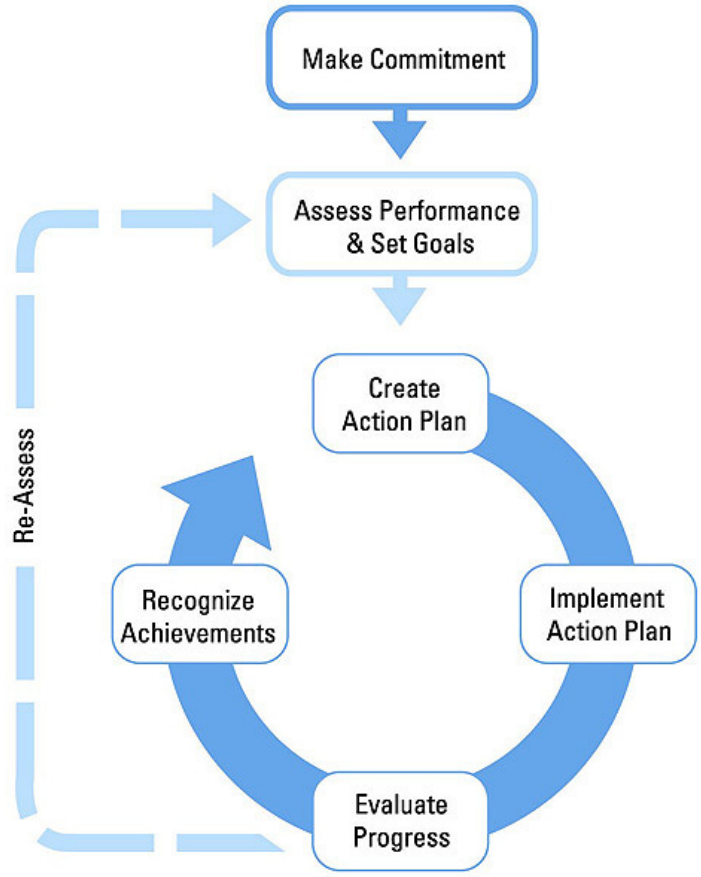
Avoiding the Energy Performance Roller Coaster through Proactive O & M

August 18, 2004

About The Web Conferences

- **Monthly**
- **Topics are structured on a strategic approach to energy management**
- **Help you continually improvement energy performance**
- **Opportunity to share ideas with others**
- **Slides are a starting point for discussion**
- **Open & Interactive**



Web Conference Tips

- Mute phone when listening! Improves sound quality for everyone.

- If slides are not advancing, hit refresh or close presentation window and press the re-launch button again.

Today's Web Conference

- Background
- Tudi Haasel – PECI
- Phil Welker – PECI
- Questions & Discussion
- Announcements

Background

Consider…

- Huge (400%) variation in energy use intensity of buildings (CBECs)
  - Not explained by age, technology, hours, size, climate
- Little improvement of overall energy consumption
  - Yet building components 30% more efficient since 1980

Avoiding the Energy Performance Roller Coaster through Proactive O&M

Presented by
Tudi Haasl and Phil Welker

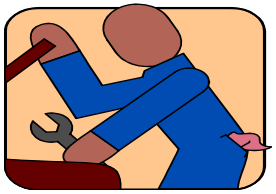
Energy Star Web Conference August 18, 2004

What We'll Cover

- Unbundling O&M
- Revisiting Energy Management
- Clues Indicating Energy Waste
- Getting Proactive with Retrocommissioning
  - What is it?
  - How is it different from a tune up?
  - Overview of the process
- Making the Case for RCx
- Resources

Operation and Maintenance –
Striking a Balance

- Maintenance is about repairing, cleaning, lubing, of the equipment (primarily physical)



Capacity

- Operation is about schedules, energy efficient control strategies, and sequences of operation (primarily mental)

Performance

Revisiting Energy Management

Three Energy Management Plan Elements:

1. Purchase reliable energy at the lowest cost
2. Replace old (less efficient) equipment with new EE technologies
3. <u>Operate energy consuming systems efficiently</u>

Peter Herzog's book *"Energy-Efficient operation of Commercial Buildings: Redefining The Energy Manager's Job*. BOOK AVAILABLE THROUGH McGraw HILL PUBLISHING

Goals for Energy Efficient O&M

1. **O**perating energy-using equipment only as much as needed
2. **O**perating energy-using equipment as efficiently as possible when it is needed
3. Performing strategic **M**aintenance to enhance and maintain efficient operation

Energy Waste Clues

"Buildings are actually screaming their problems if we just have the skill and take the time to hear them."

