Building Re-tuning™- A Low-Cost Path to Energy Efficiency and Cost Savings
Pacific Northwest National Laboratory

Commercial buildings account for almost 20% of the total U.S. energy consumption, and between 10% and 30% of the energy used in commercial buildings is wasted because of improper and inefficient operations.

While sophisticated energy management and control systems are used in large commercial buildings to manage heating, ventilating, and air conditioning systems and components, many buildings are not properly commissioned, operated, or maintained. This lack of proper operation and maintenance leads to inefficiencies, reduced lifetime of equipment, and—ultimately—higher energy costs.

Pacific Northwest National Laboratory (PNNL) researchers have developed a Building Re-Tuning™ approach to detect energy savings opportunities and implement improvements. To put this methodology into practice, PNNL offers resources for both large (>100,000 sq. ft.) and small (<100,000 sq. ft.) buildings as well as an online interactive training curriculum.

The training provides building operators and managers, as well as energy service providers, with the necessary skills to identify and correct operational problems in commercial buildings at no- or low-cost. These resources provide an excellent source of information for anyone who owns or operates a commercial building and has to meet the new Seattle Building Tune-Ups mandate.

Purpose of Building Re-tuning Training Course (for buildings with building automation system)

The purpose of this course is to help building operations staff as well as other contractors (retro-commissioning agents/control vendors) learn how to operate large buildings with a building automation system (BAS) more

efficiently, reduce operating costs and provide energy savings. The knowledge and skills learned through the training will be highly valued by organizations and companies seeking to improve the performance of their buildings.

This link (http://buildingretuning.pnnl.gov/resources.stm) will take the reader to a wealth of resources that includes training materials for students and an instructor's guide for large commercial buildings.

Guide to Re-tuning Measures

Re-tuning **building with BASs** focuses on a number of commonly occurring operational problems in buildings. PNNL developed nine different guides that are focused on each of the measures. The guides provide details on how to detect good (normal) and bad (abnormal) operations. The guides also provide a list of points to trend, charts to generate, and suggested actions to implement to improve the operational efficiency of the building. The following nine guides were created for specific re-tuning measures with specific steps and examples:

1) Air-Side Economizer Operation,
2) Air-Handling Unit (AHU) Static Pressure Control,
3) Air-Handling Unit (AHU) Discharge-Air Temperature Control,
4) Occupancy Scheduling: Night and Weekend Temperature Set back and Supply Fan Cycling during Unoccupied Hours,
5) Zone Heating and Cooling Control,
6) Central Utility Plant Cooling Control,
7) Central Utility Plant Heating Control,
8) AHU Minimum Outdoor-Air Operation and
9) AHU Heating and Cooling Control.

Additional tools are provided to help users understand how to configure trend data in a format that provides actionable data (charts and graphs). Two case Studies are also provided to highlight re-tuning efforts (successes and challenges) in two different commercial office building locations.

Similar to large building re-tuning resources, PNNL researchers also developed a suite of tools geared for smaller buildings.

Purpose of Building Re-tuning Training Course (for buildings without BAS)

The purpose of this course is to help building operations staff as well as other contractors learn how to operate small buildings (without a BAS) more efficiently, reduce operating costs and provide energy savings.

This link (http://buildingretuning.pnnl.gov/small_bldg.stm) will take the reader to a wealth of resources that includes training materials for students and an instructor's guide for small commercial buildings.

Another resource for users includes a primer (Small Building Re-tuning Primer) that can be used as a tutorial on envelope (roofs, walls, windows and doors), HVAC systems, zoning issues, internal loads (plug loads, solar gain and other loads), lighting technologies, hot water heating systems, meters, sensors and controls. This resource is a great tool for organizations whose maintenance staff have less technical background or formal training and is a great refresher for those who have more technical acuity.

Potential Savings for Re-tuning

Many commercial buildings consume more energy than they should, while also simultaneously failing to maintain adequate occupant comfort. The inability to adequately sense, monitor, and control buildings effectively leads to significant energy waste. A study was initiated to systematically estimate and document the potential savings from improving building operations. The purpose of the study was to quantify 1) the technical energy savings potential from deployment of accurate sensors, proper and advanced controls, and automated fault detection and diagnostics in the commercial building sector and 2) lowered commercial peak electric demand by using demand-response measures. These estimations were performed via simulation of individual measures as well as packages of measures using the U.S. Department of Energy's (DOE's) EnergyPlus building energy modeling software.

The results from this study, which are documented in a report, are a good source of information for estimating the possible savings from Tune-Ups.