Results for Your Site

These results from REopt summarize the economic viability of PV, wind, battery storage, CHP, prime generator and/or GHP at your site. You can edit your inputs to see how changes to your energy strategies affect the results.

Your recommended battery power and capacity

3,086 kW
battery power

4,070 kWh
battery capacity

This system size minimizes the life cycle cost of energy at your site. The battery power (kW-AC) and capacity (kWh) are optimized for economic performance.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your potential life cycle savings (25 years)

This is the net present value of the savings (or costs if negative) realized by the project based on the difference between the total life cycle costs of doing business as usual compared to the optimal case.

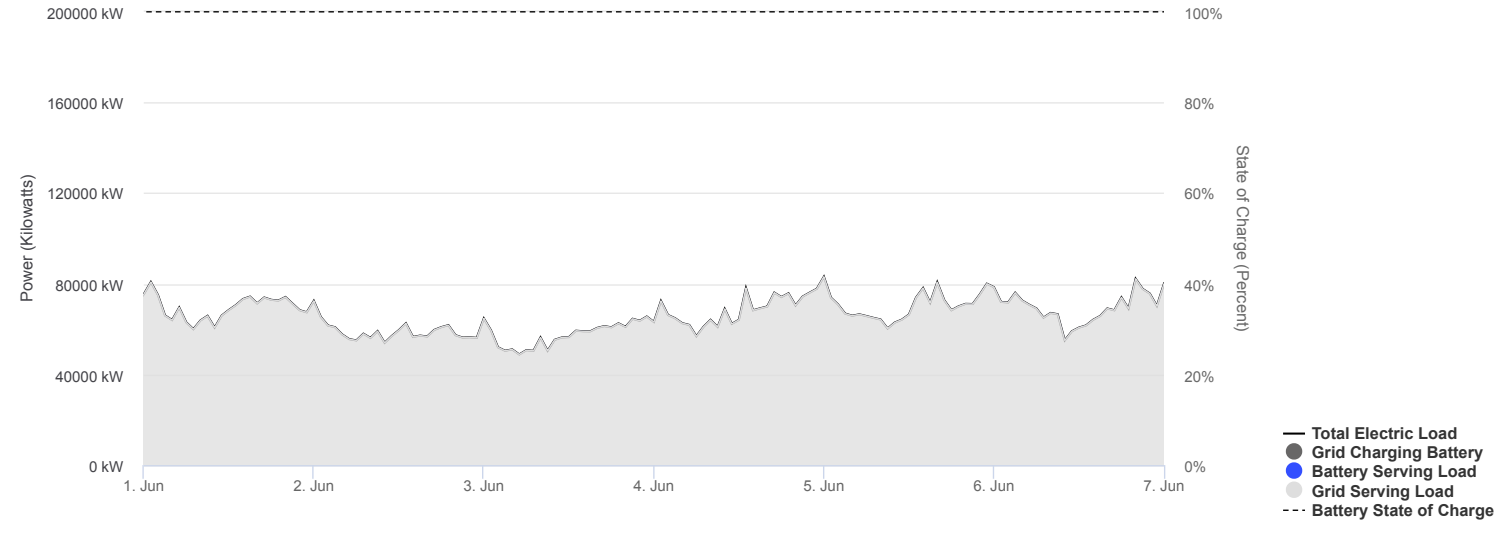
$2,264,843

View citation

System Performance Year One

System Performance Year One

This interactive graph shows the dispatch strategy optimized by REopt for typical operation of the recommended system for every hour of the year. Graphs showing the optimized dispatch strategy during specified outages can be found in the Resilience vs. Financial tab below. To zoom in on a date range, click and drag right in the chart area or use the "Zoom In a Week" button. To zoom out, click and drag left or use the "Zoom Out a Week" button.



Annual Electricity Production Breakdown

This data shows the annual production of electricity for each technology and the breakdown of where the electricity goes. For PV and Wind, this is the average annual production which includes the year-over-year degradation included in the model.

