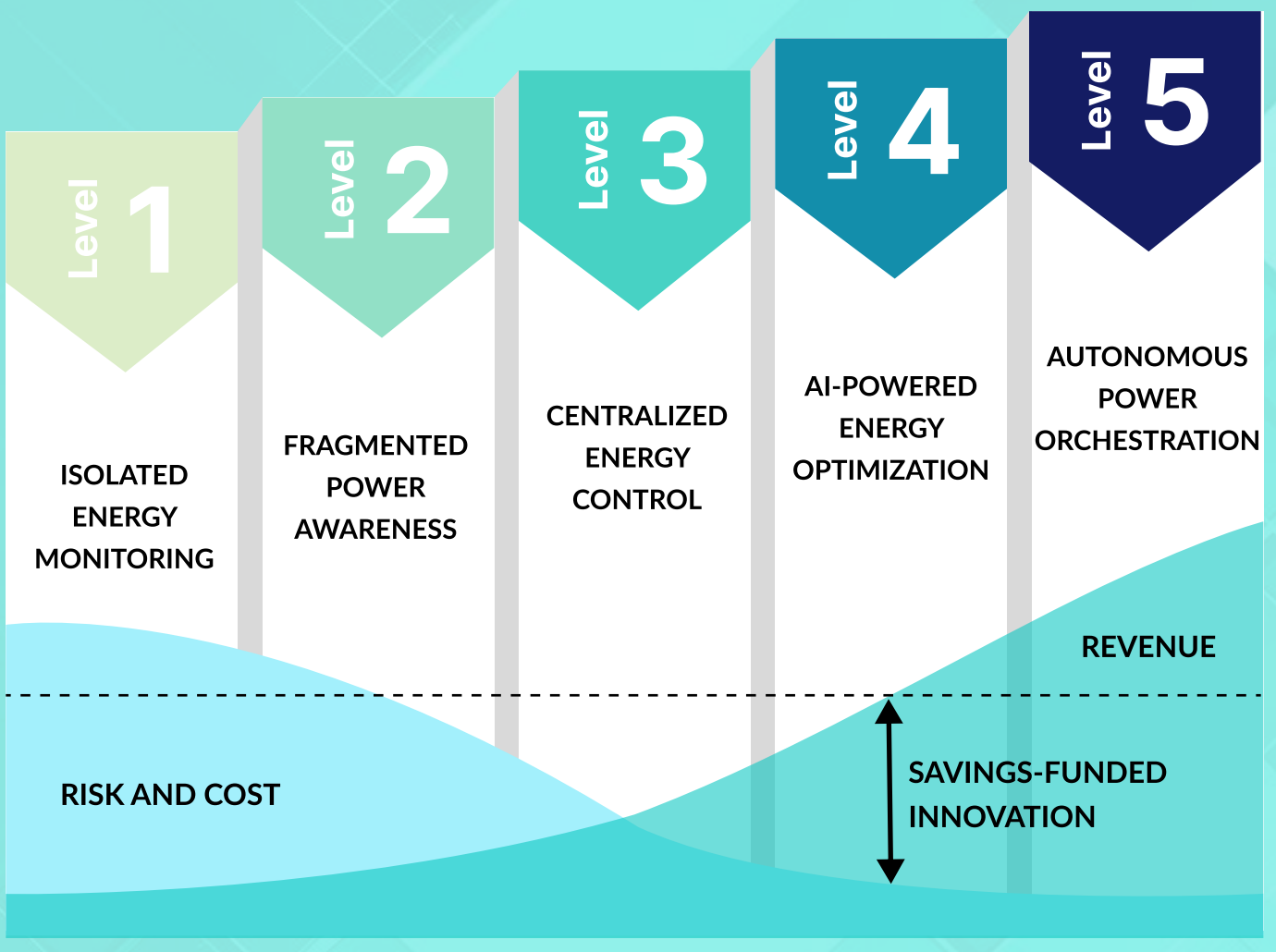
VERDIGRIS

White Paper:
The Energy Management Maturity Model



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Executive Overview

In today's data-driven landscape, energy stands as a critical—yet often under-optimized—asset for data centers. Rising energy costs, inefficiencies, and operational risks are the consequences of outdated, fragmented energy monitoring systems. As data centers grow in complexity and the demand for sustainable operations intensifies, mastering energy management has become essential for ensuring competitiveness, cost-efficiency, and operational resilience.