Dave Sellers - Technical Manager
PECI

Energy Waste Clues

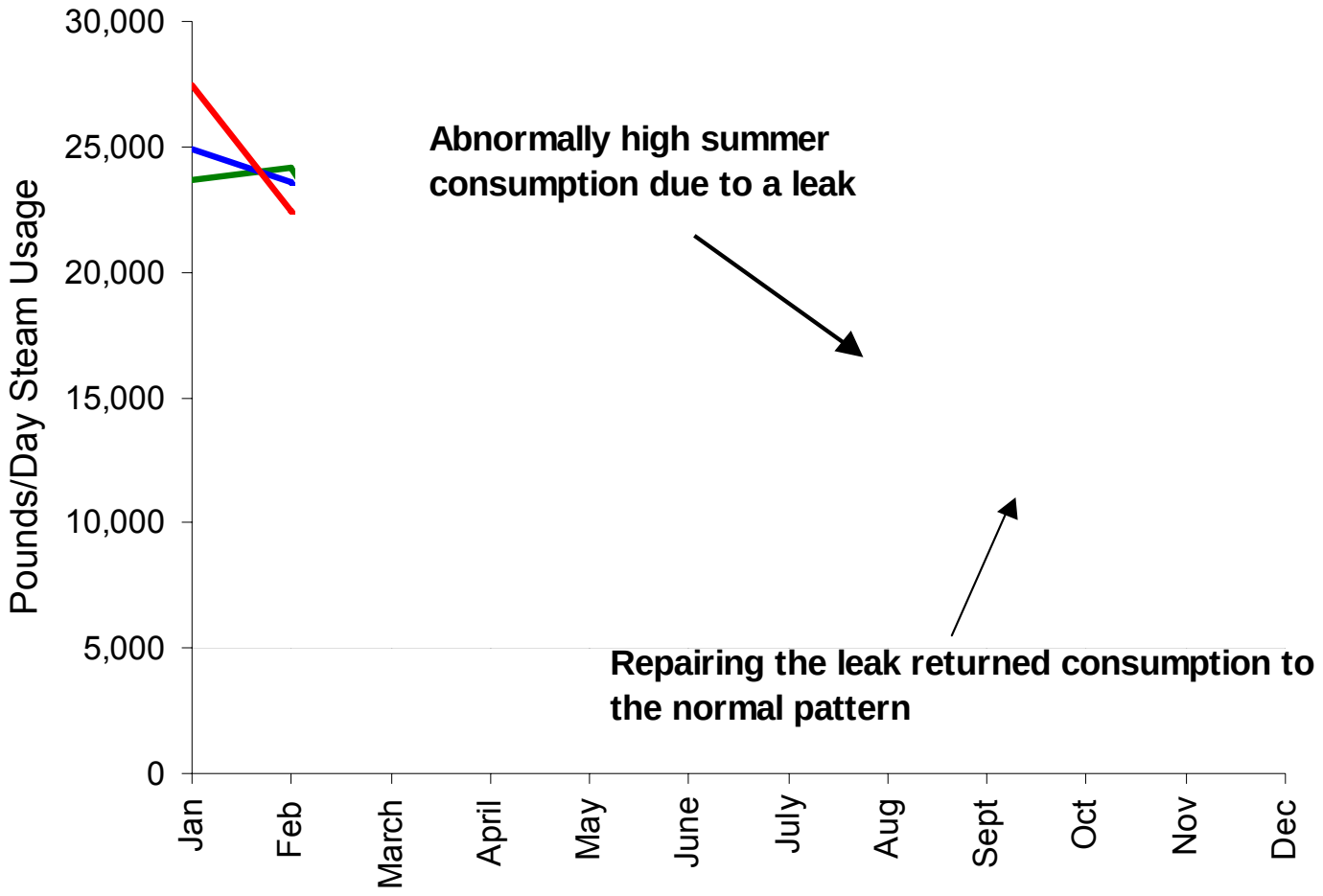
- Excessive comfort calls
- High **E**nergy **U**se **I**ndex (BTU per Sq. Ft.)

OR

- No comfort calls
- High **E**nergy **U**se **I**ndex (BTU per Sq. Ft.)

