"*Post Occupancy Building Commissioning Successes through Continuous Commissioning®*"

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Course Description

This presentation on Continuous Commissioning will build the case for commissioning, explain the differences between CCx and Retro Cx, describe the results of several facilities that engaged in this service, and highlight the importance of persistence.

Learning Objectives

At the end of this session, participants will be able to:

1. Understand the value of “tuning up” or continuously commissioning an existing building
2. Appreciate the value of existing building commissioning
3. Understand the differences in multiple commissioning services
4. Understand that performance decay **WILL** occur in an existing building – you can count on it, year in and year out

Agenda for Today……

A. Building challenges today

B. Typical causes found in most buildings today

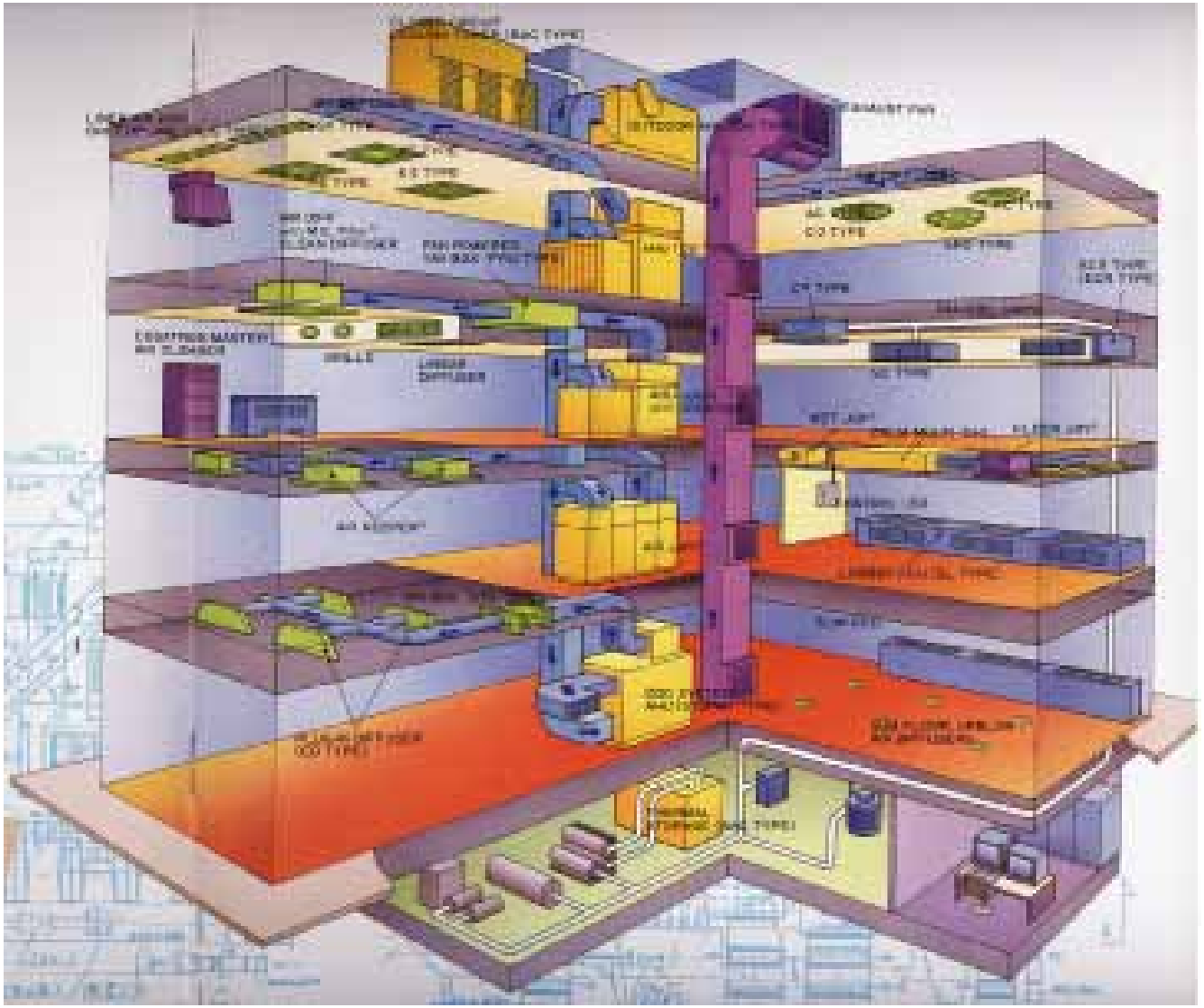
C. Can Continuous Commissioning make a difference?

D. Case Studies

E. Value of Persistence (ongoing)

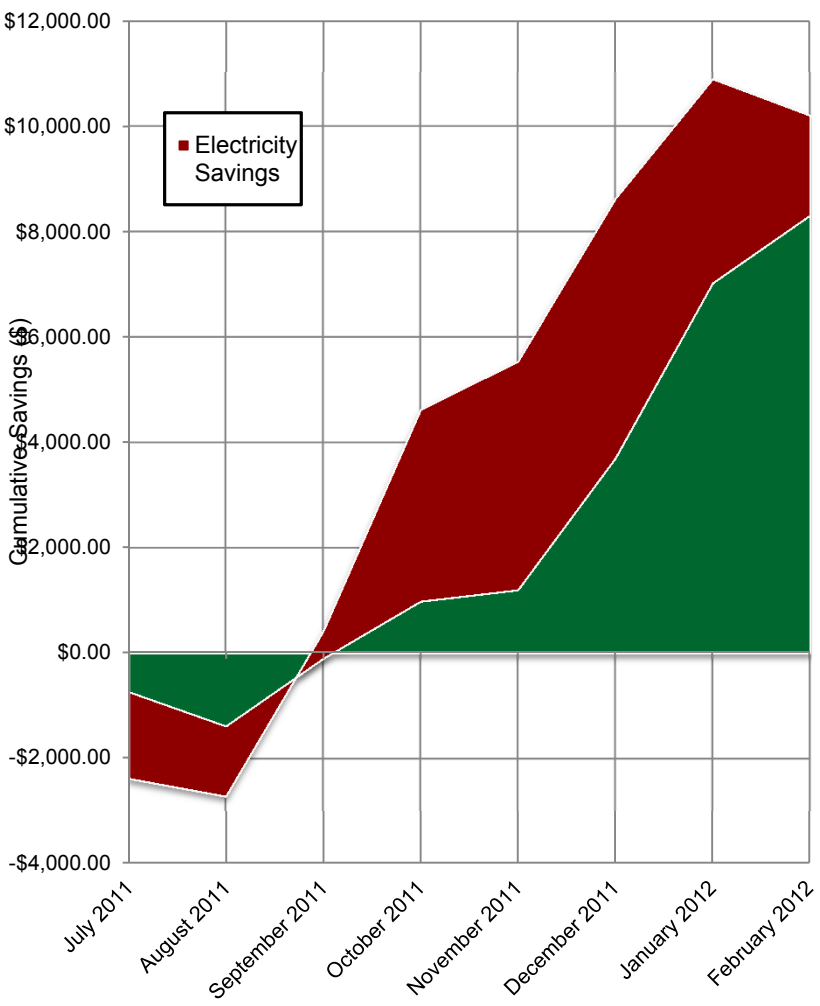
F. Wrap Up

Challenges…



Buildings are complex, inefficient, and expensive.

