MANTIS™ INNOVATION

Data center excellence: Optimizing the facilities behind the digital era

Driving competitive edge, sustaining reliability and uptime, achieving market-leading performance, and reaching sustainability targets for small and mid-size facilities.

March 2025

TABLE OF CONTENTS

About Mantis

At Mantis Innovation, unlocking efficiencies is our driving force. We specialize in energy efficiency, energy procurement, and facilities management solutions. Our tailored strategies help you optimize operations, minimize costs, streamline processes, and elevate performance.

Our expertise allows us to thoroughly assess your facility operations, identify areas for improvement, and craft long-term strategies for sustainable success. By enhancing energy management and implementing effective practices, we help you navigate budgetary risks and improve operational planning.

Together, we ensure your organization operates at its peak potential while setting new standards of excellence in your industry.

mantisinnovation.com

From ENIAC to exponential growth — small and mid-sized data center evolution in the modern AI age

Eighty years ago in 1945, ENIAC — the Electronic Numerical Integrator and Computer housed at the University of Pennsylvania — completed its first calculations. That milestone cemented not only ENIAC's place as the world's first general-purpose, programmable, electronic computer, but also as what many consider to be the world's first data center.

Now in 2025, data centers have become one of the fastest-growing sectors of the US economy. They're also the backbone of the current digital era, including hugely growing needs for data storage, cloud computing, and the more-recent burgeoning proliferation of artificial intelligence (AI) workloads.

Those market trends show no signs of slowing down anytime soon. In just the first weeks of this year:

- A consortium including OpenAI and NVIDIA announced the Stargate Project, a four-year, $500-billion push to expand AI data center infrastructure in the US,
- Goldman Sachs unveiled updated forecasts estimating a potential 165% growth in overall data center electricity demand by the end of this decade, and
- A Recon Analytics market survey found that of corporations that use the cloud as their primary form of data storage, nearly two-thirds expect that need to more than double within the next three years.

While it's often the Big Tech hyperscalers making headlines, in reality, smaller and mid-sized private and colocation data centers are equally strong workhorses of the sector for North American businesses.

Today's data center leaders are racing to meet historic and unprecedented growth. As they do, they're under intense pressure to come online fast, stay online reliably, and squeak every ounce of capacity out of their systems. Ensuring the combination of five 9s uptime and ever-improving power usage effectiveness (PUE) puts data center facility energy strategy front and center in the drive for innovation and competitive edge. Plus, it's central to meeting critical decarbonization goals and lower-carbon computing targets.

In this white paper, we take a closer look at specific trends and drivers in the sector, as well as the role of facility energy strategy for coming out ahead.

Achieving facility and operational excellence for ALL data center types

GREENFIELD

Effectively bridging between upfront design and ongoing operations with comprehensive controls and O&M expertise

BROWNFIELD

Providing new-build system design support while tackling retrofit challenges like aging roofs and building envelopes left out of tenant fit-outs

LEGACY

Leveraging retrofit expertise for system design, airflow optimization, controls upgrades, cooling management, and lighting improvements to boost long-term efficiency and reliability

Five major influences on data center facility strategy, operations, and maintenance

With the data center economy booming — and major expansion in the months and years ahead — several key market influences are putting facility strategy, operations, and maintenance at the epicenter.

Planning for power needs

1

AI-related computing demand requires more power than typical enterprise IT and non-AI cloud computing. (AI tools draw almost 10 times more electricity than a typical Google search.) Increasingly, greenfield data centers need to demonstrate better, comprehensive electricity planning in order to get approvals from state and local permitting authorities, as well as smoother, faster interconnection with grid operators. Meanwhile, greenfield, brownfield, and legacy data centers alike are also looking to manage energy costs within their OpEx, plus consider green procurement options that can keep their carbon footprint leaner.

Boosting reliability and ensuring uptime

2

Today's consumers expect always-on connectivity — a chronic appetite that puts data centers in the hotseat for keeping all systems optimized for the "five 9s" — 99.999% uptime. This means data centers need a comprehensive uptime strategy that ensures cooling systems, integrated facility energy strategies, and backup power systems all work seamlessly and effectively toward the five 9s. Moreover, with AI training runs that can last weeks, power quality and continuity is essential for avoiding disruptions that could result in costly computing time setbacks.

Continually improving PUE

3

As one of the industry's key performance metrics — and with growing regulations that define minimum PUE standards — data centers must find ways to streamline non-IT facility energy efficiency, ensuring that PUE numbers trend downward and keep operations lean. PUE is a metric that continues to set apart leaders, such improvements can garner better permitting for greenfield data centers that demonstrate leading PUE, and PUE improvements to legacy data centers can translate into stronger financial performance and smaller carbon footprints.

