Net Zero

Operations —

Phillip Saieg | September 17, 2013



The dial is always spinning one way or the other





AGENDA

- Net Zero Operations vs. Conventional Operations
- Best practices for Net Zero Building Operations
- Project examples



V.S. Conventional Operations



Component-based

- Service of each piece of equipment on its own merit
- Change parts when part break
- Improve efficiency with more efficient parts
- We serve each piece of equipment on its own time as if was not connected to anything else





Systems-based

- Systems testing
- Integrated systems maintenance
- Performance verification
- Functional performance testing





Moment-in-time view

- What is the system doing right now
- Energy Auditing (only)





Continuous Performance View

- Constantly monitoring performance
- Remote monitoring
- Ongoing Cx
- Real-time feedback





Individual Intelligence

• We rely on a building engineer to understand and work with many different systems in very demanding work place. Constantly being asked to respond to hot/cold calls, fix maintenance issues, and investigate opportunities in existing systems





Collective Intelligence

- National benchmarking
- Leveraging specialists
- Best-practice collaboration
- Building competitions
- Portfolio energy/sustainability managers





Low-Tech

- Bare minimum BAS capabilities
- Unable to create any building trending
- Unable to make control modifications

lizplays -	a list of files and subdirectories in a directory.
DIR [driv [/S]	s:llpathltfilename] [/P] [/W] [/A[[:]attribs]] [/D[[:]sortord]] [/D] [/L] [/C[W]]
[drive: ∕P ∕W	lEpath][filename] Specifies drive, directory, and/or files to list. Pauses after each screenful of information. Uses wide list format.
attribs	D Directories R Nead-only files H Hidden files S System files A Files ready to archive - Prefix meaning "not"
∕0 sortord	List by files in sorted order. N By name (alphabetic) S By size (smallest first) E By extension (alphabetic) D By date & time (narliest first) G Group directories first - Prefix to reverse order C By compression ratio (smallest first)
/S /B	Displays files in specified directory and all subdirectories. Uses have format (no beading information or summary).
2L	Uses lowercase.
ACTH1	Displays file compression ratio: /CH uses host allocation unit size.
Switches) preset зы	way be preset in the DINCMU environment wariable. Override itches by prefixing any switch with - (hyphen)for example, /-4.
100	



Hi Tech

- Energy alarming
- Algorithms for out of balance system • performance

Performance Monitoring - Boiler

extending into "on peak" hours. Boiler set points were set too high

Systems that learn overtime

1.017 919 HTC: 712 610

- Let - Pittsburg





Reactive

- Building Management is reactive
- Hot/Cold Calls
- Comfort Issues
- Equipment Problems



Preventative, Predictive, Proactive

- + Time-based testing & inspection using a predetermined schedule
- + Dedicated warning signs of equipment or component failure once damage has already occurred
- + Tracking performance of equipment in a system, as well as the system itself and assuring the equipment is running efficiently



Slow response

- How do you know when something isn't working?
- Delayed response due to lack of information
- Call vendor, often truck-based repair
- Especially a problem with PV





Immediate Access

- Automated response
- Alarming stimulates quick, local response or quick remote response







Anecdotal performance information

- The best building report is no report at all
- We often don't measure performance of the building, but only wait for issues to arise





Performance Scoring

- Benchmarking tracking
- Real-time energy tracking
- Energy budgeting
- Annual Energy accounting





Best Practices —Net Zero Operations—



Enabling Information

Getting the data to act on:

- Utility provided pulse outputs (15 minute)
- Install pre-programmed equipment to "sub meter"
- Install infrastructure (conduit, wiring, networking)
- Networked, secured information
- Wireless or wired



You can't manage what you can't measure, and you can't measure effectively if you get the information 1.5 months too late!



Enabling Information







Ongoing Commissioning





Ongoing Commissioning – Threshold Alarming







Ongoing Commissioning – Threshold Alarming

Examples of Custom Alarms:

- Simultaneous heating and cooling in a single unit or across groups, short cycling, lack of diversity control
- Deviation of energy intensity (kw/sq ft/degree day) from benchmarks, baselines, goals along with time, duration and cost
- Degradation of cooling or heating performance (i.e., unit runs but does not deliver expected cooling/heating)
- Economizers open while heating and cooling
- Non-functioning sensors (temp, kw, etc)
- Lights or other loads operating when they shouldn't
- Setpoints overridden and not changing with schedules as expected



Ongoing Commissioning – Systems Improvement





Facility Condition Assessments

- Known inventory of major assets and lifecycle information to facilitate capital planning;
- Building systems operate more effectively, efficiently, and are easier to maintain;
- Life expectancy of a facility and building service equipment systems are prolonged;
- Work environment is improved; and
- Customers are better satisfied with services provided.





case study

City of Boulder

Multiple Net Zero sites

- 22 buildings under ongoing Cx
- Remote Monitoring
- Energy alarming
- Buildings benchmarked against each other
- 25%+ City-wide energy savings
- 1.1MW+ of annual solar energy production



One PV array contributing to over 1 MW of Solar Energy in the City



case study

History Colorado Center

Ongoing Cx

- 2 year cycle of functional testing
- Detailed commissioning plan
- Achieving Low EUI
- Protecting investment of high performance building





case study

Littleton Adventist Hospital

Ongoing Cx

- Energy Savings Opportunity Assessments
- Ongoing Operational Performance Verification
- Recurrent Training for Efficient
 Operation of Systems
- Operational Trend Data Review and Analysis
- Ongoing DDC Training
- Collaborative Change Management Approach





Littleton Adventist Hospital

LAH Energy Savings 25% 20% Savings from Baseline (Apr '06 – Mar '07) 15% 10% 5% 0% -5% Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Electric Energy Savings (% KWH) -2% 6% 7% 7% 6% 5% 8% Gas Energy Savings (% Therms) 4% 17% 23% 24% 23% 21% 15% Energy Cost Savings 0% 8% 12% 9% 9% 8% 7%

\$140,000 \$600,000 \$120,000 \$500,000 **Cummulative Avoided Costs** Annual Avoided Cost \$100,000 \$400,000 \$80,000 \$300,000 \$60,000 \$200,000 \$40,000 \$100,000 \$20,000 \$0 \$0 (\$20,000) (\$100,000) Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Annual Avoided Cost (\$1,465.09) \$82,632.07 \$118,454.17 \$90,644.09 \$94,262.42 \$78,413.11 \$74,727.13 Cummulative Avoided Cost (\$1,465.09) \$81,166.98 \$199,621.15 \$290,265.24\$384,527.66\$462,940.76\$537,667.89





Thank you

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