PowerAlpha®: How AI-Driven Software, Cutting-Edge Hybrid Solutions and Energy Storage Can Unlock 24/7 Access to Clean, Affordable Power

OVERVIEW

Delivering 24/7 carbon-free energy presents a challenge in striking a balance between clean power availability and affordability. This challenge is particularly pronounced for facilities like data centers, where load flexibility is very limited and having access to uninterrupted power is of utmost importance. The intermittent nature of renewable energy sources necessitates a sophisticated solution to ensure reliability while supplying increasing portions of such facilities' load with clean power.

BrightNight's industry-leading, AI-driven software platform, PowerAlpha® provides a unique solution in finding the right combination of hybrid generation and storage technologies to deliver energy reliably and cost effectively around-the-clock.

Renewable energy presents itself as an attractive option for both economic and emission-related targets, as long as it is cost-efficient and can overcome its inherent intermittency and move towards 24/7 around-the-clock solutions.

THE CHALLENGE

Power demand is growing globally, as is the push for clean power. Data centers are one of the fastest-growing customer segments. The International Energy Agency's (IEA) Electricity 2024 report forecasts that global data center power demand could double by 2026 from 2022 levels. In 2022, according to the IEA's report, data centers used 460TWh, representing 2% of all global electricity. Power-hungry AI applications are the main reason behind this surge in demand, with workloads rising as the uptake of generative AI accelerates.

The United States alone, according to the IEA, houses a third of all data centers globally, with data center demand expected to increase from ~4% of total domestic electricity consumption in 2022 to ~6% in 2026. The energy needs of incoming data centers pose a challenge to utilities in their effort to serve these new customers while also meeting sustainability requirements and ensuring a reliable electricity supply for existing businesses and ratepayers.

For example, Washington state's Clean Energy Transformation Act (CETA) requires all utilities and energy producers to be carbon neutral by 2030, and for all fossil fuels to be out of the electricity system by 2045. The Western Resource Adequacy Program (WRAP) is also emerging as a new capacity program, establishing a shared pool of resources in the Western Electricity Coordinating Council (WECC) to balance supply and demand and requiring participants to meet seasonal capacity requirements.

It has become apparent across many US regions that not only does the grid need to increase its capacity quickly, it also needs to do so primarily through clean energy resources while focusing on addressing the reliability concerns created by intermittent renewable generation. With energy costs representing between 30-60% of every data center's operational cost, renewable energy presents itself as an attractive option for both economic and emission-related targets, as long as it is cost-efficient and can overcome its inherent intermittency and move towards 24/7 around-the-clock solutions.

THE POWERALPHA® SOLUTION

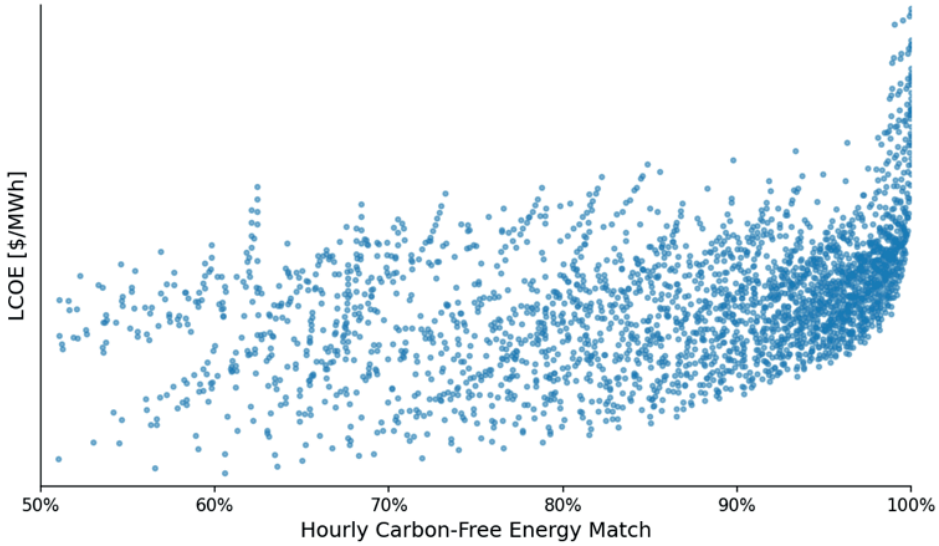
BrightNight's proprietary software platform, PowerAlpha, optimizes the configuration of hybrid generation and storage solutions to deliver carbon-free energy (CFE) reliably and cost effectively around-the-clock – perfect for electricity-hungry data centers that never sleep. By optimizing 24/7 CFE for data centers, PowerAlpha is using AI to grow AI.

An industry-leading software platform with integrated technical models, datasets, and financial models, PowerAlpha finds solutions that exceed typical hybrid project designs and provide superior value to BrightNight customers. Tools within the PowerAlpha software suite allow BrightNight to deploy AI-driven data analytics to discover the optimum renewable solutions and a net-benefit framework provides BrightNight and its customers a clear view of the trade-offs between the cost of energy and the respective CFE attainment under different configurations.

PowerAlpha evaluates a decision space of thousands of possible configurations combining diverse renewable resources (solar, wind, hydro) and hybrid storage assets. As such, it models the mix of asset types and capacities against load to assess the extent of data center power needs that can be served through renewable projects economically. For example, each dot in the graph below represents a distinct power plant configuration with a unique combination of assets and sizes of those assets. By simulating generation and dispatch of each one of these solutions, it is possible to visualize the level of hourly CFE % match with corresponding Levelized Cost of Energy (LCOE) in $/MWh. Using such powerful insights, commercial energy users can determine the right resource combinations for achieving their CFE goals in a given grid at the lowest cost.