Maximizing site-specific performance and optimizing across portfolios

4

Data center companies often contend with a complex mix of legacy, brownfield, and greenfield facilities. The challenge is to balance squeezing every last drop of practical, economic performance out of legacy data centers, with implementing best practices from day one at new facilities, thereby avoiding common pitfalls stemming from a lack of coordination between design and operations teams. The design phase becomes paramount to ensuring a seamless connection of sensors, controls, and networks during the construction phase.

Achieving sustainability targets

5

With rising electricity and water consumption comes heightened environmental and emissions footprints. After years of declining Scope 2 electricity emissions, many data center operators and tenants are seeing upticks due to AI-driven computing demand and energy consumption. Communities and regional authorities are putting heightened scrutiny on data center water use, too. From public pressure, to media coverage, government programs, corporations' voluntary sustainability targets, and colo data center landlords wanting to stay competitive in attracting tenants, reducing emissions and achieving other sustainability targets is more important than ever.

MANTIS PARTNER SPOTLIGHT

Updating airflow management drives Tier 3+ compliance for Atlanta colo facility

CHALLENGE

An international multi-tenant colocation firm sought Tier 3+ compliance in an Atlanta facility, where mechanical systems were running unnecessarily due to lack of controls — resulting in inefficient cooling — while all CRAC units were running, preventing the company from selling remaining space.

OPPORTUNITY

Mantis improved airflow management by integrating all power and cooling systems, installing heat exchangers and automated valves and pumps, and automating two-way valves for better air distribution.

OUTCOME

The new system slashed PUE from 2.1 to 1.5, giving the facility the ability to scale to over 200 watts per square foot — driving N+1 redundancy and Tier 3 compliance, while boosting tenant satisfaction.

2.1 to 1.5	4,400,000	3,000	55%
PUE REDUCTION	TOTAL ANNUAL kWh SAVED	METRIC TONS OF CO_2 EQUIVALENT SAVED	RECOVERY OF MECHANICAL CAPACITY OF CRAC UNITS, PUMPS, AND COOLING TOWERS

Tailored building management system integration for new-build facility

CHALLENGE

An 80 MW data center needed a robust building management system (BMS) delivered at an accelerated timeline, and on a tight budget.

OPPORTUNITY

Mantis scoped modifications prior to bidding, driving budget accuracy, and collaborated with more than a dozen vendors to create and execute concurrent workstreams across 10 data halls — while identifying code violations and solutions that enabled the project to be delivered on time.

OUTCOME

Implementing best practices in the planning phase, before any work was started, Mantis delivered the BMS integrations on time and on budget.

80 MW	10	1 BMS
FACILITY DEMAND	DATA HALLS	INTEGRATION COMPLETED ON TIME AND WITHIN BUDGET

How facility assets and systems support data center business value

The aforementioned five influences all point in one common direction: optimized facilities to achieve data center excellence. That optimization includes consideration of major assets and systems, including:

Airflow management and cooling systems

As data centers grow and host more and more servers, cooling becomes a top priority to maintain operational efficiency — i.e., ensuring servers maintain optimal operating temperatures to avoid hardware failures — and in turn, ensure reliable uptime. As both uptime and facility maintenance and repair can have significant impacts on a data center's bottom line, cooling takes on an outsized role in operational stability.

Three best practices highlight the massive importance of managing data center cooling:

- **Managing airflow**. The balancing act between science, budget, and on-site standards and protocols makes air flow management a tricky process — especially for legacy data centers with aging control systems. Cool air needs to reach servers or data centers risk overheating — a potentially catastrophic problem that can disrupt uptime and prove costly if hardware needs to be repaired or replaced. In fact, outages can cost data centers $100,000 or more on average.

  Blanking panels and floor penetration sealing can help prevent air flow issues, but adding containment doors and upgrading to modern floor tiles like directional perforated tiles is even better. Upgrading controls and adding filler panels between racks are also vital steps in airflow management. But these upgrades can drive up project costs and risk disruptions to tenants if the work isn't managed properly.

- **Staying on top of equipment life cycles.** Every piece of hardware in a data center has a shelf life. Efficient building management systems include processes that back up equipment to avoid costly downtime should hardware fail or need to be replaced.

  Preventative maintenance and regular inspection of key equipment should also factor into an efficient BMS. For example, heating and cooling from HVAC systems can account for up to 40% of energy costs, making cooling far more than a budgetary afterthought. Legacy systems may become outdated, contributing to budget impacts that negatively affect a data center's bottom line.

