CONSORTIUM for BUILDING ENERGY INNOVATION

Re-tuning Case Study

Vornado/Charles E. Smith Re-tunes Office Building to Save Energy. Arlington, VA

Re-tuning drives additional efficiencies and utilizes sophisticated BAS

Address: 2100 Crystal Drive, Arlington VA
Owner: Vornado/Charles E. Smith
Lease type: Gross Lease
Size: 250,000 Square Feet

Vornado/Charles E. Smith is one of the nation's largest owners and managers of commercial real estate. The company is committed to environmental responsibility and is aggressively pursuing green initiatives. Over 25 million square feet of Vornado's office portfolio has earned the ENERGYSTAR label.

In October 2012, with training assistance from the Pacific Northwest National Laboratory (PNNL), Vornado trained its building operators to re-tune its worst-performing, highest Energy Use Intensity (EUI) building in the DC Maryland Virginia area: Crystal Plaza 3. Combined with its highly sophisticated Building Automation System (BAS) and associated dashboard, Vornado reduced its electricity consumption in the building by 4.4% compared to predicted usage (see Figure 1).

Vornado's commercial holdings all use advanced BASs managed by a central Tenant Services Center to ensure that tenants are comfortable and secure. Their Tenant Service Center is one of the largest and most sophisticated remote monitoring and emergency response centers in the United States. Through this centralized hub, operated by licensed engineers, Vornado continually maintains precise thresholds in HVAC power usage. Not only does this technology optimize energy efficiency, it ensures all systems are monitored before they impact comfort, business operations, energy efficiency or productivity.

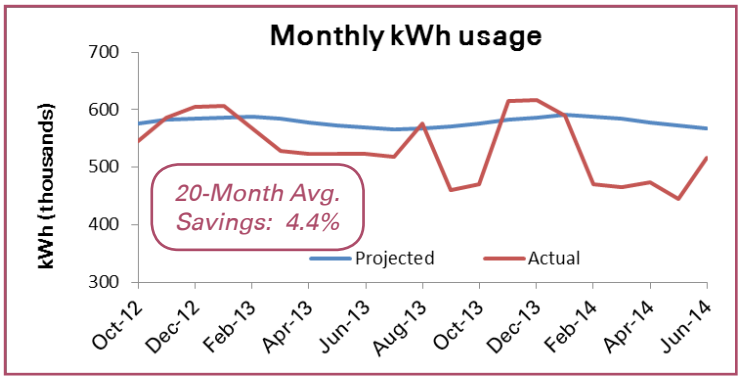

Figure 1. Projected kWh usage based on a year's monthly consumption prior to re-tuning and weather normalizaed.

Even with the impressive efficiencies of its BAS, Crystal Plaza 3 still has many re-tuning opportunities available. Details of the technical re-tuning recommendations are listed in Table 1.

What is Building Re-Tuning?

Building re-tuning is a systematic process to identify and correct building operational problems that lead to energy waste. Building Re-Tuning Training is a blend of building walk-throughs and classroom instruction that teaches building operations staff and service personnel how to save energy and increase occupant comfort through low and no-cost operational improvements. There are two versions of the training: one for small/medium sized buildings without a building automation system (BAS) and one for large buildings with BAS. This case study utilized the large building with BAS re-tuning protocol.

No- and low-cost savings opportunities include items such as replacing faulty sensors, adjusting set-points and inefficient schedules, utilizing variable speed fans and economizers, insulating pipes, adding CO2 sensors, widening thermostat dead bands, and sealing building envelope leaks. This process can reduce building energy use up to 20%.

Building re-tuning saves energy and money

From late 2013 to early 2015, PNNL helped identify re-tuning measures in 20 office buildings. Many of the measures were implemented by the building operations staff. The measurement and verification process is ongoing. Preliminary results indicate the savings are between 2% and 21% in buildings that implement at least a few measures. The average savings are 14% and the median savings are 12%.

Example: Re-tuning Measure Identified from Trend Data for Chiller Efficiency

Figure 2 shows that the chiller water temperature delta is very low between the supply temperature (blue line) and the return temperature (red line). The chilled water temperatures are compared against outdoor air temperature (teal line) for reference. This suggests a low building load for the chiller. Based on this data, re-tuning suggests that the chilled water temperature set point could be reset based on the actual building load to save significant amounts of energy.

