Ensuring Accurate Valuations:
BatterySIMM Revenue Forecast Validation

By Michael Fisher, PhD, Senior Manager of Portfolio Analytics &
Margot Genereux, Energy Analyst

Ascend Analytics has guided and supported over 100 project financings and M&A transactions for energy storage and hybrid assets since 2020. The valuations produced by Ascend's long-term forecasting and valuation tool, BatterySIMM, are accepted by development, banking, and finance institutions worldwide because they can trust that our forecasts have been validated by real-world experience. This experience is developed in another Ascend product offering - SmartBidder - that provides live bid optimization for operational assets. This paper will compare results from the SmartBidder live operations product and the BatterySIMM long-term valuation product.

BatterySIMM & SmartBidder Product Overview

The BatterySIMM and SmartBidder products play pivotal roles within Ascend's product ecosystem, centered on maximizing the value of storage and renewable assets. BatterySIMM focuses on long-term forecasting and valuation for development-stage and operational energy-storage assets. Utilizing Ascend's 20+ year nodal sub-hourly price forecasts developed by our Market Intelligence team, the software determines the value of storage at specific locations by performing complete dispatch simulations. Within these simulations, market selection decisions (Day-Ahead (DA)/ Real-Time (RT) Energy and Ancillaries), round-trip efficiencies, charging/discharging constraints, cycling limits, and expected degradation and augmentation schedules are all configurable parameters. BatterySIMM dispatch simulations respect the physical limitations of each project while adhering to ISO market rules and conditions. SmartBidder offers a platform for live asset operations, allowing custom bid optimization based on an owner's unique risk/return requirements. This product considers the same physical and market constraints as BatterySIMM but is highly tuned for short-term forecasting and includes more sophisticated market participation strategies. SmartBidder currently provides operational decision making for over 6 GW of storage across the U.S.

A Look Under the Hood: What's Different About BatterySIMM and SmartBidder

In order to create a fair comparison between BatterySIMM and SmartBidder, it is important to first understand how their dispatch and revenue estimation methodologies differ. Both products follow market rules and try to maximize revenue, but their approach to simulating imperfect knowledge of future prices is different. BatterySIMM approximates the real-world by introducing month-hour rules (setting decisions on energy vs. ancillary participation that are fixed within a given month) and costless adders (setting minimum price hurdles for energy arbitrage) to simulate the difficulty of predicting price action within a multi-day window. SmartBidder exerts more computational intensity by simulating actual short-term forecasts under imperfect foresight that are not constrained by month-hour rules or static costless adders. SmartBidder's dispatch strategies are also more nuanced, dynamically adjusting real-time bids to capture ancillary and energy value as market conditions evolve. **Table 1** overleaf highlights and differentiates the features of each product.

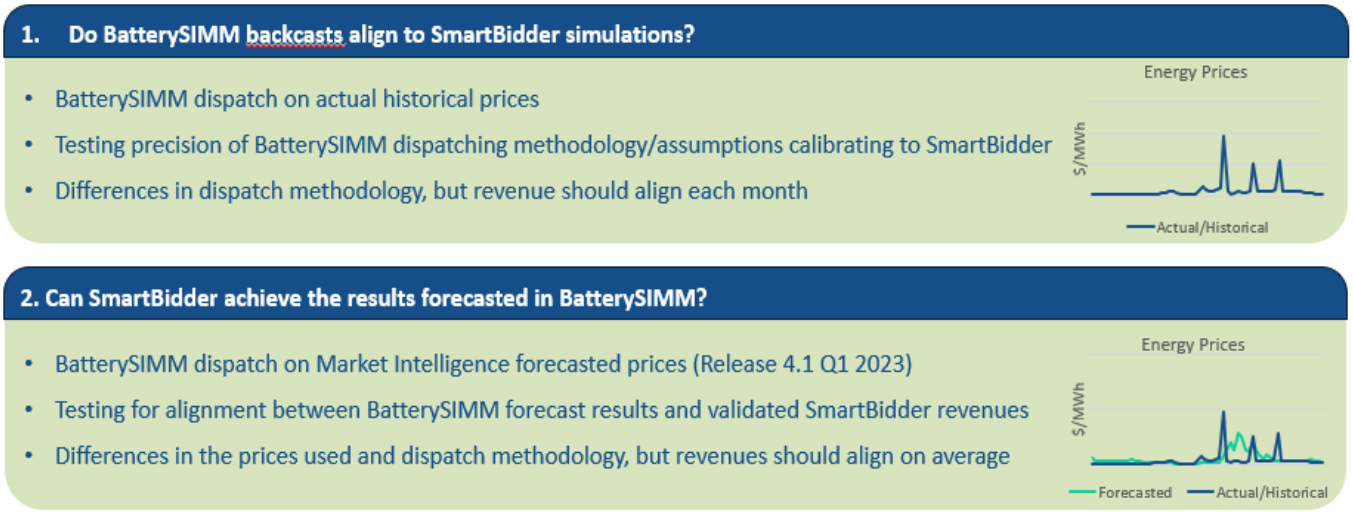
Table 1: BatterySIMM & SmartBidder Features