- **Reducing water consumption.** Water access and use poses a significant financial and planning burden on data centers. Water rights vary drastically by region, and in some areas where other conditions are conducive to data center growth — e.g., readily available land and sustainable energy sources — water may be scarce. Using closed-loop systems can help reduce water consumption, thereby lowering operating costs and providing a more sustainable system long-term.

Backup power and redundant systems

Data centers suffer severe consequences during any downtime, even if it's not a protracted period of time. Downtime, anytime, can lead to revenue reductions as well as reputational damage with short- and long-term negative effects.

To improve uptime, small and mid-size data centers need strategic redundancy controls that include:

- **Backup power systems.** Uninterruptible power supplies (UPS) kick in automatically should power outages occur in order to keep vital hardware running.
- **Dual power supplies with automated failover.** This redundancy system implements two independent power sources. If one fails, the other kicks on automatically.
- **Redundant cooling units that kick in as needed.** Like dual power supplies, redundant cooling units pick up duties when another fails. This ensures consistent cooling, thereby lowering equipment damage risk.

Non-IT equipment energy efficiency

PUE is fundamentally a simple ratio of total facility energy use vs. IT-specific equipment energy use. A perfect PUE score = 1, meaning that 100% of a facility's electricity consumption went toward IT equipment. In reality, some energy goes toward non-IT systems. But keeping that number as lean as possible means that more energy consumption is going toward revenue-generating data storage and computation.

For example, last year Amazon Web Services (AWS) reported a PUE of 1.15 in 2024. Google claims a PUE of 1.10 across its global portfolio of data centers. Improving your PUE involves squeezing more computation per MWh of electricity from data center systems. Facility teams can better control airflow and cooling, and adjust temperature set points to optimize performance — without sacrificing reliability. In legacy data centers, human-led solutions can maximize efficiency without major infrastructure changes.

Working toward a stronger PUE number ensures your data center is using energy where it's needed most: IT-specific processes that serve the customer and data centers' bottom line.

Operational value

While every data center faces its own unique challenges, operations and maintenance (O&M) best practices dictate efficient ways to drive value and maintain operational consistency.

By reimagining operational strategy, data centers can support broader business goals, including the following:

- **Enhancing predictive maintenance and life cycle optimization**. A no-surprises approach to facility systems ensures greater budget certainty. Assigning a specific, accurate budget to maintenance and equipment replacement can be accomplished through collecting and analyzing facility asset inventory and BMS data. Predictive maintenance leads to stronger profitability and operational continuity by reducing the likelihood of critical failures and reducing or eliminating downtime.

- **Improved employee experience.** Sure, data centers have fewer employees per square foot than other forms of real estate, but that's no reason to ignore the teams you do have keeping your facilities running smoothly. Better tools and a more proactive approach to facility management with an employee focus can reduce unexpected failures, emergency calls, and extended troubleshooting. It also creates a future-proof approach to employee systems to ensure operational consistency during employee transitions.

Sustainability advances

Sustainability is no longer optional for data centers — it's a competitive necessity. From corporate net-zero commitments to tenant expectations and media scrutiny, pressure is mounting to reduce emissions and environmental impact. For colocation (colo) providers, aligning with sustainability goals is key to attracting tenants with Science-Based Targets initiative (SBTi) commitments and other carbon reduction plans.

A well-executed energy strategy strengthens sustainability efforts while improving operational efficiency. Smart and connected systems like sensors, smart meters, and building management systems can optimize energy consumption in real time, reducing waste and cutting costs and carbon.

Strategic procurement that integrates clean energy, renewable energy certificates (RECs), and infrastructure upgrades leads to stronger ROI by meeting or exceeding sustainability goals, in turn attracting more tenants and reducing reliance on costly and price-volatile fossil fuels.

Enhancing mechanical systems reduces energy use, supports customer satisfaction

CHALLENGE

The nation's largest communications infrastructure provider had a facility in New York with continuously running dry coolers, CRAC overuse, supply air short-circuiting, and no ability to control loop pressure — all leading to wasted energy and cost.

OPPORTUNITY

Mantis retrofitted three 150-ton dry coolers with 42 dry cooler fans to EC motor technology, created an airflow management system with intelligent system logic within the existing BMS, and optimized loop performance.

