



# Machine Learning and Chiller System Optimization

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# Algorithms vs Machine Learning

## Algorithms

- A sequence of instructions given to a computer to perform

## Machine Learning

- Algorithms that learn from exposure to data and improve their performance over time



# Implication for Chiller System Optimization

## Algorithms

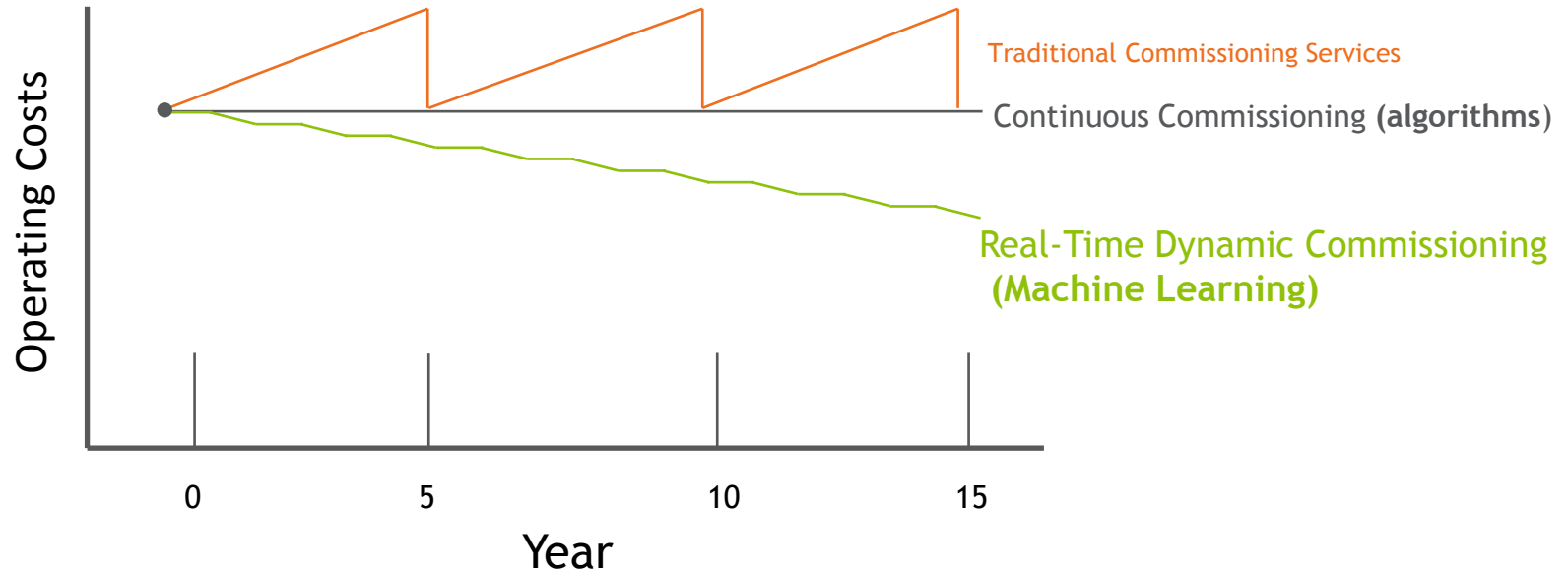
- Directs the BAS to turn on/off a chiller at a given time

## Machine Learning

- Adapts to the equipment in a chiller plant and directs the BAS to turn on a **specific chiller** at a given time.



