SHOWCASE PROJECT: ASTRAZENECA: ENERGY AND ENVIRONMENTAL SAVINGS THROUGH CONTINUOUS MONITORING AND ADVANCED ENERGY ANALYTICS

SOLUTION OVERVIEW

AstraZeneca is a global biopharmaceutical company that focuses on the discovery, development, and commercialization of prescription medicines. The campus in Gaithersburg is one of three of AstraZeneca's global strategic R&D centers. With 9 buildings across the campus, there are significant savings opportunities associated with the operations of heating, ventilation, and air conditioning (HVAC) systems for offices, labs, and manufacturing areas. Implementing a continuous HVAC controls and monitoring system using advanced analytics and machine learning capabilities has been identified as a key strategy to achieving higher efficiency and reducing environmental impacts for the campus. To implement this strategy, AstraZeneca engaged a third-party vendor through a 3-year energy monitoring contract to provide virtual sub-metering and dashboards for tracking and monitoring energy usage.

The continuous monitoring capability revealed numerous opportunities for low-cost energy savings, including optimal start controls on all air handler units. The campus is expecting to save more than 6,900,000 kWh of electricity and 170,000 therms of natural gas each year from this effort which equates to ~$851,000 per year. This will prevent 6133 tons of carbon from being released into the environment equivalent to taking 1210 passenger vehicles off the road (EPA).

The existing data collection system used by AstraZeneca collected continuous system-level data from 8000+ sensors and 250+ control points. The system took 12 to 24 hours to analyze and interpret results, which made it difficult to implement real-time adjustments to optimize control strategies. To derive more insights from the data and monitor facility energy performance, a project was developed to upgrade the sub-metering and controls system to provide continuous equipment-level data using advanced machine learning-based algorithms. The goal for the new data collection system was to have virtual sub-metering and additional dashboards for energy tracking. This would enable building operators and energy managers to identify and correct outliers as they occur. Additionally, the existing control system was not being fully utilized and this was determined to provide a significant energy efficiency opportunity for the AstraZeneca Gaithersburg facility.

SECTOR TYPE
Industrial

LOCATION
Gaithersburg, Maryland

PROJECT SIZE
1.24 million square feet

FINANCIAL OVERVIEW
Cost of ASHRAE LV II and Overhead of BMS Controllers time for one year