This white paper outlines the five stages of energy management maturity, offering a roadmap to assess your current capabilities and guide you toward more efficient, cost-effective, and sustainable energy use. By reading this white paper, you will:

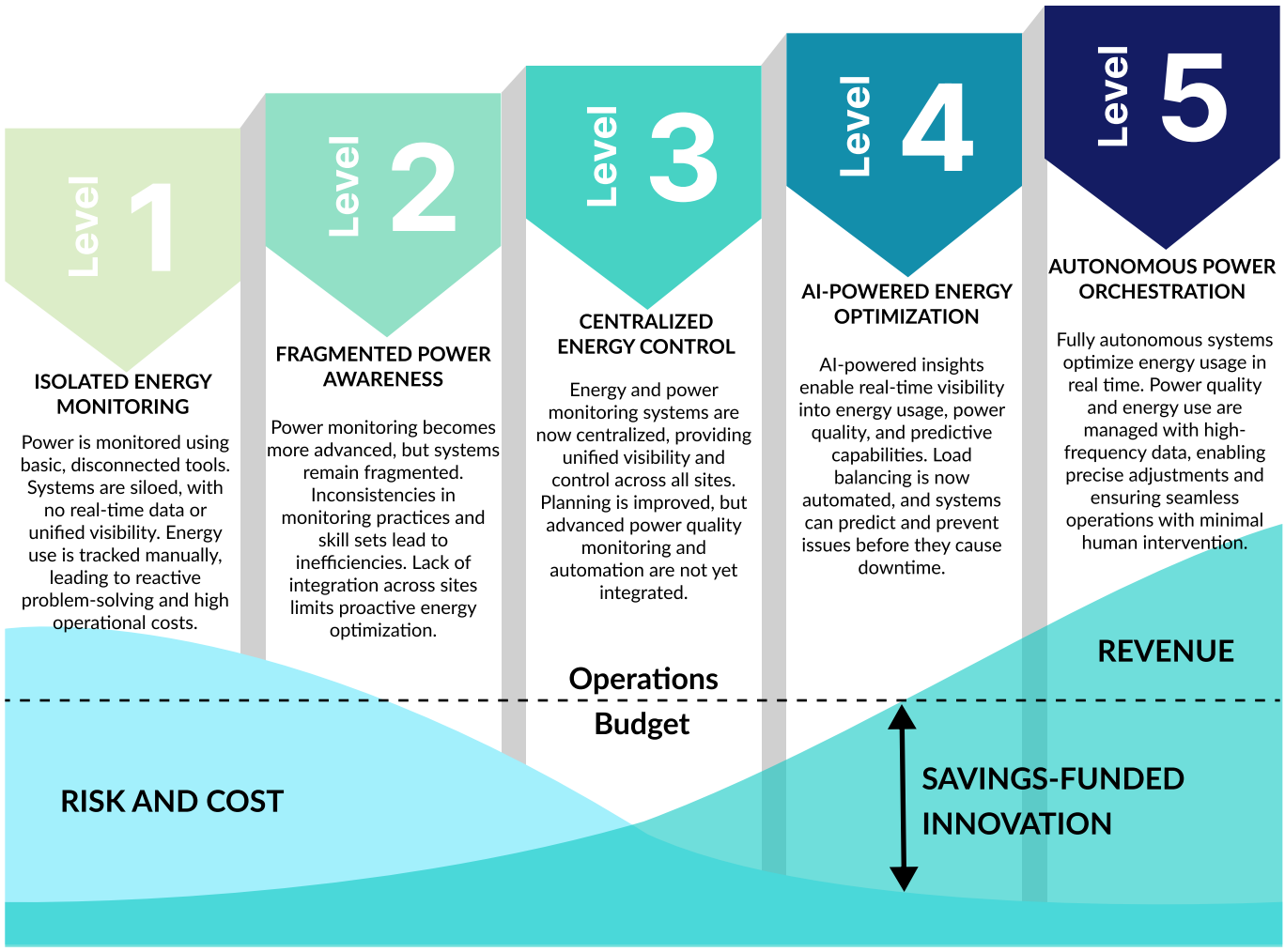
- Gain insight into the five stages of energy management maturity and how each impacts efficiency, operational costs, and risk mitigation.
- Identify inefficiencies and risks in your current energy management system, from siloed data to a lack of predictive capabilities.
- Learn how to leverage AI and automation to reduce downtime, lower costs, protect critical infrastructure, and enhance sustainability.

