Pacific Northwest
NATIONAL LABORATORY
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Large Commercial Buildings: Re-tuning for Efficiency

Introduction

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Purpose of Today's Class

- Provide you an in-depth overview of the Pacific Northwest National Laboratory (PNNL) Commercial Buildings Re-Tuning Method
- Prepare the participating technicians for hands-on field training on one of your buildings over the next few days
- Provide an opportunity for you to ask questions and get clarification on any aspect of the re-tuning process

"Tell me and I'll forget;
show me and I may remember; involve me and I'll understand"

Chinese Proverb

Who are We?

- PNNL project staff:
  - Buildings scientists and engineers with many years of experience developing and testing new technologies and approaches to improve the efficiency of commercial buildings
  - Staff with years of experience operating, maintaining, and managing buildings and building systems as well as deploying energy efficiency programs in the field
  - A multi-disciplinary research and development organization
  - A not-for-profit contract research and development institute, Battelle, operates PNNL for the U.S. Department of Energy (DOE) in Richland, WA

U.S. Department of Energy Re-Tuning Training Outreach

- Re-tuning Training was Originally Developed as part of a Project Funded by the Washington State (www.retuning.org)
- Extending Training Outreach Beyond WA State (www.pnl.gov/buildingretuning)
  - Organizations with large building stock interested in getting trained in the re-tuning process
- Working with a number of organizations to recruit for both the above approaches

Project Objective

- Improve operational efficiency of the commercial building sector by transferring the skills to “re-tune” large commercial buildings
  - Training building operators and service providers in the general principles and practices of good energy management
  - Publicizing the results of the project to other building operators and HVAC service providers, who are not part of the training, and to customers to encourage widespread adoption of these energy-saving methods
  - Preparing case studies to quantify comfort impact and energy savings resulting from re-tuning

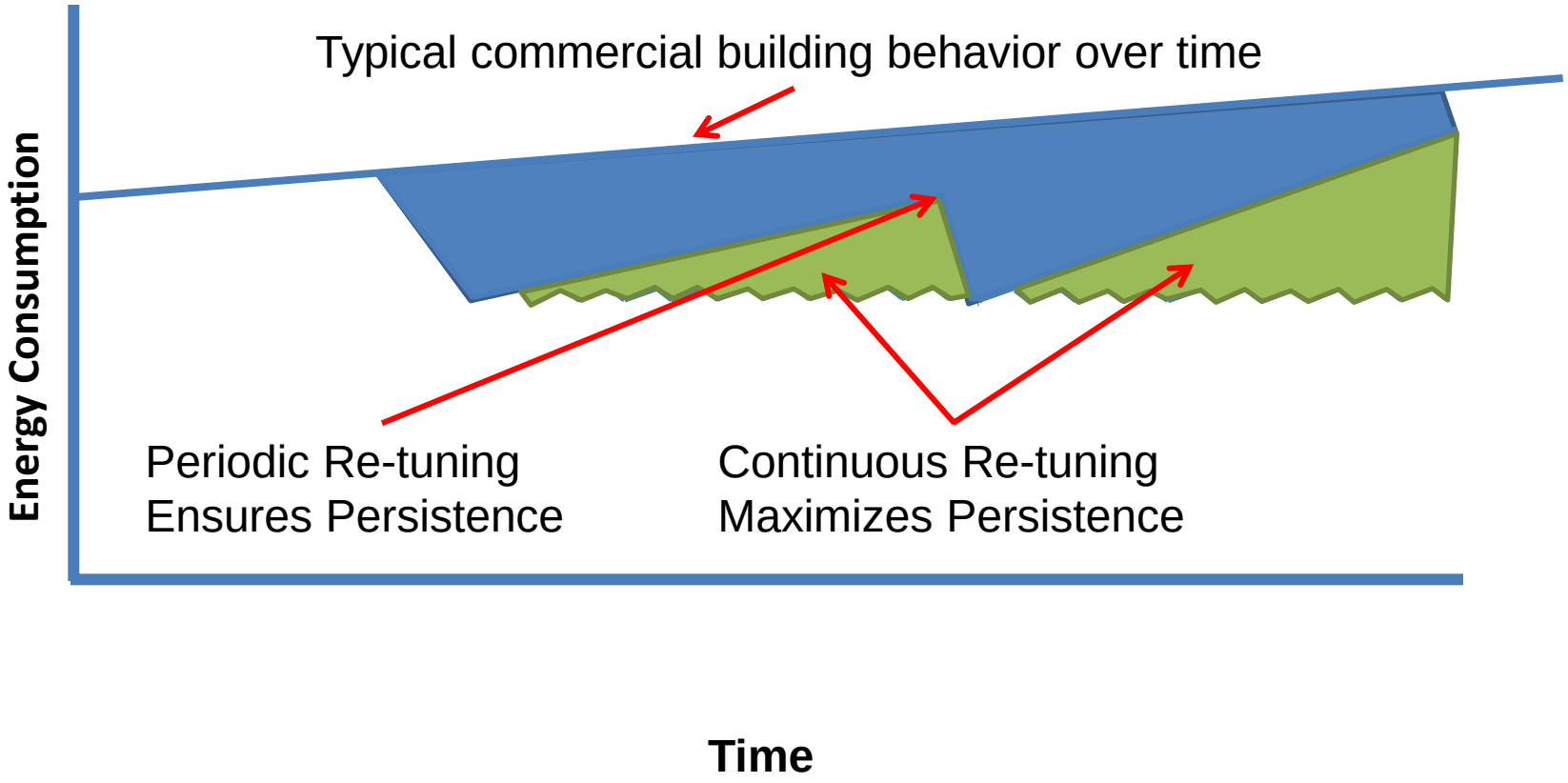
Why is Retro-Commissioning not Widely Used?

