

From Raw Data to Real Gains

Increasing Data Center Energy Intelligence Through Analytics



It takes a considerable amounts of energy to operate in today's data-driven and automated data center environment. Consider the numbers. In 2025, the data center sector had a capacity of 61.8GW and used roughly 224 terawatts-hours, representing 5% of capacity and 5.5% of total energy usage in the U.S., roughly twice the amount from 2022.¹ The projections are calling for doubling capacity and energy use again over the next 5 years.



Data centers typically allocate around 40% of their operating budget to power, at an average cost of \$7.4 million each year.⁶

Consider as well, data centers' Power Usage Effectiveness (PUE), an industry-standard metric that measures energy efficiency by calculating the ratio of total facility power to IT equipment power. A PUE of 1.0 is ideal, indicating 100% efficiency, while higher numbers mean that more energy is wasted on cooling, lighting, and power conversion. Currently, hyperscale data centers are operating at a 1.1-1.2 PUE while colocation and enterprise data centers operate respectively at 1.3-1.6 and 1.5-1.8 PUE.² Based on average utility rates, an .1 increase in PUE represents around \$70,080 per year. This also translates to 876,000 kWh per year, or 483 metric tons of CO2 emissions.

Based on these numbers, data centers are among the most voracious users of energy in the commercial building space. This energy consumption comes at a significant cost. The average data center allocates around 40% of their operating budget to power, at an average cost of \$7.4 million each year.³

We're all feeling the effects of this higher energy consumption, in the form of higher prices. As data centers expand, propelled by the proliferation of AI, wholesale energy prices have spiked by as much as 267% in some areas over the past five years.³ Electric and gas utilities initiated nearly \$31 billion in rate increases in 2025, more than double the \$15 billion in rate increases requested in 2024.⁴ Since 2021, electricity prices have climbed nearly 40%, making them the fastest inflation driver.⁴



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Faced with a volatile energy market and escalating costs, data center stakeholders are under increasing pressure to adopt better, smarter strategies for improving energy efficiencies and lowering energy consumption. That requires having a clear picture as to where, when, and how energy is generated, consumed, and wasted across data center portfolios.

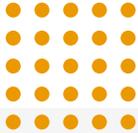
Enter Energy Intelligence.

Data Center Energy Intelligence | A Smart Approach to Operational Data

It's no longer enough to collect and monitor operational data. To move the needle, data center stakeholders must transform that raw data in Energy Intelligence. So, what does that mean, exactly?

Energy Intelligence refers to the continuous, data-driven optimization of how energy is used, distributed, and consumed across building systems, equipment, and assets. A data center's Energy Intelligence is fed by vast amounts of granular information captured by Building Automation Systems (BASs), Building Management Systems (BMSs), Energy and Power Monitoring Systems (EPMS), IoT sensors, automated controls, meters, and more.

As data centers increasingly integrate more systems and expand in scale, they generate a wealth of data waiting to be harnessed. Therein lies both the opportunity and the challenge. Through Energy Intelligence, data center stakeholders can extract actionable insights from this deluge of operational data to predict, optimize, and adapt their facility's performance, drive energy efficiencies and savings, and improve resilience.



Analytics in Action | Use Case Scenarios for Data Centers

Drawing on BMW and EPMS data, an analytics platform can provide data centers a significant advantage over standard monitoring by moving threshold alarms to logic-based patterns. This enables operators to identify low-hanging fruit that deliver quick and measurable energy efficiency improvements.



Cooling and Chilled Water Optimization

Analytics can detect when temperature differences between supply and return water is too low, to prevent over-pumping and chiller cycling. **Potential PUE impact: 0.05+.**

In another scenario, analytics can recommend the optimal sweet spot for running two chillers at 40% load versus running one chiller at 80%, based on real-time Coefficient of Performance (COP) curves. **Potential PUE impact: 0.04-0.07.**



Heat Rejection and Data Hall Management

Using analytics, operators can correlate floor tile temperature with actual server inlet sensors to identify cool air that's going where it isn't needed. **Potential PUE impact: 0.03-0.05.**

Analytics can also identify hot air recirculation patterns, in which hot air leaking back into the cold aisle forces the BMS to run faster than necessary. **Potential PUE impact: 0.02.**



Capacity and Load Management

Analytics reporting can reveal racks where power is allocated but not used, allowing more IT load in the same footprint, which naturally lowers PUE.

With insight from analytics, operators can correlate UPS power output with CPU utilization, flagging zombie servers for decommissioning when power is high but CPU is less than 5%.

Potential PUE impact: 0.10-0.20.



Maintenance and Operations

Analytics can be used to flag valves that are cycling too frequently, to avoid mechanical wear and tear and stabilize the PUE.



