How AI-Driven Software and Hybrid Assets Drive Higher Utilization for Existing Energy Infrastructure

OVERVIEW

Much like the rest of the US, the Pacific Northwest is facing constraints with power transmission infrastructure capacity. Available transmission capacity is scarce and underutilized transmission rights are a loss for both power companies and ratepayers.

The intermittent nature of renewable energy resources limits the capacity factor of individual solar or wind plants. BrightNight believes significant and urgently needed transmission capacity can be unlocked by increasing the utilization of existing transmission lines and interconnection infrastructure, hybridizing generation resources, and incorporating energy storage to optimize power delivery. The state-of-the-art solution optimization software PowerAlpha® is utilized to maximize value attainable for projects with shared interconnection capacities.

THE CHALLENGE

When a power generation project consistently operates at its full capacity throughout the year, its capacity factor reaches 100%. However, this level of consistency is unattainable with renewable energy sources due to their variable and intermittent nature – there is no solar overnight and the wind doesn't always blow. Most renewable projects usually score below 35% capacity factor (calculated as the total production over a one-year period divided by the total capacity of the interconnection point). Despite the intermittent nature of both solar and wind resources, there are inherent patterns in their generation that offer varying degrees of complementarity depending on the region. For instance, while the sun shines during the day, wind tends to ramp up during evening and overnight hours. By strategically combining these two assets along with optimized capacity of energy storage, it becomes possible to deliver power in a much more predictable manner.

Optimization of hybridized renewable generation assets like solar-wind or solar-hydro is critical in leveraging underutilized transmission infrastructure and unlocking more predictable renewable power when and where it is needed.

THE POWERALPHA® SOLUTION

In various markets across the country, especially in regions with constrained transmission, BrightNight is developing hybrid solar and energy storage projects behind existing hydroelectric, wind, or thermal project interconnections. By planning around shared utilization of existing power infrastructure facilities and utilizing surplus interconnection capacities, capacity factors can be increased significantly.

For example, in Oregon, the state's largest utility has been operating a wind facility with an installed capacity of more than 400MW and producing power since 2007. BrightNight's solar and energy storage project is positioned strategically near the existing wind farm, enabling joint utilization of the interconnection capacity owned by the wind project. Another notable example involves a BrightNight project in Oregon where solar and energy storage assets are integrated with an existing hydroelectric facility.

Colocation of multiple resources not only saves costs and accelerates timelines by using existing infrastructure, but it also greatly improves the utilization of transmission rights in a region where that capacity is in high demand. Through this joint transmission utilization, power can be transmitted from where it's produced to where the load is, using the existing projects' reserved transmission capacity, which has only been utilized on average 27% of the time historically.

AI-driven data analytics by BrightNight's proprietary software platform, PowerAlpha, is used to run millions of simulations to design the optimum configuration for collocating a new solar and energy storage project with existing wind, hydro, or thermal facilities across the country.

HOW POWERALPHA FINDS THE UNIQUE SOLUTION

Using AI and highly scalable computations, PowerAlpha analyzes a very large space of existing facilities to find underutilized capacities and proposes possible co-location projects that could co-utilize existing interconnection capacities. Additionally, it proposes possible configurations of renewable resources and storage options to optimize the hybrid project for generation and transmission. These configurations explore such variables as the amount of land required, the types of PV modules and the capacity of the accompanying batteries. PowerAlpha analyzes these variables to arrive at the configuration that will maximize the net value of this hybrid project for the customer.

Understanding the statistical distribution of generation patterns including rare but impactful extreme weather events is crucial in designing projects that share interconnection infrastructure. That is why PowerAlpha conducts analyses using long spans of historical weather data to estimate solar and wind production and their implied uncertainties. Such multi-year analysis allows for capturing year-to-year variabilities, extreme weather events, capacity shortfalls, and other low-probability events.

In addition to long-term weather analysis, PowerAlpha performs highly granular simulations. While the industry standard for time granularity in renewable asset investment and planning models is hourly, PowerAlpha's simulations run at minute-level granularity. This enhanced granularity improves modeling accuracy, enabling better capturing sub-hourly variations and their impact on battery operation patterns and energy curtailment.

THE POWERALPHA RESULTS

Following a rigorous modeling approach using the AI-driven PowerAlpha modeling platform, BrightNight has sized solar and storage assets that best complement the existing facilities and add the highest overall project value. Additionally, the minute-level modeling granularity has enabled up to 0.5% improvement in the accuracy of monthly production estimates. This will amount to de-risking of about $8 million cash flows over the project's lifetime. Moreover, the presence of as much as 40% variation from the median monthly power production indicates the importance of capturing variability via long-term modeling. If such variability goes unchecked and sufficient energy storage capacity is not available to capture the deviations, as much as 10% of a month's revenues could be at risk. Overall, PowerAlpha results for a surplus interconnection project demonstrate

- as much as **$70 million in increased value to the ratepayers over the life of the project**
- Through optimized colocation of renewable generating assets and by integration of 250MW of solar PV and battery energy storage system to the existing wind facility, **transmission utilization and net annual capacity factor increase by as much as 46% (from 28% to 41%).**
- **De-risking of about $8 million cash flows** over the project's lifetime through time-granular modeling

PowerAlpha is built on strong optimization solvers which use scalable computation to run many scenarios in parallel. BrightNight has spent more than five years developing PowerAlpha™ in-house, developed by experts with deep understanding of renewable power, mathematical optimization, and financial modeling.

PowerAlpha brings the intelligence to enhance the utilization of highly valuable grid infrastructure and deliver affordable reliable power when it's needed.

BRIGHTNIGHT
Power when you need it