Building Retro-Commissioning
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Providing effective strategies for public and private buildings in Illinois
What is Retro-Commissioning?

- Commissioning is the process of ensuring that building systems operate as intended.
- Should occur when building is first constructed and delivered to client.
- Re-done later in the life of the building (re-commissioning), or;
- May be done later in the life of a building if commissioning was never done before (retro-commissioning).
Retro-commissioning Incentives and Requirements – DCEO Public Sector

- Retro or Re-commissioning is a “service-incentive” program – the SEDAC analysis is the incentive received by the client.

- In order to qualify for the incentive (from SEDAC)
  - Public sector building more than 5 years old.
  - Larger than 150,000 sf
  - Existing BAS system
  - High energy use index
When to Retro-Commission

- If the building has never been commissioned.
- If the original usage of the building has changed.
- If the building is experiencing any of the following:
  - high energy consumption
  - occupant comfort complaints
  - indoor air quality problems
  - Numerous operation and maintenance problems
RCx Impact

- **Great Savings**
  - RCx savings 16% median *whole-building* energy

- **Quick Paybacks**
  - Cost $0.30-$2.00/sf
  - SPB 1.1 years

- **Multiple Benefits**
  - Longer equipment life
  - Lower utility bills
  - Lower maintenance costs
  - Fewer comfort complaints

“arguably the single-most cost-effective strategy for reducing energy, costs, and greenhouse gas emissions in buildings today”  Evan Mills, LBNL
Process Overview

- Site inspection
- Data gathering plan
- Sensor installation and/or BAS trend logging
- Data collection and analysis
- Recommended RCx measures
- Client implements measures (at least $10,000 worth)
- Measurement and Verification
Typical Findings from RCx

• Missing or broken equipment/components
• Incorrect thermostat settings and control sequences
• Incorrect or missing BAS schedules for fans, pumps, lights, and other key components
• Malfunctioning control sensors such as outside air temperature sensors, supply air temperature sensors, damper position, etc.
• Heating and cooling systems fighting each other (excessive reheat).
Excessive Reheat

[Graph showing a seasonal trend with a peak during Summer.]
Why the summer gas usage?

- VAV reheat
- Boxes oversized so damper always at minimum position
- But room still too cold so reheat valve always open – always heating the space
## Incorrect Schedule

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What’s wrong with the schedule?

- Friday fan operation is the same as all the other weekdays – but Friday occupancy schedule is actually the same as Saturday.

- Also, fans start early on weekdays – but not on Saturdays and Sundays – why should they? (no good reason).

- It’s a big deal because each fan system is about 100 hp.
Incorrect Control Sequence

February 17, Inside Temperature and Heating Valve Pressure

Temperature (F) and Pressure (PSIG)
What’s wrong with the control sequence?

- BAS says schedule is 76 unoccupied, 72 occupied.
- Great for cooling season – OOPs its February.
- Heating valve status shows the system terminal unit is heating at night.
- System heats to higher temperature all night while unoccupied all winter long.
- Might also be happening in summer – so instead of floating up to 76 – heating to 76.
Midnight Drive-By RCx and the Case for Light Loggers.  (photo by McNally Engineers)
A “Light – Logger” Can Also be Used
RCx Challenges - Lighting

• Time clock schedule – hard to define; impossible to change. Hence, it was not used.
• Light harvesting – partial implementation
• Dimming feature not implemented.

RESULT
• The owner was not empowered to use the system, hence it was operated using only the central ON/OFF feature.
• Many lights were left on 24/7.
Typical Light Logger Lighting Data
VFDs Not Varying
What’s Wrong with the VFDs?

▪ Common problem is VFDs not properly controlled.
▪ sensor failure
▪ sensor location
▪ no sensor
▪ Control variable does not vary – misapplication of VFD
Opportunity for Tighter Demand Control

![Graph showing CO2 ppm, temperature, and relative humidity over time with a peak on Sept. 3.](image)
What is the opportunity?

