USE CASE – FEASIBILITY STUDY HIGHLIGHTS

Financial impact of adding energy storage to a utility-scale photovoltaic solar system

HOMER Front

Challenge

A California-based developer wants to evaluate the revenue and impact of adding energy storage to a photovoltaic (PV) solar plant.

The developer needs to determine if adding energy storage to the solar plant will increase annual revenue and return on investment (ROI) and serve the load requirements of the plant's utility offtaker.

The utility offtaker needs to meet expected electrical demands and fulfill its commitments to greenhouse gas (GHG) emission reduction and renewable energy resources.

The project will participate in the California Independent System Operator (ISO) day-ahead and real-time energy wholesale and resource adequacy markets.

With the addition of storage, the offtaker will agree to a Capacity Services Agreement (CSA). The CSA allows the offtaker to use stored energy to meet resource adequacy (RA) requirements while allowing the developer to market excess capacity.

The developer must determine if additional revenues from the energy storage system are enough to offset the added costs of developing, installing, operating and maintaining the energy storage system.

Solution

UL conducted a feasibility study using HOMER® Front modeling software to analyze the financial impact of solar-plus-storage.

The team modeled participation in the wholesale energy markets using hourly and sub-hourly locational marginal pricing from a node within a primary North-South transmission line in California. The model also included a 2020 RA network event schedule in California ISO markets.

Analysis included solar resource generation data, battery operation, energy and capacity revenue and the financial impacts of construction costs. The analysis also evaluated ongoing operation and maintenance, including energy storage capacity degradation, augmentation and replacement strategies to determine the internal rate of return (IRR).

Impact

UL conducted an analysis with HOMER Front, providing the developer with expected financial results for a solar-plus-storage system.

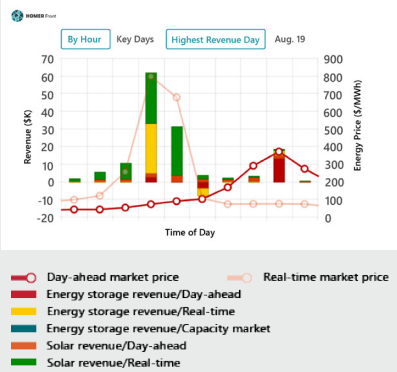
Financial results

- Initial equity investment – $104 million
- 20-year internal rate of return – 7.8%
- Payback – 13 years

$	Year-one revenue
6.9M	Resource adequacy – capacity
2.4M	Resource Adequacy – day-ahead
2.4M	Day-ahead energy market
2.6M	Real-time energy market

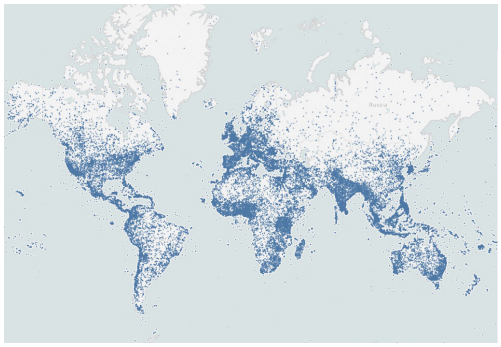
Project	Location	Technologies modeled	Revenue services
PV solar + energy storage	Northern California, U.S.	PV 100 MW Storage: 100 MW/400 MWh	Time of delivery Day-ahead Real time Resource adequacy

Sample screenshots of the results of HOMER Front analysis.



The graph above illustrates revenue stacking and wholesale energy price results.

HOMER Front results show solar and storage integration with simulated operation or charge and discharge cycles.



Map shows locations of 250,000+ project calculations in 190+ countries performed by users of HOMER software.

Proposed solar and storage system inputs	
Location	Northern California
Interconnection limit	100 MW
PV size	100 MW
ESS size	100 MW/400 MWh
ESS capacity degradation	2.0%/year, 100% DoD, 1 cycle/day
Battery characterization	Advanced storage model, lithium iron phosphate (LFP)
Power conversion electronics	DC-coupled
Solar resource model	Full-diligence energy production report (EPR)
System CAPEX	$194.6M, turnkey – Includes generation equipment, balance of plant, development fees, interconnection, extended warranty, financing
Location marginal price	NP-15, 2020
Resource adequacy	Back-casted settlement, four-hour duration
Revenue streams	Energy wholesale, including day-ahead energy, real-time energy, resource adequacy (capacity) markets
Financial parameters	Discount rate: 8% State tax rate: 8.25% Federal tax rate: 21% ITC: 26% Other – MACRS, bonus depreciation
CAPEX assumptions	PV: $0.80/$W_{DC}$ Storage: $290/$kWh_{DC}$
OPEX assumptions	PV – $6.64/$kW_{DC}$/year Storage – $12.08/$kWh_{DC}$/year

UL modeled numerous factors to determine the optimal size and configuration of the Battery Energy Storage System (BESS), co-located with on-site solar generation. HOMER Front's optimization algorithm finds the most effective dispatch strategy to charge the battery for planned participation in the wholesale energy and capacity markets. The software also considers system interconnection, a critical factor that sets a hard limit on the power exported to the grid, which may limit revenue.

Why UL and HOMER Front are right for you

We leverage our expertise in engineering in combination with HOMER software's unmatched energy storage modeling. The combination delivers accurate modeling, design, economic evaluation and optimization.

Capabilities include market and regulatory assessment, project and site evaluation and business model technical design and analysis.

To request the full feasibility study and for more information, visit homerenergy.com.

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