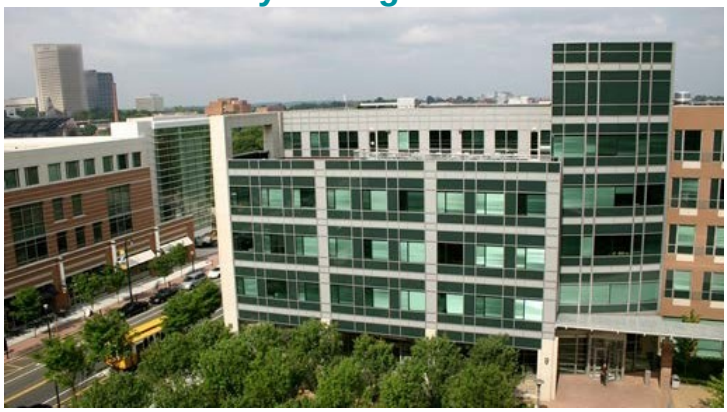
Re-tuning Case Study

GeorgiaTech Re-tunes Research Building and Saves 34.7% on Electricity. Atlanta, GA

34.7% electricity savings results from Building Re-tuning Training



Address: TSRB, 85 Fifth St NW, Atlanta, GA
Owner: The University Financing Foundation Inc.
Lease: Georgia Tech, Triple Net Lease
Size: 209,000 Square Feet

The Technology Square Research Building (TSRB) is an academic research center at the Georgia Institute of Technology, owned by The University Financing Foundation Inc. and managed by Gateway Facility Services. It houses five research centers with space for 500 researchers. TSRB also houses state-of-the-art conference facilities that accommodate several special events. The TSRB is part of the Better Buildings Challenge Atlanta and has committed to reducing energy usage 20% by 2020 – total savings have surpassed the goal and reached 26.84% since its 2009 baseline. The building faces energy challenges such as variable occupancy, 24/7 operational lab spaces, and a data center.

In July 2013, experts from the Pacific Northwest National Lab conducted a re-tuning training with the property management staff. The building utilized its building automation system (BAS) to identify re-tuning opportunities in addition to the indoor and outdoor building walk-through. Following the training, five re- tuning measures were implemented which contributed to electricity savings of 34.7% over 2 years compared to projected usage (Figure 1). Improvements were made to the building's envelope, cooling schedule, and the condensing water system. In addition to energy savings, the building's tenants have benefited from increased comfort due to optimizing the set points of the HVAC system.

Since its construction in 2002, the building has continually improved its energy performance, increasing its ENERGY STAR rating from 35 in 2009 to 75 in 2016. Re-tuning contributed to this improvement and the building's ongoing process of re-tuning should help increase the building's ENERGY STAR score further over time.

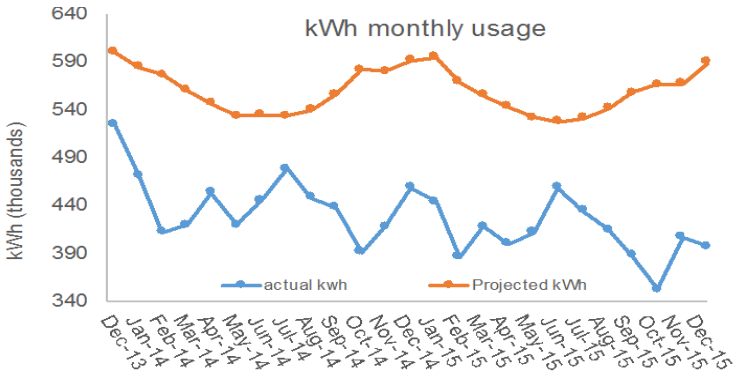


Figure 1. Projected kWh usage based on a year's monthly consumption prior to re-tuning and weather normalized.