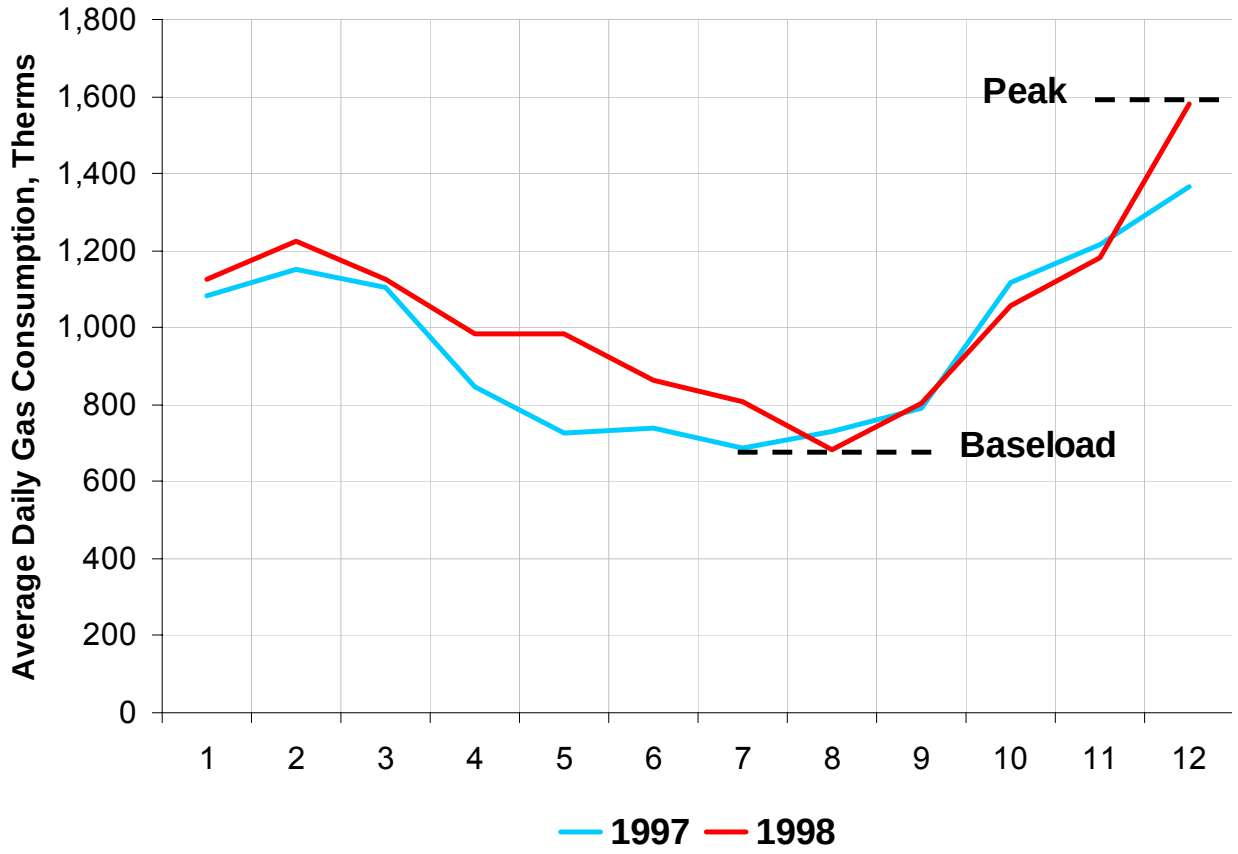
  - Know how your building EUI compares to your peers' by Benchmarking
  - Energy Star Portfolio Manager available at benchmarking website.