OUTCOME

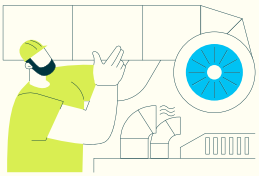
Today, the facility has two pumps running at 50–75%, rather than three pumps constantly at 100%. The new airflow management system allows for granular monitoring and control over HVAC equipment, based on temperature and humidity. Leading to significant operational savings, the facility was able to pay back the upgrade project in just over a year.

$175,000	1,084,000	93%
ANNUAL SAVINGS	kWh SAVED	OF AIRFLOW DIRECTED IN FRONT OF RACK VS. MIXING INTO HOT AISLE AIR STREAMS

The path to high-ROI data center optimization

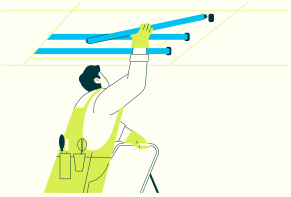
01 CAPTURING HIGH-ROI OPPORTUNITIES

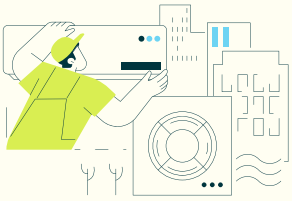
02 MODERNIZE COOLING



03 SEAL THE BUILDING ENVELOPE

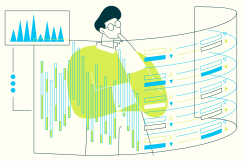
04 UPGRADE TO EFFICIENT LIGHTING





05 UPDATE HVAC SYSTEMS

06 ASSESS ENERGY USE & PROCUREMENT



07 LEVERAGE BUILDING MANAGEMENT SYSTEMS (BMS)

08 PUTTING IT ALL TOGETHER

Now that the new data center is built, or the legacy data center is converted and updated, it's time to look forward — far forward, ensuring it runs smoothly for years or even decades to come. Keeping long-term costs down and property values high over the life of the facility starts in the planning stages, but doesn't end there.

Despite the big challenges that small and mid-size data centers face in today's market, expert-led solutions can give those data centers a competitive edge. The process of optimizing a data center facility starts with a careful assessment of existing data to capture high-ROI opportunities while informing subsequent improvement steps.

With comprehensive data at hand, the facility optimization journey can begin. From cooling modernization to upgraded lighting, and even new energy procurement and O&M process improvements, each data center journey is tailored to specific needs, opportunities, revenue drivers, and budget.

Capturing high-ROI opportunities

Are you making the most out of your cooling? A preliminary assessment of PUE, site layout, cooling needs and control strategy can uncover opportunities to reduce the need for cooling and associated electricity cost through airflow management and other approaches. When applied across a portfolio of facilities, best practices quickly emerge to scale the amount of savings.

Operational practices, tracking data, and ongoing assessment are all crucial to motivate required maintenance, repair, and replacement tasks needed to steer toward net-zero emissions or other sustainability goals.

Modernize cooling

With great computational processing comes great cooling needs. Cooling is therefore a vital piece of the facility puzzle, which is usually achieved by capitalizing on water sources nearby. Major changes to these systems can improve efficiency and reduce energy and water spend, and are most cost-effective when making end-of-life upgrades.

- Closed systems reduce the volume of water needed to cool data centers. Recirculation keeps that water in use longer, leading to less wastewater.

- Freecooling offers a key opportunity to reduce cooling energy costs. Freecooling refers to cooling systems that obtain water and air from naturally cold sources. This allows the cooling system to cool without using a compressor or other mechanical refrigeration.

Server rack densities have increased in recent years, leading to more heat. Air cooling systems can help alleviate heat produced by high-density racks, as can higher-ambient-temperature design.

Seal the building envelope

Your data center's physical structure needs attention and care over time to ensure it's efficient, safe, and impermeable. An analysis of the building envelope — including roof structures, walls, floors, and any passages between the indoor space and the outdoors — summarizes the permeability of the data center structure, as well as the age and expected service life of its various components. Reducing leaks prevents long-term structural damage and protects components within.

A proactive building envelope program can help data centers extend the service life of the building itself, and make the most of limited budgets by prioritizing repair work and only conducting this work when it is necessary.

Upgrade to efficient lighting

Is your current lighting system illuminating ways to cut costs? If you've already upgraded to LED, consider how long ago that was. The newest LED tech is far more efficient than previous generations.

Advantages to LED lights include less maintenance, utility incentives to offset upgrades and installation costs (in certain regions), and little to no disruption of overall data center operations.

Update heating, ventilation, and air conditioning (HVAC) systems

HVAC systems often operate as big, energy-hungry beasts at the heart of your data center operations. Between 10% and 30% of total energy use in commercial buildings is used to support systems like HVAC, process heating and cooling, and exhaust systems. Fortunately, these components are often prime targets for efficiency improvements.