Whether your data center is beginning its energy optimization journey or aiming to achieve fully autonomous energy orchestration, this guide provides the knowledge and insights necessary to drive meaningful change.

Energy Management Maturity: A Path from Risk to Revenue

The energy management maturity model offers a clear path for data centers to evolve from reactive, high-cost operations to proactive, efficient, and revenue-enhancing systems. By progressing through each maturity level, data centers not only reduce operational risks but also unlock new levels of efficiency that directly impact their bottom line. This journey is about more than improving technology; it's a strategic evolution toward mastering energy as a valuable asset rather than just a line item expense.

Each step forward on this maturity model brings data centers closer to a future where energy management is not only automated but optimized in real-time, allowing operators to achieve maximum performance with minimal human intervention.



Energy Management Maturity: A Path from Risk to Revenue *(continued)*

In the early stages, risks are high, and cost control is limited due to manual processes and lack of visibility. As data centers adopt centralized and AI-driven systems, they gain unprecedented insights into power usage, improve uptime, and move closer to an ideal state of energy autonomy. Here, AI not only monitors but also forecasts and responds to power demands, ensuring that facilities remain efficient, resilient, and aligned with cost projections.

As data centers mature on the path towards autonomous orchestration, they find new "innovation capital" through energy cost savings and reduced risk exposure, which they can use to invest in cutting-edge advancements. This innovation-driven approach helps data centers turn cost savings into revenue opportunities as lower operating costs translate to stronger financial performance.

Let's explore each of the stages in more depth.

Level 1: Isolated Energy Monitoring

At this initial stage, energy monitoring is fragmented and inefficient. Power consumption is tracked through disconnected tools, offering no real-time visibility or integrated system overview. As a result, organizations operate reactively, addressing issues only after they arise, which leads to increased operational costs and unplanned downtime.

Key Characteristics:

- Fragmented monitoring with no real-time data.
- Reactive issue resolution causes frequent outages and inefficiencies.
- High energy costs driven by manual interventions and lack of optimization.
- No predictive capabilities, leading to unplanned downtime and equipment failures.
- Inefficient energy use due to limited oversight and control.

> *Imagine a data center grappling with frequent, unexpected outages, each incident resulting in tens of thousands of dollars in lost productivity. With disconnected tools and no real-time insights, every disruption is a race against time, with no ability to anticipate, adapt, or prevent. This reactive cycle drains resources, driving up costs and stalling innovation.*

Level 2: Fragmented Power Awareness



At this stage, power monitoring technology becomes more sophisticated, but the lack of integration across systems and platforms prevents organizations from fully leveraging it. Different data centers often follow inconsistent monitoring practices, and operational teams vary in skill and expertise, making it difficult to establish cohesive energy management strategies. Without a unified portfolio of energy management tools, proactive energy optimization remains out of reach, leading to inefficiencies and higher operational costs.