Consumption Pattern Clues

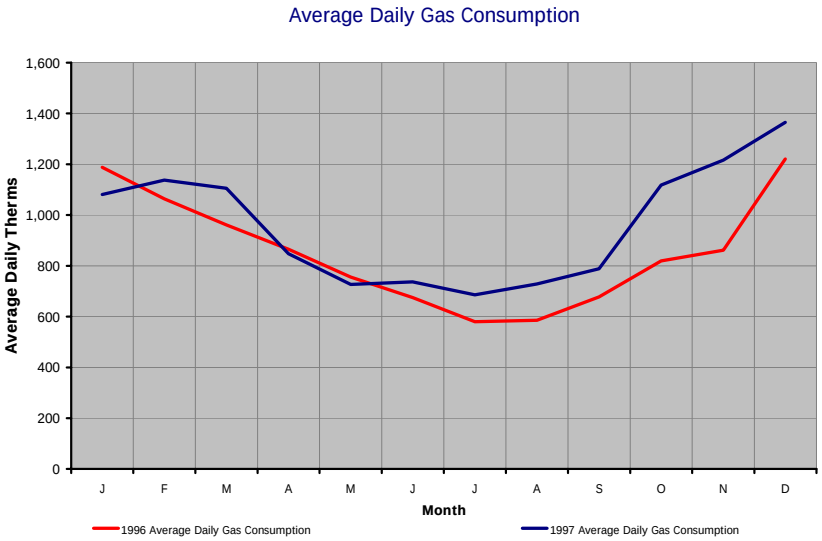


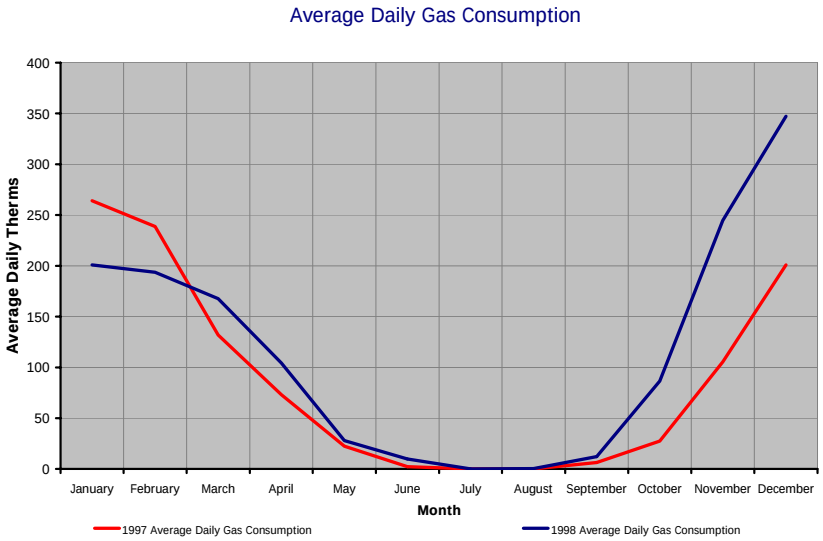
Baseline Clues

- Utility Bill Tracking – Beyond Benchmarking



Baseline Clues





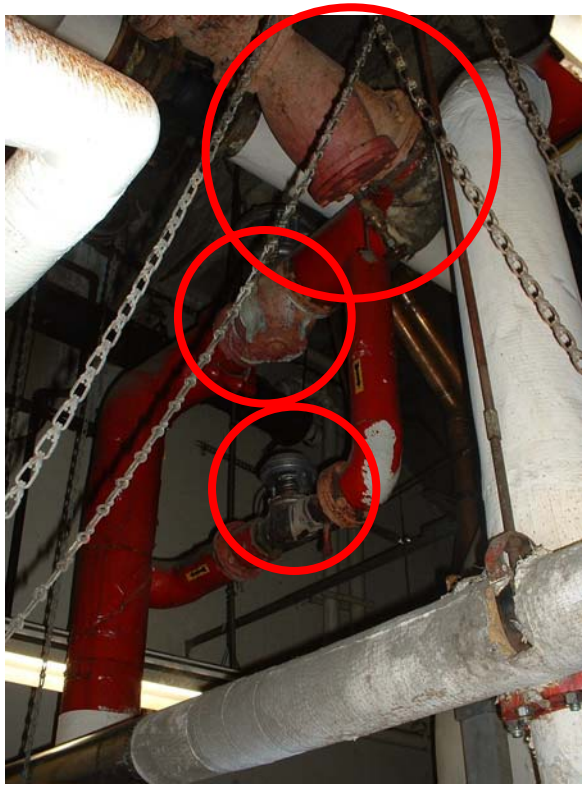
- High Base Line Consumption
- Seasonal Base Line Consumption

Visual Clues

- Condenser and evaporator pumps heavily throttled
- Energy in at the motor
- Dissipated at the valve immediately down stream
- Reducing pump head capacity saves $13,000