	BatterySIMM™	SmartBidder™
Use Case	Long-term BESS asset valuation	Short-Term BESS bid optimization
Forecast Length	20+ years	Day-Ahead: 1 day Real-Time: 16 hours
Price Forecast Methodology	Ascend Market Intelligence 20+ year deterministic market view of energy & ancillary prices	Mosaic of models generating probabilistic forecasts for nodal energy and ancillary prices, DA-RT price spreads, and RT spike events
Dispatch Foresight Management	Approximates imperfect foresight with fixed month-hour participation rules across market products and a Costless Adder	Entirely blind to future market conditions (e.g., prices and expected ancillary energy throughput)
Runtime for 1 Year of Dispatch Simulation	~10 minutes	~1 day
Time Granularity	5-minute	
Physical Constraints	BESS capacity, duration, round-trip efficiencies, cycling limits, VOM costs, SOC management, product participation mix	
Market Constraints	Adheres to ISO rules	

Head-to-Head Comparison

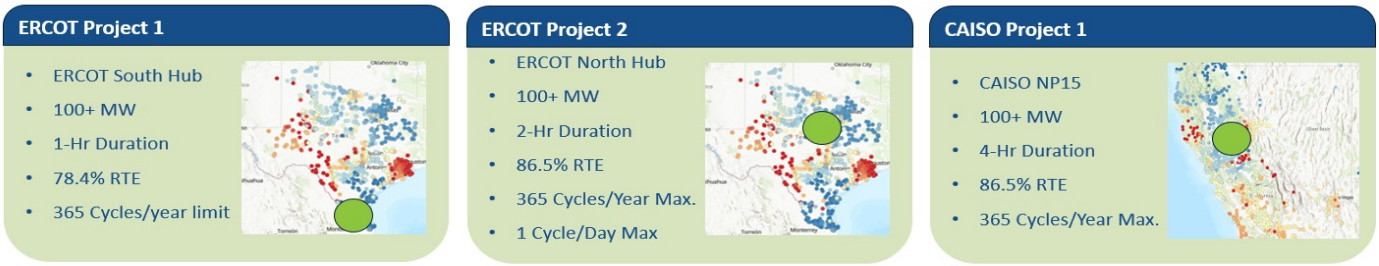
For the purpose of this validation exercise, we employed two different comparison methods to evaluate if: 1. BatterySIMM's algorithms are a realistic representation of SmartBidder's actual foresight ability *and* revenue capture, and 2. if the forecasted prices and algorithms used in BatterySIMM valuations combine to produce realistic results. These comparison methods are highlighted in **Figure 1** below. The principal difference between the methods is the use of actual historical prices in method 1, versus forecasted prices for BatterySIMM results in method 2.

Figure 1. Comparison Methodologies Employed



Ascend conducted these comparisons on 3 BESS projects, one in ERCOT South, ERCOT North, and CAISO NP15. CAISO and ERCOT were selected because these regions represent the majority of merchant storage installations nationwide. Project specifications are shown in **Figure 2** below. Ascend typically produces a Low, Base and High simulation case in BatterySIMM to provide an expected range of ability to capture price action. These cases were compared with a SmartBidder dispatch to show how well real-world results align to BatterySIMM's ranges. The difference between the BatterySIMM low/base/high cases lie in differing dispatch strategies and foresight. The Low case represents conservative BESS operations participating in RT energy arbitrage only with imperfect foresight, the Base case allows revenue stacking of energy arbitrage and ancillary market participation but with imperfect decision-making over which product to sell, while the High case serves as an upper-bound with near perfect foresight where the BESS co-optimizes between RT energy arbitrage and DA ancillary participation.