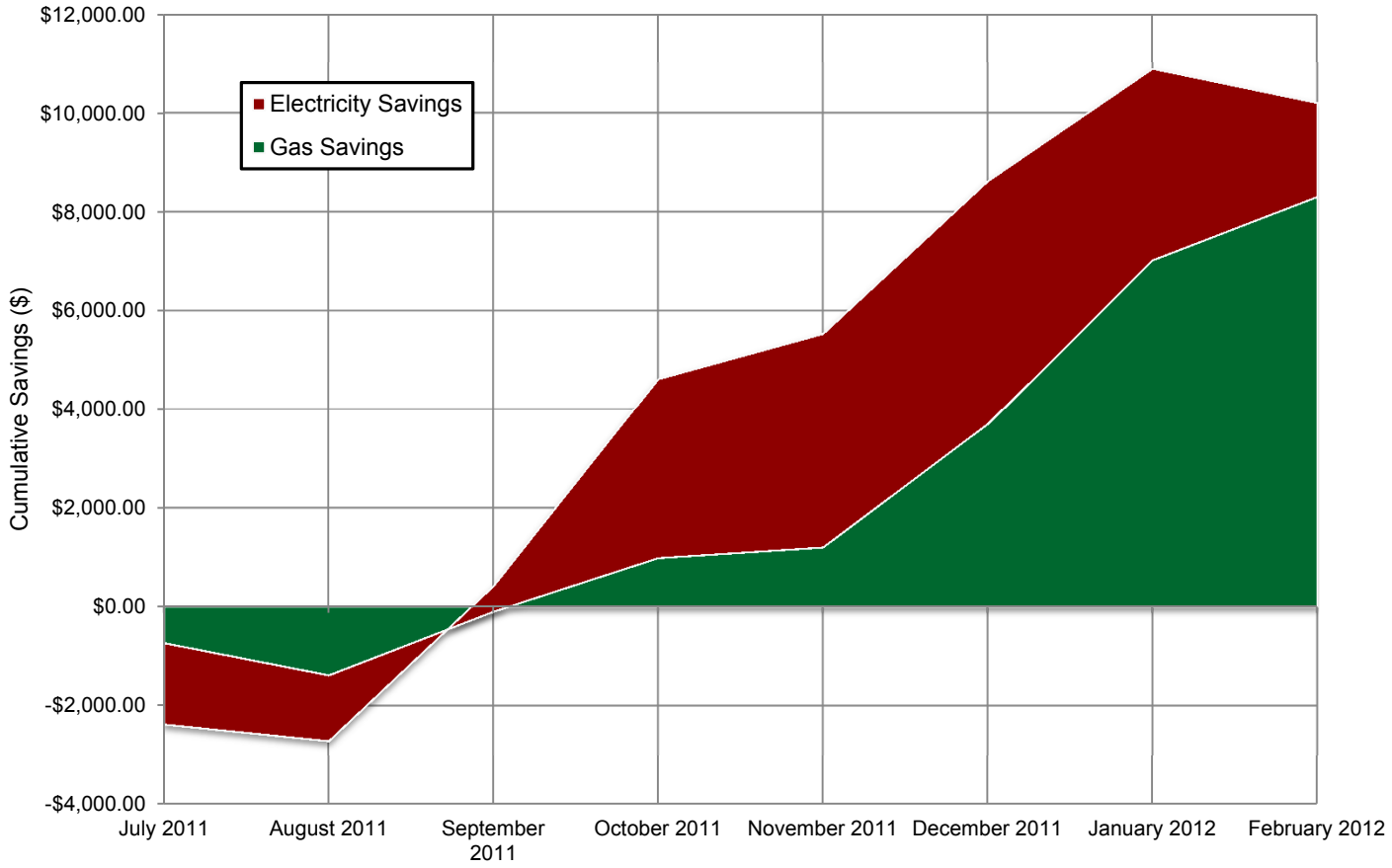
The End Game


$12,000.00
$10,000.00
$8,000.00
$6,000.00
$4,000.00
$2,000.00
$0.00
-$2,000.00
-$4,000.00
Cumulative Savings ($)
Electricity Savings
July 2011
August 2011
September 2011
October 2011
November 2011
December 2011
January 2012
February 2012


$$ saved
Improved operations
Improved comfort
Staff Training

The End Game

Energy Operations Comfort Training



Challenges…

Higher costs

Lower Revenues

Shrinking Margins

Cash Flow/Funding

Staffing

Reduced Operating Budgets

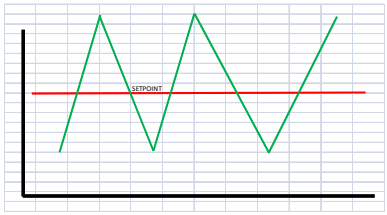
HIGHER ENERGY COSTS

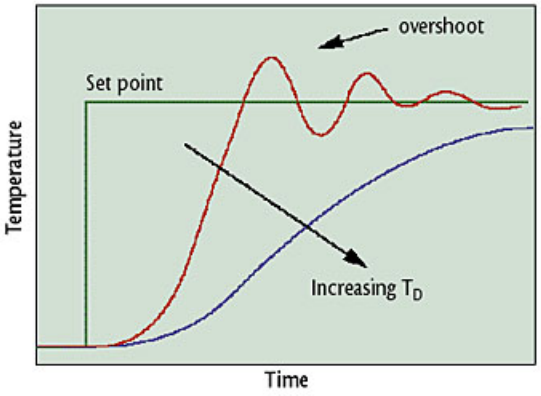
You've heard it all before

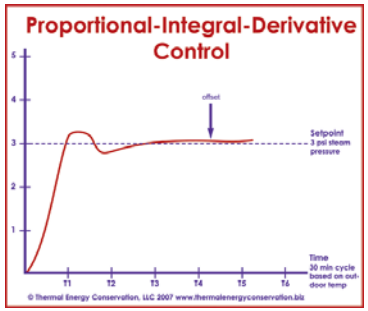
Some of the causes in your world…

- Control system may be consistent with design intent <u>but does it</u> operate in accordance with the building needs?
- Air Terminal programming is almost always incorrect
  - Takes time, time is money
- Air side economizers very seldom fully utilized
- Simultaneous heating and cooling
- Occupied / Unoccupied scheduling very rarely perfected, if used at all
  - Surgery suites
- Constant setpoints in lieu of resets

Poorly tuned control loops (PID)







Some of the causes in your world…

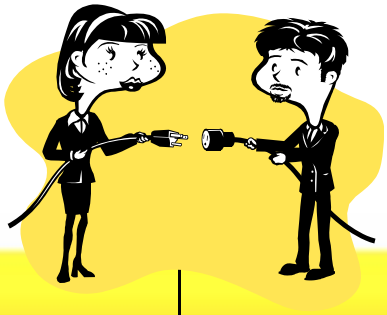
Specs say…. “must be capable of…”

- Hot water supply reset
- Supply Air Temperature reset
- Static Pressure reset
- Condenser water temperature reset
- Scheduling

Almost NEVER implemented during construction phase

New Facilities are built to higher energy standards than ever before, but do they operate more efficiently?