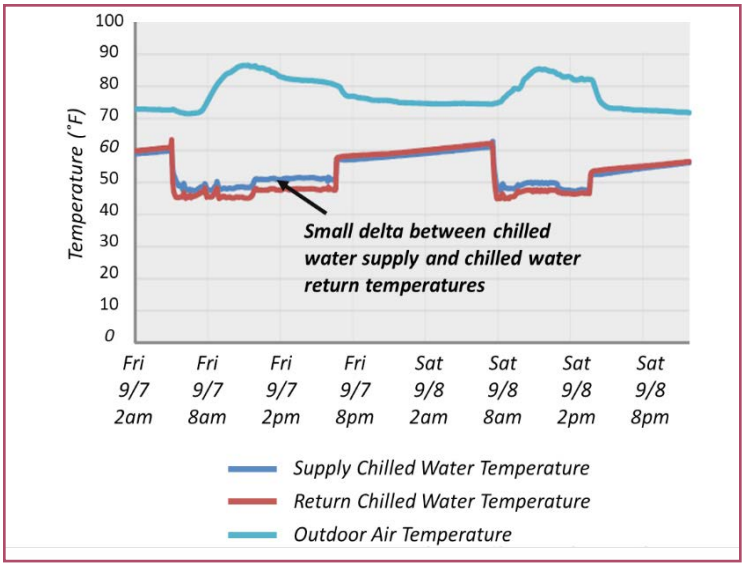

Figure 2. Trended Chilled Water Supply and Return Temperatures and Outdoor Air Temperature

Specific Re-tuning Measures Implemented to Improve Chiller Efficiency

One type of opportunity the training uncovered at the Crystal Plaza 3 was efficiencies with the chiller and chilled water temperatures. It took the Vornado building 2-3 months to implement recommended re-tuning measures. For the chiller specifically, these measures were applied:

- Installed a VFD on water-sourced Chiller 2, which is now the lead machine at all times
- Implemented higher discharge air reset to both AHUs to help lower the chiller load
- Implemented higher chilled water temperature set point to the chiller
- Reset the 300/340 Ton air cooled chiller from 44°F to 48°F

Why Invest in Building Re-Tuning Training?

Building Re-Tuning Training is a worthwhile investment because saving energy is not reliant on commissioning agents, energy auditors or professional engineers. Facility engineers and building operators - the people who are in the buildings regularly – learn to identify energy saving opportunities and act. The savings are regenerative because the trained building operator or facility engineer is able to continuously re-tune his/her building and maintain optimized conditions.

Table 1. Re-tuning Recommendations recommended for Crystal Plaza 3

System	Recommendation	Effort	Savings
Scheduling	Align schedules for all air handling units and lighting more closely with occupancy schedule	Low	High
Terminal VAV Box	Add a duct static pressure reset for the floor/ zone control dampers for each floor	Low	High
Air Handling Units	Add a supply air temperature reset to the both air handlers	Low	High
Air Handling Units	Add duct static pressure reset for both air handlers	Low	High
Chiller System	Implement chilled water temperature set point reset based on outside air temperature	Low	Med
Condenser Temperature	Reset the condenser water temperature set point for the condenser water loop system for the chilled water	Low	Low
Variable Air Volume (VAV) Boxes	For VAV boxes in areas that have little to no use by the occupants, wire them into the existing lighting occupant sensors in order to put a room into a standby or unoccupied state when the room is not occupied.	Med	Med

Strategy for Success: Centralized BAS for Automated Alerts and Anomalies

The concept of continuous proactive building re-tuning is exemplified by Vornado's Tenant Services Center. The center uses a BAS and associated analytics dashboard to get alerts of anomalies in equipment operations and specs. The Tenant Services Center has begun energy forecasting to better prepare for knowledge when it comes time for utility load reduction or other sensitivities.

By receiving such anomaly alerts (~30/day) and automating the building's demand response events, Vornado has reduced the need for live intervention, saving valuable man-hours. Vornado is programming the BAS code so that every process a human building engineer would go through is utilized automatically as the system develops anomaly alerts

Acknowledgements:

This case study and related work is funded by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. Pacific Northwest National Laboratories created the building re-tuning training program and performed the building re-tunings for this case study.

Re-tuning Training Opportunities and Online Resources

The Department of Energy funded Pacific Northwest National Labs (PNNL) to create the Building Re-Tuning Training program. The Consortium for Building Energy Innovation (CBEI) is leading efforts for DOE to make Building Re-Tuning Training available. See *https://www4.eere.energy.gov/workforce/projects/buildings-retuning-training* for information about accessing the training. Classroom training material, training instructor manual and online re-tuning interactive training and energy charting and metrics tools are available at *http://buildingretuning.pnnl.gov/*