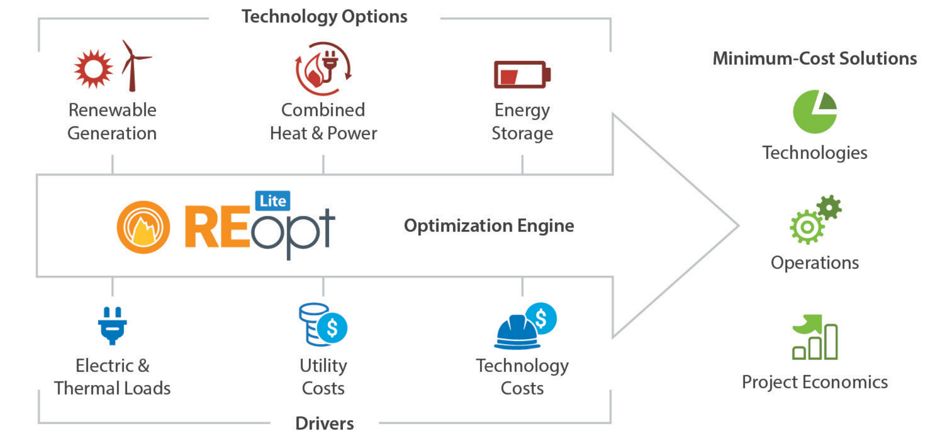
U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY & RENEWABLE ENERGY

Incorporating Combined Heat and Power Modeling into the REopt Lite™ Web Tool



The REopt Lite tool evaluates the economics of grid-connected renewable energy and storage at a site. Recent updates add CHP to the web tool.
Graphic image courtesy of National Renewable Energy Laboratory.

The National Renewable Energy Laboratory (NREL), working with project partners, has extended the U.S. Department of Energy's (DOE's) REopt Lite tool to include combined heat and power (CHP) modeling capabilities.

REopt Lite[1] provides technoeconomic optimization and resilience analysis for grid-connected solar photovoltaics (PV), wind, and battery storage at a site. The recent addition now adds CHP, absorption chillers, and thermal energy storage to the mix. The tool analyzes hourly data across the project lifecycle and evaluates the trade-off between capital costs, operating costs, and savings to find the most cost-effective mix of technologies.

The tool also allows users to identify the system sizes and battery dispatch strategy that minimize a site's life cycle cost of energy, estimating the amount of time a PV, wind, CHP, battery, thermal energy storage, and diesel generator system can sustain the site's critical load during a grid outage. Outputs include recommended technology types and sizes, economics, emissions, and resilience metrics.

Benefits for Our Industry and Our Nation

CHP, also known as cogeneration, produces electricity and thermal energy on-site, replacing or supplementing electricity provided from a local utility and fuel burned in an on-site boiler. CHP systems significantly improve energy efficiency. CHP has been employed for many years, mostly in industrial, large commercial, and institutional applications. CHP systems can use a variety of fuels, both fossil- and renewable-based. CHP systems combined with PV, wind, and/or energy storage components—known as hybrid CHP—can provide additional benefits. Such systems can lead to additional energy and cost savings for end users and increased American competitiveness. Further benefits of hybrid CHP systems can include:

Improved resilience. Renewable generation resources constitute a growing portion of electricity generation, increasing the need for dispatchable generation resources to maintain grid stability. CHP systems provide stable and reliable services that can counter renewables' intermittency—or supplement during a grid outage.

Demand reduction. Hybrid CHP systems excel at counterbalancing peak demand energy usage. This offset both improves power reliability and quality during peak periods and reduces costs associated with time- of-use pricing.

Energy arbitrage. A hybrid system's storage components charge during low-price hours and discharge during times of high price, enabling system operators to reduce energy costs and even sell power back to the utility, helping to offset system costs.

Greater sustainability. Using solar or wind power and CHP from clean, renewable sources allows facilities to meet emissions goals and enhance energy security.

REopt Lite addresses the need for a tool in the public space that stakeholders can use to evaluate the costs and benefits of implementing hybrid CHP systems.

Applications in Our Nation's Industry

The REopt Lite CHP web tool educates customers and informs investment decisions about hybrid CHP systems.

The tool is publicly accessible through an easy-to-use web interface. The model is also accessible through an application programming interface (API), which allows developers to integrate the REopt Lite tool with other models and enable scripted modeling to execute complex analyses. Furthermore, the open source code enables developers to add new capabilities and adapt the model to their needs.

The REopt Lite CHP tool enables a broad range of users to make informed decisions about their facilities' energy future. The tool enhances the mission of the U.S. Department of Energy's CHP Technical Assistance Partnerships (CHP TAPs)[2] to offer fact-based, non-biased engineering support to manufacturing, commercial, institutional, and federal facilities and campuses. The CHP TAPs and end users can use the new tool to screen for CHP opportunities.

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1 REopt Lite: *https://reopt.nrel.gov/tool*

2 CHP TAPs: *www.energy.gov/chptap*

Model Description

DOE's Federal Energy Management Program and Solar Energy Technologies Office support development of REopt Lite, to provide technoeconomic optimization and resilience analysis for integrated PV, wind, and energy storage systems. DOE's Advanced Manufacturing Office has extended the model to include detailed CHP modeling and integration with other CHP resources, enabling building owners, industry representatives, and researchers to identify the conditions, optimal system sizes, and dispatch strategies that maximize the economic benefit of hybrid CHP systems.