Visual Clues

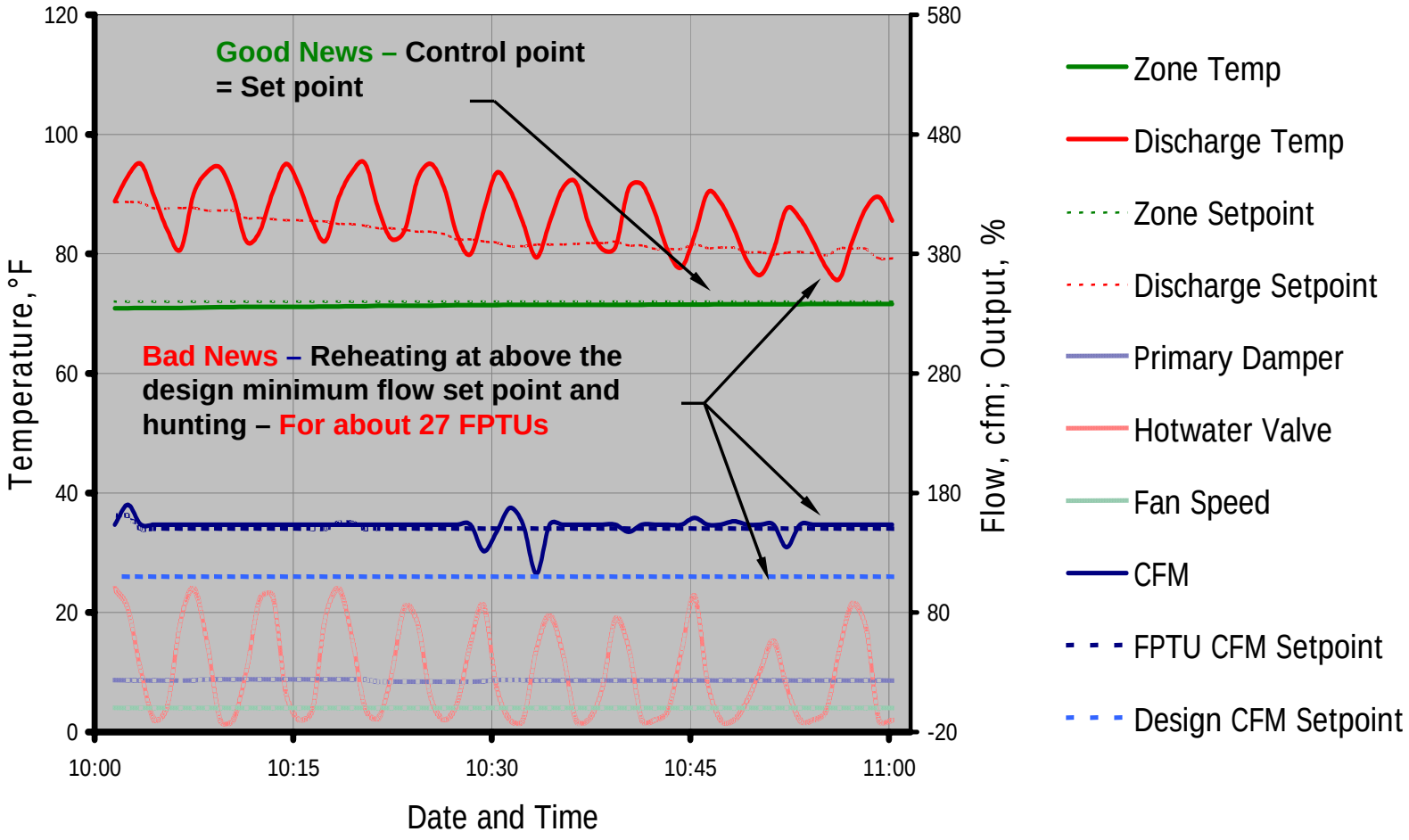
- Steam valve and specialty Insulation
- Easily implemented
- Significant, persistent savings - $12,500



Download a technical bulletin about with a heat loss estimating table at DOE website.

Operational Clues are often Hidden

FPTU3 - January 10, 2002, 10:00 - 11:00 am



Wasting $50 - $100 of Energy …

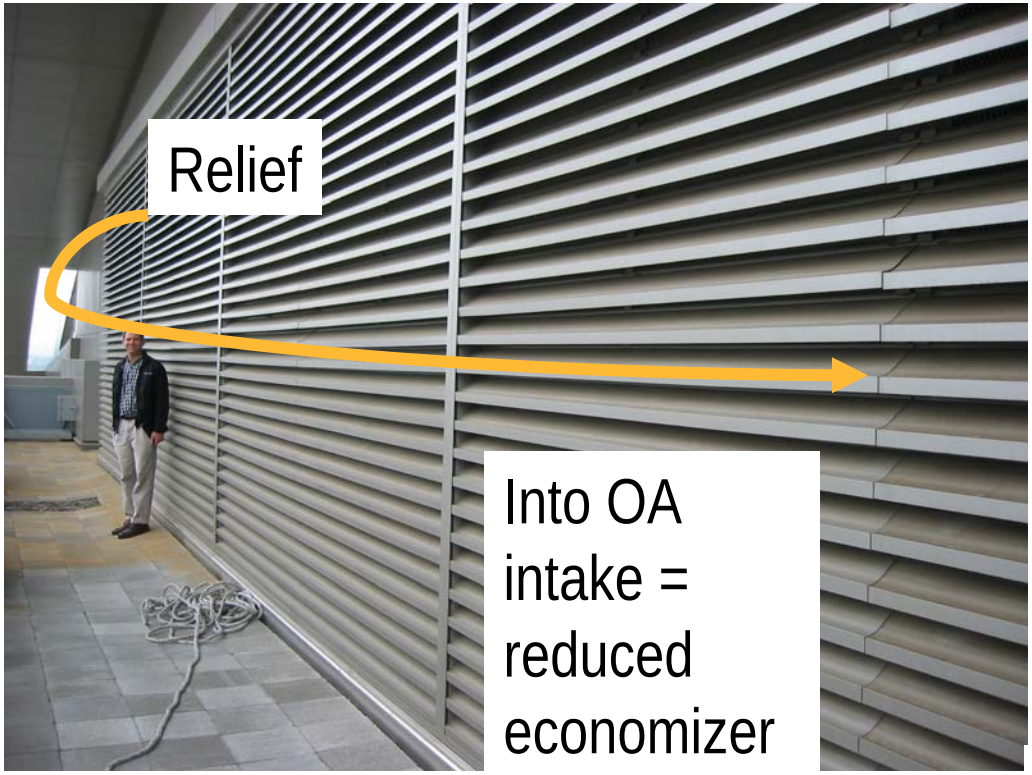
… doesn't seem so bad.