# Comparison of Commissioning Methodologies



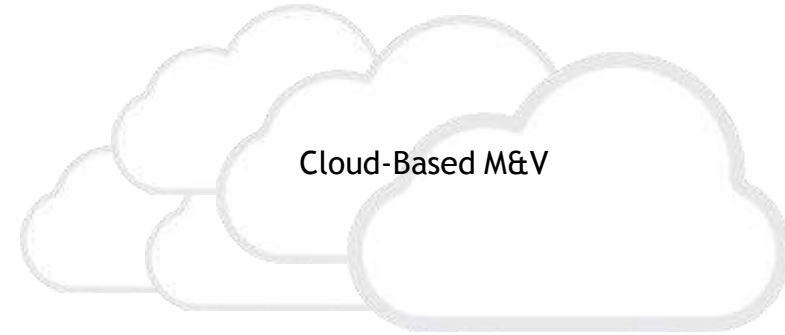
The Machine Learning approach to commissioning learns and adapts over time



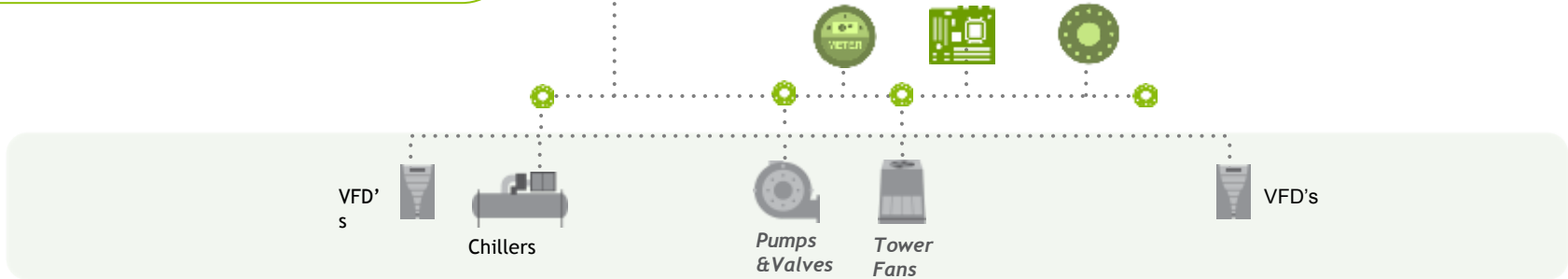
# Current Optimization Approach: Algorithms



- Patented relational control algorithms
- Automatically and continuously optimize plant performance in real time
- Dynamically adapt to yield the lowest energy draw while meeting availability requirements
- Flexible implementation: e.g., ability to start with cooling towers



OptimumLOOP



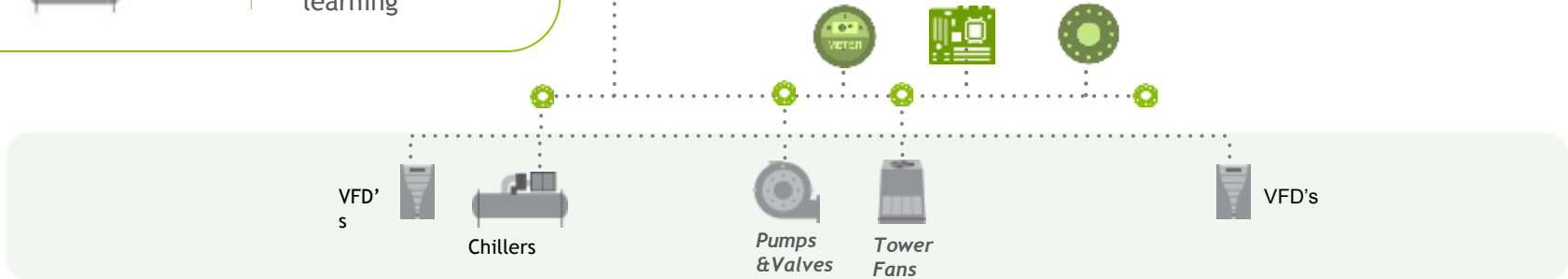
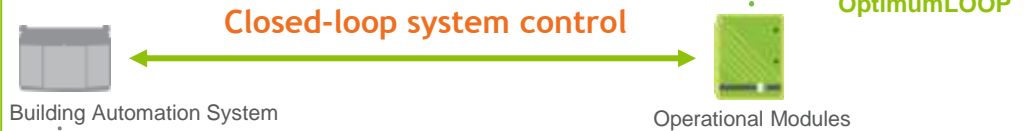
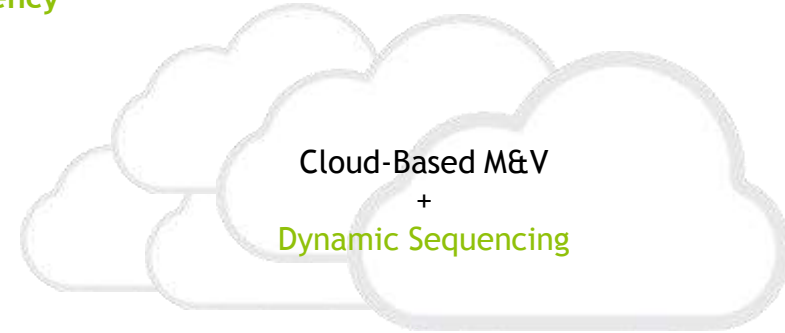
# Next-Generation Optimization: Machine Learning