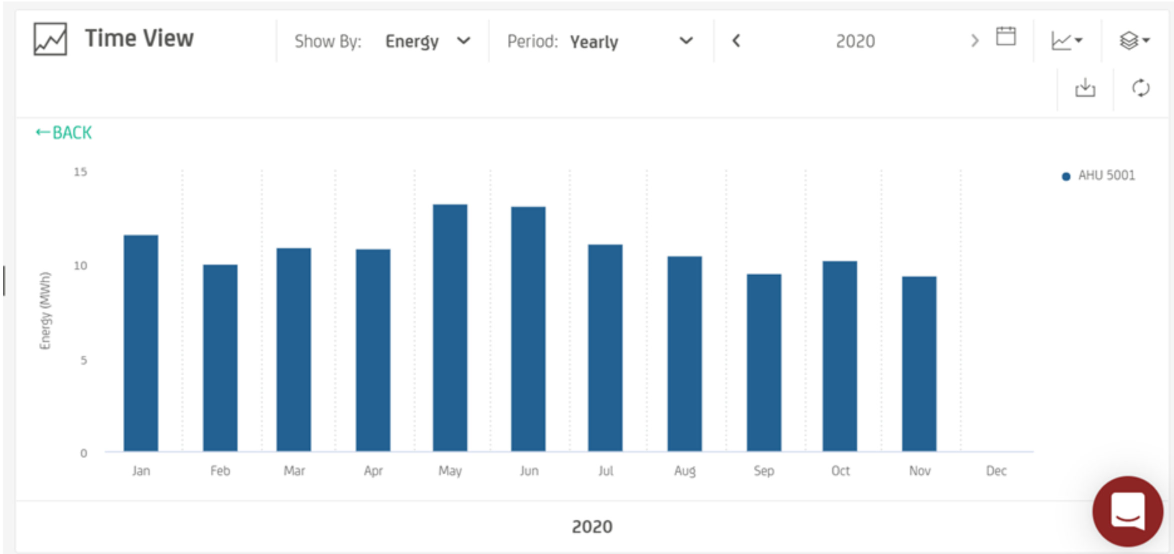
SOLUTIONS

In May of 2019, AstraZeneca implemented a virtual data sub-metering system that allows building operators to make real-time changes to control settings while tracking campus-wide energy data. Overall, integrating continuous data monitoring into the old system took more than three months and between 120- and 150-labor hours. The first step involved collecting data from the current building management system, cleaning it, and sending it to the new server.

The data consisted of approximately 8,000 readings of various parameters including temperature, pressure, and system status. To accommodate the size of the data set, additional servers had to be purchased to increase the system's data storage and processing power. To manage storage capacity, data was captured in a 5 to 10-minute resolution and sent to the cloud servers for analysis twice an hour for access by the vendor. To automate this process, the system was programmed to schedule the data to be pulled from the building management system, configure the data points to a template recognizable by the analysis software, and time-sync a data dump from the local system to the cloud server.

The second step was to analyze the collected data using the third-party vendor's data analytics algorithms. The results were instantaneously generated and displayed to the facility team via a web-based dashboard (see figure 1 for a screenshot). The dashboard includes a virtual sub-metering model built for the facility using the data from the Building Management System and equipment nameplate information. Any discrepancy to normal equipment operations that the algorithm finds is immediately reported via an email ticketing system. This ticketing system allows the vendor to identify an equipment parameter that is out of range and inform facility personnel. AstraZeneca can then immediately respond to make process changes to restore the system to normal operations and achieve optimal efficiency.

Figure 1: Virtual sub-metered energy consumption from an air handler unit in building 950, from site dashboard



Due to the relationship with the utility company for acquiring rebates and the effectiveness of the dashboard to verify savings, a 3-year monitoring contract with the vendor has been put in place. The cost includes energy analysis and dashboarding services. Additionally, a percentage of the utility rebate dollars from all identified controls projects are shared with the vendor. Half of the rebate funds to the site are dedicated to fund additional sustainability efforts. With the implementation of the continuous monitoring strategy, corrections to equipment operations can be done almost instantaneously. System errors have been corrected since the system came online, including settings that were inadvertently left in place that kept equipment running during unscheduled hours.