Grid

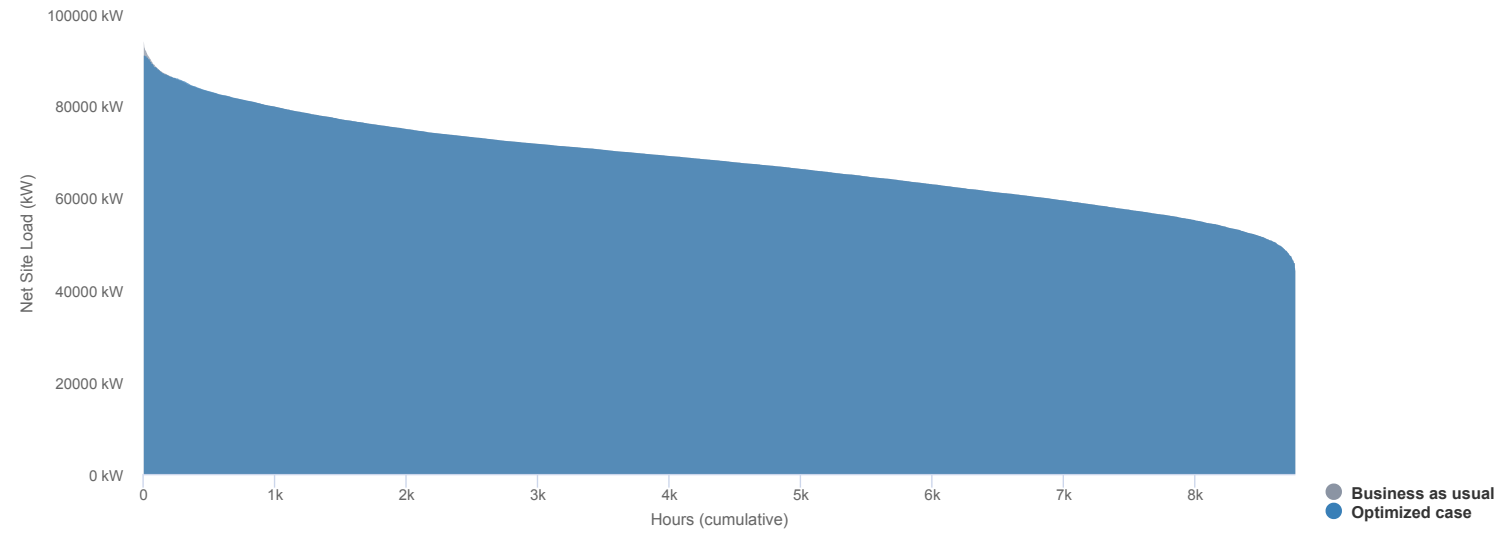
Average Annual Dispatch Results	
Grid Serving Load (kWh)	595,034,147
Grid Charging Battery (kWh)	137,303
Grid Total Electricity Consumed (kWh)	595,171,450

Battery

Average Annual Dispatch Results	
Battery Serving Load (kWh)	124,532

Net Load Duration

This interactive graph shows the reduction in peak load that occurs when the REopt recommended technologies are implemented. To zoom in on a date range, click and drag right in the chart area. To zoom out, click and drag left or use the "Reset zoom" button.



Download Load Duration Spreadsheet

Download All Dispatch Data | Download All Annual Energy Production Breakdown Data

Energy Resilience Performance

Energy Resilience Performance

The Energy Resilience Performance (ERP) of the solution is assessed based on the reliability of assets included for all possible outage periods in a year. The SOC for the start of an outage any time in the year is based on the optimization dispatch results. You can also modify the system architecture to see how reliability performance might change. Common changes to consider are increasing the the nameplate capacity per unit.

Distributed Energy Resources	Total nameplate capacity (Optimized)	Number of units	Nameplate capacity per unit	Total nameplate capacity
Battery Power (kW)	3,087 kW	1	3087 kW	3,087 kW
Battery Energy (kWh)	4,070 kWh	1	4070 kWh	4,070 kWh

Max outage duration (hours)

24

Critical load factor (%)

50%

Advanced Inputs

Results Comparison

Results Comparison

These results show how doing business as usual compares to the optimal case.