Example: BAS Trend Data Provides Retuning Opportunity in Overcooled Zone

Figure 2 shows the actual zone air temperature (blue line) for one of the zones in the TRSB building, compared to the zone's temperature set point (green line), and its damper position. The fact that the average temperature is consistently below the set point indicates that the zone is overcooled. A significant number of zones were observed to be at minimum temperature and damper position, confirming that many spaces were overcooled. Upon further analysis, the building staff determined that the cause was attributable to the zone's minimum CFM (cubic feet per minute) value being too high. This led the building to institute a re-tuning measure for CFM minimum reset, which led to energy savings as well as increased occupant comfort.

Conditions to spot in General Zone Data Analysis

Key conditions to identify while analyzing BAS graphs:

- No night time setback for air temperature or pressure
- Significant reheat for interior zone terminal box during occupied hours

Building re-tuning saves energy and money

From late 2013 to early 2015, PNNL helped identify re-tuning measures in 100 office buildings. Many, but not all, of the recommended measures were implemented by the building operations staff. Annual energy savings ranged between 2% to 26%, with a median savings of 15%. Annual normalized cost savings ranged between 0.0$/sf to 0.60$/sf, with a median savings of 0.12$/sf. If all re-tuning measures identified were implemented, the savings would have been even larger.

- Overcooling or overheating
- Significant reheat during summer/cooling season for exterior zone terminal box
- Supply-air temperature too cool or too warm
- No use of supply-air reset
- Certain zones (e.g. corner offices) driving AHU operation
- Some zones out of control, oscillating between heating and cooling

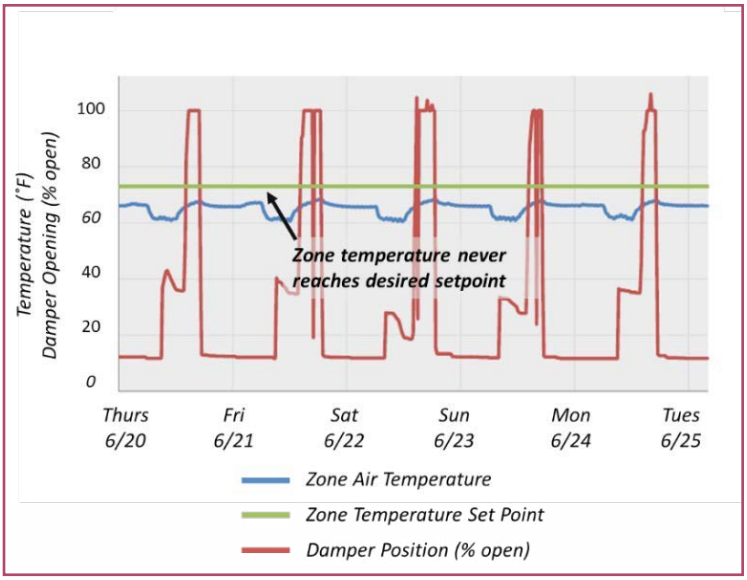


Figure 2. Trended Graph of Zone Temperature and Damper Position Reveals an Overcooled Zone.

Strategy for Success: Re-tuning on a Continuous or Periodic Basis

Perform re-tuning on a continuous or periodic basis. After the initial building re-tuning, follow-up actions should include:

1. All operation and maintenance (O&M) actions recommended should be implemented to maximize energy savings, reduce energy costs, and improve the comfort of occupants.
2. For any recommendations that can only be partially implemented, take steps to fully implement these actions and capture the complete savings benefits.
3. Continue conducting re-tuning analyses to calibrate any changes in the building's personality and uses, such as changes in tenants, schedules, remodels, etc.
4. O&M staff continually look for problems and opportunities that can be resolved with re-tuning.
5. Document plans for continuous re-tuning. Establish schedules for re-tuning activities and refer to them frequently to ensure that follow up continues.
6. Take re-tuning lessons learned and train colleagues, as a success measure for staff development and continuous improvement in building performance.

What is 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: Observation-driven re-tuning for buildings without a building automation system (BAS) and data-driven re-tuning for buildings with BAS. This case study utilized the data-driven 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 CO_2 sensors, widening thermostat dead bands, and sealing building envelope leaks. This process can reduce building energy use up to 25%.

