PowerAlpha® Intelligently delivering reliable, renewable power... when you need it.

- Saves millions of $'s
- Creates more accurate and predictable outcomes
- Reduces time periods from months to hours
- Generates better returns
- Leverages more comprehensive data sets

THE TRILLION-DOLLAR PROBLEM

The International Renewable Energy Agency (IRENA) has projected that renewable energy has the potential to supply 90 percent of global electricity by 2050.

Achieving this goal and reaching net-zero emissions within the same timeframe would necessitate an annual investment of approximately $4 trillion in renewable energy technologies and related infrastructure until 2030. With this monumental growth, renewable energy projects development business has become an intensely competitive space. Renewable projects are inherently complex and have a multi-decade project lifecycle, making them especially sensitive to project assumptions made over the lifecycle of the project.

Understanding the implications of project assumptions and closely monitoring the real-time performance, while also considering the risks involved, can significantly enhance decision-making at every phase of project development. This approach is key to paving the way for a renewable project's overall profitability.

Traditionally, renewable project developers have relied on off-the-shelf project performance modeling tools or third-party consulting firms for evaluating projects. Industry standard tools such as PVSyst, or a host of hybrid renewable modeling tools can evaluate the technical performance of renewable projects with cursory attention to economic evaluation over the long-term.

These tools are also typically specialize in either generation or storage technologies and have the basic ability to propose a hybridized solution for customer needs. Adding to the complexity is aligning these tools with guidance provided by power flow and production cost models: the challenge of identifying a winning solution becomes piecewise and less accurate over long-term.

BRIGHTNIGHT
Power when you need it

A conventional renewable development workflow uses the technical performance results by financial analysts to evaluate the economic impact of decisions taken during project development. Due to the disconnected nature of this approach, these traditional methods are fundamentally inadequate to capture the complexity of renewable projects by limiting their ability to rapidly evaluate decisions in the levelized cost of energy (LCOE), levelized cost of storage (LCOS), or other financial variables of interest (referred to as LCOx combined here onwards).

In a fragmented landscape of solutions aimed at tackling the complexity of building hybrid power solutions, PowerAlpha emerges as a transformative one-stop fully integrated solution. Developed by BrightNight, this proprietary patent-pending software platform revolutionizes the design, optimization, and operation of hybrid renewable power projects. Leveraging advanced engineering and the latest software capabilities with a full-blown, integrated financial model, PowerAlpha addresses a critical challenge in renewable energy: the alignment of fluctuating energy production with the dynamic demands of the power grid.

With tight integration with industry leading production cost models, PowerAlpha considers comprehensive customer needs and the customer's broader portfolio, transmission systems constraints, and evolving power demands. Using state of the art AI-powered optimization techniques, it identifies the size, configuration, and suitable energy storage technology to couple with the generation assets. PowerAlpha simulates different design possibilities at scale - up to millions of iterations - with an integrated financial model, identifying the best design that maximizes project returns for best-in-class LCOx.

During the operation of the asset, PowerAlpha utilizes digital twin technology to revolutionize hybrid asset dispatch and operations. Through continuous diagnostics and predictive analytics driven by machine learning, PowerAlpha delivers actionable insights to optimize asset performance, ensuring maximum efficiency. Additionally, PowerAlpha optimizes economic dispatch, seamlessly shifting power in hybrid plants as needed to maximize revenue streams. With its ingrained DNA of always focusing on a project lifetime value, PowerAlpha solves the complex puzzle of building the best power solutions for our customers, at best-in-class costs.

1 Levelized Cost of "x" s the levelized cost of generating each unit of end product (X). It factors in all project related costs on a net present value basis (capital expenses, operating costs, financing costs) in order to compare the cost of generating "X" across competing technologies, configurations, and use cases

POWERALPHA BENEFITS

PowerAlpha creates value over the lifetime of a renewable power solution with three key value drivers:

DESIGN hybrid renewable power projects to build a portfolio solution for lowest cost and maximum return.

OPTIMIZE generation and storage assets to customize the power solution for customer's unique needs and its broader portfolio.

OPERATE the power solution, managing hybrid renewable assets for minimizing downtime risks and making dispatch decisions for firm power.