Water Usage Effectiveness (WUE) Analytics

By monitoring the makeup water versus blowdown water in cooling towers, data centers can optimize the cycles of concentration.

Energy Intelligence Starts with Analytics

In translating massive amounts of operational data into Energy Intelligence, data center stakeholders confront myriad obstacles across a portfolio of properties. A wide variety of equipment manufacturers along with different BMS, SCADA, and EPMS platforms, all executed by different teams, makes it more difficult to unify, normalize, and standardize data to act on. Ensuring the cleanliness and accuracy of data remains paramount. Yet many data center facilities and operational teams simply don't have the in-house time and tools to turn raw data into useable insight.

The solution to these challenges can be found in analytics, a software solution which analyze data sets in perpetuity to find operational efficiency anomalies. Bottom line: you can't have Energy Intelligence without having the right analytics strategy and platform in place, running 24/7. To ensure analytics deliver actionable insight, there are multiple important considerations to keep in mind.

Unifying, Normalizing, and Standardizing Data

Today's data centers generate massive amounts of data from many different sources. The resulting data silos can lead to communication breakdowns, inaccurate information, workflow inefficiencies, and missed savings opportunities. Unifying this disparate data is essential to building an effective analytics strategy that delivers Energy Intelligence.

In data centers, the cost advantages of unified data is high, generating up to 30% reduction in energy usage by consolidating workflows.⁵ Along with unifying data, your analytics strategy should incorporate data normalization to scale and adjust diverse datasets (such as energy usage, temperature readings, and occupancy metrics captured by various sensors) into a common range or distribution.

Normalization supports fair comparisons and accurate modeling across systems. For instance, factoring in local cooling needs based on seasonal averages ensures an accurate gauge of energy without the oversized influence of weather or utility costs by region. So that ultimately, the focus remains operational efficiency. For IT-dominant environment like data centers, normalizing data also increases asset visibility, ensures reliable reporting, and supports maintenance planning while cutting decision-making friction by up to 30-50%.⁶



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Hand in hand with data normalization comes data standardization: the process of transforming data from different sources into a uniform format, ensuring consistent units, naming conventions, and structures. In addition to improving analytics readiness, standardizing data ensures you're basing decisions on a single source of operational truth – potentially saving thousands of labor hours by minimizing data errors.

Standardization also allows you to take advantage of simplified modularity, repeatability, and scalability, making it easier to leverage data across an entire data center portfolio. Standardized data additionally sets the stage for future AI applications, with an AI-ready data layer that models can learn from, understand, and act on to drive performance improvements.



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Insight Quality Over Data Quantity

To drive Energy Intelligence, the accuracy, completeness, and timeliness of your data matters more than raw volume. Your analytics should target information that reveals opportunities for the biggest impact with the least amount of effort – using already available resources.

A powerful analytics tool, screening frameworks prioritize and filter vast datasets to pinpoint high-impact variables that affect energy usage, performance, uptime, and risk. By applying structured criteria, these frameworks rank data sources and call out key inputs. For example, your framework may identify instances of overcooling in low-occupancy zones, airflow imbalances, or signs of potential equipment breakdowns, enabling you to target those specific areas and make timely adjustments.

Frameworks can be especially useful for data centers, by analyzing sensor data from servers, cooling systems, and power units to forecast failures before they cause downtime. By processing real-time metrics like PUE and temperature trends, frameworks pinpoint inefficiencies in energy or cooling, help improve resource allocation, and extend asset lifespans.

See the Whole Picture with Time-Series Data

To be a truly effective driver of Energy Intelligence, however, analytics must capture time-series data that provides historical context. Yes, real-time data is important in that it gives you the pulse of current operations, allowing you to respond quickly to issues, anomalies, and problems early on – before they impact energy consumption and uptime. This early intervention can save significant costs. Real-time data tracks live metrics like temperature, humidity, and server loads via IoT sensors to enable instant adjustments.



When analyzed together, real-time and historical data turns simple energy monitoring into actionable Energy Intelligence.

But historical data is equally valuable, revealing long-term trends like weekly or monthly energy peaks or equipment degradation that have a significant impact on datacenter energy usage, empowering more proactive and predictive decision-making. This data allows you to benchmark progress, predict future needs, address chronic issues, and identify cost centers—creating a feedback loop of continuous optimization.

When analyzed together, real-time and historical data turns simple energy monitoring into actionable Energy Intelligence. Instead of reactively fixing problems as they arise, facilities teams can proactively optimize performance and continually finetune systems for increased efficiency, resiliency, and security.