- Optimizes resource and system efficiency
- Recommends optimal sequences for achieving maximum savings

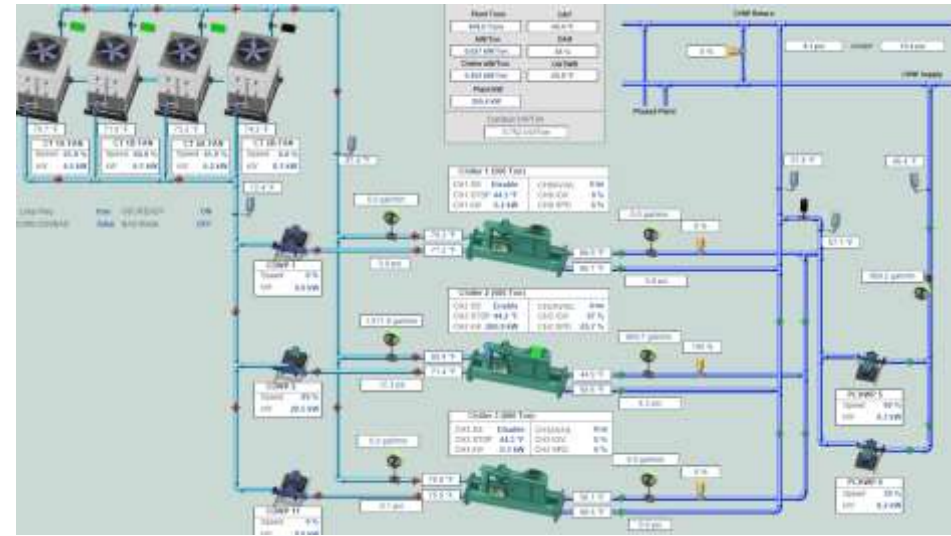
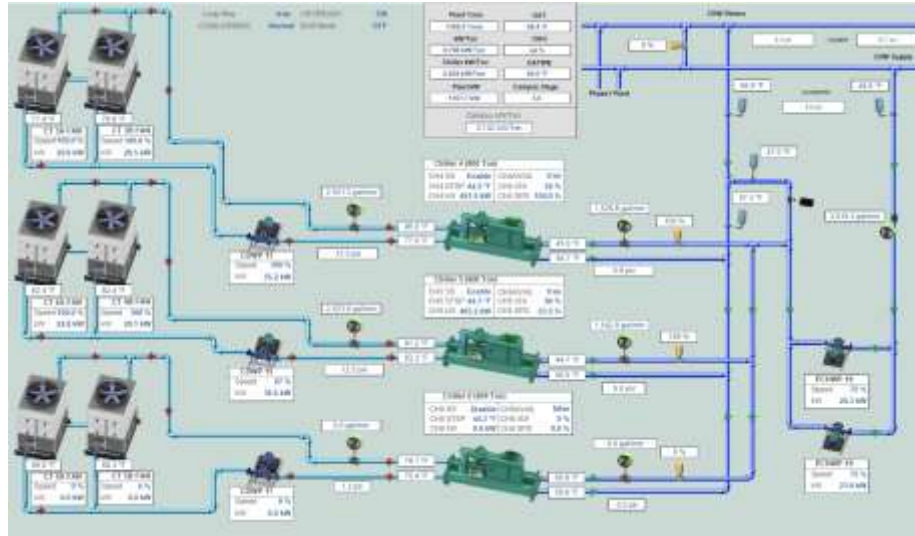