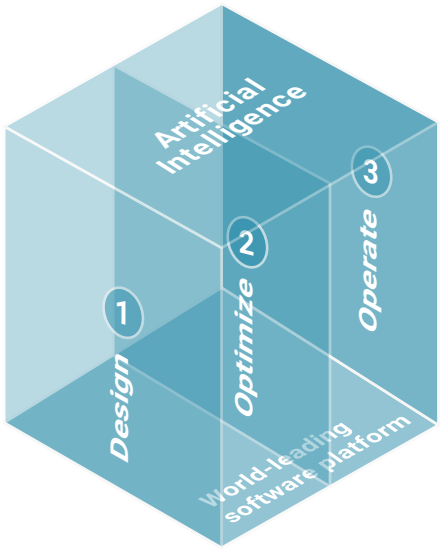

Figure 1 *PowerAlpha: AI-powered platform for renewable power solutions*

DESIGN

Specifically designed for utility and commercial & industrial (C&I) customers, PowerAlpha selects the most advantageous land and components, and makes system design choices that maximize lifetime performance. This meticulous approach results in solar and hybrid power projects that result in the best-in-class LCOx, setting a new standard in the industry.

In an integrated approach to renewable energy project development, the selection of critical resources, such as land with the highest net gain to project returns, is paramount. This process extends to optimizing solar photovoltaic (PV) plant designs, considering a multitude of factors including ground coverage ratio (GCR), inverter loading ratio (ILR), and DC/AC ratio, to achieve a project blueprint primed for pricing. Similarly, the design of Energy Storage Systems (ESS) is refined across a multitude of parameters like overbuild capacity, choice of equipment, augmentation schedules, facilitating precise final pricing and technology selection. This approach also encompasses hybrid PV+ESS plant designs, tailored across various design parameters to ensure an optimal mix of performance and cost-effectiveness. Extending beyond solar and ESS, the approach adapts to include other renewable generation and storage technologies like wind and hydrogen, showcasing a comprehensive commitment to maximizing efficiency and sustainability across the renewable energy technology spectrum.

CASE STUDY

Using GIS integration to select and utilize land

PowerAlpha's advanced integration with Geospatial information systems (GIS) tackles the challenging problem of identifying the best land for a project by calculating lifetime economic potential of the land with the help of a proprietary Land Score calculator. It's a representative score of value created per unit area of land that considers the usability of the land and energy generation potential (figure 1), generating layout of solar arrays (figure 2). Furthermore, having digital recordkeeping of land parcels sets the blueprint for creating a digital twin of the power plant for cross-functional collaboration and managing assets during operations (figure 3). Using such quantitative insights to perfect design can decrease project risk in early stages and boost the project returns, ensuring best-in-class LCOx.

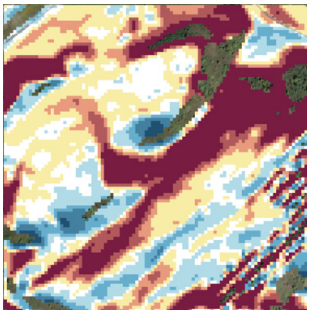

Figure 2 *Energy generation potential of land (blue -> red scale indicates gain to loss against reference)*

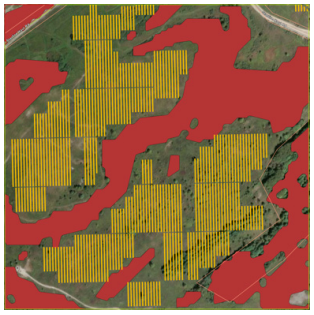

Figure 3 *Land score generating solar array layouts*

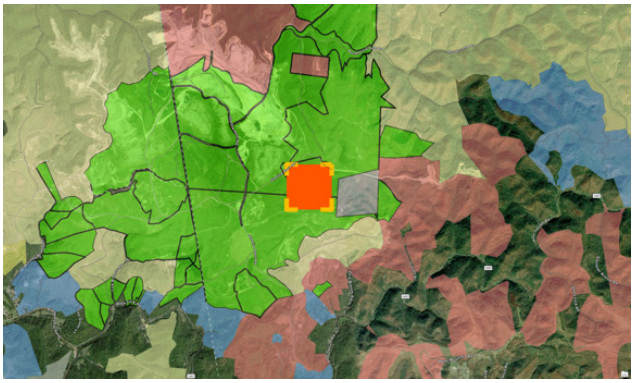

Figure 4 *Land parcels management*

CASE STUDY

PowerAlpha shows that choosing design parameters based on project lifetime economics leads to best-in-class LCOE

Integration of a detailed financial model (FIMO) with technical performance models sets PowerAlpha apart with its ability to focus on project lifetime economics. Every design iteration is evaluated through the lens of LCOx and target project returns, capturing maximum value for the stakeholders.

