 2023 - Oct 2024. A 3-step modelling process was employed to develop a robust estimate of the annual 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 complete solar resource dataset and annualized load data, to mimic observed controls and match observed KPIs.

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

During the Optimal simulation, random forecast error is introduced throughout to approximate the prediction error we've observed from our live systems, ensuring a robust estimate of savings potential. In the Baseline simulation, we've also incorporated the unique generator control settings of the existing system controller, which is the lead energy storage inverter, as extracted from the monitoring platform.

KPIs

Metric	Description	Objective
Demand	Amount of electricity consumed at the site	Maintain
Generator	Amount of electricity derived from the generator	Minimize
PV	Amount of electricity derived from the solar array	Maximize
Curtailment	Amount of additional solar resource not captured	Minimize
Net Efficiency	Ratio of total demand to total generation	Maintain
Generator Cost	Estimated total cost of generator runtime	Minimize

Baseline Control Inputs

Generator ON SoC	15%
Generator OFF SoC (Summer)	50%
Generator OFF SoC (Winter)	70%

Highlights

$19,400
Savings

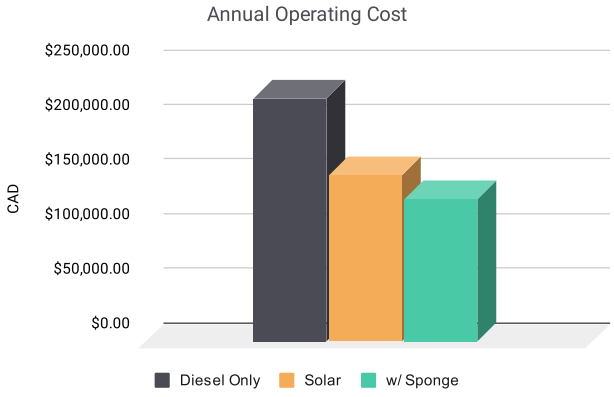
12.8%
Diesel Offset

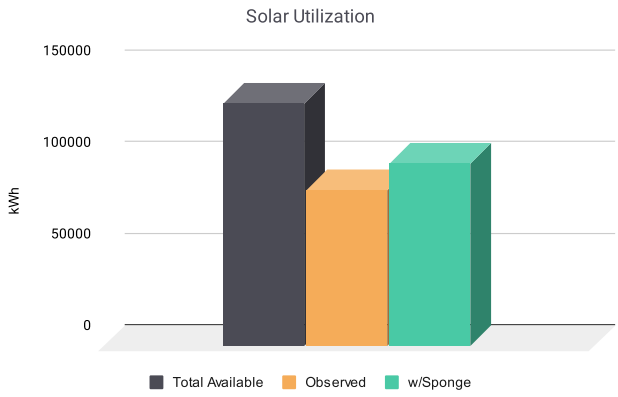
17.2%
Solar Boost

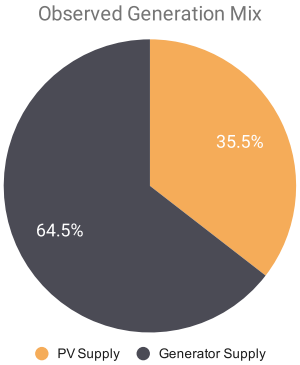
	Demand (kWh)	Generator (kWh)	PV (kWh)	Net Efficiency (%)	Generator Ratio (%)	PV Ratio (%)	Generator Cost
Observed	197,839	137,721	75,718	92.7	64.5	35.5	$156,951
Baseline	195,064	133,173	84,865	89.5	61.1	38.9	$151,768
Sponge Optimized	**195,064**	**116,150**	**99,492**	**90.5**	**53.9**	**46.1**	**$132,367**
Sponge + Load Ctrl	195,064	108,738	106,564	90.6	50.5	49.5	$123,961

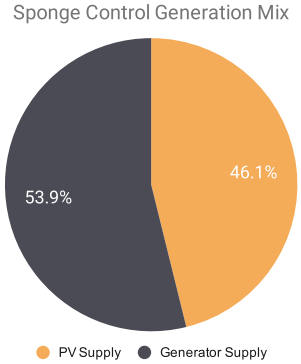
RESULTS

Our assessment indicates additional diesel offset potential of 12.8% leading to annual savings of approximately CA$19,400. This result will depend on year to year variation in load, and will increase over time as our forecasting algorithms continuously improve and diesel prices increase. Further savings potential from the addition of water heater load control has been included for exploration purposes, and amounts to 18.1% total or CA$27,807 per year, a CA$8,407 improvement over predictive optimization alone.