- CO₂ data shows every day (until economizer starts) that peak CO₂ is around 700 ppm.
- ASHRAE says we can go to 1,000 ppm.
- So, we can reduce outside air quantity, save cooling and heating energy.
- Don’t need sophisticated CO₂ controller, just fine tune the system outside air based on a nice long term CO₂ data collection.
## Comfort assessment

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**Overall Temperature Average Score = 2.71**

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**Overall Humidity Average Score = 3.04**

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**Overall Lighting Average Score = 2.93**
Why do a comfort Assessment?

- Often system configuration has evolved in an attempt to meet occupants’ comfort issues.
- Sometimes satisfying a few vocal occupants results in discomfort for a larger number of occupants.
- Systems can get “tweaked” into suboptimal configurations.
- RCx should result in better comfort and less energy usage.
Retro-commissioning services are delivered through a network of commissioning providers that have been trained in program protocols and participation processes. This program is part of the Illinois Energy Efficiency Portfolio and is limited to ComEd and Ameren Illinois electric service territories; Ameren Illinois, Nicor Gas, Peoples Gas or North Shore Gas natural gas service areas.
A Spending Commitment is required

- The owner must be prepared to assume costs and expenses of at least $10,000 for agreed-upon measures that result in a combined estimated simple payback of 18 months or less based upon electrical and therm savings.

- If at least $10,000 worth of recommended measures are not implemented within one calendar year from receipt of recommendations, the owner will be responsible for reimbursing the SEDAC program for the cost of the analysis.
Available RCx Analysis & Funding

**Public Sector**
- Administered by SEDAC
- > 5 years old
- >150k sf
- BAS system
- $10k investment

**Private Sector**
- Commercial Buildings
  - >100ksf
  - >5 yrs
  - BAS
  - $10k investment
- Healthcare facility
- Compressed air systems

**Private Sector Commercial Buildings**
- 500 kW demand
- > 5 years old
- >150 ksf
- BAS system
- Required Operator Training
- $15-30k investment
- Joint Electric/Gas Partners

- Analysis is the incentive. Buys down discovery phase.
- RCx costs after required investment *may* be eligible for *custom incentives* based on electrical and natural gas savings – check w/ program
The Building Dashboard
Why Dashboard Enhanced M&V?

- Experience has shown that persistence of RCx savings can be short, on the order of months.

- Often upper management is not fully aware of RCx energy savings, and overall building performance.

- Providing a dashboard application for upper management will increase awareness of building energy system consumption and help prevent “backsliding’ of building energy performance.
Goals of the SEDAC Enhanced M&V Pilot

- Evaluate effectiveness of dashboard based M&V products at SEDAC RCx client sites.
- Examine client satisfaction with a variety of dashboard products.
- Identify and solve technical issues with regards to dashboard implementation at a variety of client sites.
- Increase upper management awareness and participation in tracking and maintaining building energy system performance.
Requirements for Participation in Pilot

- Previous or current SEDAC RCx client.
- Willing to implement dashboard application by May 31, 2015.
- Willingness to commit staff time to assist in implementation of the dashboard, and attend dashboard training.
- Willingness of upper management to provide a desktop “home” for the dashboard.
Dashboard Program Details (in process)

- SEDAC funds 80 and 100 percent of dashboard implementation costs, including:
  - Metering
  - Software
  - Training

- Amount of funding will be evaluated on case by case basis and will be at the discretion of SEDAC.

- Dashboard will initially be for internal usage, public display will be a choice of the client.

- SEDAC will have real time (or approximately) real time access to all data pushed through the dashboard.
Dashboard Program Details (in process)

- Dashboard vendors being evaluated:
  - Lucid (Building OS or Building Dashboard)
  - Pulse Energy Manager
  - McNally Budgetworks
  - Ensol

- Other vendors identified by the client will be considered on a case by case basis.
Energy Dashboards

- Put the energy consumption information on your desktop
- Track trends, monitor for high consumption
- Use to plan future efficiency efforts, and assess impacts.
Presentations will be available at: presentations.sedac.org

Web site: www.sedac.org
Contact: info@sedac.org
1-800-214-7954