RESILIENTPOWER

A project of CleanEnergyGroup



REopt Lite: Sizing Solar+Storage for Savings and Resiliency with NREL's New Tool



November 1, 2017

Housekeeping



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Who We Are

Evolution of a New Clean Energy Strategy

www.cleanegroup.org

www.resilient-power.org

Clean Energy Group

to Meet Severe Weather Threats

September 2014





THE

Meridian Institute





11TH HOUR PROJECT

THE NATHAN CUMMINGS FOUNDATION THE KRESGE FOUNDATION



SURDNA FOUNDATION

Fostering sustainable communities in the United States

Resilient Power Project

- Increase public/private investment in clean, resilient power systems
- Engage city officials to develop resilient power policies/programs
- Protect low-income and vulnerable communities
- Focus on affordable housing and critical public facilities
- Advocate for state and federal supportive policies and programs
- Technical assistance for pre-development costs to help agencies/project developers get deals done
- See <u>www.resilient-power.org</u> for reports, newsletters, webinar recordings



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Resilient Power Project

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CONTACT

Seth Mullendore Project Manager seth@cleanegroup.org (802) 223-2554 x213

The Resilient Power Project, a joint initiative of Clean Energy Group and Meridian Institute, is focused on accelerating market development of resilient, clean energy solutions for affordable housing and critical community facilities in low-income and disadvantaged communities. The Project is targeted to the deployment of solar PV combined with energy storage (solar+storage) - to power essential services during extended power outages and to reduce the economic burden of energy costs in vulnerable communities. The goal is to further clean energy equity by ensuring that all communities have access to the economic, health, and resiliency benefits that solar and energy storage technologies can provide.

Clean Energy Group's role in this process is to inform, coordinate, and assist in the planning and implementation of resilient power projects in underserved communities, in both rural and urban areas, across the country. In addition to providing program guidance to policy makers and technical assistance to developers and community organizations, we also prepare reports and analysis on resilient power programs and projects, clean ---- Passas table and bast smallers

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Tweets by @Resilient_Power



@Resilient Power

Webinar today: American Samoa's Solar+Storage Microgrid, with @solarcity, @EPA, & the American Samoa Power Authority bit.ly/2kO0BUA



Panelists

- Kate Anderson, Senior Engineer and Manager, Engineering and Modeling Group, Integrated Applications Center, National Renewable Energy Laboratory
- Emma Elgqvist, Engineer, Engineering and Modeling Group, Integrated Applications Center, National Renewable Energy Laboratory
- Seth Mullendore, Project Director, Clean Energy Group (Moderator)









REopt Lite: Sizing Solar+Storage for Savings and Resiliency

Kate Anderson, Emma Elgqvist National Renewable Energy Laboratory November 2017

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Optimization • Integration • Automation



- Portfolio prioritization
- Cost to meet goals

- Technology types & sizes
- Optimal operating strategies
- Microgrid dispatch

100%

80%

60%

40%

20%

0%

REOR

• Energy security evaluation



Cost-effective RE at Army bases

Cost-optimal Operating Strategy

Extending Resiliency with RE

Integration and Optimization

REopt Inputs and Output

REOD[†] Integration and
 Optimization



Project Example: Identifying & Prioritizing Projects across a Portfolio

REopt portfolio screening can help:

- Identify & prioritize cost-effective projects to minimize lifecycle cost of energy or achieve net zero
- Estimate cost of meeting renewable energy goals



Sites Evaluated	696
Cost-Effective PV	306
Size	38.79 MW
NPV	\$37 million
RE Generation	64.7 GWh
RE Penetration	10.5 %

🛞 REOP

Integration and Optimization

- Determine economically optimal PV + storage system size & dispatch using:
 - o 15-minute electric load
 - Southern California Edison utility tariff TOU-8
- Results show 12.4 MW PV + 2.4 MW:3.7 MWh storage can provide \$19.3 million NPV
- Battery is only economical when paired with PV at this site due to wide peaks
- Optimal battery dispatch strategy reduces all three demand charges



REC



Savings from Demand Reduction

Integration and

NREL evaluated thousands of random grid outages and durations throughout the year and compared number of hours the site could survive with a diesel generator and fixed fuel supply vs. generator augmented with PV and battery

	<u>Generator</u>	<u>Solar PV</u>	<u>Storage</u>	Lifecycle Cost	<u>Outage</u>
1. Base case	2.5 MW		-	\$20 million	5 days
2. Lowest cost solution	2.5 MW	625 kW	175 kWh	\$19.5 million	6 days
3. Proposed system	2.5 MW	2 MW	500 kWh	\$20 .1million	9 days



REopt Lite Web Tool

- Publicly available beta version of REopt Lite launched September 2017
- Evaluates the economics of grid-connected PV and battery storage at a site
- Allows building owners to identify the system sizes and battery dispatch strategy that minimize their life cycle cost of energy



Step 1: Select Your Technology

Do you want to evaluate PV, battery, or both?



Step 2: Enter Your Data

Enter information about your site and adjust the default values as needed to see your results.