Figure 5 shows an example of a typical solar project for which the PowerAlpha approach sensitizes the project LCOx using a full project lifetime discounted cash flow financial model ("LCOE with FIMO") whereas the conventional approach uses project costs per kWh generated as a simple levelized cost of energy (LCOE). Comparing the two approaches, the design space can be dramatically different based on project specifics such as the location of the project, choice of opting for Production tax credits (PTC) vs. Investment Tax credits (ITC).

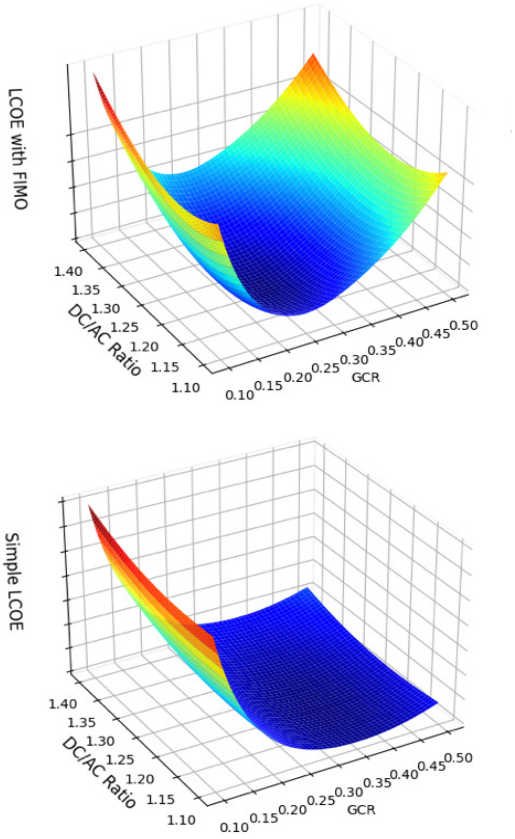

Figure 5 *PowerAlpha makes design decisions based on lifetime economics*

Choosing PV GCR for lowest LCOE

Ground Coverage Ratio (GCR) is a prominent PV design parameter representing ratio of surface area of PV modules to ground area required to install them. Lower GCR increases the spacing between tracker rows and increases the rotational limits of the trackers, resulting a greater net annual energy production. Conversely, greater GCR decreases the spacing between tracker rows and decreases the rotational limits of the trackers, resulting in less net annual energy production. This creates a project trade off in which lowering the GCR to achieve greater annual energy production is counterbalanced by the increased cost and logistics of additional land consumption. Depending on the project's choice of opting in for a Production Tax Credit (PTC) vs. Investment Tax Credit (ITC) for tax incentives, implications of this trade off can dramatically change the ideal GCR for the project's lifetime economics. PowerAlpha's design suite finds the ideal GCR for the project evaluating this trade off in lifetime economic impact, resulting in up to 2% LCOE reduction for the project over conventional simple LCOE method and concludes that as a result, choosing PTC is up to 1% more beneficial than choosing ITC for given project specifics.

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OPTIMIZE

PowerAlpha also optimizes hybrid power solutions to meet various customer objectives, including cost savings, reliability enhancement, emissions reduction, existing infrastructure utilization, and market volatility risk mitigation. It empowers stakeholders to make informed decisions, such as choosing between different configurations of solar plants and storage systems, based on comprehensive criteria including cost, capacity, and dispatchability.

In its pursuit to deliver highly tailored hybrid power solutions, PowerAlpha excels in two key areas: First, it co-optimizes hybrid power solutions incorporating solar PV, energy storage systems (ESS), wind, and hydrogen technologies and does so by considering the customer's load and existing asset portfolio. This optimization is conducted across various asset classes, sizes, and configurations to perfectly match the specific power requirements of customers. Second, PowerAlpha goes a step further by quantifying the lifetime economic value and associated risk of these power solutions for customers. This insight to the customer considers each customer's unique needs for energy, capacity, and renewable credits, thereby offering a comprehensive view of the net benefits.