- Until you multiply it by 27 other terminal units doing the same thing
- Simple fixes to typical problems lead to short paybacks
- Operational Solutions
  - Tune loops
  - Correct programming mistakes
  - Apply solutions to multiple similar units

Operational Clues are Often Obvious, but No One is Looking

- **5 floors lighting 24/7: over $14,000/year waste**
- Who can break into the janitor's closet?
- Give control back to occupants by adding accessible override switches for common areas
- Reinitiate lighting sweeps for offices with correct programming
- Buy-in from tenants for schedules

Design Clues:
Location by Design Costs an Estimated $7,000 in Lost Economizer Savings



O&M staff efforts helped a little: blanked off the relief louvers

What Can We Do to be More Proactive?

- Know and track your EUI – Benchmark
- Track and analyze energy bills early and often
  - Share the information with O&M staff
- Look for the visual clues and take action
- Remember the “O”
- Use the BAS to trend critical points – Analyze the data for “O” clues
- Train staff on the “O” as well as the “M”
- Consider Retrocommissioning

Retrocommissioning

What is RCx?

- An event in the life a building that applies a systematic process for improving an existing building's performance
- It provides a rigorous investigation using a systems approach to identify problems and integration issues
- Generally looks for lower cost operational improvements to obtain comfort and energy savings
- May be done alone or in concert with a retrofit project
- Has typical energy cost savings between 5% and 20% with < 2 year simple payback

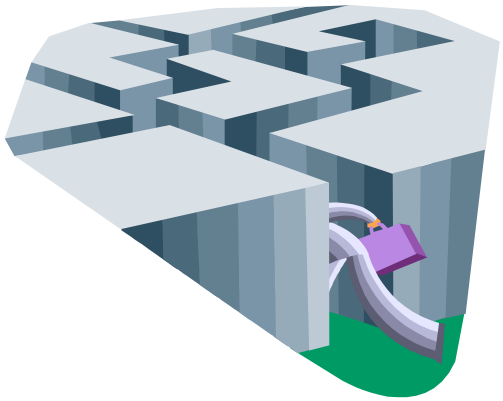
How Does RCx Differ From a Tune-up?

- Tune-up
  - Maintenance
  - Equipment and Components
  - Capacity
  - Physical
  - Identifies More Obvious O&M Issues
  - Saving Ops
- RCx
  - Operation emphasis
  - Systems and Integration
  - Performance
  - Mental
  - Identifies More Hidden O&M Issues
  - More Savings Ops

RCx includes tune-up procedures, but RCx moves beyond tune-up to look at operational and integration issues using a systems approach to improve whole–building performance.

Why RCx?

- Owners do not typically receive fully functional building systems
- Owners face increasing numbers of performance problems
- Buildings are more complex and
- Building systems are becoming increasingly specialized and integrated



What Else?

- Reduces Risk
- Avoids Costs
- Increases Bottom line

Typical RCx Goals

1. Update or create new design (operational) intent to reflect current operating requirements
2. Improve building performance to meet owner's objectives
3. Train operating staff throughout the course of the project
4. Develop persistence strategies so benefits last

RCx Process Overview

- Planning
  - Screening
  - Scoping
- Investigation
  - Testing
  - Analysis
  - Selection

Budget 1 - **Study**

- Implementation
- Hand-off

Budget 2 - **Act**

Planning Phase - Screening

- Select good building candidates for RCx

Appropriate building characteristics:

~ Existing medium to large commercial buildings

~ Buildings with existing direct digital controls (DDC or EMCS)

~ High energy consumption (BTU/ft^2) (optional)

~ Proactive management philosophy

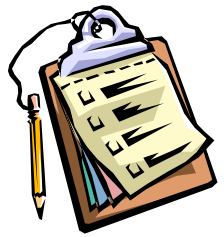
~ Mechanical equipment in relatively good condition and not at end of life

Planning Phase - Scoping

- Establish the building's energy baseline and EUI (Energy Use Index or BTU / Sq. Ft.)
- Assess the potential for low-cost energy and demand reduction opportunities with a site walk through
- Analyze results
- If sufficient opportunities exist - develop a scope of work to complete RCx process

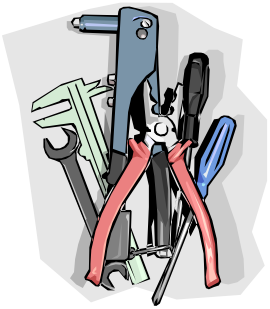
Investigation Phase

- Review building documentation
- Understand the current operational requirements
- Perform diagnostic testing and monitoring
- Analyze data to determine which improvements provide the greatest benefit
- Develop a Master List of Findings and Recommendations
  - **Focus on long lasting operating improvements with short paybacks first**
  - **May recommend capital improvement opportunities**
- Select measures for Implementation



Implementation Phase

- Develop a detailed implementation plan, scopes of work, specs, and budget
- Implement the selected cost-effective improvements (and capital measures if included)
- Verify and document results



How does it all get done?