Since 2016, TSRB has been in a state of continuous commissioning. The chief engineer and the building engineer have participated in the retuning process. Two capital improvements that have impacted building energy consumption since July 2013 are:

- Demand ventilation in the first floor conference center in June 2014
- Tied laboratory exhaust fan into the BAS in August 2014

The company has in-house personnel that make changes in the BAS and have done retuning work by directly accessing the BAS interface.

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 shows the implemented recommendations and associated effort and energy savings in selective systems.

System	Recommendation	Effort	Savings
Envelope	Repaired discrepancies in exterior walls and installed weather stripping on doors.	Low	Low
Temperature Reset	Programmed reset schedule for supply air temperature	Med	High
Static Pressure Reset	Programmed reset schedule for supply air pressure	Low	High
Terminal VAV Boxes	Reduced minimum CFMs on Terminal Units	Med	High
Condensing Water Loop	Reset condensing loop differential pressure set point based on building load and process load.	Med	High
Condensing Water Loop	Programmed cooling temperature control reset schedule	High	Med

Table 1. Re-tuning Recommendations Implemented at TSRB

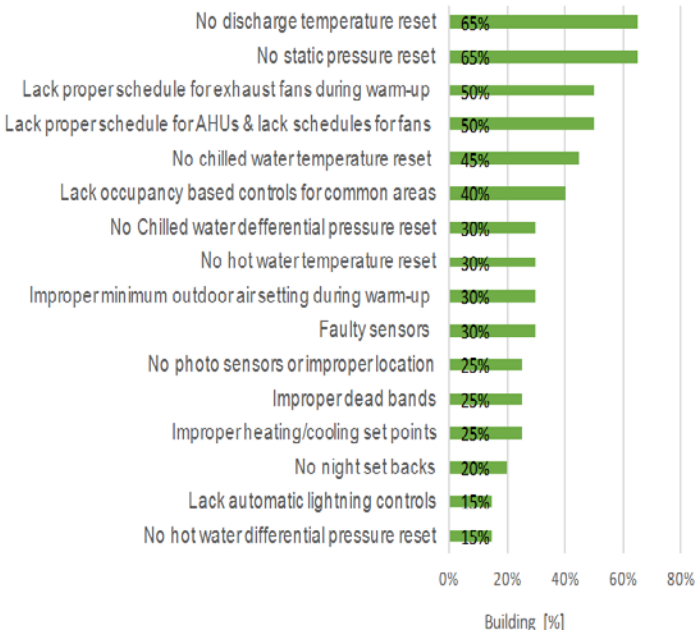


Figure 3. PNNL Meta-Analysis of 100 Commercial Office Buildings (2013-2015)

How to read this chart: 50% of the buildings in which re-tuning took place lack proper schedules for AHUs and/or lack schedules for exhaust fans or fans running during warm-up mode; over 65% of the buildings do not use static pressure or discharge temperature reset on AHUs; over 30% of the buildings have one or more faulty sensors and/or improper minimum outdoor-air setting during morning warm-up, etc.

Description of The University Financing Foundation, Inc. (Building Owner):

The University Financing Foundation, Inc. ("TUFF") is a leading resource for the assessment, planning, and implementation of cost-saving energy conservation measures. TUFF's staff and agents have years of experience in first understanding the issues at an institution and engaging the right professionals to determine what projects should be considered - assessment. TUFF then engages directly with institution staff to outline a project based on the assessment - planning. Finally, TUFF has access to low cost financial resources (tax-exempt capital) to employ in the development of the project - implementation. TUFF provides a full service turn-key development of any type of sustainability project from the replacement of energy saving lighting to the retrofit of entire central utility plants and campus infrastructure. Also, as a 501(c)3 organization, it is TUFF's mission to deliver the project at below market cost and transferring ultimate ownership of these facilities and/or improvements to the institution, when the contractual requirements have been satisfied, for nominal consideration.

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. The Pennsylvania State University updated the results in 2016 with actual building performance data.

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. Penn State led efforts for DOE to make Building Re-Tuning Training widely accessible. 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/