



Evaluating Behind-the-Meter Energy Storage Systems with NREL's System Advisor Model

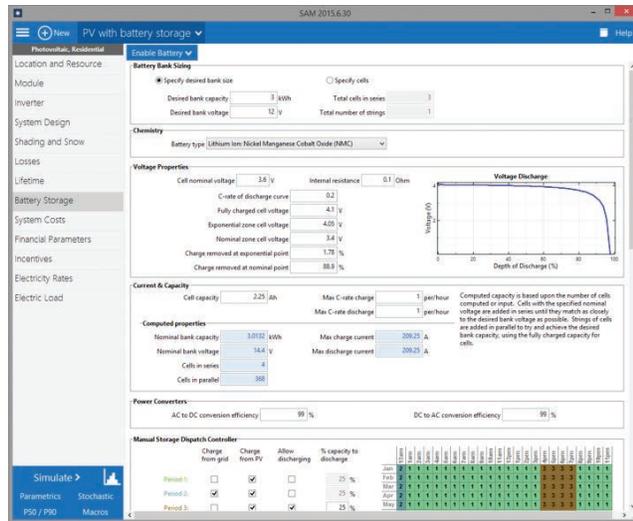
A new model helps companies assess the performance and economic effects of integrating battery energy storage systems into the electric grid.

The Challenge

Battery energy storage is a key enabling technology for the integration of large amounts of solar generation onto the electric distribution system. With an 80% drop in battery prices in the last six years and new mandates for energy storage solutions in California and elsewhere, interest in understanding how to cost-effectively integrate battery energy storage into the electric grid has grown tremendously. However, modeling the behavior of energy storage is often very complex given the interplay among short- and long-term battery performance and degradation, solar generation, complex utility tariff structures, incentives, and costs. With the advent of new cutting-edge energy storage models developed in NREL's free System Advisor Model (SAM) software, detailed questions about energy storage systems can now be approached and evaluated holistically.

Our Solution

NREL's SAM team, in conjunction with energy storage experts from NREL's Energy Systems Integration team, developed a detailed PV-coupled battery energy storage model that can accurately predict the voltage, capacity, thermal, and long-term degradation behavior of lead acid and lithium-ion battery systems. Leveraging SAM's built-in detailed photovoltaic models and comprehensive financial models, with the addition of a feature to run the model at one-minute timesteps throughout the 30-year potential lifetime of a system, users can now evaluate both performance issues as well as the resulting economic viability of behind-the-meter energy storage. Complex issues such as battery replacement costs incurred due to heavy cycling are fully captured in the model at a level of detail not previously possible with other optimization tools. The NREL ESI team validated the model against measured test data for two different typical battery systems, demonstrating very good agreement across numerous metrics and scenarios.



Screenshot of NREL's SAM PV+battery model, Version 2015.6.30.

The Impact

The SAM PV+battery model is a first-of-a-kind solution for holistically evaluating battery energy systems on a project basis. Beyond NREL's own studies of battery economics, the new model is being actively used by numerous companies and organizations to assess potential battery systems, including Black and Veatch, NRECA, and others. As the market potential for battery energy storage grows, the broad analysis capabilities of SAM will be indispensable to both startup companies and mature players that both have a need to consistently and credibly evaluate possible battery energy solutions.

For More Information

Visit sam.nrel.gov to learn more about the System Advisor Model, or contact Nicholas A. DiOrio, nicholas.diorio@nrel.gov.

References

Battery Storage for Photovoltaic Systems (recorded webinar). sam.nrel.gov/node/69635

DiOrio, N.; Dobos, A.; Janzou, S. (2015). *Economic Analysis Case Studies of Battery Energy Storage with SAM*. NREL/TP-6A20-64987. www.nrel.gov/docs/fy16osti/64987.pdf

DiOrio, N.; Dobos, A.; Janzou, S.; Nelson, A.; Lundstrom, B. (2015). *Technoeconomic Modeling of Battery Energy Storage in SAM*. NREL/TP-6A20-64641. www.nrel.gov/docs/fy15osti/64641.pdf

National Renewable Energy Laboratory

15013 Denver West Parkway • Golden, CO 80401 • 303-275-3000 • www.nrel.gov
 NREL/FS-5D00-65729 • January 2016
 NREL prints on paper that contains recycled content.