Who does what?

Hand-off Phase

- Develop Persistence Strategies
  - Track energy and re-benchmark
  - Develop a Re-commissioning plan
  - Update PM program and service contract
  - Redefine responsibilities
  - Train Staff
- Develop the Final RCx Report
- Hold a Project Close-Out Meeting
  - Present Final RCx Report and Persistence Plan

Making the Case for RCx

RCx's Energy Savings Potential

- Most projects see a 5% - 25% reduction in utility cost as the result of Retro-commissioning efforts
- Paybacks of 2 years or less are common

  - See *Retro-Commissioning's Greatest Hit's*, Tudi Haasl. Presented at ICEBO 2001. Available at PECI.org website.

What Does It Cost?

- $1,500 to $3,000 to scope out a typical project
- $0.10 to $1.00 per square foot for the RCx process depending on:
  - Number of systems
  - System complexity
  - Number of zones
  - Data logger rentals
  - Owner's requirements
  - Subcontractor requirements
  - Implementation involvement
  - Owner involvement

How Do You Sell It?

- Simple Payback
  - Traditional approach
  - Easy to assess
  - Limited perspective
- Net Operating Income (NOI)
  - Expense Analysis
- Asset Value
  - Investment Analysis

Net Operating Income (NOI) =

Gross Income

- Rental income
- Parking fees
- Vending receipts

… adjusted for vacancy rate and bad debt

less

Operating Expenses

- Utilities
- Repairs
- Maintenance
- Insurance
- Management fees
- Supplies
- Taxes

Energy is a very large portion of operating expenses

Asset Value

$$\Delta \text{ Asset Value} = \Delta \text{ NOI} / \text{Capitalization Rate}$$

$$\Delta \text{ NOI} = \$ / \text{ft}^2 / \text{yr. Savings}$$

$$\$ / \text{ft}^2 / \text{yr. Savings} = \frac{\$ \text{ Savings} / \text{ft}^2}{\text{Payback}}$$

For example, a $0.20/ft^2 RCx upgrade with 2 year simple payback period supports $0.10/ft^2 in higher NOI and $1.00 /ft^2 in higher asset value

Persistence is Crucial

- The results of RCx can have a major impact on value
- Increases in tenant retention/attraction due to improved comfort generally lead to “persistent” NOI benefits
- Improved asset value will only be realized at the time of sale if the RCx results persist
  - Simple is important
  - Training is important
  - Robust implementations are important

Non-Energy Benefits

- *Comfort*
- *Reliability*
- *Equipment life*
- *Maintainability*
- *Productivity*
- *Liability*
- *Indoor Air Quality*
- *Tenant Satisfaction*

NEBs Improve Payback Potential

- Non-Energy Benefits valued by the beneficiaries at up to 50% of the energy savings benefit
- NEBs often trigger RCx Projects; can be of more value to some owner/managers

Non-Energy Benefits Including Productivity, Liability, Tenant Satisfaction, and Others: What Participant Surveys Tell Us about Designing and Marketing Commercial Programs

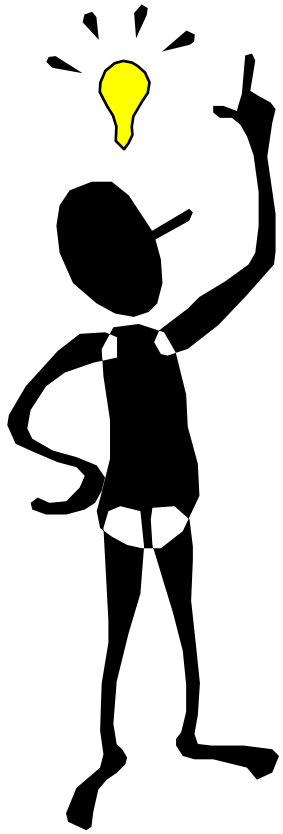
- Dennis Pearson, Seattle City Light
- Lisa A. Skumatz, Skumatz Economic Research Associates, Inc.