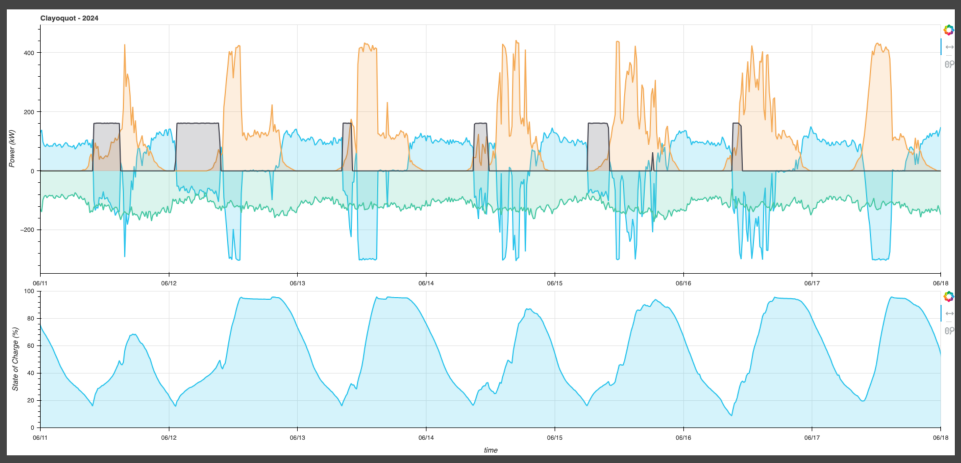




Sample Performance Data

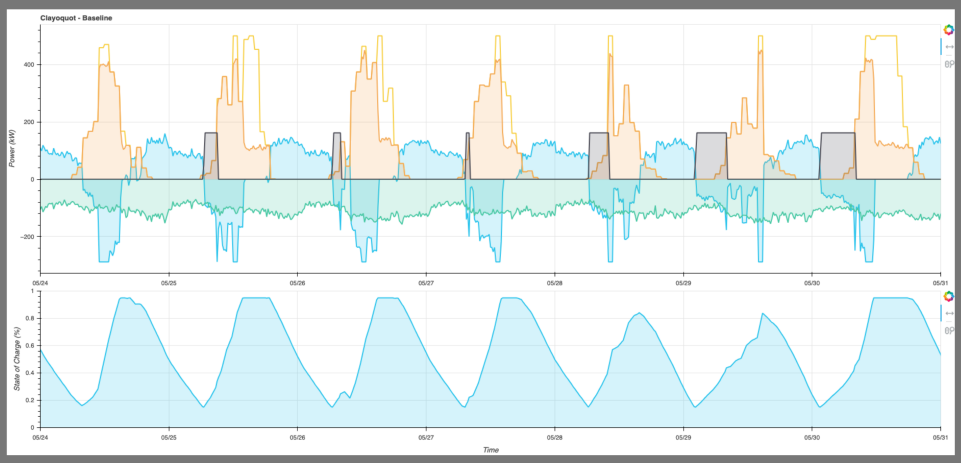
Observed

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 seasonal cut-out point of 50% or 70%, or until the solar generation exceeds the facility load. At this point, when the sun is up, the battery has less space available to charge. Once it is full, solar capture is limited to the load of the facility and any excess is curtailed, leading to excess diesel consumption.