Site and Utility (required)		Θ
		* Required field
* Site loc	Homer, AK, United States	
* Load p	rofile 🕝 💿 Simulated	
	O Custom Load Profile	
* Type of bu	ilding 🛛 Retail Store 🗸	
* Annual energy consumption (kWh) ❷ 116800	
* Electricit	y rate 📀 Homer Electric Assn Inc: Industrial 🗸	
	URDB Rate Details	
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\$ Financial		•
I PV		Ð
Battery		•
Resilience		•

https://reopt.nrel.gov/tool

NATIONAL RENEWABLE ENERGY LABORATORY

Get Results 🕤

	Current Platform Capabilities	Phase 1 Web Tool Capabilities	
Technologies Evaluated	PV, SHW, SVP, Wind, Biomass, LFG, WTE, GSHP, Storage, Conventional reciprocating and combustion turbine generators	PV + Storage	
Sites Evaluated	Multi-site	Single site	
Load Types	Electric, thermal, interval data from actual load profiles or simulated from DOE commercial reference buildings, others for customized analysis	Electric only interval data or simulated from DOE commercial reference buildings	
Rate Tariffs	Blended rates, simple rate tariffs, and custom rates entered by user	Rate tariffs selected from URDB	
Resiliency Analysis	Simple outage analysis or complex stochastic outage modeling	Simple outage analysis	

REODT Integration and
 Optimization

Task	Description
API	Expose API and provide wiki to call model via API
Resiliency	 Expand resiliency analysis Design a system to a specified probability of sustaining a critical load Build up a critical load profile based on equipment components Model existing diesel and PV systems Incorporate the costs of microgrid components and the value of lost load
User data storage	Allow user to retrieve and edit stored inputs for future analysis
Wind	Add wind technology, purchase license for wind dataset
Custom utility rate	Allow user to enter custom utility rate tariff
Report	Downloadable sensitivity analysis report and dispatch strategy
User resources	Training materials and case studies

REODT Integration and
 Optimization

REopt Lite Live Demo

Five Required Site Specific Inputs

Step 2: Enter Your Data

Enter information about your site and adjust the default values as needed to see your results.

Site and Utility (required	ŋ		e
			* Required field
	* Site location 😧	Palmdale, CA, United States	
	* Load profile 😌	Simulated	
		Custom Load Profile	
	* Type of building 😔	Retail Store 🗸	
	* Annual energy consumption (kWh) 😯	500000	
	* Electricity rate 3	Southern California Edison Co: Time of Use, Gene	
		URDB Rate Details	
		Show more inputs	CReset to default values
\$ Financial			€
📲 PV			Ð
📼 Battery			Ð
Resilience			Ð
			Get Results 🖨

Additional Inputs Can Be Edited, Or Left As Defaults



Results Summary Includes System Sizes and Savings

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Results for Your Site

These results from REopt Lite summarize the economic viability of PV and battery storage at your site. You can edit your inputs to see how changes to your energy strategies affect the results.

😔 Edit Inputs





Your recommended solar installation size



Measured in kilowatts (kW) of direct current, this recommended size minimizes the life cycle cost of energy at your site.



Your recommended battery opwer and capacity

17 kW battery power



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



Your potential annual savings

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

\$50,877

?

Results Output – Economics Summary

• The summary table compares the optimal case with the business as usual case.

Results Comparison

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

	Business As Usual 🧿	Optimal Case 🥹	Difference O
PV Size (kW) 🧿	0 kW	218 kW	218 kW
Annualized PV Energy Production (kWh) 💡	0 kWh	386,871 kWh	386,871 kWh
Battery Power (kW) 💡	0 kW	17 kW	17 kW
Battery Capacity (kWh) 💡	0 kWh	22 kWh	22 kWh
DG System Cost (Net CAPEX + O&M) 💡	\$0	\$243,223	\$243,223
Year 1 Utility Energy Payments 💡	\$84,292	\$53,686	\$30,606
Year 1 Utility Demand Payments 💡	\$41,513	\$30,672	\$10,841
Year 1 Energy Supplied From Grid (kWh) 💡	1,000,000 kWh	652,022 kWh	347,978 kWh
Total Utility Energy Cost 💡	\$946,089	\$602,571	\$343,518
Total Utility Demand Cost 💡	\$465,937	\$344,264	\$121,674
Total Lifecycle Energy Cost 💡	\$869,196	\$818,319	\$50,877
Net Present Value 💡	\$0	\$50,877	\$50,877

Download ProForma Spreadsheet

Results Output – Dispatch Graph

- The hourly dispatch graph allows the user to see how the battery and PV systems are operating on an hourly basis.
- The zoom feature allows the user to look at different time periods (full year, month, week, day etc.)



Hourly dispatch for one day

- REopt website: <u>https://reopt.nrel.gov/</u>
- REopt Lite web tool: <u>https://reopt.nrel.gov/tool</u>
- REopt technical report: <u>https://www.nrel.gov/docs/fy17osti/70022.pdf</u>
- REopt fact sheet:

http://www.nrel.gov/docs/fy14osti/62320.pdf

Integration and

Kate Anderson <u>kate.anderson@nrel.gov</u> 303-384-7453

www.nrel.gov



NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Thank you for attending our webinar

Seth Mullendore

Project Director Clean Energy Group <u>Seth@cleanegroup.org</u>

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