- Learns over time how chillers perform
- Adapts in real-time
- Orchestration of chiller operations driven by machine learning



# Pilot Test Overview: Dynamic Sequencing

- Pharmaceutical company, Jacksonville, FL
- 6 chillers, 2 x 500ton, 4 x 800ton, Total = 4200tons
- Pilot has been enabled and operating full-time for 4 months

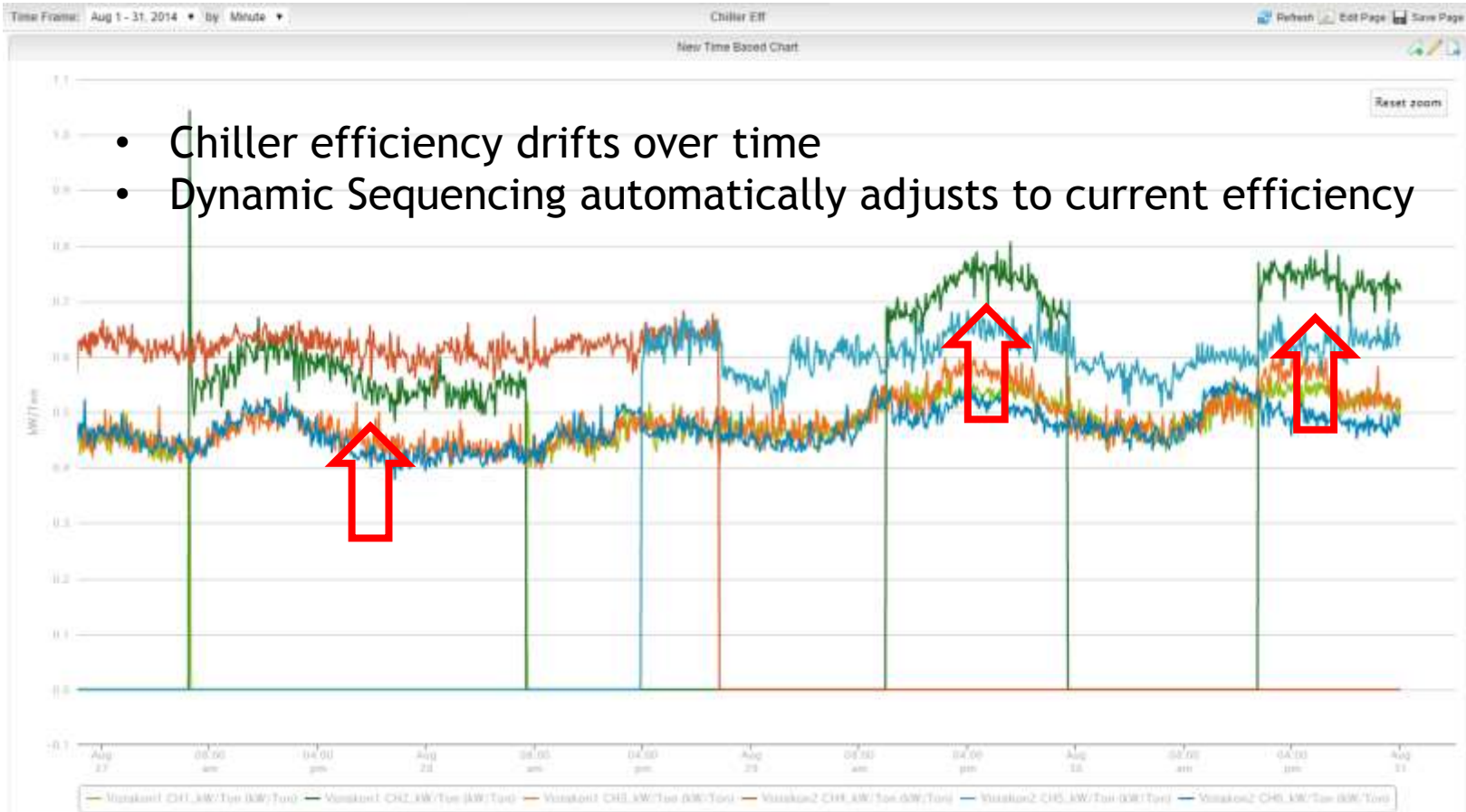