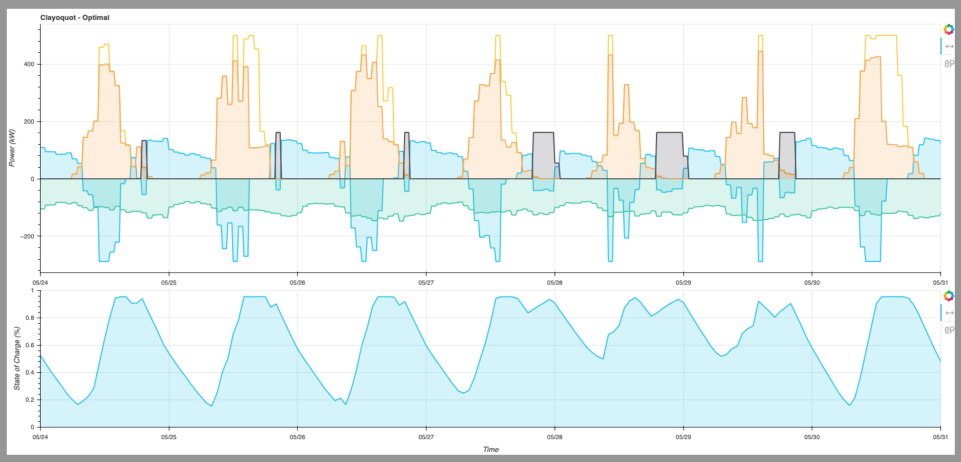
Baseline

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. The amount of curtailment that results can be observed in the difference between the yellow line (total solar resource) and orange line (captured solar).



Optimal

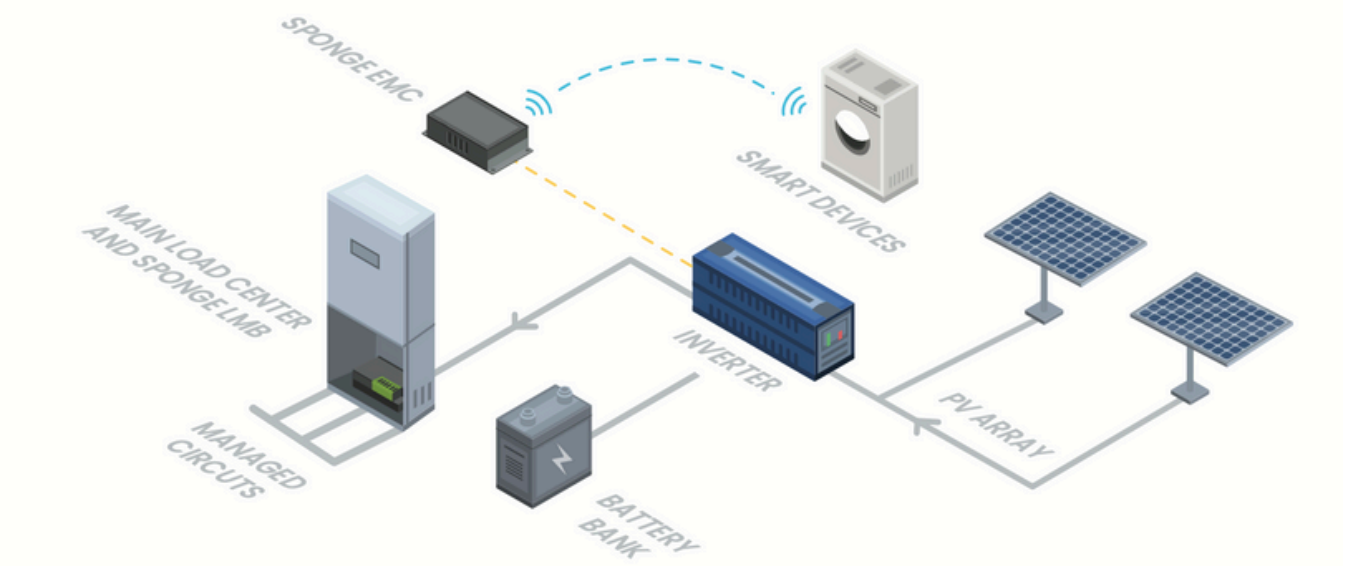
In the predictive control simulation, forecasted demand and solar resource are evaluated by the controller on an ongoing basis to determine when to run the generator. The controller seeks to run the generator during time periods that minimize the impact on solar curtailment. This approach commonly shifts 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.