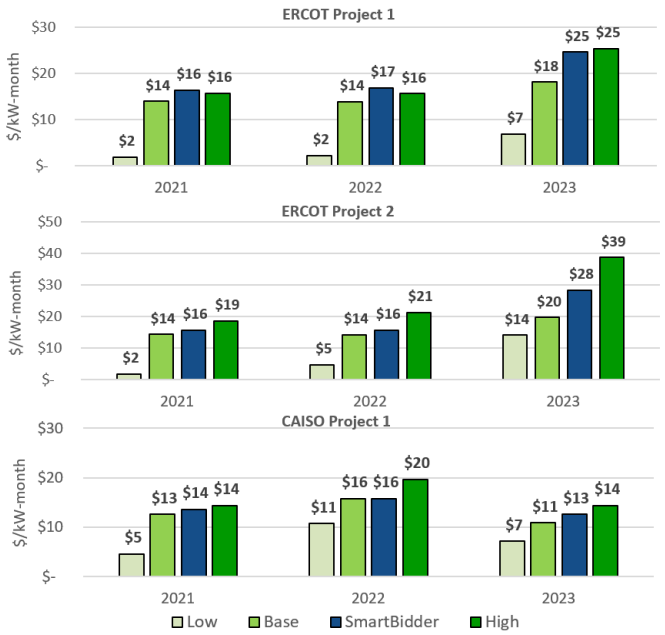
Figure 2. Project Locations and Specifications



Method 1 Results: Do BatterySIMM Backcasts Align to SmartBidder Simulations?

We ran dispatch simulations on actual historical prices from the trailing 24 months (September 2021 to August 2023) to compare them to SmartBidder results on the same prices and timeline. **Figure 3** (right) shows the average monthly merchant revenues (in $/kW-month) of all three projects. The comparison shows that BatterySIMM's dispatch model produces realistic revenues when compared to SmartBidder results. SmartBidder's consistent outperformance of BatterySIMM's base case points to a level of conservatism that Ascend has built into our 20+ year asset valuations. This outperformance is on average 23%, 24%, and 8% for ERCOT Project 1, 2, and CAISO Project 1 respectively.

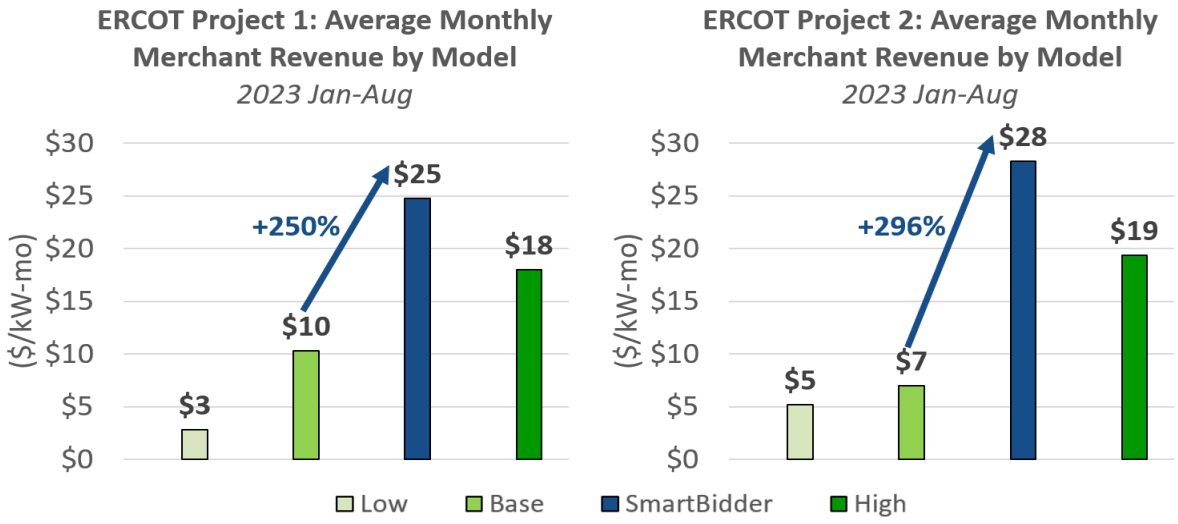
Figure 3. Average Monthly Merchant Revenue of Trailing 24-Month Backcasts: Sept 2021 - August 2023. The average outperformance of SmartBidder over BatterySIMM base case is 23% and 8% for ERCOT and CAISO, respectively.



