WHITEPAPER

Why Performance Improvement and AI Are a Natural Fit for Your Chiller Plant



Your building's chiller plant is a practical place AI can make a difference in building operations. It can support continuous improvement, with the potential to drive energy efficiency and comfort, while helping address the growing talent gap.

When management challenges you to rein in energy costs, report sustainability gains and keep people comfortable in every corner of the building, chiller plant performance comes instantly to mind. You know you could improve building performance — if you had enough time to continuously monitor plant performance and if your staff had the advanced programming expertise that modern chiller plant operations require. Most likely those "ifs" are not your reality, and you're probably already thinking that artificial intelligence may be the solution.

The use of AI applications in building management is growing. Considering how much and how quickly it may help move the needle on reducing cost and helping to lower carbon emissions while elevating occupant comfort, the chiller plant is a practical place to start. Introducing AI to your chiller plant may be easier than you think. If modern controls are already in place, your plant may be virtually AI ready. If plant modernization is coming up on your project list, now is the time to start planning for a future that includes AI.

A Natural Progression

Artificial intelligence is already affecting our everyday lives in small but meaningful ways. You may not even think of it as AI or realize how much you've come to embrace it: Navigation apps adjust routes in real time to help avoid traffic snarls and get you home faster. Smart devices learn what we like and want based on the digital content we engage with, so we discover things we need but didn't know existed. Most of the time, AI feels like natural improvements to things we already use — not a dramatic shift.

That same pattern is happening in building systems. In chiller plants, digital controls have existed since the 1970s. Following a natural technology progression, many chiller plants have been getting ready for AI without even realizing it.

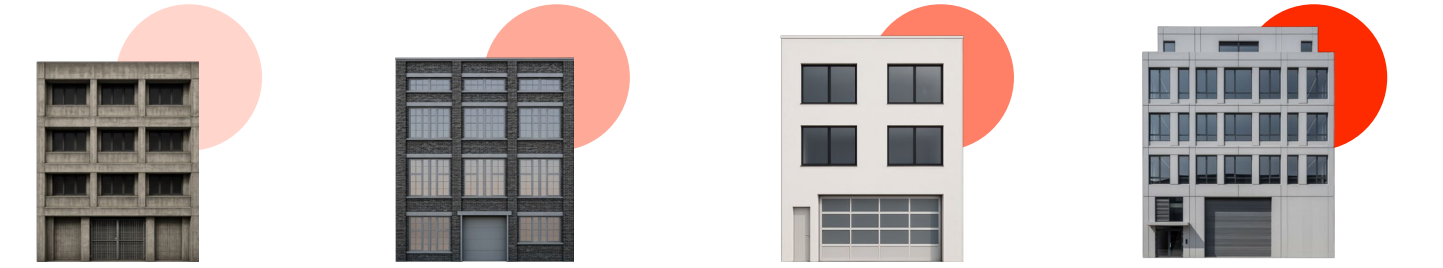


Right now, chiller plant control is in the "automation generation," where the lines between equipment and controls have blurred. Chillers alone are designed for efficiency and reliability. Performance gains may be achieved when digital controls manage chillers, pumps and cooling towers together as a system using advanced, data-rich building automation platforms like Tracer®.

And here's a great twist: Once the data-rich framework is set up for automated chiller plant control, the plant is virtually AI-ready. If controls modernization is done well, AI may not need anything "new." It may simply use the same data and tools.

The Controls Evolution

The evolution from chiller plant **automation** to AI **autonomy** naturally continues the trajectory of historical chiller plant control improvements that began in the 1970s.