Commissioning Timeline…

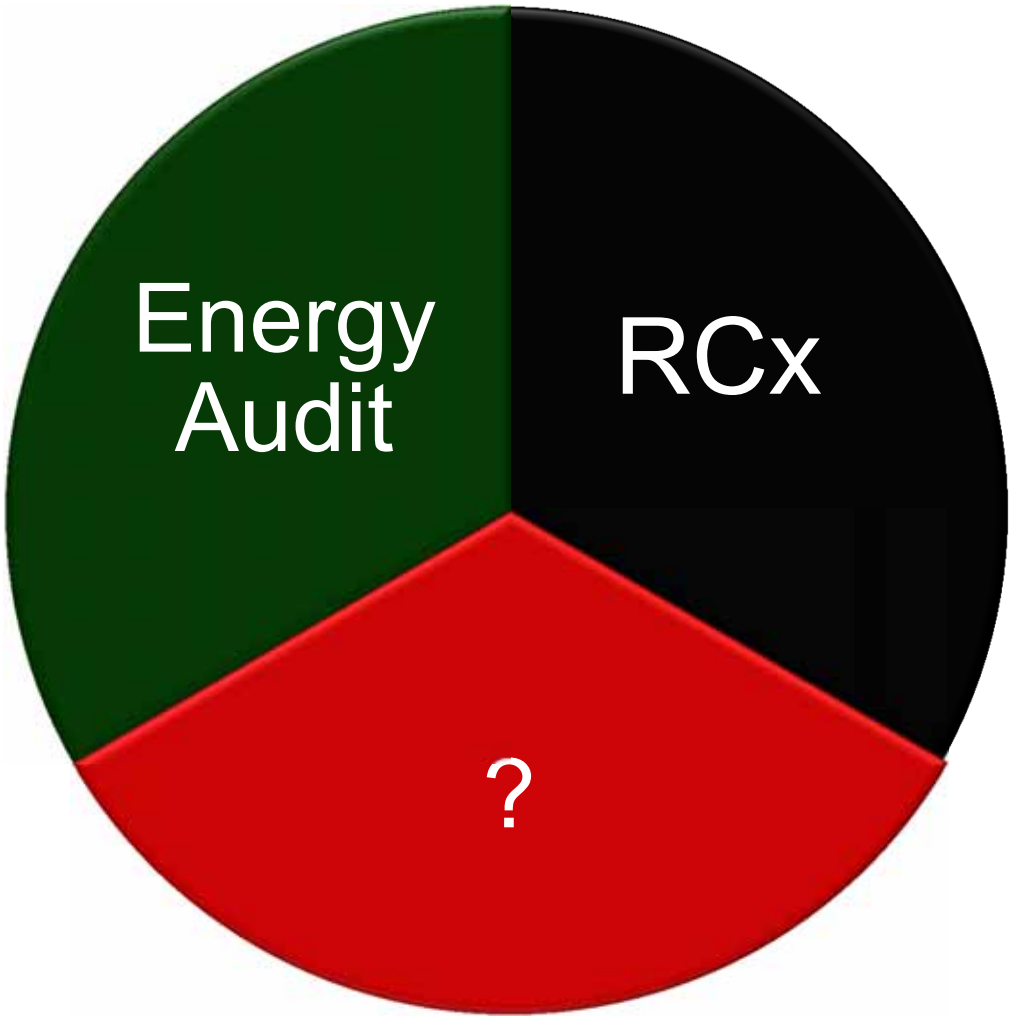


PLANNING	DESIGN	CONSTRUCTION	TURNOVER	OPERATIONS





Project Timeline



What service can solve my problems?


Continuous
Commissionin
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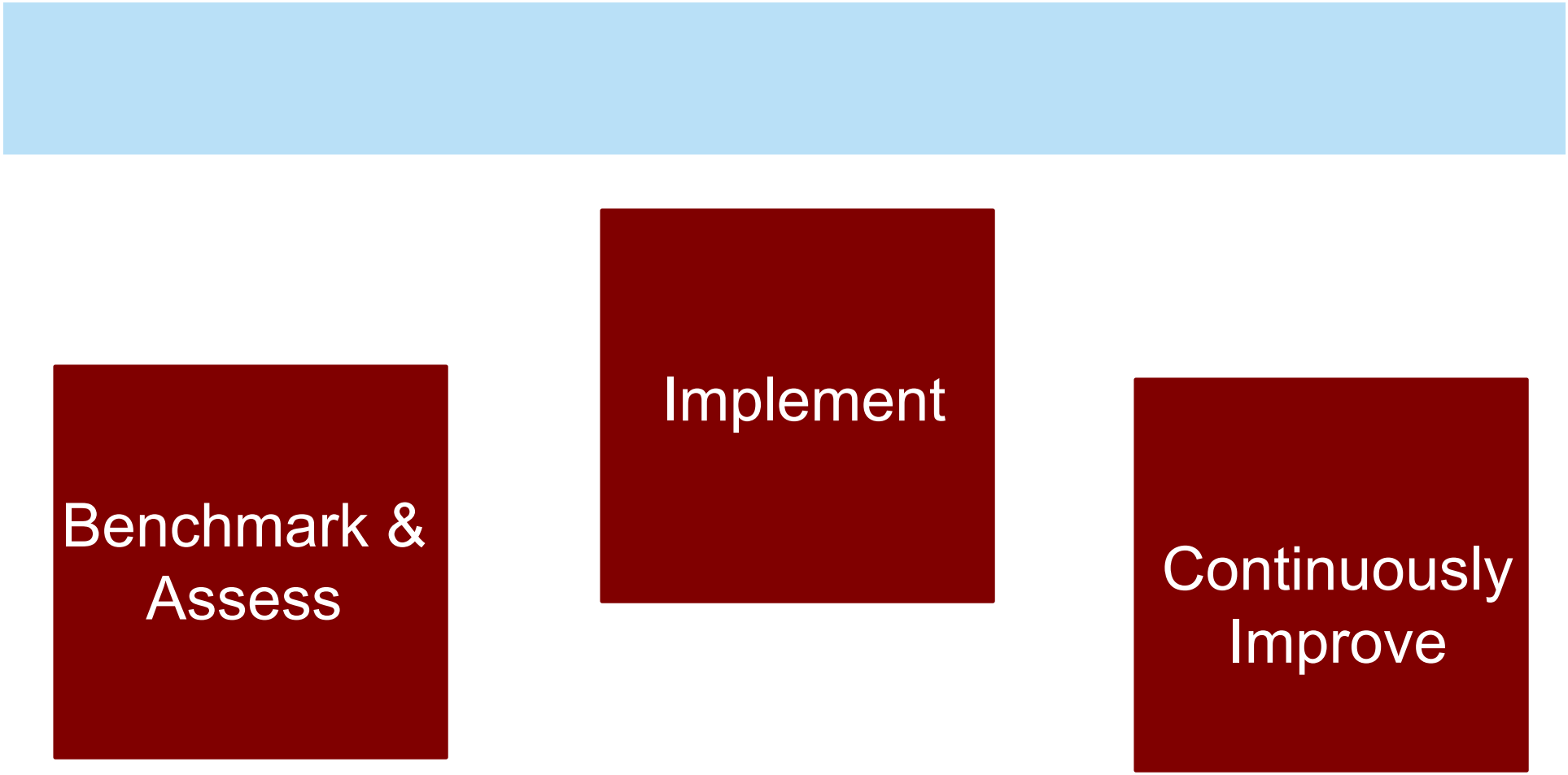