Method 2 Results: Can SmartBidder achieve the results forecasted in BatterySIMM?

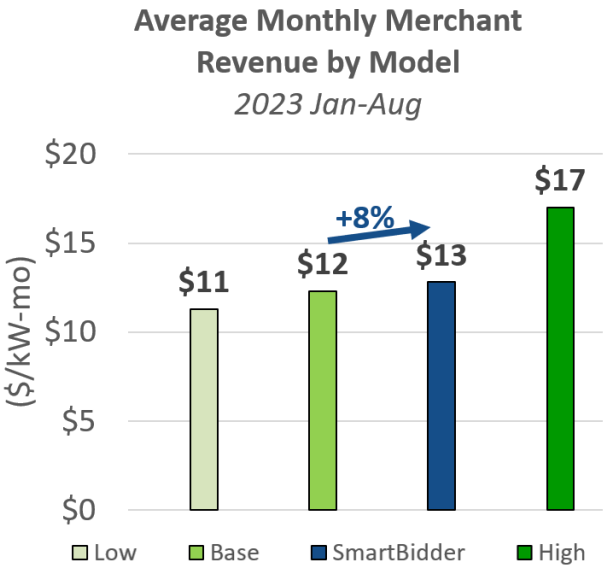
We also ran BatterySIMM dispatches from January 2023 to August 2023 using nodal price forecasts from Market Intelligence's ERCOT 4.1 and CAISO 4.1 market views released in Q1 2023 adjusted for changes in the underlying gas forward curves. **Figure 4** below shows the comparison to SmartBidder revenues on actual prices over the same timeframe - SmartBidder significantly outperformed BatterySIMM's base case by 250% and 296% for ERCOT Project 1 and 2 respectively. SmartBidder revenues benefitted from the high volatility in ERCOT in August; this month accounts for 63% and 75% of SmartBidder's year-to-date revenue. Excluding August, SmartBidder still outperformed BatterySIMM's base case by 22% and 23% respectively.

Figure 4: ERCOT Projects 1 and 2: Results of Comparison Method 2. SmartBidder's significant outperformance is related to August's extreme volatility. Excluding August, SmartBidder still outperforms the BatterySIMM base case by approximately 22%



For the CAISO project, SmartBidder results land between BatterySIMM's Base and High case, with an 8% premium on the Base case as shown in **Figure 5** on right. The relative outperformance of SmartBidder over BatterySIMM in ERCOT vs CAISO this year can be attributed to weather conditions and the way markets are operated. The heat wave and record peak load in ERCOT led to significant volatility capture by SmartBidder. CAISO, on the other hand, tends to over-procure resources in the DA market which leads to RT volatility suppression. Nevertheless, all three project locations show SmartBidder outperformance relative to BatterySIMM's base case.

Figure 5: CAISO Project 1: Results of Comparison Method 2



Results You Can Trust in a Dynamic Market Environment

This comparison exercise has validated the reliability of Ascend's long-term revenue forecasts produced by the BatterySIMM tool. Built from our industry-leading Market Intelligence price forecasts at the nodal level, and calibrated to the real-world with SmartBidder results from live operations, BatterySIMM's forecasts have been trusted in billions of dollars of transactions from both buy and sell-side parties. The conservative bias of BatterySIMM's base case results gives developers, lenders, and investors confidence that our forecasts are achievable under uncertain market outcomes. Looking to the future, SmartBidder allows us to continuously monitor changes in market conditions, dispatch strategy performance, and risk metrics, ensuring that BatterySIMM forecasts are calibrated appropriately as market conditions evolve.