

Re-tuning Case Study

Parmenter Re-tunes Las Colinas Tower for Significant Energy Savings. Dallas, TX

Energy Star score improves by four points with Building Re-tuning training.



*Address: 225 E. John Carpenter Frwy, Irving TX
Owner: Parmenter Realty Partners
Size: 349,436 square feet*

As a member of the Better Buildings Challenge, Parmenter Realty Partners is constantly looking for ways to improve their sustainability and reduce the impact their buildings have on the environment. Building re-tuning provides an opportunity to reduce energy consumption across the company's portfolio. In January 2014, with training experts from the Pacific Northwest National Laboratory (PNNL), Parmenter re-tuned its Las Colinas Tower II building in Irving, TX. Re-tuning provided the facilities management team with the ability to identify and understand building scheduling opportunities that drove significant, low-cost energy savings.

In the 6 months post-training, the building has saved an average of 4% on its electricity usage due to a long list of energy savings opportunities (details shown on following pages. See Figure 1). Las Colinas Tower II also improved its ENERGY STAR score by four points from 67 to 71.

Initial implementation of re-tuning measures led to the discovery of additional efficiency opportunities. First, Parmenter adjusted the outside air temperature sensor placement so it would read more accurately. Once the temperature sensor was calibrated, the operators realized that their BAS program contained numerous additional overrides. The more the Las

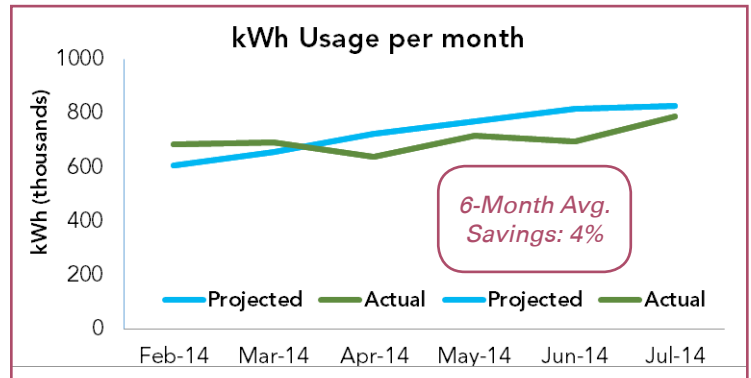


Figure 1. Projected kWh usage based on a year's monthly consumption prior to re-tuning and weather normalization.

Colinas building engineers investigated the root logic of BAS operations, the more opportunities they identified. Over the span of a few months, Parmenter implemented over two dozen no- to low-cost re-tuning measures and is continuing to re-tune Las Colinas II periodically for consistent savings.

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 Opportunity to Adjust Negative Building Pressure & Reheat Inefficiencies Found in BAS Trend Data

In Figure 2, the mixed air temperature (green line) and return air temperature (blue line) trended data readings both show patterns that may indicate the building is operating in a negative pressure condition at night (and perhaps even during the day). After the supply fan shuts down, both the mixed air and the return air temperature sensors immediately drop toward the outdoor air temperature value (teal line), in some cases dropping as low as almost 40°F. It appears that during the 6-day period in November, the return air temperatures progressively got cooler (possibly indicating that this building also got cooler). Perhaps the reheat system is not working properly, or some other issue exists such as

significant infiltration. There is a re-tuning efficiency opportunity to explore further and solve the root of the problem.

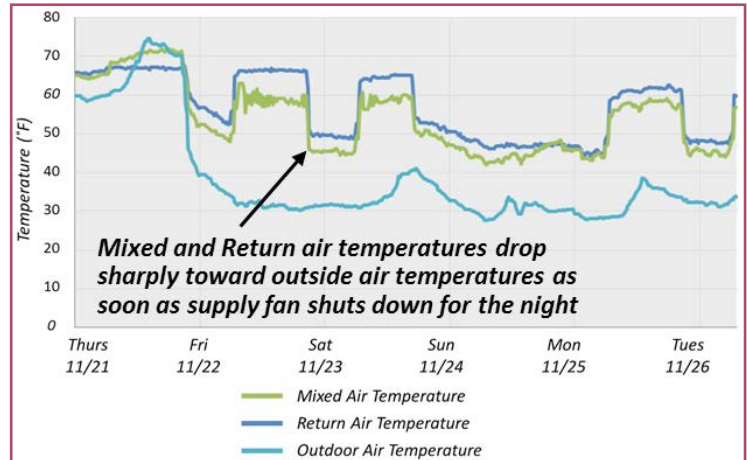


Figure 2. Trended Data Showing Return Air and Mixed Air Temperature Performance

Table 1. Sample of Re-tuning Measures Implemented for the Las Colinas II Building Automation System (BAS)