HOW IT WORKS

Sponge Offering

The Sponge solution includes the delivery, installation and commissioning of our Energy Management Controller, which operates our proprietary control algorithms. But it doesn't stop there. Our team has full remote access to every system we deploy, enabling over-the-air updates, remote monitoring, system maintenance and most importantly, quality assurance.



Control Philosophy

At Sponge, we respect that system reliability is paramount. Thats why our control approach is simple and nonintrusive. Our controls operate completely outside the loop of mission critical system operations and simply make adjustments to targeted set points as required in order to instigate the performance we want to see. After the control action, defaults settings are restored. This means that there is no incremental complexity or reliability risk introduced, just added value and improved performance.

Performance Guarantee

We stand by our system and offer a full performance guarantee. In parallel to the active control loop our software runs a counterfactual simulation, keeping track of its performance relative to the baseline controls that were in place previously. That means we can continuously track the performance boost we are providing, and ensure it's meeting our expectations.

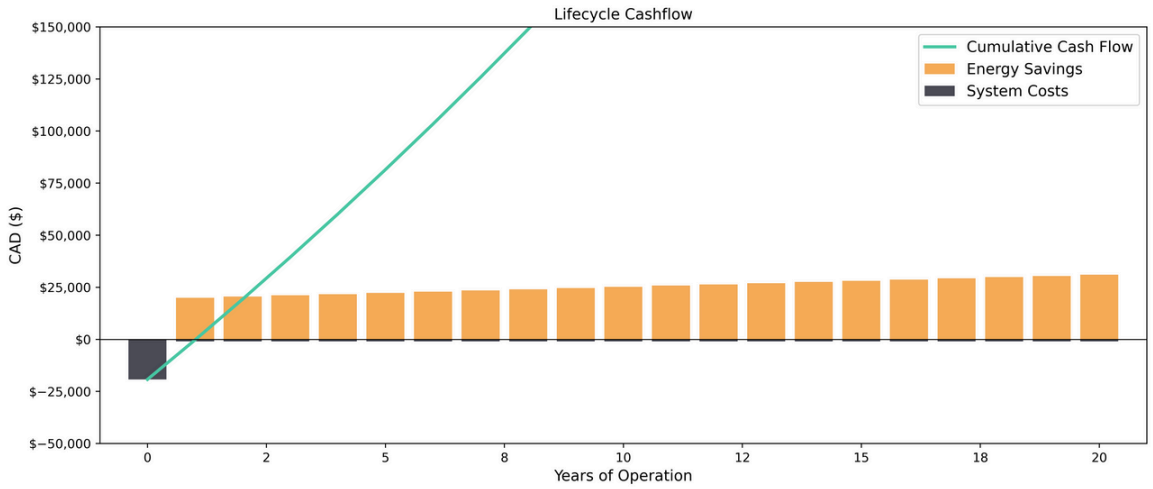
Project Fees

Our fee structure follows a CapEx model. We charge for our hardware, commissioning, and software licensing up front, and then the system is yours. While the system is operating, we only take a small annual maintenance fee to cover our costs of continuous updates, monitoring and quality assurance.

Sponge Energy Management Controller	$2,750
Optimization Software License	$12,000
Onsite Commissioning	$4,500
TOTAL	**$19,250**
Annual Maintenance Fee	$1,000

Financial Analysis

At Sponge, we pride ourselves on providing a sound financial solution. In this case, we are able to achieve a payback period of 1.0 years and a 102% rate of return. In the renewable energy world, a value proposition like this is a true no-brainer.



Highlights

$19,250
Investment Amount

$19,400
Annual Savings

1.0 Years
Payback Period

$303,661
Net Present Value

102%
Internal Rate of Return

OUR PROPOSAL

Thank you for considering our proposal.
We welcome your feedback and look forward to discussing next steps.

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SPONGE Microgrids

Monitor | Forecast | Optimize