	Business As Usual	Financial	Difference
System Size			
Battery Power	0 kW	3,086 kW	3,086 kW
Battery Capacity	0 kWh	4,070 kWh	4,070 kWh
Energy Production and Fuel Use			
Average Annual Energy Supplied from Grid	595,158,679 kWh	595,171,450 kWh	12,771 kWh
Renewable Energy Metrics			
Annual Renewable Electricity (% of electricity consumption)	0%	0%	0%
Climate Emissions			
Avoided CO_2e Emissions throughout Analysis Period	N/A	7 tonnes	7 tonnes

Health Emissions			
Avoided NO_x Emissions throughout Analysis Period	N/A	-0.01 tonnes	-0.01 tonnes
Avoided SO_2 Emissions throughout Analysis Period	N/A	0.00 tonnes	0.00 tonnes
Avoided $PM_{2.5}$ Emissions throughout Analysis Period	N/A	-0.01 tonnes	-0.01 tonnes
Year 1 Utility Electricity Cost — Before Tax			
Utility Export Benefit	$0	$0	$0
Utility Energy Cost	$44,434,513	$44,435,453	$939
Utility Demand Cost	$16,837,312	$16,275,184	-$562,128
Utility Fixed Cost	$0	$0	$0
Utility Minimum Cost Adder	$0	$0	$0
Total Year 1 Utility Cost - Before Tax	$61,271,825	$60,710,637	-$561,189
Life Cycle Cost Breakdown			
Technology Capital Costs + Replacements, After Incentives	$0	$3,829,015	$3,829,015
O&M Costs	$0	$0	$0
Total Utility Electricity Cost	$665,341,031	$659,247,173	-$6,093,858
Cost of Climate Emissions throughout Analysis Period (If Included in Objective)	$0	$0	$0

Cost of Health Emissions throughout Analysis Period (If Included in Objective)	$0	$0	$0
Summary Financial Metrics			
Total Upfront Capital Cost Before Incentives	N/A	$4,660,337	$4,660,337
Year 1 O&M Cost, Before Tax	$0	$0	$0
Total Life Cycle Costs	$665,341,031	$663,076,188	-$2,264,843
Net Present Value	$0	$2,264,843	$2,264,843
Payback Period	N/A	6.8 yrs	6.8 yrs
Internal Rate of Return	N/A	13.5%	13.5%

Renewable Energy & Emissions Metrics

Renewable Energy & Emissions Metrics

These results show emissions outcomes for the business as usual and optimized cases. If marginal grid emissions rates are utilized (the default inputs), users should focus on avoided emissions, rather than emissions totals. Note for all emissions outputs, “t” (as in, "t CO_2e") represents metric tons (tonnes).

	Business As Usual	Financial	Difference
Renewable Energy			
Annual Renewable Electricity (% of electricity consumption)	0%	0%	0%
Climate & Health Emissions Costs			
Cost of Climate Emissions throughout Analysis	$50,612,988	$50,612,721	-$267

Period			
Cost of Health Emissions throughout Analysis Period	$58,535,274	$58,536,274	$1,000
Climate Emissions, CO_2e			
Average Annual Emissions (t CO_2e)	51,282	51,281	0
Average Annual Emissions from Grid Purchases (t CO_2e)	51,282	51,281	0
Average Annual Emissions from Onsite Fuel Burn (t CO_2e)	0	0	0
Total Emissions throughout Analysis Period (t CO_2e)	1,282,038	1,282,031	-7
Emissions from Grid Purchases throughout Analysis Period (t CO_2e)	1,282,038	1,282,031	-7
Emissions from Onsite Fuel Burn throughout Analysis Period (t CO_2e)	0	0	0
Percent Reduction in CO2 Emissions from BAU (%)	N/A	0.00%	0.00%
Breakeven Cost of CO_2e Emissions Reduction ($/t CO_2e)	N/A	N/A	N/A
Health Emissions, NO_x			
Average Annual Emissions (t NO_x)	22.84	22.84	0.00
Average Annual Emissions from Grid	22.84	22.84	0.00