Benchmark & Assess
Implement
Continuously Improve

Can Continuous Commissioning make a difference…?

William A. Harrison, P.E. in ASHRAE presidential address in 2008

"Energy use in buildings could be reduced by 10 to 40 percent by improving operational strategies in buildings."

Gordon Holness, P.E., ASHRAE President 2009-2010

ASHRAE Journal August 2009

"While we can build the seemingly most efficient buildings, that means nothing if we cannot keep them operating efficiently. We need to learn why building performances typically deteriorate as much as 30% in the first three to four years of operation and the role that commissioning and retro-commissioning can play to reduce that performance decay." ***PROOF OF THIS LATER!***

Can Continuous Commissioning make a difference…?

Lawrence Berkeley National Laboratory

"energy savings from a utility-sponsored retro-commissioning (building tune-up) program targeted to large commercial buildings ranged from **3% up to 19%,** but that those savings may not persist beyond a few years.[1]……..The reasons for savings degradation include operator error (disabling optimized control sequence), sensor and device failures, and operator turn-over."

California Commissioning Collaborative

"that the new construction Cx will result in a range of energy savings between $0.02 to $0.19 and non energy savings between $0.23 to $6.96 per sq.ft. – a total opportunity of **$0.25 to $7.15 per sq.ft**."

Portland Energy Conservation Incorporated

"a new 100,000 sq.ft. building that is NOT commissioned is likely to have $19,000 of higher energy costs per year. Almost **$200,000 over a ten year period** with potential non-energy increased cost as high as $715,000."

Energy Systems Laboratory (Texas A&M University)

"continuous commissioning projects undertaken in various building types across the U.S. the average annual energy bill savings opportunity is **22%** (ranged from 8% to 45%)."

VA VISN 16 SUMMARY

8,934,299 square feet

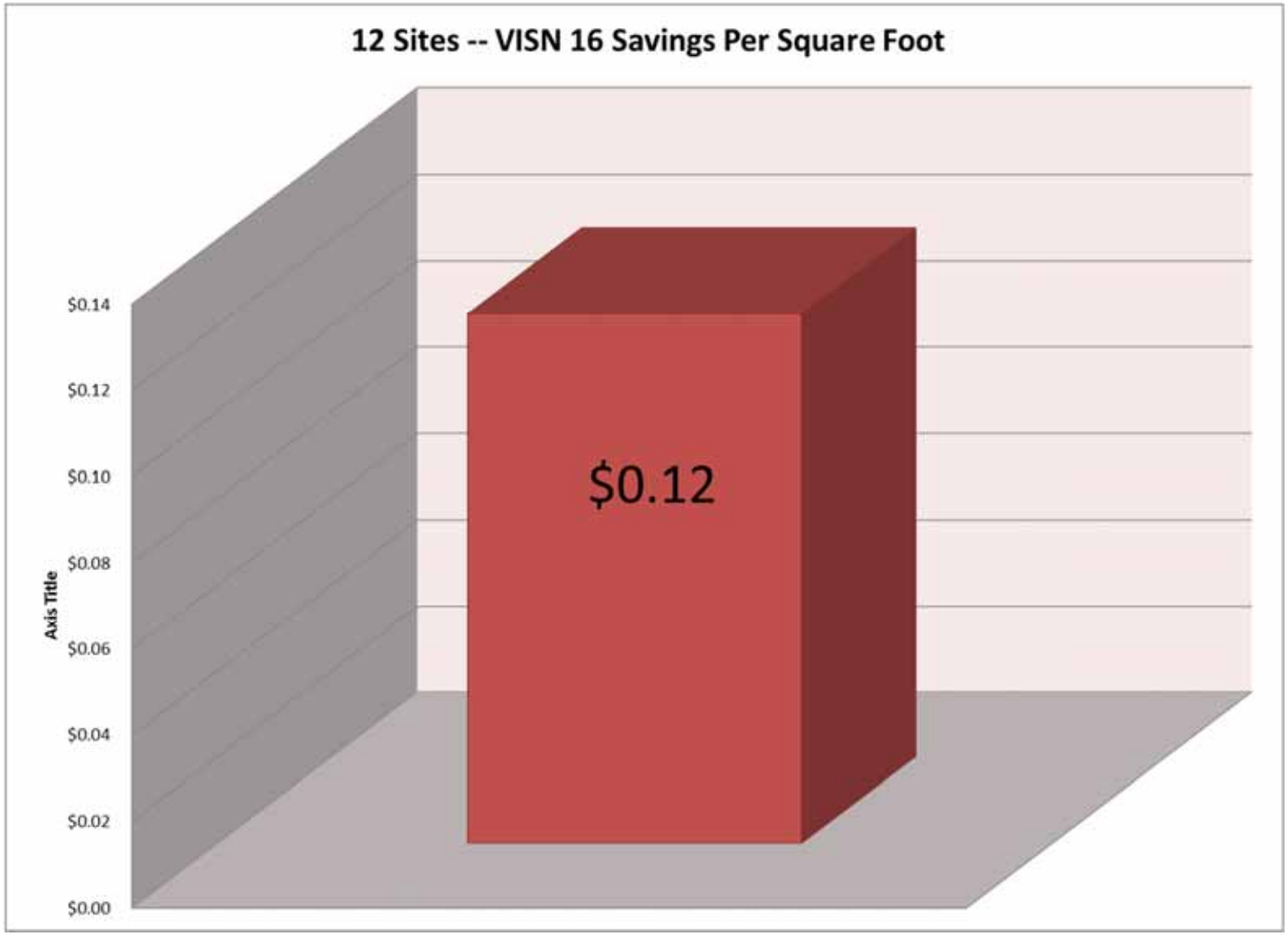
Contract Summary

October 2009 thru September 2011

VA VISN 16

- Prime Contractor
  - Energy Systems Lab/Texas A&M
    - SSRCx – Sub Consultant
    - Command Commissioning – Sub Consultant
    - Sub Consultant