Digital control introduced at the equipment level



Emergence of true chiller plant control and sequencing



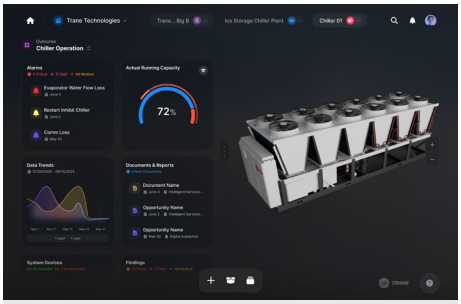
System-level optimization strategies mature



Peak of rule-based "optimized" plants

The AI Pathway

Let's take a deeper dive into the similarities and synergies between modern chiller plant controls and AI-driven systems. In both, a continuous data stream feeds the logic that supports energy efficiency, resiliency and sustainability.



Why chiller plants are a prime candidate for AI.

1. High energy intensity promises a strong ROI
2. Sensor-rich environment provides a solid data stream
3. Clear performance metrics, including kW/ton, delta T, lift and more

Stage 1: Chiller Plant Control

Tracer chiller plant control (CPC) is a pre-engineered software application that operates on the Tracer® platform. Programming sequences and strategies developed by Trane's HVAC system experts coordinate multiple chillers and other system components for improved performance.

System efficiency is designed and driven by multiple pre-programmed applications:

- Chiller sequencing and staging
- Temperature-based add/subtract logic
- Efficiency-based staging
- Chilled water setpoint calculations
- Soft start mode
- Rapid power failure recovery
- Chiller rotation
- Failure and alarm management
- Plus, traditional Trane Tracer for waterside optimization at the broader plant level: chilled water reset, pump pressure reset, chiller/tower optimization, enhanced cooling tower staging and load-based condenser water reset

CPC uses pre-programmed, rule-based logic that is configured at commissioning. While it is designed to deliver highly reliable, repeatable real-time control, it operates on a fixed-logic framework rather than continuously learning and evolving its strategy over time.

Stage 2: Adding AI Control

AI systems may expand on the capabilities control systems like Tracer offer, adding predictive decision making that may help improve the plant over time through learning and memory. Trane's recent optimization solution, Trane AI Control powered by Brainbox AI, layers on top of Tracer using the same data streams.

AI Control does not replace Trane's engineered sequencing and safety logic — it enhances and adjusts in real time and predictively, with limited operator intervention. The core distinction is rules-based vs. adaptive optimization.

- **Predictive, not reactive:** Traditional rules-based control strategies respond to temperature changes that have already occurred (with strategies like trim and respond). AI control can help unlock the ability to achieve deeper performance improvement by leveraging ML-driven models to further improve the staging of chillers, pumps and cooling towers, deriving setpoints to help reduce overall kW/ton.
- **Learning and improvement over time:** Tracer chiller plant control performance is static from day one. Trane AI Control models are designed to improve as more operational data accumulates. The system can continue learning and adapting the longer it runs.
- **Drift compensation:** All systems drift — sensors age, equipment degrades, occupancy patterns shift and manual overrides accumulate. CPC can detect but cannot correct this. Future versions of AI control may be able to continuously recalibrate to real conditions and therefore helps support efficiency as time goes on.

CPC and AI together may achieve efficiency and performance improvements. As facilities professionals, we understand how to solve optimization problems. We simply have computational limitations that AI may overcome.

AI Readiness

Understand the Capabilities

How does AI Control actually work within a chiller plant?

Typically, it is introduced as an advanced supervisory layer that interacts with an existing control system. It can both read and write to the control points, meaning it receives information from the system and implements the appropriate reaction.

That may not sound all that different from CPC and its rules-based, reactive system automation based on incoming data. The difference is AI Control's capacity for active learning, deeper analysis and predictive responses. It adds a supervisory layer that activates system autonomy by receiving system information, integrating outside data like weather and occupancy, analyzing it, and then activating the appropriate action with limited intervention by your facilities team.