Purchases (t NO_x)			
Average Annual Emissions from Onsite Fuel Burn (t NO_x)	0.00	0.00	0.00
Total Emissions throughout Analysis Period (t NO_x)	571.08	571.09	0.01
Emissions from Grid Purchases throughout Analysis Period (t NO_x)	571.08	571.09	0.01
Emissions from Onsite Fuel Burn throughout Analysis Period (t NO_x)	0.00	0.00	0.00
Health Emissions, SO_2			
Average Annual Emissions (t SO_2)	3.28	3.28	0.00
Average Annual Emissions from Grid Purchases (t SO_2)	3.28	3.28	0.00
Average Annual Emissions from Onsite Fuel Burn (t SO_2)	0.00	0.00	0.00
Total Emissions throughout Analysis Period (t SO_2)	82.02	82.02	0.00
Emissions from Grid Purchases throughout Analysis Period (t SO_2)	82.02	82.02	0.00
Emissions from Onsite Fuel Burn throughout Analysis Period (t SO_2)	0.00	0.00	0.00
Health Emissions, $PM_{2.5}$			

Average Annual Emissions (t $PM_{2.5}$)	6.33	6.33	0.00
Average Annual Emissions from Grid Purchases (t $PM_{2.5}$)	6.33	6.33	0.00
Average Annual Emissions from Onsite Fuel Burn (t $PM_{2.5}$)	0.00	0.00	0.00
Total Emissions throughout Analysis Period (t $PM_{2.5}$)	158.34	158.35	0.01
Emissions from Grid Purchases throughout Analysis Period (t $PM_{2.5}$)	158.34	158.35	0.01
Emissions from Onsite Fuel Burn throughout Analysis Period (t $PM_{2.5}$)	0.00	0.00	0.00

Download Hourly Grid Emissions Factors

Inputs

Your Inputs

The results are based on the following user supplied inputs.

Energy Goals
Cost-Savings $

Technologies Selected
Battery

Site	
Evaluation name	Grid Dependent DC
Site Location (latitude, longitude)	37.271087, -121.768936
PV & wind space available	Land
Land available (acres)	1,000,000

Utilities	
URDB rate	City of Palo Alto, California (Utility Company) - Large Commercial Block Green Power

Load Profile	
Typical electric load profile type	uploaded
Typical electric load profile filename	load_profile_template_edited(Google).csv

Clean Energy Accounting	
Cambium location	CAISO

Battery	

Defaults

Default Inputs

The results are based on the following default inputs.

Site	
Solver optimality tolerance (%)	0.1%
Solver name	HiGHS

Optimization timeout (seconds)	600

Utilities	
Compensation type	No compensation for exports

Load Profile	
Load adjustment (%)	100%
Annual electric energy consumption (kWh)	595,158,679

Financial	
Analysis period (years)	25
Host discount rate, nominal (%)	6.38%
Host effective tax rate (%)	26%
Electricity cost escalation rate, nominal (%)	1.7%
O&M cost escalation rate (%)	2.5%
Third Party Ownership	false
Third-party owner discount rate, nominal (%)	6.38%
Third-party owner effective tax rate (%)	26%
Prime Generator fuel cost escalation rate, nominal (%)	1.5%

Clean Energy Accounting	
EPA's AVERT Region	California
Geographic resolution	GEA Regions 2023
Cambium Levelization Years	25
Metric	LRMER CO2e Combined
Grid scenario	Mid-case