The model considers all common CHP prime movers (reciprocating engines, combustion turbines, fuel cells, microturbines, and steam turbines), multiple potential fuel sources, PV, wind, absorption cooling, and electric and thermal energy storage including batteries, chilled water storage, and hot water thermal energy storage.

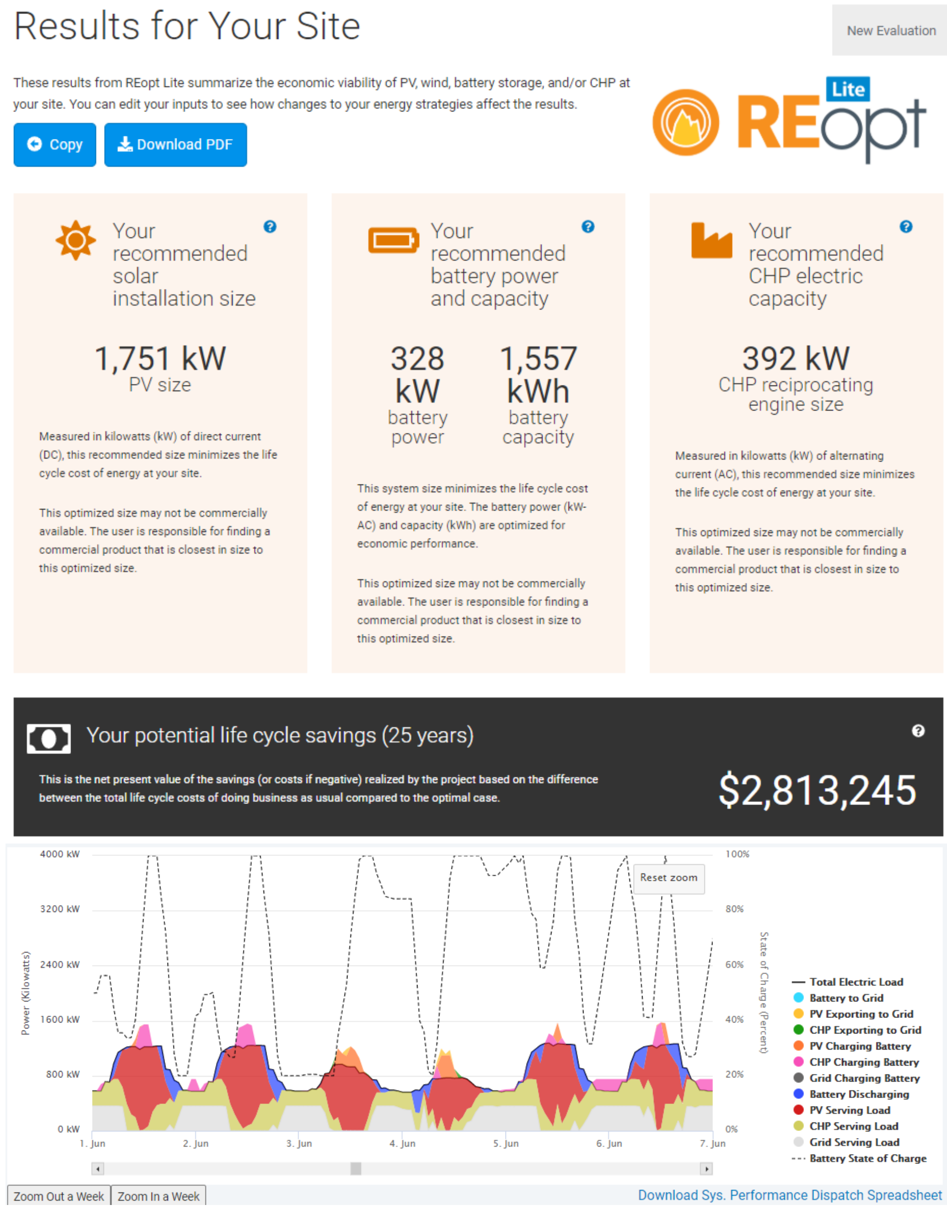
For each user, the REopt Lite CHP tool provides results specific to the site. The model identifies an optimal hybrid CHP system size and operating strategy to maximize economic benefits while meeting energy, emissions, and resilience goals—such as sustaining critical loads during a grid outage.

Overcoming Barriers

U.S. facilities have been slow to install hybrid CHP systems. One constraint to their widescale adoption is a lack of understanding of how CHP project economics, technical configuration options, and potential resilience benefits can change when integrated with other distributed energy resources.

The expanded REopt Lite now provides accurate and rapid modeling results for a wide range of CHP options in a user-friendly web interface and API. The project team will work in partnership with the CHP TAPs to encourage the enhanced tool's wide dissemination, use, and integration with other industry models. By identifying hybrid CHP opportunities, the model will expand awareness of system benefits and catalyze adoption.

This project can ultimately lead to increased resilience of U.S. facilities and campuses, improved economic competitiveness and energy productivity across industries, and better support for overall grid operations.



REopt Lite recommends hybrid CHP system sizes and dispatch strategies to minimize the lifecycle cost of energy to a site. *Graphic image courtesy of NREL.*

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