- Analysis of HVAC systems can reveal opportunities to reduce energy costs and work toward sustainability goals. Replacing or retrofitting may be necessary in certain situations.

- Refrigerants have changed in recent years, as have emissions regulations. An analysis of HVAC systems can reveal whether a data center's HVAC is 'up to code' and running on refrigerants that meet sustainability standards.

Assess energy procurement, demand control, and renewables

Energy is one of the top operating costs for data centers. With energy prices fluctuating due to global events, weather, and policy shifts, data centers need a proactive approach to securing reliable, cost-effective energy — and managing consumption shrewdly, too. And for those data centers in deregulated states, taking a strategic approach to procurement can help mitigate price risk from market volatility.

We help building owners/operators tackle energy cost and risk from both the demand side and the supply side (strategic procurement). This begins with understanding the playing field: what's going on in wholesale electricity markets? How can you implement demand response programs to curtail energy usage?

Reducing peak demand with sophisticated demand management tools is a key strategy for lowering costs and improving resilience. Advanced energy management systems optimize usage through automation, helping reduce reliance on the grid during high-cost periods. For example, our smart controller staggers equipment and machinery run times to flatten your overall usage pattern, resulting in a 20–50% reduction of your demand charges — without altering performance.

In terms of incorporating renewables, renewable energy certificates (RECs) offer a flexible way to offset fossil fuel use and meet sustainability targets, but they don't directly reduce your facility's dependence on grid power. Integrating renewable energy sources like solar and wind can provide long-term cost savings and lower emissions, though feasibility depends on factors like location, cost, and infrastructure timelines.

For new data centers, long grid interconnection delays can pose challenges. Onsite solar, however, offers a faster path to operational readiness, providing immediate power generation while enabling participation in demand response programs that help reduce peak energy costs.

Leverage building management systems (BMS)

The smoothest-running ships operate from a central command center. Your data center should, too. Building management systems (BMS) provide a thousand-foot view of all of your data center systems, and the ability to manage them in one place.

A well-structured BMS enables:

- System integration: HVAC, mechanical, security, and lighting.
- A more holistic view of efficiency, losses, and areas for improvement.
- Remote monitoring: improve efficiency across equipment, ramp systems up and down to match demand.
- Customizable scheduling: modify schedules of multiple systems to meet demands at various times of day, monthly, seasonally, etc.

Putting it all together

Analytics, cooling, uptime, PUE, energy procurement, your building systems, your bottom line — all of the factors and others mentioned above coalesce to form a facilities management plan that improves your ROI.

Achieving that final plan — which integrates energy and sustainability goals with PUE improvements and efficiencies that impact operating costs— starts with a simple plan:

- Get a "fast start" by understanding current performance and identifying low-hanging fruit.
- Develop a big-picture optimization playbook.
- Prioritize and implement projects.
- Outsource project management in order to focus more on running data centers and less on managing the complexities of each project.
- Account and report.

MANTIS PARTNER SPOTLIGHT

Modernized lighting and controls offer a fast path to reduced energy spend on a tight budget

CHALLENGE

A New York facility required a complete lighting and lighting controls retrofit at a 38,000 square foot data center facility, at a minimal cost due to tight budget limitations. Existing facility constraints further complicated retrofits and upgrades.

OPPORTUNITY

Mantis took the opportunity to retrofit the existing fixtures with dimmable 2x4 LED kits with integrated occupancy and daylight sensors that adjust lighting according to ambient conditions and occupant needs. Overall, 147 2x4 recessed troffers were replaced with more modern 2x4 LED kits that use less energy.

OUTCOME

Integrated sensors increased energy savings by more than 20%, as the fixtures were grouped together and dimmed down to IES recommended light levels. Mantis also secured incentives to complete the project, resulting in a year-over-year square foot — driving N+1 redundancy and Tier 3 compliance, while boosting tenant satisfaction.

$34,000	230,500	163	<1 year
ANNUAL FINANCIAL SAVINGS	kWh ANNUAL ELECTRICITY SAVINGS	METRIC TONS AVOIDED CO_2 EQUIVALENT	PROJECT PAYBACK PERIOD

Your partner for facility excellence

The data center industry is evolving at warp speed. The data center leaders who embrace smarter facility and energy strategies are the ones who'll position themselves to excel in this era of rapid transformation — whether at greenfield, brownfield, and/or legacy facilities. Our team is ready to help you succeed.

> Contact a Mantis Innovation expert today to start the conversation.

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