Use emissions averaged over the analysis period?	Yes
Cambium start year	2025
Include distribution losses?	Enduse
Projected annual percent decrease in grid health emissions factors (%/year)	4.590%
Count exported renewable electricity towards renewable energy goals?	true
Count exported electricity towards emissions offsets?	true
CO_2 cost ($/t CO_2)	51.0
On-site fuel burn NOx cost ($/t NOx)	30,713.07
On-site fuel burn SO_2 cost ($/t SO_2)	55,556.78
On-site fuel burn PM2.5 cost ($/t PM2.5)	603,804.35
Grid emissions NOx cost ($/t NOx)	29,567.20
Grid emissions SO_2 cost ($/t SO_2)	53,350.76
Grid emissions PM2.5 cost ($/t PM2.5)	313,811.29
CO_2 cost escalation rate, nominal (%)	4.22%
NOx cost escalation rate, nominal (%)	4.28%
SO_2 cost escalation rate, nominal (%)	4.74%
PM2.5 cost escalation rate, nominal (%)	4.39%

Battery	
Energy capacity cost ($/kWh)	$455
Power capacity cost ($/kW)	$910
Allow grid to charge battery	Yes
Energy capacity replacement cost ($/kWh)	$318

Energy capacity replacement year	10
Power capacity replacement cost ($/kW)	$715
Power capacity replacement year	10
Minimum energy capacity (kWh)	0
Maximum energy capacity (kWh)	Unlimited
Minimum power capacity (kW)	0
Maximum power capacity (kW)	Unlimited
Minimum battery duration (hours)	0
Maximum battery duration (hours)	Unlimited
Rectifier efficiency (%)	96%
Round trip efficiency (%)	97.5%
Inverter efficiency (%)	96%
Minimum state of charge (%)	20%
Initial state of charge (%)	50%
Total percentage-based incentive (%)	30%
Total power capacity rebate ($/kW)	$0
MACRS bonus depreciation	60%
MACRS schedule	7 years

⚠ Caution

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Investment decisions should not be made on REopt results alone. These results assume perfect prediction of solar irradiance, wind speed, and electrical and thermal loads. In practice, actual savings may be lower

based on the ability to accurately predict solar irradiance, wind speed, and load, and the control strategies used in the system. And, when modeling a grid outage the results assume perfect foresight of the impending outage, allowing the battery system to charge in the hours leading up the outage. If a natural gas-fueled CHP system is included, the resiliency results assume the natural gas supply is not disrupted during an electrical grid outage.

The results include both expected energy and demand savings. However, the hourly model does not capture intra-hour variability of the PV and wind resource. Because demand is typically determined based on the maximum 15-minute peak, the estimated savings from demand reduction may be exaggerated. The hourly simulation uses one year of load data and one year of solar and wind resource data. Actual demand charges and savings will vary from year to year as load and resource vary.

Asset dispatch decisions are determined by the model as part of the cost-minimization objective. In application, some aspects of these operational decisions may not work well with the existing infrastructure or may not follow best practices. For example, in results with CHP, boiler dispatch may result in short cycling or periodic boiler use that is not possible without hot-standby. The user should review the dispatch results with these limitations in mind.

👉 Next Steps

Next Steps

This model provides an **estimate** of the techno-economic feasibility of solar, wind, battery, and/or CHP but investment decisions should not be made based on these results alone. **Before moving ahead with project development, verify:**

- The utility rate tariff is correct.
    - Note that a site may have the option or may be required to switch to a different utility rate tariff when installing a renewable energy system.
    - Contact your utility for more information.
- Actual load data is used rather than a simulated load profile.
- The load adjustment is entered as intended. (To learn more about achieving energy efficiency savings, visit the Better Buildings Solution Center).
- PV, wind, battery, and CHP costs and incentives are accurate for your location.
    - There may be additional value streams not included in this analysis such as ancillary services or capacity payments.
- Financial inputs are accurate, especially discount rate and utility escalation rate.
- Other factors that can inform decision-making, but are not captured in this model, are considered. These may include:

    - roof integrity
    - shading considerations
    - obstacles to wind flow
    - ease of permitting
    - mission compatibility
    - regulatory and zoning ordinances
    - utility interconnection rules
    - availability of funding.
- Multiple systems integrators are consulted and multiple proposals are received. These will help to refine system architecture and projected costs and benefits. REopt results can be used to inform these discussions.

Contact NREL at reopt@nrel.gov for more detailed modeling and project development assistance.