12 Sites -- VISN 16
$1,096,000
$773,647
$$ saved 17 months
$$ Saved Annualized


12 Sites -- VISN 16 Savings Per Square Foot
Axis Title
$0.14
$0.12
$0.10
$0.08
$0.06
$0.04
$0.02
$0.00
$0.12

Pensacola VA Outpatient Hospital

Energy Star ~ 35

Built 2008

1 main building, 3 stories

206,000 square feet

Energy Use Index (EUI) – 240.5 kBtu/ft^2/yr

- ASHRAE/IES Std 100-2006R target = 143 kBtu/ft^2/yr

Energy Cost Index (ECI) -- $4.50/ft^2/yr

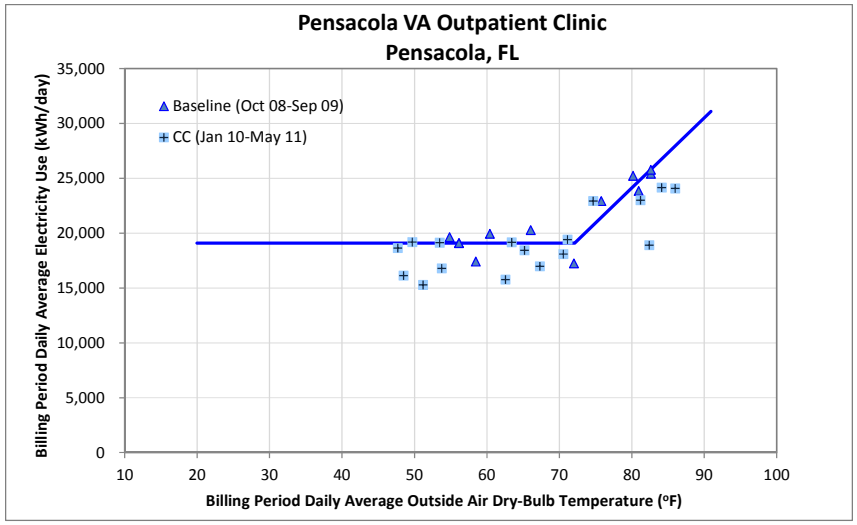
Pensacola VA Outpatient Hospital

Assessment identified a total of 10 CC opportunities that were implemented.

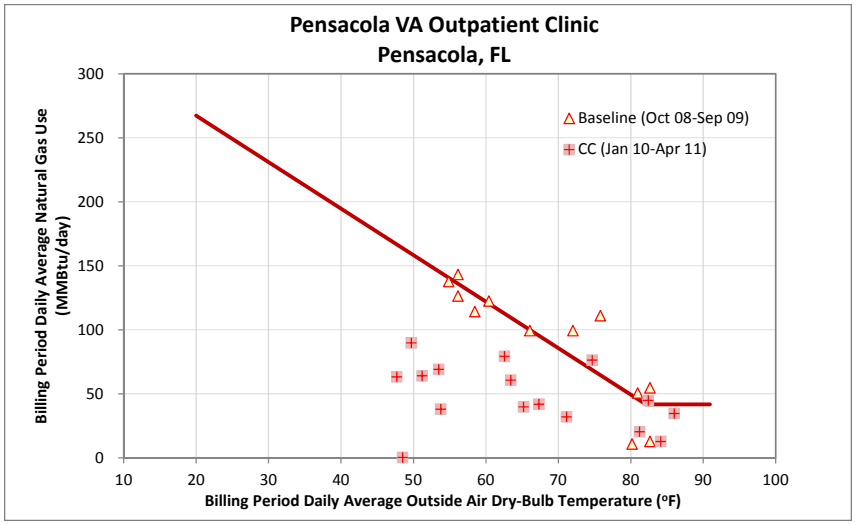
	Savings	Estimated
1.	Optimize Chilled Water Temperature Reset.	$ 12,500
2.	Optimize Chilled Water Loop Differential Pressure Control.	$ 2,000
3.	Reduce Amount of Outside Air Required by AHUs 1, 2, 3, 4, 5, and 10.	$ 21,000
4.	Optimize AHU Discharge Air Temperature Reset and Static Pressure Reset.	$ 30,000
5.	Optimize Unoccupied Period Shutdown/setback	$ 95,000
6.	Optimize the Heating Hot Water Supply Temperature Reset.	$ 10,500
7.	Optimize the Operation of Heating Hot Water Bypass Valve.	$ 5,000
8.	Optimize Minimum Airflow Setpoint for Terminal Boxes.	$ 30,000
9.	Optimize Chiller Staging Control.	$ 30,000
10.	Cooling Tower Temperature Reset Based on System Capability.	$ 18,000
	TOTAL ESTIMATED SAVINGS DURING ASSESSMENT PHASE	**$254,000**
	TOTAL ACTUAL SAVINGS MOST RECENT 12 MONTHS	**$249,511**