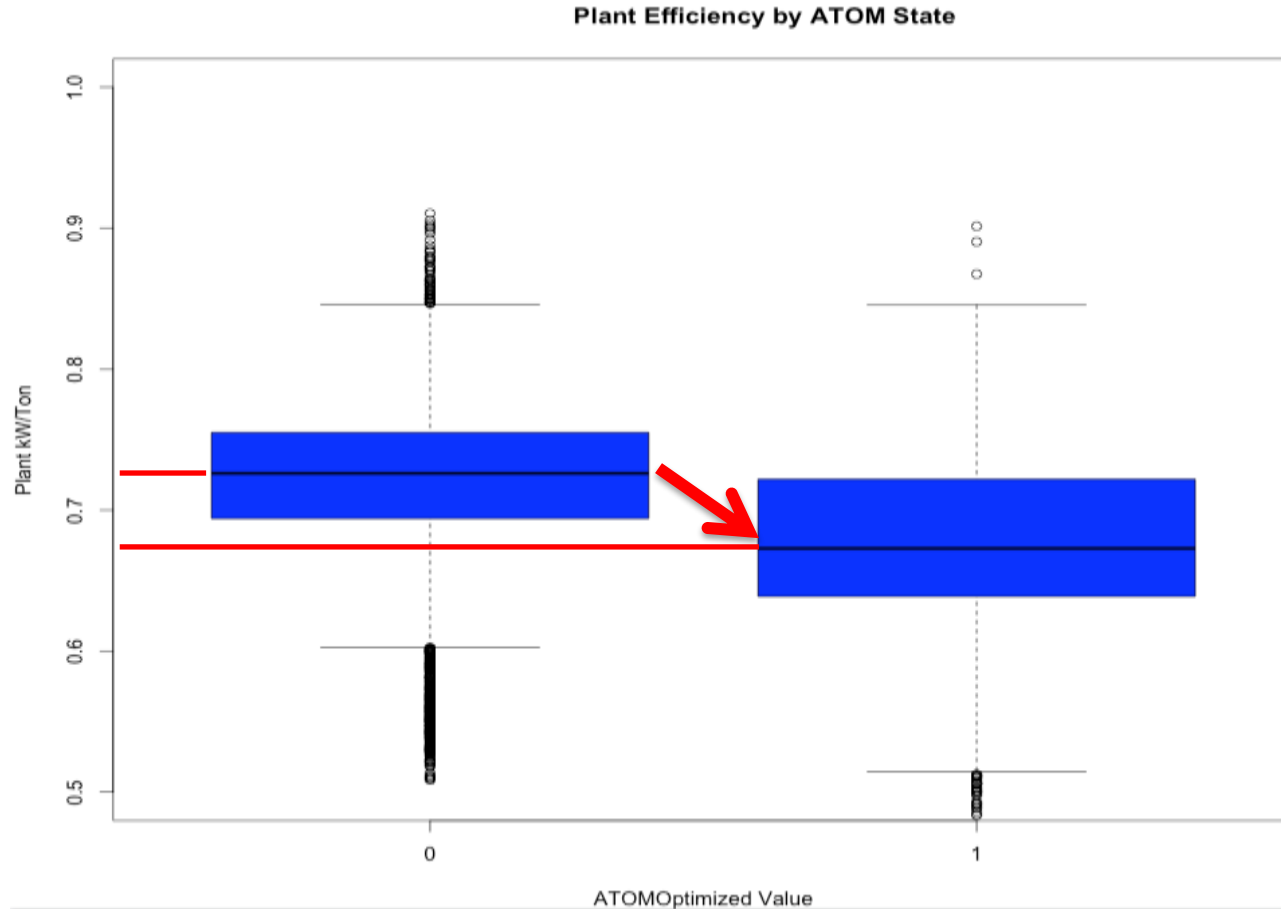


# Performance Drift

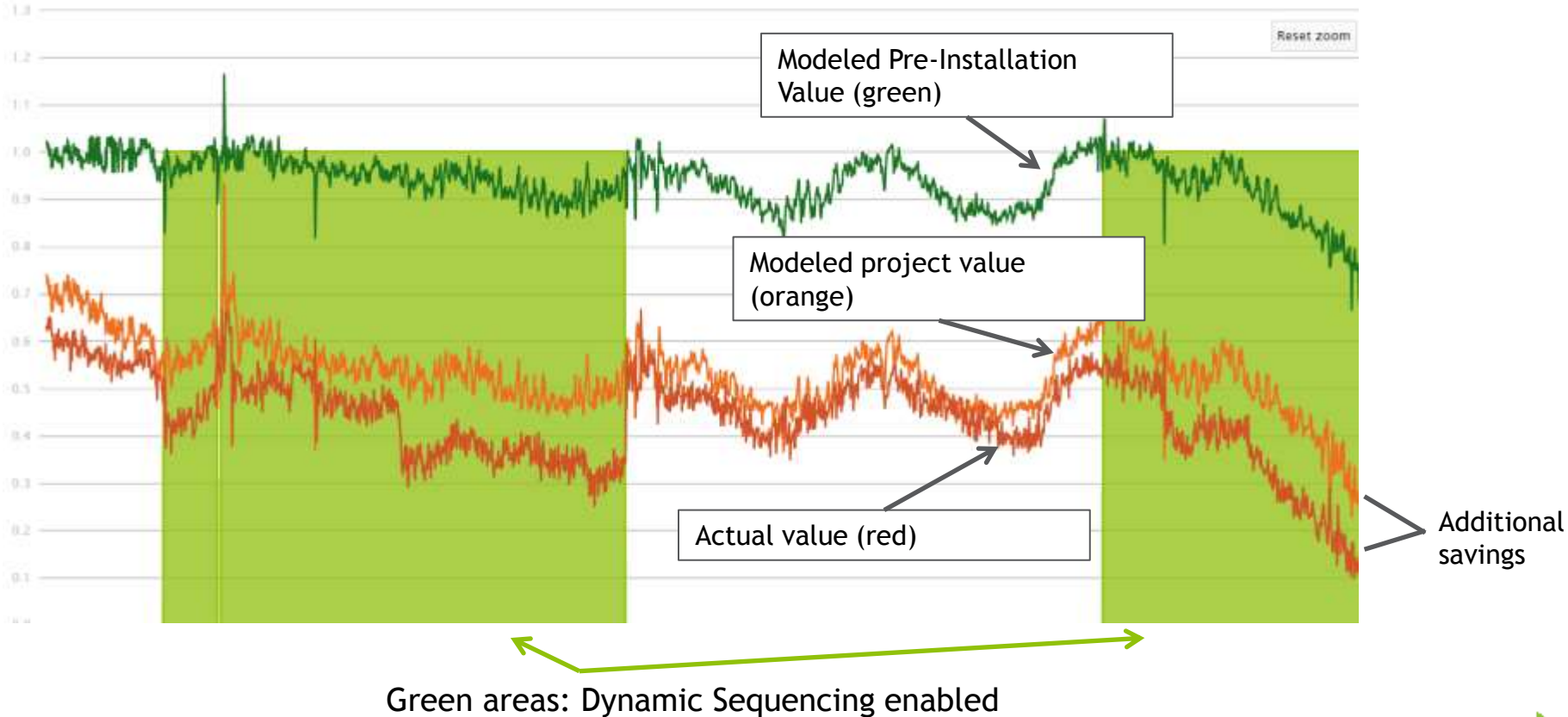
- Chiller efficiency drifts over time
- Dynamic Sequencing automatically adjusts to current efficiency