- There is a perception that retro-commissioning can be expensive
  - It can be expensive, but typically has less than 3 year paybacks
- There is a perception that measures addressed during retro-commissioning do not persist for a long time (>6 months)

Re-tuning can Fill the Gap

- Re-tuning can address both the cost and the persistence question
- Because re-tuning is implemented by leveraging information from building automation system and primarily targets operational problems, cost of implementation is significantly lower than retro-commissioning
- Because re-tuning costs a fraction of retro-commissioning, it can be periodically done to ensure persistence

Life Cycle of Retro-Commissioning/Re-Tuning



What is Re-Tuning?

- A systematic process to identify and correct building operational problems that lead to energy waste
- Implemented primarily through the building control system at no cost other than the labor required to perform the re-tuning process
- May include small, low-cost repairs, such as replacing faulty sensors
- Includes identifying other opportunities for improving energy efficiency that require investment
- Might be thought of as a scaled-down retro-commissioning focused on identifying and correcting operational problems

Major Focus Areas in Re-Tuning

- Occupancy scheduling
- Discharge-air temperature control
- Discharge-air static pressure control
- Air-handling unit (AHU) heating & cooling
- AHU outside/fresh air makeup
- AHU economizer operation
- Zone conditioning
- Meter profiles
- Central plant

Six Primary Steps of Re-Tuning

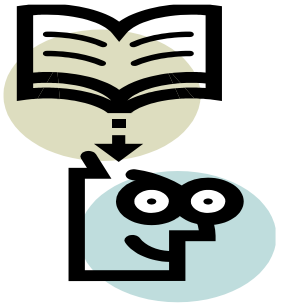
- Collecting Initial Building Information: Basic building information
- Pre-Re-Tuning Phase: Trend-data collection and analysis
- Building Walk Down: Getting to know the building
- Re-Tuning: Identifying and correcting operations problems
- Post Re-Tuning: Reporting re-tuning findings
- Savings Analysis: Determining and reporting the impacts

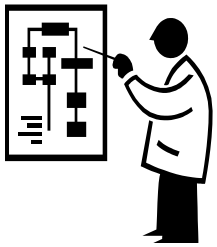
Purpose of Re-Tuning

- Improve the building's energy efficiency through low-cost and no-cost operational improvements (mostly control changes)
- Identify opportunities to further increase the building's energy efficiency
- Identify problems requiring physical repair
- Catch the big energy saving opportunities – operations

Definitions

- **Retro-commissioning, Re-commissioning, Continuous-Commissioning**
  - All of the above can be costly, and are directed toward operations and equipment upgrades
- **Building Re-tuning Is**
  - A **no cost or low cost** approach to saving energy, which translates into dollars saved
  - Focused on **low and no cost** operational improvements.
  - A process of setting up control systems to some known design configurations and the process of verifying set points and adding control algorithms
  - How do we know what these set points and configuration points are?
    - Engineering plans?
    - Building owner?
    - Tribal knowledge from service technicians?





Example of Building Re-tuning: Sam Nunn Atlanta Federal Center

- 1.8 million square feet 2 city blocks high rise
- 10 MW feeder to the building
- All electric, perimeter box reheat
- 4 chillers, 3 1500-ton, 1 500-ton
- Variable chilled water flow
- Paired VAV air handler for each floor
- Mostly glass all sides
- True VAV facility
- ~ 100 air handlers total

Example of Building Re-tuning: Sam Nunn Atlanta Federal Center

- Major changes to facility
  - Re-commission unoccupied modes
    - Complaint was the building would not recover from set backs
    - Proved it could recover with some special coding
  - Re-commission variable chilled water pumping and chillers
    - 3 150-HP secondary chilled water pumps running 100% 24/7, down to 1 and sometimes 2 pumps most days. 1 pump 50% at night
    - Intelligent chilled water reset - 42 to 48^{o}F based on humidity and loads at coils
    - 2 1500-ton large chillers ran all night, now 1 500-ton smaller chiller at night
    - 2 250-sf server rooms were driving chilled water set point! Why? 500 sf out of 1.8 million sf are driving cost!!!