Pensacola VA Outpatient Hospital

Electricity

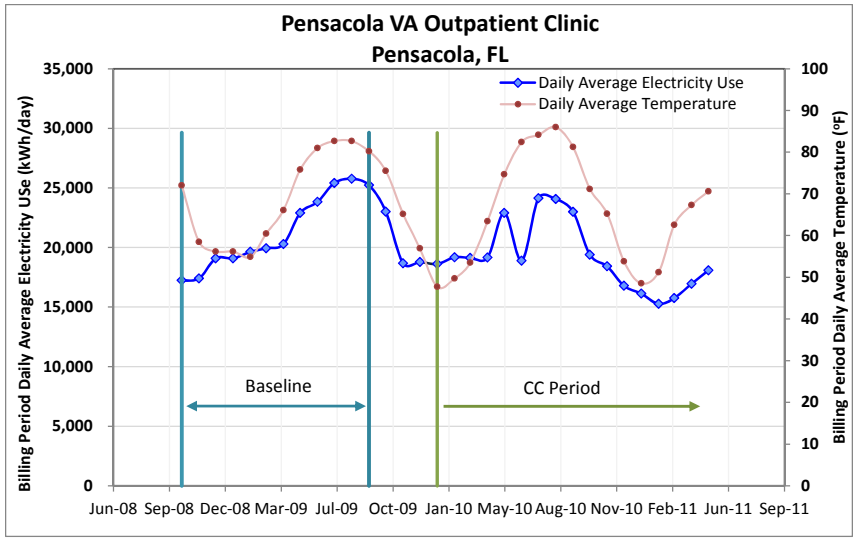


Gas

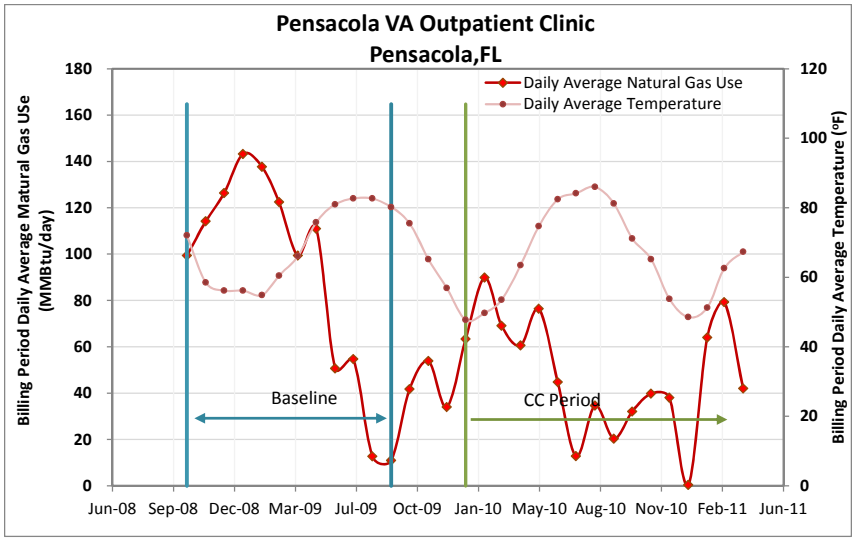


Pensacola VA Outpatient Hospital

Electricity

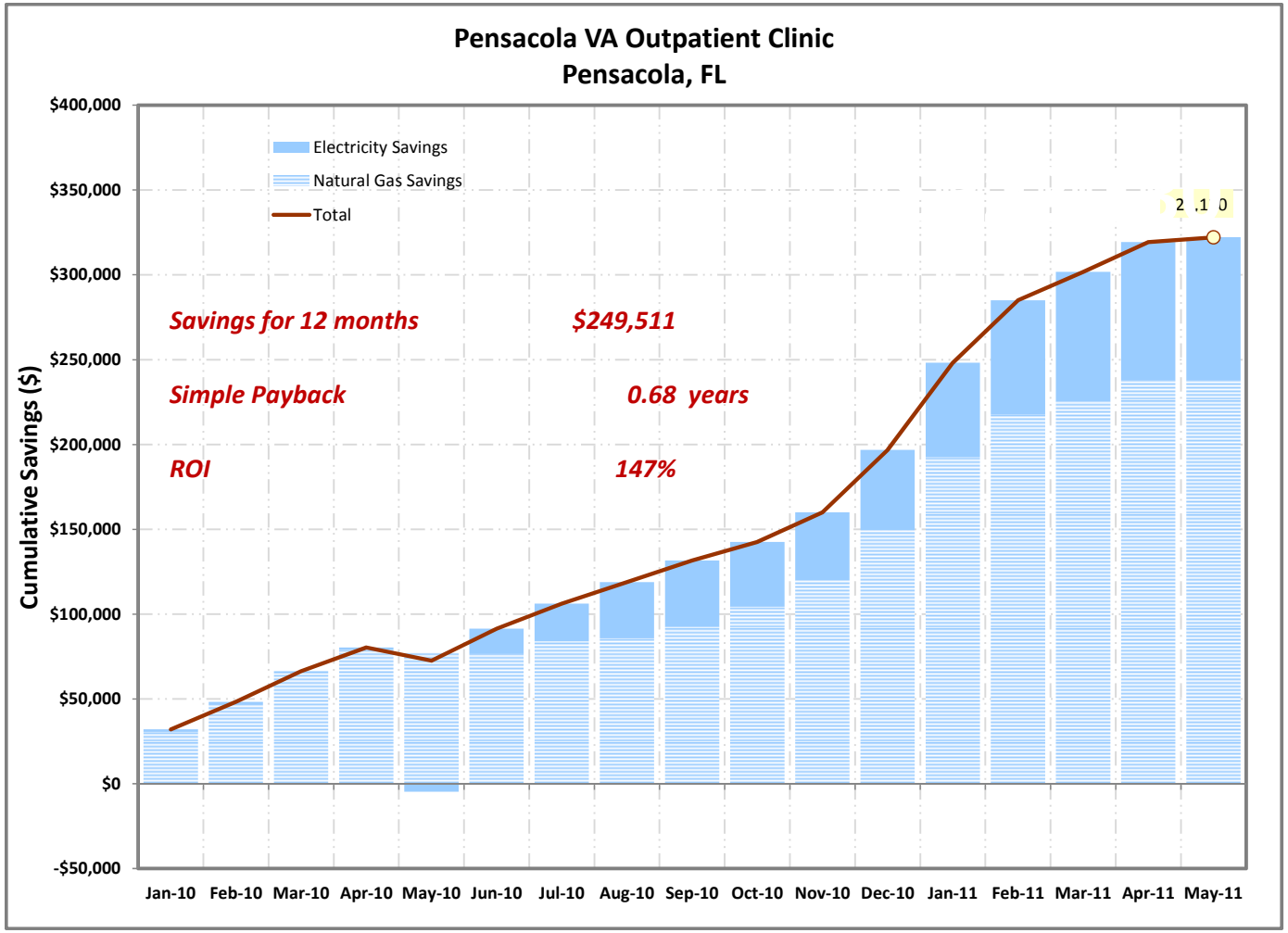


Gas



Pensacola VA Outpatient Hospital

(~27% savings raised Energy Star rating by ~35 points ~70)



Jackson VA Outpatient Hospital

Built 1961 with additions in1977, 1991

701,760 total square feet

Energy Use Index (EUI) – 246.77 kBtu/ft^2/yr

ASHRAE/IES Std 100-2006R target = 141 kBtu/ft^2/yr

Energy Cost Index (ECI) -- $3.45/ft^2/yr

Jackson VA Outpatient Hospital

10 CC opportunities that were implemented.

1. Optimized cooling tower staging and CW setpoint control.
2. Optimized staging of secondary ChW pumps based on AHU control valve positions.
3. Optimized staging of tertiary ChW pump control.
4. Optimized HHW supply temperature reset schedules.
5. Implemented scheduling for STM to HHW heat exchangers.
6. Implemented shutdown schedule for AHU preheat heat exchanger systems –
7. Implemented AHU discharge air temperature setpoint reset control
8. Optimized AHU economizer operation
9. Optimized AHU preheat control
10. Implemented AHU discharge air temperature setpoint reset control