By combining **Trane AI Control** smarts with the advanced **Tracer** building automation solution, many buildings may see significant results[1]:

- **Up to 40% reduction in carbon footprint**, enhancing sustainability efforts
- **Up to 25% reduction in HVAC energy costs**, improving financial outcomes
- **Ongoing system monitoring and performance improvement** sustained efficiency with limited human intervention

Through active learning, it can help to:

- Enhance occupant comfort by making load predictions and initiating the right response predictively
- Reduce energy use by analyzing current sequences and implementing changes to improve performance
- Save money by reducing total power consumption of the whole chiller plant rather than each component separately
- Reduce downtime and risk by using advanced methods to detect anomalies

Autonomous management moves chiller plant operation beyond the limits of traditional control by continuously learning how components respond to dynamic conditions. Because it operates autonomously, it can help take improving plant performance off your long list of job priorities.

Define the Purpose

Many AI pilots stall when the objectives are undefined. The right provider can help you to align your organizational goals with the capabilities of the AI solution. This often requires input from a team of stakeholders: the building owner, business managers, finance directors, IT and more. Success is more likely when everyone has a chance to weigh in on the objectives: What should AI accomplish? How can it be measured? How long should it take? Does it have visibility and support from top management? Trane Account Managers can work with you to facilitate a design and planning workshop to document all critical areas of input and define a strategy that supports everyone's goals.

Prepare Your Plant

Whether your AI timeframe is next month or a few years down the road, now is the time to start preparing your plant.

- If you haven't already, **establish system-level control**, instead of managing each component in isolation. Advanced control platforms like Tracer can support the work by applying structured, rule-based sequencing.
- **Improve data quality.** Properly deployed systems can help produce data that is both abundant and well organized.
- **Bring in additional information.** Start incorporating demand-response strategies that adjust operation based on utility signals or energy pricing.
- **Help newer employees understand basic chiller plant operations.** Deploying user interfaces that interpret complex functions into clear human language helps to quickly build the skill sets that may become increasingly important when their job descriptions evolve to keeping powerful AI systems under control.

[1] Trane Commercial, "Decarbonizing Buildings with AI's Help," 2023.

Build the Data Foundation

One key point to remember: AI optimization is only as intelligent as the data behind it. A common misconception is that AI requires massive quantities of data. In practice, data quality is often more important than data quantity. Prioritizing sensor accuracy and data quality is important for today's system performance, and it becomes increasingly important for AI systems to be effective.

Here are a few considerations for building an AI-ready data foundation that may help enhance the benefits from current control systems.

- **Measure what matters:** Accurate flow, temperature and power measurements provide a trustworthy picture of plant performance.
- **Create equipment-level visibility:** Granular data from chiller pumps and cooling towers can support system improvements.
- **Incorporate external information:** Add context to building behavior with data on weather conditions, occupancy schedules, utility signals and time-of-use data.
- **Build data consistency:** Common tagging, point naming, timestamps and metadata help users interpret and act on information.
- **Think beyond today:** The right trending intervals and long-term storage create the historical record future AI models may need.



How data is used.

Reliable sensors, resilient infrastructure and well-structured data streams create the foundation for meaningful analysis by facility managers and AI. Long-term data storage through solutions such as Tracer® Ensemble® and Trane Cloud can preserve the operational history needed to identify trends, evaluate performance and support AI applications.

Ease Into AI Confidence

If you're already comfortable with automated chiller plant control, transitioning to AI won't mean abandoning what you know and doesn't have to happen all at once. Your facility team can begin by using AI to analyze a limited period of chiller plant data, test optimization theories and identify opportunities for improvement. As AI earns your trust, more autonomy can be introduced — with defined operating boundaries.

Ready When You Are

AI can help deliver meaningful improvements in building performance. The goal is not to "adopt AI." It is to use AI's capabilities to help support improved building performance, lower operating costs, resilience and less day-to-day system intervention.

Tracer provides the controls, connectivity, data infrastructure and building expertise that can help establish that foundation. Trane AI Control builds on it with intelligent, autonomous optimization that is designed to continuously learn from building data and adapt operations to changing conditions.

Together, they provide a practical path from connected controls to intelligent optimization. Whenever you're ready, we can help your facility team improve performance today while preparing your buildings for a future that includes AI.

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