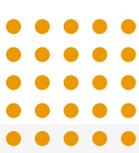
Partnering with an Analytics Expert

The operational advantages of analytics are clear. But implementing, managing, and utilizing analytics takes time and resources you may not readily have available. Partnering with an outside analytics expert can help you harness analytics for enhanced Energy Intelligence while also maximizing your existing resources.

As building systems and analytics become increasingly complex and data-driven, an outside partner can bring the specialized expertise needed to navigate the complexities and translate vast amounts of data into focused, useable insight.



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Your 5-Point Checklist for Choosing an Analytics Partner

1 Verify Industry Expertise

Look for a partner with a confirmed track record in energy management, building systems, operational and information technology, and analytics in the data center space. Your analytics partner should have expertise in cleaning, normalizing, and unifying data; creating standardized dashboards and reports; and knowing which data will have the greatest impact on your energy usage and operational performance.

2 Evaluate Technology and Tools

Assess the vendor's platform for integrating, filtering, and presenting data from disparate systems, applications, equipment, and assets. Make sure they give you access to time-series data (real-time and historical) and can scale your analytics across multi-site portfolios. Look for a partner who is solutions-agnostic, and whose platforms and tools work with your existing systems.

3 Review Security Protocols

The analytics partner you choose should implement robust security protocols to protect your data and keep out cyberthreats. Examine their protocols and processes around cybersecurity frameworks, end-to-end data encryption, access controls, intrusion detection, auditing, reporting, and adherence to data privacy regulations.

4 Service Level Agreements

Check the vendor's SLAs, with close attention to uptime guarantees, response times for issue resolution, data accuracy guarantees, remediation for breaches and data loss, and regular performance reviews to ensure alignment with your Energy Intelligence goals.

5 Collaborative Approach

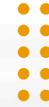
Your analytics partner will be working closely with your facilities department, IT team, and key data center stakeholders to develop and implement a strategy and implementation plan. Ask the vendor to walk you through their collaboration model, including their use of dashboards, availability of ongoing support, cadence of communication and reviews, training resources, and accountability for performance.

Energy Intelligence Begins with a Smart Analytics Strategy

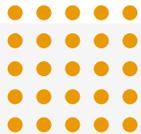
As building systems become more automated, data-driven, and complex, and data center stakeholders seek smarter strategies to reduce energy consumption and costs, the need for better Energy Intelligence has never been clearer. Data center operators must move from a reactive approach to monitoring operational data, to a proactive and predictive analytics strategy.

Data center stakeholders who adopt, embrace, and leverage advanced analytics have a distinct advantage in harnessing operational data to drive smarter, more agile, and profitable decisions. A strategic approach to analytics, supported by the right analytics partner, is the key to improving energy efficiencies and savings, enhancing operational uptime and data center resiliency, and preparing for the future.

To learn more about leverage analytics to increase data center Energy Intelligence, reach out to Albireo Energy today.



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Leveraging Analytics to Meet the NFPA 70B Standard with Analytics

In 2023, NFPA 70B transitioned from a recommended best practice to a mandatory standard requiring data centers to implement an Electrical Maintenance Program (EMP) to ensure equipment reliability and safety. Analytics equip data center operators with the intelligence they need to both demonstrate compliance and optimize equipment usage over time.

Using analytics, operators can learn normal behavior and flag anomalies early for repair before failure, while still showing that equipment has been inspected and testing at defined intervals. Data center stakeholders can also use analytics to build a risk model, scoring each asset on the impact on IT load, condition, ambient temperature, and load profile. These scores can help prioritize maintenance plans and frequencies identified in the EMP.

Along with increased visibility, analytics dashboards provide an audit trail showing maintenance task completion rates to prove EMP adherence. Operators can also use trend analytics to show how preventative and predictive maintenance are reducing incidents and risk.

With analytics, operators can easily maintain a digital model of the electrical one-line, with each asset's maintenance history, test results, and sensor streams attached. Analytics can simulate failure scenarios such as loss of a UPS, breaker, or transformer, and help plan maintenance windows that preserve redundancy. For multi-site operators, this also enables benchmarking across facilities and standardizing EMP practices.

Sources

1. Venditti, Bruno. "Charted: The Energy Demand of U.S. Data Centers (2023-2030P)." Visual Capitalist. May 27, 2025.
2. "Powering Tomorrow's AI Data Centers." Morningstar Equity Research. July 15, 2025.
3. Saul, John et al. "AI Data Centers Are Sending Power Bills Soaring." Bloomberg. September 29, 2025.
4. "Utility Bills Are Rising." Powerlines. January 2026.
5. Essick, Kristi. "The cost of compute: A \$7 trillion race to scale data centers." McKinsey & Company. April 28, 2025.
6. Graglia, Ignacio. "Data Normalization, Explained: What Is It, Why It's Important, and How to Do It." Invgate. February 9, 2026.