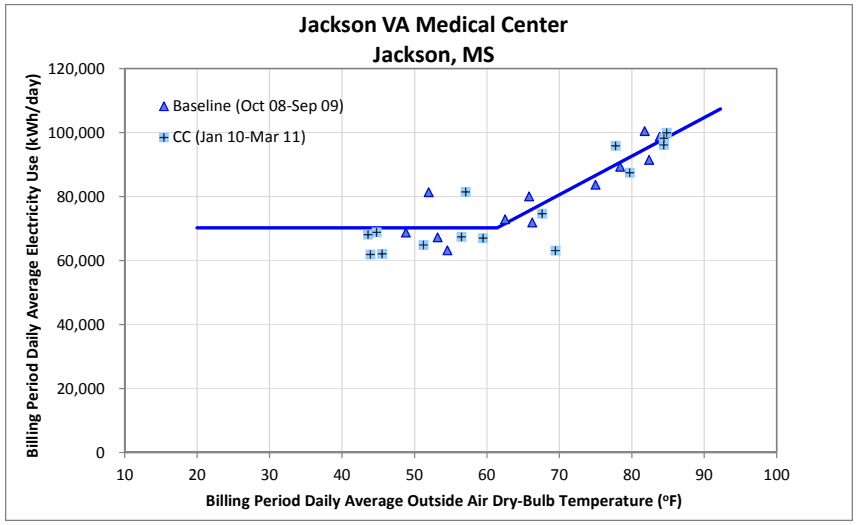
Recommended but not approved for implementation (1 of several)

1. *Implement optimal AHU unoccupied period shutdown or setback schedule where appropriate –*
    1. *This CC measure was not implemented due to complaints from the facility occupants.*

TOTAL ANNUAL PROJECTED SAVINGS	$412,000
TOTAL ACTUAL SAVINGS MOST RECENT 12 MONTHS	$168,276

Jackson VA Outpatient Hospital

Electricity



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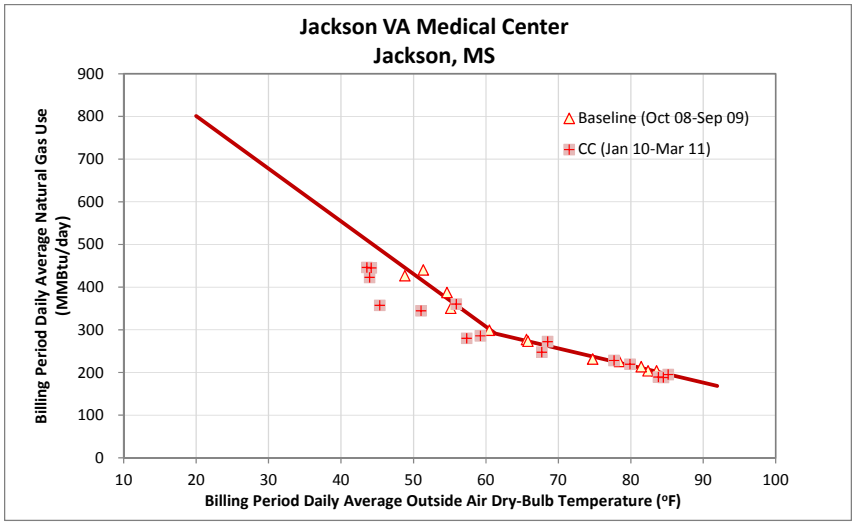
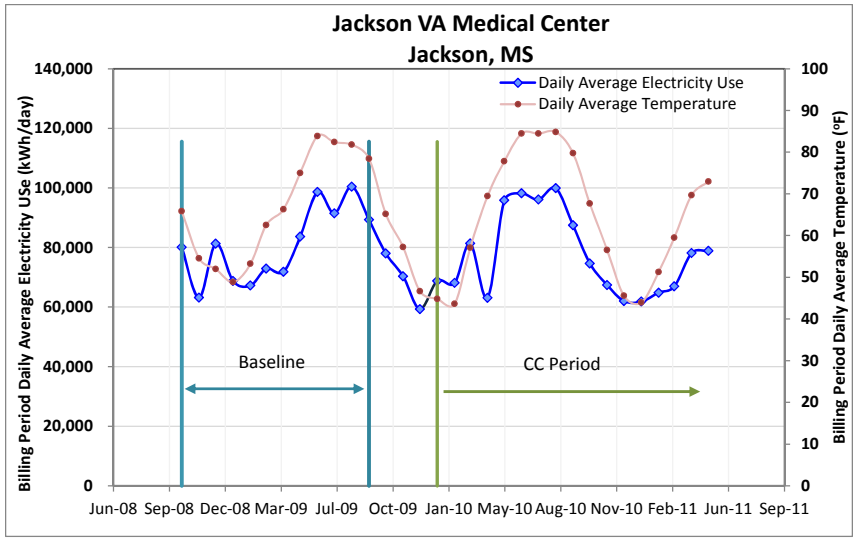
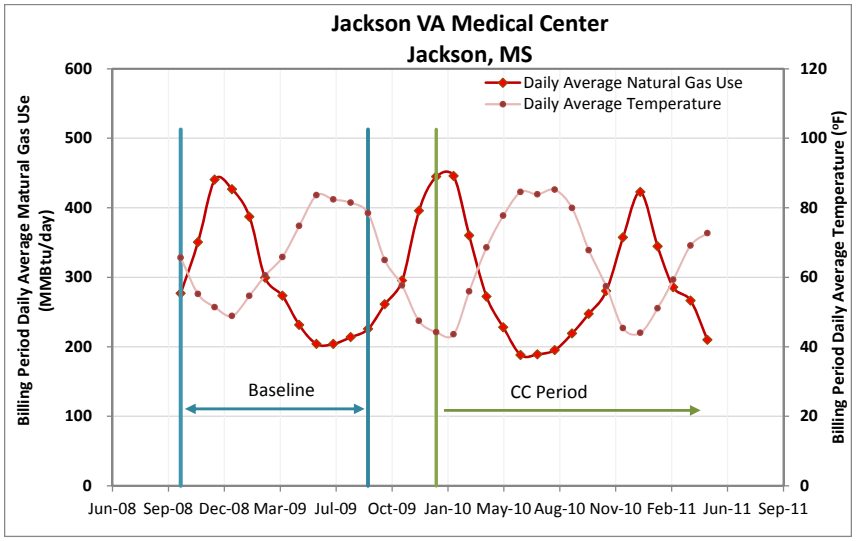