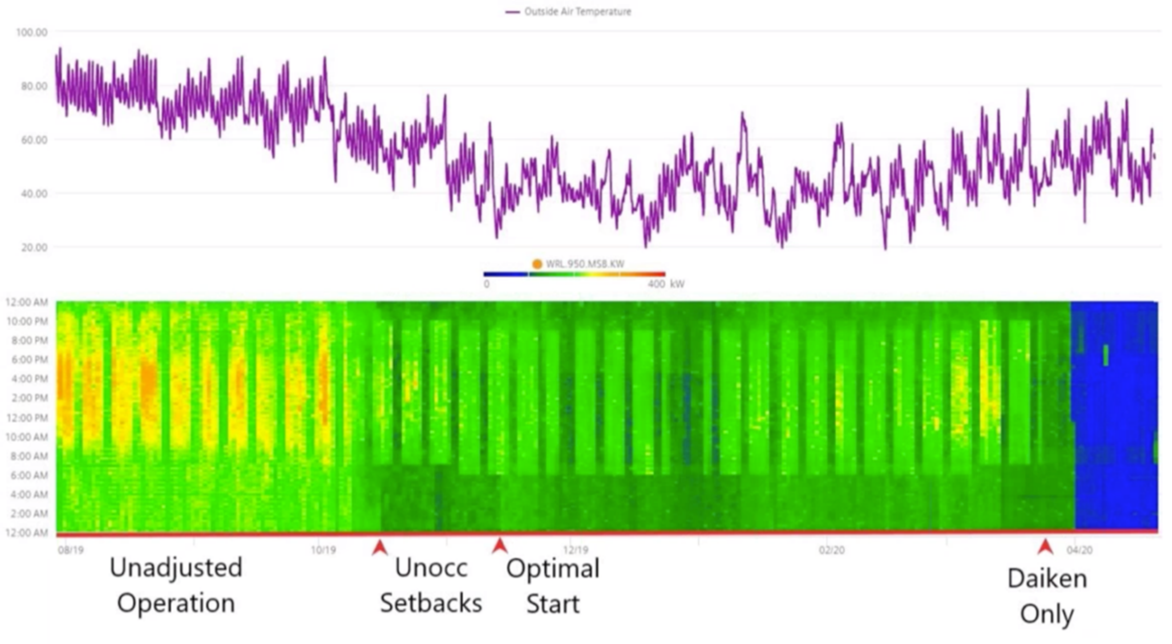
The optimal start control project came about from insights provided by the continuous data monitoring system. Before the optimal start controls were implemented, hardcoded schedules were utilized so the HVAC systems would start at designated times regardless of outside temperature or the building load. The use of the optimal start system saves 1.5 hours of system runtime most days by anticipating the heating or cooling needs of a workspace and starting the HVAC equipment at the right time to ensure optimal heating and cooling needs are met when the space is in use. The control system also utilizes outdoor air and considers building envelope conditions to determine the exact time each morning to begin heating and cooling.

No additional hardware was needed for the optimal start project since all configuration and testing were completed internally at AstraZeneca. The process of configuring the optimal start control was relatively simple. Once the settings were updated, the optimal start control was tested at a single building on just one Air Handling Unit (AHU) during Memorial Day weekend. The configuration parameters for the control tool had to be determined using a trial and error approach. Though it took almost 60 hours to get the first AHU running properly with the optimal start strategy, the same template was applied throughout the campus, which only required 1-2 hours per day to test each zone.

Once the control strategy was implemented throughout the campus, facility maintenance personnel were trained on how the control system functions, but since the optimal start controls are self-learning this cuts down on engineering time and labor to determine appropriate start times and make seasonal changes manually. The algorithms make use of reinforcement learning techniques by correlating the operating conditions with past performances to identify the optimal controls for each

AHU zone. During the learning phase, the algorithm builds a data table between outside air temperature and the time it takes to achieve the required room temperature. It took an average of 10-12 days for the algorithm to learn the optimal strategies for each system during the summer for cooling while the heating controls were leaned much faster. The total annual energy savings from the optimal start controls project was 732,465 kWh, 22,028 therms, which equals $96,435 per year in cost savings. See figure 2 for heat map of optimal start.

Figure 2: **The heat map of the facilities energy consumption is plotted against the outside air temperature, showing energy reductions resulting from the optimal start strategy**



OTHER BENEFITS

AstraZeneca plans to use the higher resolution data provided by the new virtual sub-metering system to refine models used to forecast energy consumption and track facility-level energy performance. This will help the company meets its measurement and verification requirements for Better Plants, Superior Energy Performance 50001, and ISO 50001 metrics. It has also become easier to verify the energy savings associated with implementing various control strategies. Given that the savings calculated for the controls are backed by real data, getting the appropriate utility rebates has become much easier.

By expanding the continuous monitoring and associated analysis to include maintenance parameters like equipment vibrations, it is now possible for AstraZeneca to determine when a piece of equipment is close to failing. Integrating this information into the facility maintenance workflow enables the maintenance team to be more proactive with planning for capital investments and upgrades.

The success of this project has presented new opportunities for other AstraZeneca facilities and is paving the way for similar control projects to be implemented at more plants.

Annual Energy Use

Baseline(2018)

131,000 MWH

Expected(2020)

109,000 MWH

Energy Savings

16.8%

Annual Energy Cost

Baseline(2018)

$9,174,000

Expected(2020)

$8,322,000

Cost Savings

9.3%