CASE STUDY

PowerAlpha optimizes systems with hybrid storage to unlock 24/7 carbon-free energy for data centers at cost-efficient targets

Delivering 24/7 carbon-free energy presents a challenge for high-load facilities, such as data centers, which need continuous and reliable power. Renewable power supply must solve for intermittency. By evaluating a decision space of thousands of possible combinations of diverse renewable resources (solar, wind, hydro) and hybrid storage assets, PowerAlpha provides a sophisticated solution in finding the right plant configuration to serve load reliably and cost-effectively around-the-clock (24/7). A least-cost frontier created from these thousands of plant simulations for generation in the Pacific Northwest reveals the optimal asset mix required to serve load at various levels of carbon-free energy. Of note is that in this analyzed case, beyond 86% CFE, solutions require a hybrid combination of short- and long-duration energy storage (LDES) technologies to achieve the lowest possible levelized cost of energy (LCOE). At high levels of carbon-free energy, plants with hybrid storage solutions achieve a 30% cost savings compared to those utilizing short-duration energy storage technologies alone.

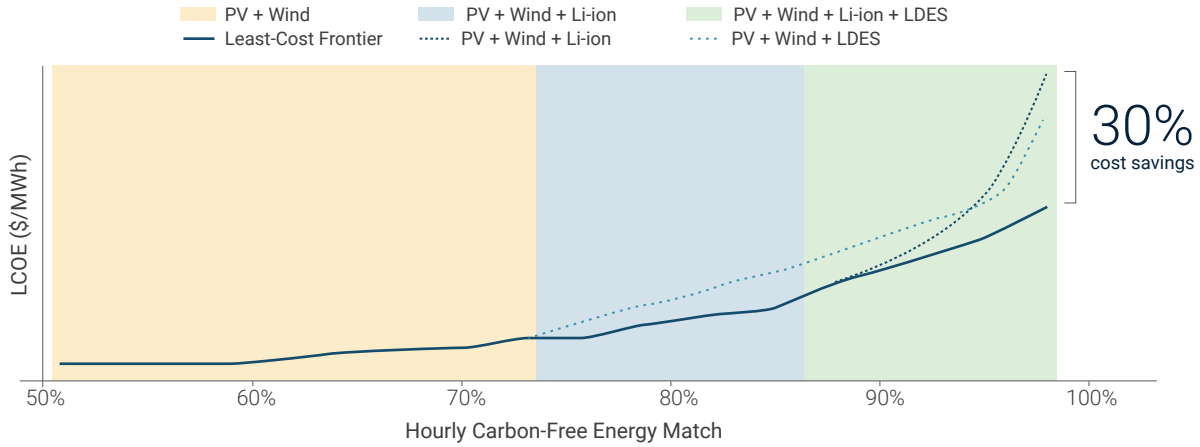

Figure 6 *Hourly carbon-free energy match with up to 30% cost savings through PowerAlpha's optimization*

CASE STUDY

PowerAlpha optimizes systems with hybrid storage to unlock 24/7 carbon-free energy for data centers at cost-efficient targets

BrightNight is tackling the challenge of underutilized transmission infrastructure in the Pacific Northwest by leveraging innovative solutions powered by PowerAlpha®. With renewable energy sources like solar and wind often operating at low-capacity factors due to their intermittent nature, BrightNight is pioneering a strategy to enhance the utilization of existing grid infrastructure and precious transmission capacity allocated to existing single-resource projects by hybridizing them with solar and energy storage. Such hybridization will increase the utilization of existing infrastructure and additionally the predictability of output power. By analyzing historical data, PowerAlpha identifies underutilized capacities across the grid and optimizes co-location projects that could unlocking significant value for ratepayers and power companies alike.

Through analyzing long spans of historical weather and resampled data and running simulations at minute-level granularity, PowerAlpha®, delves into a vast space of scenarios, producing a statistical distribution of potential outcomes. PowerAlpha's comprehensive optimization and valuation demonstrates the potential value created through integration of a solar and storage project with an existing wind project, promising up to $70 million in value created for ratepayers over the project's lifespan.

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OPERATE

Throughout asset operation, PowerAlpha enhances a plants operations via AI-enabled diagnostics, predictive analytics, real-time production forecasts, and hybrid controls. This ensures optimal performance, adherence to firm power requirements, and minimizes risks of excess or deficit, safeguarding investments over the project's lifespan.

PowerAlpha significantly boosts operational efficiency and real-time strategic decision-making for hybridized renewable power plants through its advanced features. Supported by highly scalable computing infrastructure and adaptive resource models, PowerAlpha delivers highly accurate renewable production forecasts, improving grid reliability, and reducing imbalance costs.