Key Characteristics:

- Inconsistent monitoring practices prevents uniform data collection and analysis.
- Varied operational skill sets across teams create gaps in energy management expertise.
- Fragmented tools and data hinder any centralized approach to optimization or planning.
- Incomplete energy management portfolios restrict the ability to forecast, plan, and optimize energy consumption effectively.
- Inefficient load management causes high energy peaks, resulting in inflated costs.
- No cross-site coordination, limiting optimization opportunities that could be achieved through integrated systems and communication.

	Fragmented Energy Management	Centralized Energy Management
1. Visibility and Oversight	Limited visibility due to disparate systems across sites, leading to inefficiencies	Comprehensive, real-time visibility across all facilities, enabling proactive decision-making
2. Data Collection and Analysis	Inconsistent data collection and analysis due to varied tools and practices	Uniform data collection and integrated analysis for better strategic planning
3. Operational Efficiency	Higher energy peaks and inefficient load management, resulting in inflated costs	Optimized load management and reduced energy peaks, leading to better energy utilization
4. Risk Management	Increased risk of outages and equipment failures due to fragmented control and response delays	Enhanced risk mitigation with coordinated response capabilities and reduced downtime risk
5. Cost Management	Higher operational costs due to inefficiencies and manual interventions	Lower operational costs due to automation and optimized energy use
6. Sustainability	Difficulty implementing consistent, sustainable practices across facilities	Easier adoption of sustainability measures with unified control and monitoring
7. Scalability	Challenging to scale efficiently due to the lack of integrated systems	Easier scaling with centralized systems that provide uniform solutions and remote management