This kind of solution is particularly compelling in the Pacific Northwest, the Desert Southwest and other regions where data centers are expected to experience exponential growth, putting pressure on the existing grid infrastructure.

It is challenging to generate high levels of carbon-free energy from renewable resources such as solar, wind, and hydro due to their intermittent nature. Energy storage (both short and long duration) plays the important role of shifting renewable resources so that critical loads such as data centers can continue to operate even when there is no sunshine and no wind.



There are inherently two major types of intermittencies in renewables generation that energy storage should be able to handle. First, there are high-frequency, short-duration intermittencies stemming from daily solar and wind production profiles. Such variabilities are frequent (daily) and relatively short in duration (shifting energy for up to 6 hours). Short-duration energy storage is typically the right solution to handle these intermittencies given their characteristic high round-trip efficiencies, which make their day-to-day operation efficient.

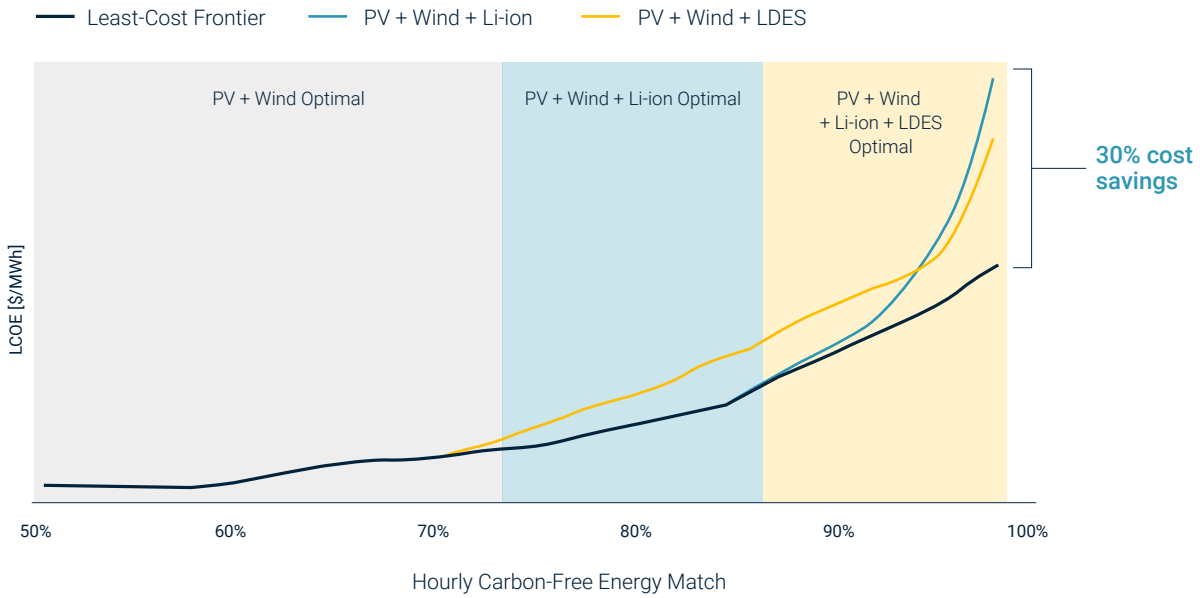
The second class of intermittencies are periods of extended renewable underperformance, for example, overcast conditions that result in low solar production for a whole day or multiple days. In such cases, longer periods of energy shifting are required, which short-duration storage technologies are not able to handle. Despite their lower overall round-trip efficiency, long-duration technologies provide the best solution for this class of variabilities due to their infrequent occurrence. Stacking multiple storage technologies (such as lithium-ion short-duration with a long-duration tech) in the same grid means the project can take advantage of their complementary performance capabilities.

THE POWERALPHA® DIFFERENCE

To make it possible and financially feasible to deliver reliable 24/7 CFE to meet the large load demands of data centers, PowerAlpha uses industry-leading optimization techniques to analyze many years of observed and simulated weather data and design the right mix of short- and long-duration storage technologies to complement available sources of clean power in regional power grids. This delivers an extremely granular level of resource optimization and sensitivity results under different weather and grid conditions. Running thousands of scenarios allows us to build a frontier of minimum cost solutions for each level of CFE attainment, identifying which configurations were suboptimal and which provided the most cost-competitive energy delivery.

In the chart below, PowerAlpha's modeling for the Pacific Northwest (PNW) regional power market indicates that to achieve CFE targets up to mid-70%, solar PV and wind will be the lowest-cost generation solution for hourly matching, with no or minimal amount of storage required. Additionally, the lowest-cost solution up to mid-80% would comprise lithium-ion batteries and that beyond mid-80% would require long-duration energy storage (LDES) technologies usually combined with short-duration energy storage. No other software solution in the market today provides this range of capabilities and the ability to find these kinds of solutions.

For example, the chart below shows how with the right configuration of hybrid storage technologies, 30% cost reduction is attainable at very high levels of CFE (+ 95%) compared to market benchmarks utilizing short duration storage only. Such a selection is not a trivial exercise as it requires high computational models that can analyze trade-offs across scenarios to determine the right level of power/energy capacity needed to meet the load needs. That is real savings, and these solutions provide viable resource options to deliver 24/7 CFE to commercial and industrial customers.



With the ability to find the right renewable solution at the right cost, PowerAlpha is an industry-leading software solution that is solving the complexity of intermittent renewable power. With its speed, precision, and seamless integration – all supported by a team of experienced energy experts – PowerAlpha can deliver exceptional solutions that surpass expectations for intermittent renewable energy. ***PowerAlpha® brings the intelligence to deliver affordable, reliable renewable power when it's needed.***

BRIGHTNIGHT
Power when you need it