Issue Area	Finding	Solution	Cost
Limited interaction with BAS by Engineers	Engineers were not internally trained to make changes to the BAS, relying heavily on the BAS vendor	Staffing was not 100%; need to hire a chief engineer with strong BAS experience. Plan training for engineers to properly use the system and make adjustments.	Within the property budget
Trending setup and monitoring	Trended data is invaluable for proper operations of the building	Trained engineers and now expect them to trend regularly	\$0
BAS Vendor evaluation	Existing BAS vendor was not qualified to re-program the system, only to make minor adjustments	Replaced vendor	\$0
Reprogram BAS (Ghost Problems)	BAS programming has been compromised over time and new vendor couldn't make small cost effective changes without effectively rewriting existing program	New vendor completely wrote a new program; all conflicting program logic was wiped and correctly restructured	\$18,000
Different BAS program consideration	Decided to focus on current BAS system and try with rewritten programming.	No action needed at this time	\$0
Airflow gaps around the chilled water coils	During the BAS walk down, found air leakage problem that allowed air to flow past the coils and not through them	Installed sheet metal at open gaps to funnel the air through coils	\$4,000
Calibration of pneumatic devices	A large percentage of pneumatic devices were out of calibration and water had been introduced to the system; the filter for air dryer was stopped up.	Recalibrate all pneumatic devices, add gauges to the air dryer, add more monitoring points to BAS for pneumatic system, train Engineers on new HVAC tracking form for hot/cold calls	\$1,700
Preventive Maintenance of dampers	Found that most dampers were dirty, gaskets are either missing or worn out, operation needs to be verified	Perform preventive maintenance on dampers and make all identified repairs. Make sure they operate properly per BAS program	In-house program

Example: When Window-to-Wall Ratio is Significant, Re-tuning Opportunities Exist in Solar Load Efficiencies

The window-to-wall ratio is significant (at least 80% or greater) in Las Colinas Tower II, meaning that solar loading significantly impacts the building. Using a thermal imaging camera (see Figure 3), a significant difference in window temperatures on the south and west sides of the building was identified. East, south and west-facing windows exhibit significant solar gains on cold, but clear days (morning low temperatures around 20°F, afternoon high temperatures around 45°F). This was creating interior temperatures between 75°F and 78°F at the perimeter spaces facing south. Re-tuning measures to consider for buildings to counter solar heat gain include:

- Send periodic messages to occupants via email to encourage the judicious use of window blinds during peak solar conditions.
- Turn perimeter lights off (where controls and switching allow) to reduce the heat gain from electric lighting loads (trade off the solar gain with the lighting heat gain or vice versa) or de-lamp where possible.
- Window tinting may be an effective investment, but should be carefully evaluated for correct tinting materials and installation methods to safeguard windows from damage

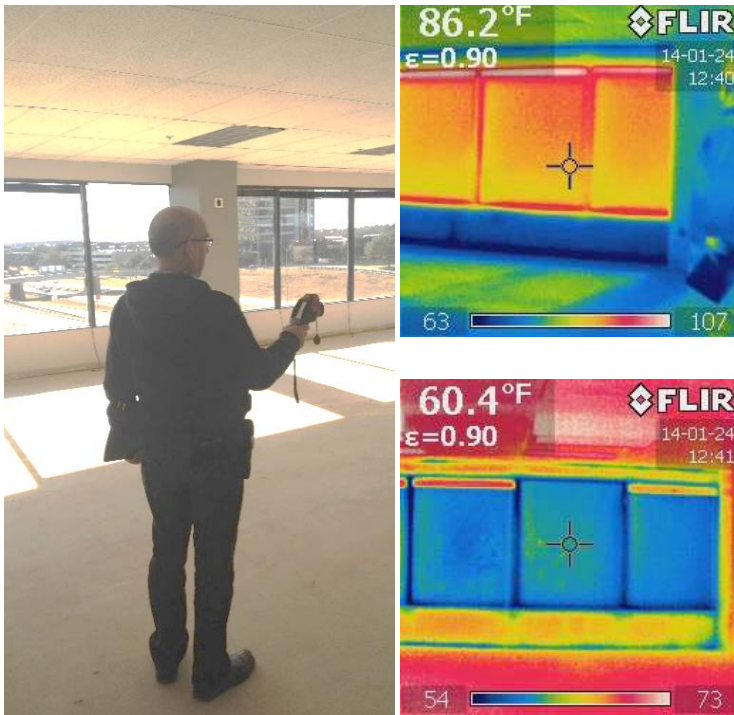


Figure 3. A thermal imaging camera is used to identify solar load for south-facing (top) and west-facing (bottom) windows

Strategy for Success: Don't Rely Solely on your BAS. Walk Down the Building Too

Building engineers sometimes rely too heavily on BAS alerts and not enough on in-person building walk-downs. While sophisticated BASs open up many possibilities for identifying efficiencies, some efficiency opportunities can only be identified from the physical act of walking through the building.

Building walk-downs help operators to get to know the building better and develop a general impression of the overall building condition, building systems, and HVAC system design.