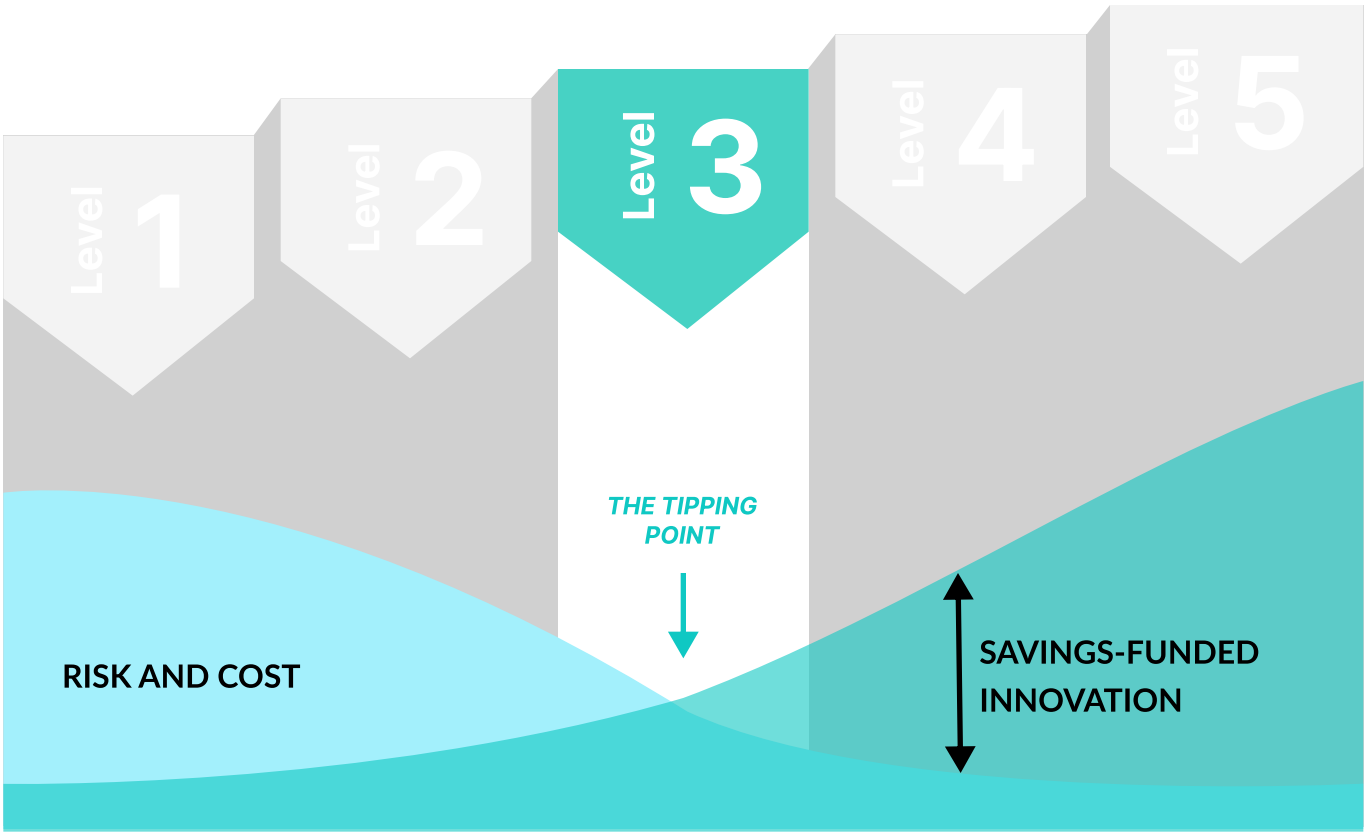
Level 3: Centralized Energy Control



At this stage, energy monitoring and control systems are centralized, providing organizations with a unified view of power usage across all facilities. This centralized visibility allows for more effective load management, improving both energy efficiency and cost savings. While energy planning becomes more proactive, advanced features such as power quality monitoring and automation are not yet fully integrated, meaning that some processes are still manually driven.

Key Characteristics:

- Centralized visibility across multiple locations, enabling better oversight.
- Real-time load balancing begins to take shape, but it's still manually controlled.
- Energy efficiency improves, but power quality insights remain limited.
- Cost reductions are achieved through better energy planning and load management.
- Proactive energy planning becomes possible, though automation of these processes is still in its early stages.



Level 4: AI-Driven Energy Optimization



At this advanced stage, AI-powered systems deliver real-time insights into both energy usage and power quality, providing predictive capabilities that transform energy management. Automated load balancing ensures optimal energy efficiency, and AI-driven predictions allow facilities to prevent issues before they occur, reducing downtime and protecting equipment. While not fully autonomous, these systems significantly reduce manual interventions and enable more proactive, strategic energy management.

Key Characteristics:

- AI-powered real-time visibility into both energy usage and power quality.
- Predictive maintenance helps identify and address potential issues before they lead to downtime or equipment failures.
- Automated load balancing optimizes energy distribution, reducing waste and ensuring efficient use of resources.
- Power quality management ensures equipment is protected from degradation, maintaining operational reliability.
- Systems greatly reduce the need for manual intervention, but are not yet fully autonomous.

> *Consider a facility that, using an AI-powered system achieved a 30% reduction in downtime in a single year. With predictive maintenance and automated load balancing, the team now prevents costly disruptions, enhancing reliability and reducing costs by 20% annually. This is the power of AI-driven energy optimization in action.*

Level 5: Autonomous Power Orchestration



At the pinnacle of energy management, fully autonomous systems optimize energy usage in real time, using high-frequency data to make precise adjustments across all facilities. Power quality is constantly monitored, with autonomous systems responding instantly to fluctuations to ensure seamless operations. Human intervention is minimal, as the system orchestrates energy flows with unparalleled efficiency, achieving maximum energy savings and eliminating waste.

Key Characteristics:

- Full AI automation delivers real-time, dynamic adjustments to energy use.
- High-frequency data collection captures detailed power quality metrics and events, allowing for precise, moment-to-moment management.
- Autonomous load management ensures uninterrupted operations, with the system making real-time decisions to balance loads across facilities.
- Minimal human intervention is needed as the AI takes over full orchestration of energy systems.
- Maximized energy efficiency is achieved through continuous, data-driven optimization, resulting in significant cost savings and reduced environmental impact.