# So what does this mean? What can Machine Learning actually do?



# Pilot Test Results to Date: kW/ton

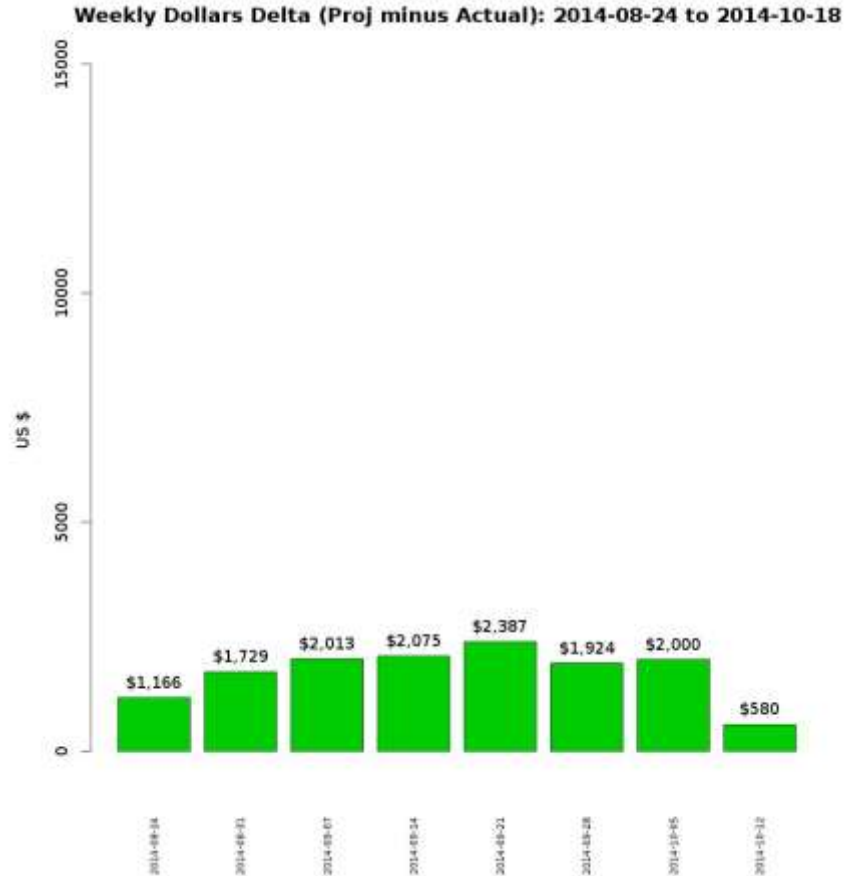


# Energy Savings

## What are the Results?

With the data obtained from the pilot project, savings at the site exceed our original estimated OptimumLOOP savings.

The results to date show 5% additional savings on top of a fully optimized campus distributed chilled water system.





Thank you.

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