Published at 2002 ACEEE Summer Study on Energy Efficiency in Buildings

The Bottom Line: RCx Can Improve Value By …

- Improving tenant satisfaction
  - Improved comfort
  - Improved productivity
  - Improved IEQ
- Improving Lease-ability
  - Tenant attraction
  - Tenant retention
- Saving energy and resources
- Lowering maintenance costs
  - Equipment life
  - Maintainability

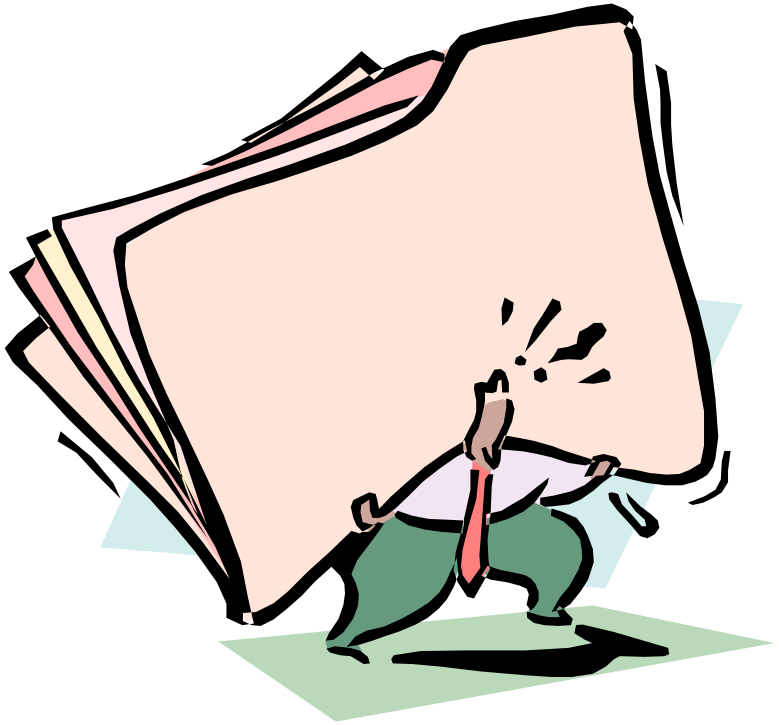
Retro-commissioning …



… is not just another good idea.

It’s Good Business!

Resources



Cx Resources

- *Practical Guide for Commissioning Existing Buildings*, Oak Ridge National Lab/PECI
- *Continuous Commissioning Guide,* Federal Energy Management Program
- *ASHRAE Guideline 1-1996: HVAC Cx Process*, (order online – focuses on Cx for new construction but has a section on RCx)

Cx Resources Cont.

- *Strategies for Improving the Persistence of Commissioning Benefits,* LBNL/PECI

- Coming soon! New guide on RCx that will include practical protocols for all phases of the RCx process – Funded through EPA

O&M Resources

O&M Best Practices Series, available in the Resources Library at PECI website. (Funded by EPA and DOE)

- *Fifteen O&M Best Practices for Energy-Efficient Buildings*
- *O&M Assessments: Enhancing Energy-Efficient Operation*
- *Putting the "O" Back in O&M: Best Practices in Preventive Operations, Tracking, and Scheduling*
- *Energy Management Systems: A Practical Guide*
- *Portable Dataloggers: Diagnostic Tools for Energy-Efficient Building Operation*
- *Operation and Maintenance Service Contracts*
  - *Guidelines for Obtaining Best-Practice Service Contracts for Commercial Buildings*

O&M Resources Cont.

- *O&M Best Practices – A Guide to Achieving Operational Efficiency*, Federal Energy Management Program

  EERE website.
- *Energy Efficient Operation of Commercial Buildings: Redefining the Energy Manager's Job*, Peter Herzog (McGraw Hill 1997)

The More Technical Resources

- National Building Controls Information Program (NBCIP)
  - DDC Online.
  - Lawrence Berkeley National Laboratory
  - Functional Test Guide
- *Using Utility Bills and Average Daily Energy Consumption to Target Commissioning Efforts and Track Building Performance*, David Sellers. Proceedings of ICEBO 2001. Available at PECI.org website.

Economic Resources

- *Energy Star Portfolio Manager*, ENERGY STAR website.

- *Understanding the Value of Commissioning in Income-Producing Office Buildings,* Mark T. Jewell, RealWinWin, Inc. In the Proceedings from the 2003 and 2004 National Conference on Building Commissioning, PECI.org website, and Realwinwin.com

Annual Conference

- NYSERDA is hosting the 2005 **National Conference on Building Commissioning**, peci.org/nbc May 4-6, 2005, New York City

Questions & Discussion

Upcoming Web Conferences

September 9* – ENERGY STAR Leaders

September 15 – All about the ENERGY STAR Awards

October 20 – Using Service and Product Providers to Leverage Your Energy Efforts

www.energystar.gov/networking

Thank You!