> *High-frequency data elevates AI's precision, capturing subtle, previously undetectable fluctuations that serve as early indicators of potential issues. This level of insight creates a proactive, always-aware energy system, enhancing reliability by alerting teams to emerging problems before they disrupt operations. By detecting and addressing these small shifts in real time, high-frequency data ensures your system's stability and readiness, even as demands evolve.*

Self-Assessment Checklist: Where Does Your Energy Management Stand?

Use this checklist to identify which stage of energy management your organization currently operates within.

Level 1: Isolated Energy Monitoring

- ☐ Are you monitoring energy manually without access to real-time data?
- ☐ Are your power systems siloed, with no integration across locations or departments?
- ☐ Do you typically address energy issues only after they cause problems, such as outages or inefficiencies?
- ☐ Are your energy costs high due to manual interventions and inefficient energy use?
- ☐ Do you lack predictive tools that can help anticipate energy issues or optimize usage?

Level 2: Fragmented Power Awareness

- ☐ Do you have more advanced power monitoring tools, but lack integration across all sites?
- ☐ Are there inconsistencies in energy monitoring practices and operational skill levels between your data centers or facilities?
- ☐ Are your energy data and tools fragmented, making centralized optimization impossible?
- ☐ Do you lack a comprehensive energy management portfolio to guide proactive planning and optimization?
- ☐ Is load management inefficient, leading to energy peaks and higher operational costs?
- ☐ Is there little coordination between your sites, causing missed opportunities for cross-site energy optimization?

Level 3: Centralized Energy Control

- ☐ Do you have centralized visibility into energy usage across multiple locations?
- ☐ Are you beginning to implement real-time load balancing, but still relying on manual adjustments?
- ☐ Has your energy efficiency improved, but you still have minimal power quality insights?
- ☐ Are your energy costs starting to decrease due to better energy planning and load management?
- ☐ Are you able to plan energy use proactively, though your system is not yet fully automated?

Level 4: AI-Driven Energy Optimization

- ☐ Does your system use AI to provide real-time visibility into both energy usage and power quality?
- ☐ Is predictive maintenance helping you reduce downtime and prevent operational risks?
- ☐ Has load balancing been automated to optimize energy use and reduce waste?
- ☐ Are you monitoring power quality to protect your equipment and ensure reliable operations?
- ☐ Has the need for manual intervention significantly decreased, though the system is not fully autonomous?

Level 5: Autonomous Power Orchestration

- ☐ Is your energy system fully automated, with AI making real-time adjustments to energy use without human input?
- ☐ Are you using high-frequency data to capture detailed power quality metrics and enable precise optimization?
- ☐ Is your load management fully autonomous, ensuring seamless, uninterrupted operations?
- ☐ Have you maximized energy efficiency, leading to significant cost savings and waste reduction?
- ☐ Is human intervention minimal, with the system orchestrating energy flows autonomously across all facilities?

Self-Assessment Checklist:
Where Does Your Energy Management Stand? *(continued)*

Evaluate Your Results:

Mostly Level 1 or 2?

You're in the early stages of energy management, with fragmented systems and manual processes holding you back. To advance:

- Focus on centralization. Start integrating your energy data into a single platform for unified visibility across locations.
- Standardize monitoring practices across all sites to ensure consistency.
- Train your teams on energy management best practices to reduce operational gaps between facilities.
- Adopt advanced monitoring tools that can provide real-time data and move you away from reactive problem-solving.
- Begin thinking about predictive capabilities to help forecast energy needs and prevent unplanned downtime.

Next Step: Prioritize investment in centralized energy management systems and automation to streamline processes and reduce manual intervention.

Mostly Level 3?

You're well on your way with centralized energy control, but there's still room to optimize and automate your systems for better efficiency. To reach the next level:

- Integrate AI tools for predictive maintenance and real-time load balancing, reducing your reliance on manual interventions.
- Expand your monitoring to include power quality data to protect equipment and prevent operational inefficiencies.
- Automate load management to avoid energy peaks and further reduce operational costs.
- Focus on predictive analytics to help anticipate energy needs and optimize planning across facilities.