Sam Nunn Atlanta Federal Center

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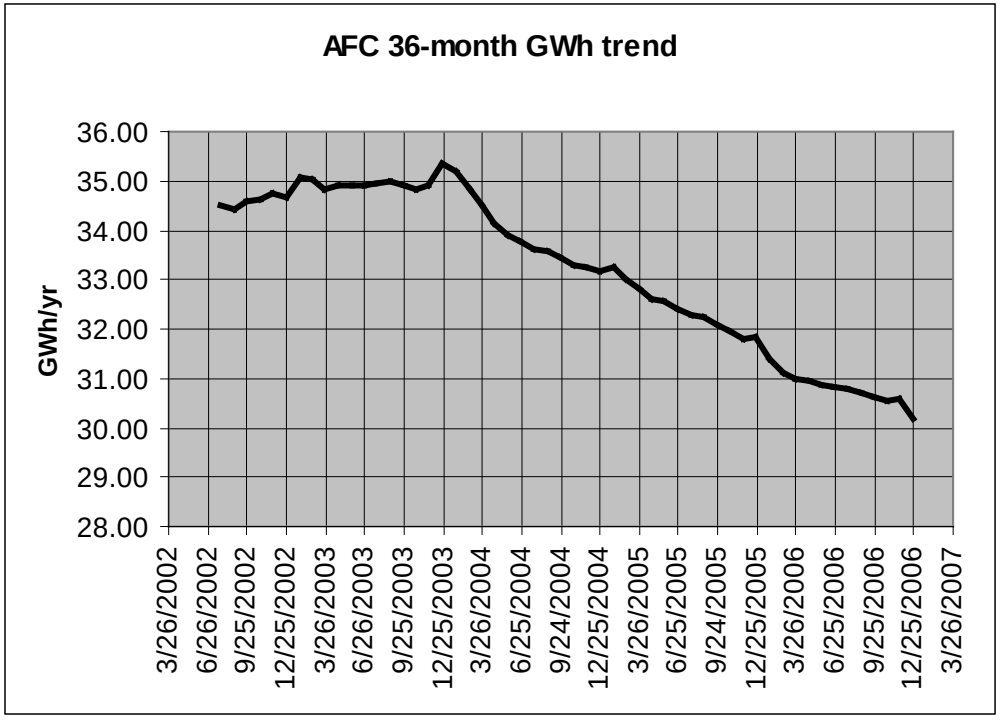
    - Intelligent chilled water reset. 42 to 48^{o}F based on humidity and loads at coils
    - 2 1500-ton large chillers ran all night, now 1 500-ton smaller chiller at night. Forced them to fix the smaller chiller
    - Currently 2, 250-sq. ft. server rooms drive chilled water set point! Why? 500 sq. ft. out of 1.8 million sq. ft. are driving cost!!!

Sam Nunn Atlanta Federal Center

- Major changes to facility
  - Installed discharge-air temperature reset based on warmest interior and coolest exterior zones depending on season and mode. Morning warm-up driven to the outside walls and boxes
  - Locked out outside-air during morning warm-up/cool-down modes
  - Installed discharge-air pressure reset based on VAV box damper positions. Read all box positions and sort for highest to lowest, then averaged 4th through 6th box conditions. Run at 75% open Now 3 identical floors will run from 0.5 in. to 1.5 in. of static pressure
  - Changed dead bands on interior and exterior to allow for floating of temperature. Open bays with set points as much as 5 degrees difference from zone to zone
  - Process took over 2 years because it was done by Pacific Northwest National Laboratory staff remotely. 1st 6 months was simply watching the facility responded to weather, solar and occupancy changes.

Can Building Re-tuning Work?

GSA Sam Nunn - Atlanta Federal Center



16%
Reduction

ROI
3 Months

Sam Nunn Atlanta Federal Center

- Major changes to facility
  - Received Energy Star rating
  - Energy use down 15% to 20%
  - Peak down on shoulder months
  - **Tenant complaints down 35%**

Building Re-Tuning Maxim

- Basic Energy Management
  - If you don’t need it, turn it off
  - If you don’t need it at full power, turn it down
  - Make energy system smart, adjusting to real needs

QUESTIONS?

www.pnnl.gov/buildingretuning