By leveraging predictive analytics driven by machine learning, PowerAlpha identifies anomalies across plant components, ensuring reliability and reducing downtime. Advanced performance monitoring tools, including cutting-edge digital twin technology, offer actionable insights to enhance production and efficiency. Additionally, with hybrid plant dispatch optimization, PowerAlpha can address a diverse range of economic, reliability, and sustainability objectives, such as achieving carbon-free energy goals at minimal cost.

This innovative platform serves as a cornerstone for continuous improvement, acting as a learning feedback mechanism for upstream functions like plant design. By integrating economic, design, and operational data, PowerAlpha facilitates Company B's evolution into a cognitive digital enterprise.

CASE STUDY

Saving Millions and Reducing Risks – How AI-Driven Software Can Better Manage Solar Forecasts and Plant Operations

Partnering with an independent power producer in 2023, BrightNight leveraged PowerAlpha to develop a tailored solar forecasting solution for their co-located solar and geothermal facility, integrating hourly weather forecast updates and plant-specific characteristics. The implementation resulted in a remarkable six percentage point improvement in forecasting accuracy, translating into equivalent annual savings of $1-2M for a 300 MW solar power plant, while enabling real-time market strategy adjustments, as depicted in the graphic below.

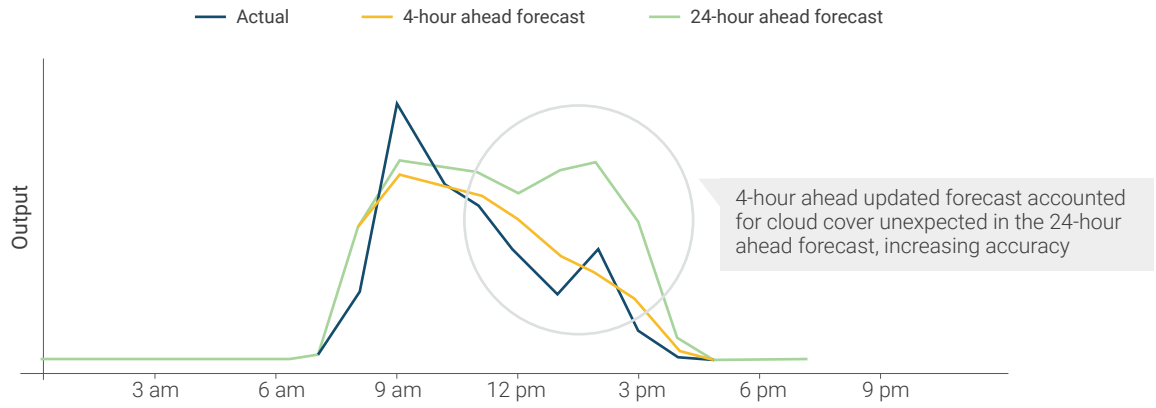

Figure 7 *PowerAlpha creates operational value through forecast improvements*

Building a Cognitive Digital Enterprise

Through its expansive business benefits, PowerAlpha emerges as the cornerstone in BrightNight's strategic transformation into a leading digital enterprise, uniquely positioning it as a true, next generation Independent Power Producer (IPP) to distinctively break away from the competition. By serving as the foundational building block, PowerAlpha not only encapsulates the essence of innovation but also embodies adaptability at its core. This adaptability ensures that BrightNight can swiftly integrate advances in technology, maintaining its stance as an industry leader. With PowerAlpha, BrightNight leverages cutting-edge digital capabilities, paving the way for a future where technology and renewable energy converge to create sustainable, market-leading solutions.

POWERALPHA – ONE STOP SOLUTION

Positioned uniquely in the market, PowerAlpha is the only software platform that fully integrates the critical aspects of designing, optimizing, and operating hybrid renewable power projects with the unique foresight of integrating industry standard power flow and production cost models. Figure 4 summarizes how PowerAlpha's key features create business and customer benefits spanning the entire project lifecycle, boosting project returns and managing risks.

It stands as a testament to BrightNight's commitment to driving value, enhancing sustainability, and achieving the lowest costs in renewable energy generation.

Figure 8 *PowerAlpha - one stop solution for best-in-class power solutions*

READY TO TALK?

Learn more about BrightNight's Power Alpha technology. Contact our development team to discuss how Ai can help you deliver reliable renewable power… when you need it.

You can reach us at info-poweralpha@brightnightpower.com