Next Step: Invest in AI-driven energy management tools that provide real-time insights, automate load balancing, and incorporate power quality monitoring for greater efficiency and reliability.

Mostly Level 4 or 5?

You're operating at the cutting edge of energy management, with AI-driven insights and advanced automation. To stay ahead and continue maximizing value:

- Continue refining AI algorithms to increase precision in load balancing and energy distribution.
- Leverage high-frequency data to enhance your power quality management and reduce even the smallest inefficiencies.
- Explore full autonomy, where AI-driven systems are capable of learning and adapting without manual input, improving with every adjustment.
- Benchmark performance metrics to ensure continuous improvement and push the boundaries of energy efficiency.
- Evaluate new technologies, such as IoT integration or machine learning enhancements, to stay on the forefront of energy innovation.

Next Step: Push for full autonomous orchestration, while continuing to improve predictive accuracy and exploring future technologies that will enhance your existing system's capabilities.

The Path Forward

Energy management is no longer a set-it-and-forget-it aspect of business operations—it's a strategic imperative. As organizations worldwide strive for greater operational efficiency, cost reduction, and sustainability, those who embrace advanced, AI-driven energy solutions will lead the way into the future.

Whether your organization is just beginning its energy optimization journey or is already deploying AI to manage real-time energy data, there is always more room for improvement. With each step forward—from fragmented, manual processes to fully autonomous power orchestration—your business can unlock new levels of efficiency, resilience, and competitiveness.

Verdigris is committed to helping businesses navigate this transformation. Our cloud-first, AI-powered platform is designed to guide organizations from basic energy monitoring to autonomous optimization. By leveraging our advanced analytics, real-time visibility, and automation, your business can stay ahead of the curve, continuously refining its energy strategy to meet evolving challenges and opportunities.

The path forward is clear: embrace automation, harness AI, and make energy management a central part of your strategy. Together with Verdigris, you can take control of your energy future, optimizing performance, reducing waste, and contributing to a more sustainable world.

About Verdigris

Verdigris empowers data centers and other mission critical facilities to rise beyond mere efficiency, transforming energy management into a strategic advantage. Energy is an asset that, when fully optimized, unlocks new levels of efficiency, cost savings, and sustainability. Through our AI-powered platform, we provide real-time insights that empower organizations to take control of their energy usage with unparalleled precision.

Our solutions go beyond traditional energy monitoring—pioneering the path from fragmented systems to fully autonomous orchestration.

Why Verdigris?

- Proven Expertise: With years of experience at the intersection of energy management and AI, Verdigris is a trusted partner for leading data centers and global enterprises. Our innovative approach to energy intelligence helps businesses reduce waste, lower costs, and increase operational efficiency.
- Cloud-First Architecture: Verdigris leverages a modern, cloud-first architecture that provides seamless scalability while ensuring unparalleled data quality and reliability. With remote access to real-time data, organizations can easily access data, troubleshoot, and correct issues from anywhere.
- AI-Powered Solutions: Our cloud-first, AI-powered solutions bridge the gap between reactive and fully autonomous energy control, bringing unparalleled resilience and precision to every level of energy intelligence.
- Sustainability and Impact: Energy efficiency is not just about cost savings—it's also about reducing your environmental footprint. By optimizing energy usage, Verdigris helps organizations reduce carbon emissions and operate more sustainably, supporting global efforts to combat climate change.

Our Vision for the Future

With Verdigris, you gain a partner who believes in a future where energy fuels growth and AI powers every decision, in real time. We're not just advancing energy monitoring; we're reshaping the potential of data centers worldwide. As we look toward the future, we are committed to advancing autonomous power orchestration and developing smarter, more intuitive systems that empower organizations to stay ahead of the curve. We believe the future of energy is autonomous, data-driven, and deeply integrated with the needs of the modern enterprise—and we're here to lead the way.

Ready to modernize your data center infrastructure?

Get started now.

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