The major steps of a building walk down include:

- Review electrical and mechanical prints
- Walk the outside of the building
- Walk the inside of the building
- Walk down the roof
- Walk down the air handlers
- Walk down the plant area
- Review the DDC system (BAS) front end

After the re-tuning training, the Las Colinas team decided to walk-down the building after hours. Operators found numerous inefficiencies: heat on after hours, task and break room lighting on while space was unoccupied, and terminal air fans running.

To solve this, they asked security to turn off all lights left on by tenants, and proposed installing electric to pneumatic (EP) switches on every floor to shut off all non-essential loads after hours.



Figure 4. Building walk-down included checking above the ceiling for duct condition, etc. (left) and reviewing electrical and mechanical prints (right)

Example: Re-tuning Opportunity Identified in Las Colinas II Loading Dock Ceiling

Figure 5 shows an infrared image of the Parmenter Las Colinas II loading dock ceiling, just below office space. The outdoor air temperature is 30°F while the ceiling temperature was measured much higher at 43.3°F. During the re-tuning training building walk-down, it was noted that the loading dock ceiling insulation may be lacking. This likely has resulted in heat loss/gain to the office spaces above, which could contribute to tenant hot/cold calls and energy inefficiencies.

Re-tuning opportunities include evaluating areas of missing insulation or poorly insulated/sealed locations in loading docks, parking garages, and similar areas open to the outdoors.

Such measures include:

- Verify that initial garage parking lot area under office spaces is adequately insulated (hard ceiling with access panels). Suggest using an infrared camera image of the floor from above (looking down) if access issues are a problem.
- Seal penetrations of conduits and piping that route from loading dock areas into the building.
- Look for similar penetrations that may not be sealed on all perimeter sides of the building

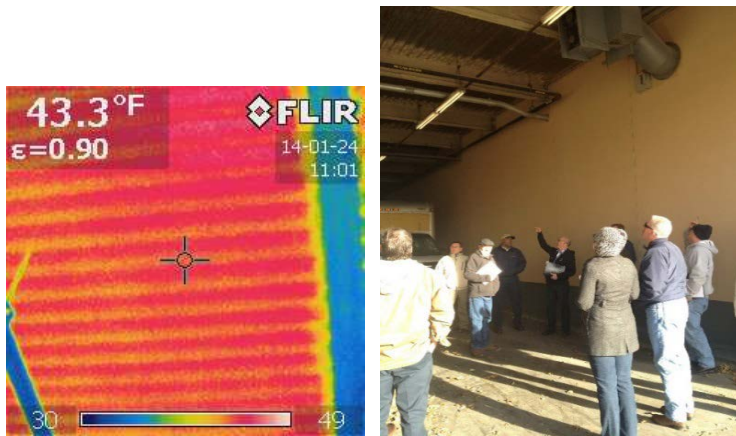


Figure 5. A thermal imaging camera is used to examine the loading dock ceiling

Example: Problem with Manual Override of a BAS and Re-tuning Solutions

In Figure 6, the AHU discharge air temperature set point (blue line) appears to be manually adjusted, based on the staggered stair-step flat lines. The discharge air temperature set point in the control code was found to be reset automatically from the return air temperature with a secondary reset based upon the outside air temperature. Figure 6 hints at manual overrides being used, so perhaps the automatic reset values are too low.

Re-tuning Solutions:

- Use a return air temperature reset only (remove the secondary outdoor air temperature reset). The current reset operation is currently between 70°F and 74°F return air temperatures, but the reset should be based upon the return air temperature operating between 72°F and 76°F. This schedule will lead to more comfortable conditions and will decrease the need for occupants/tenants to request overrides of the system's schedule.
- Reset the discharge air temperature (blue line) to be between 53°F and 63°F, a 5°F increase. The current operation is between 48°F and 58°F. With this increase, the supply air should still be cool enough to provide adequate cooling at the warmest zones and provide adequate moisture removal at the cooling coils. The existing reset parameters result in higher energy costs for cooling and subsequent reheating at the terminal boxes.

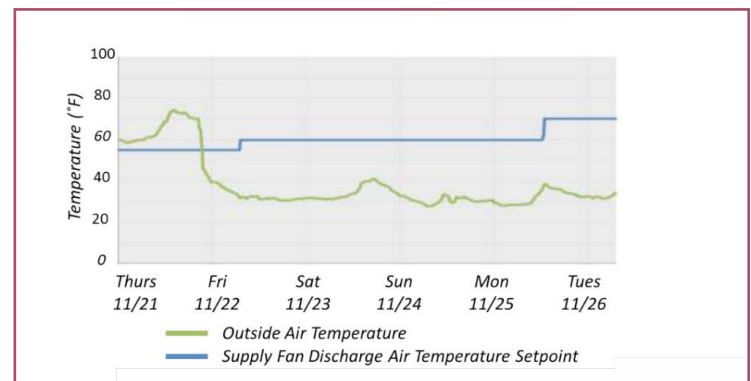


Figure 6. Manual Override on AHU Supply Fan Discharge Air Temperature Set Point

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.

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/>