Jackson VA Outpatient Hospital

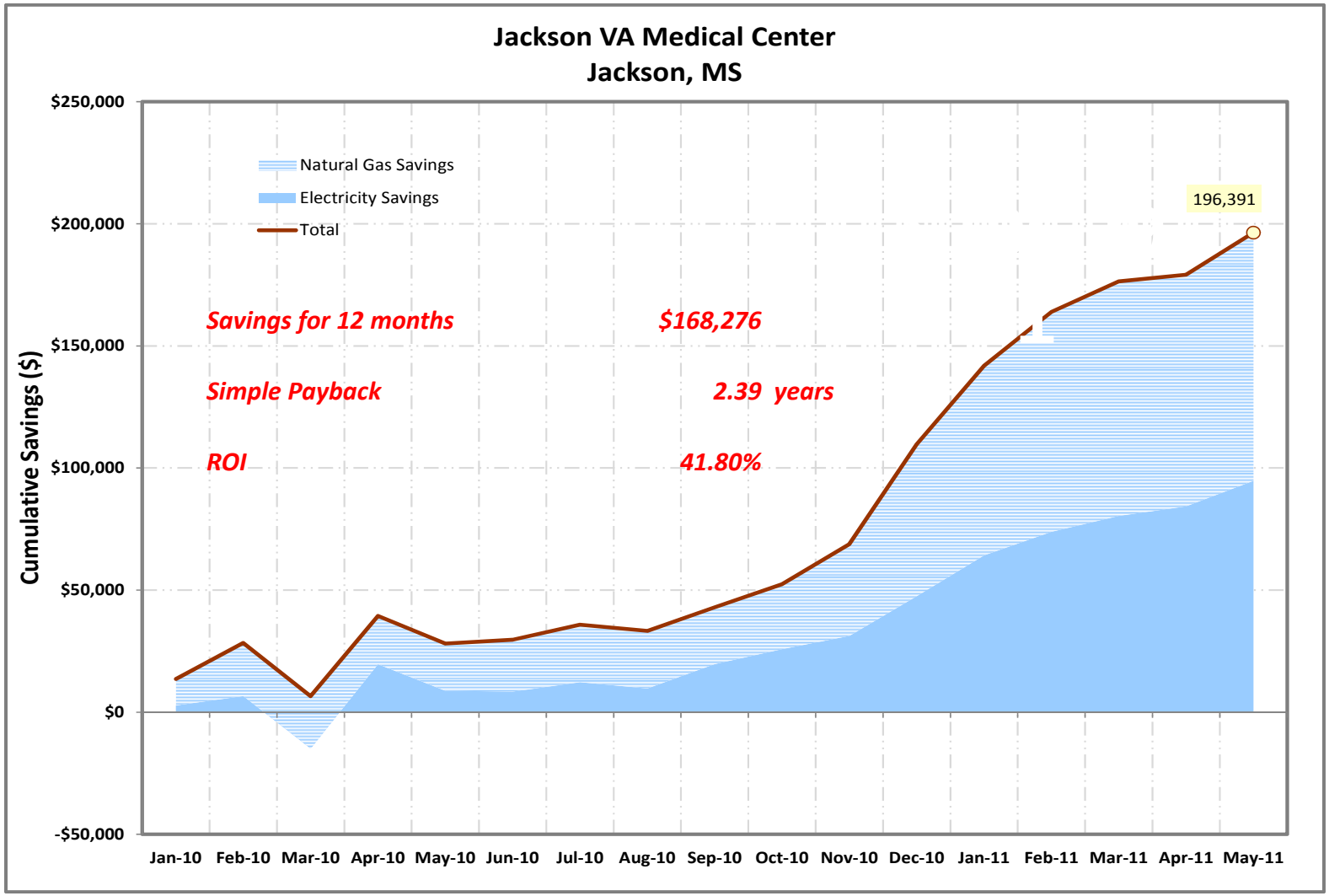
Electricity



Gas



Jackson VA Outpatient Hospital



HISTORY OF CC

Continuous Commissioning® (CC®)

- CC® Reduces Energy Use by 15-25% with ½ - 3 Year Payback
- History
  - 1992 - CC® started by ESL as part of Texas LoanSTAR Program
  - 1996 CC® implementation on A&M Campus started
  - 2000/2001 IP strategy planned, applied for first patents
  - 2005 first patent issued
  - 2006 first licensee
  - 2011 - Implemented in hundreds of buildings with more than $200 million in savings to date

Objectives of CC®

- Identify and solve existing operating problems
- Improve building thermal comfort and indoor air quality
- Minimize building energy consumption
- Minimize total operating cost

PERSISTENCE

“Ongoing”

“Continuous”

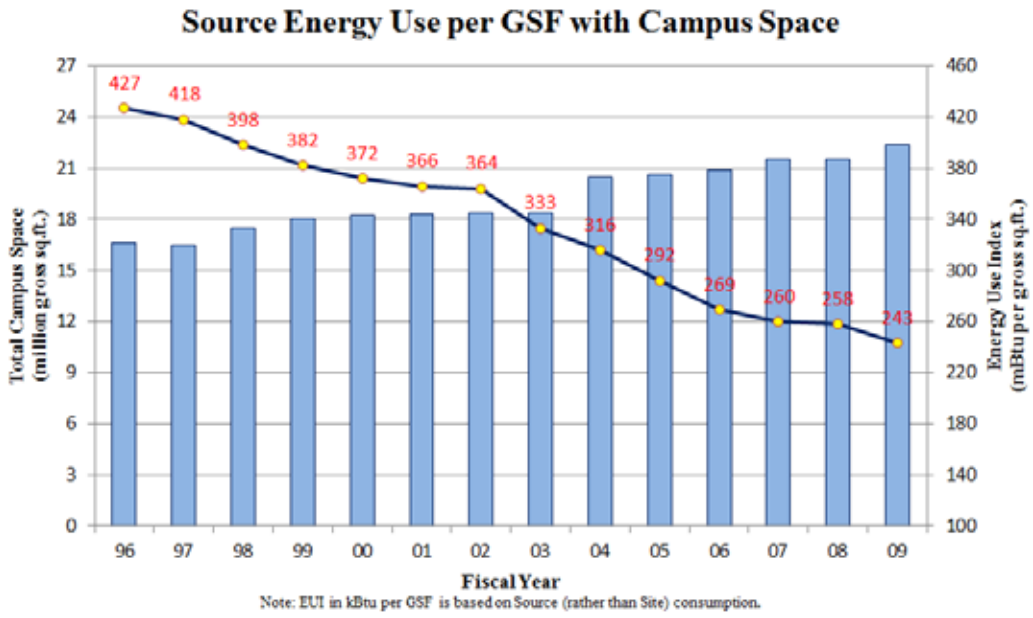
“Monitoring Based”

How important Is performance degradation?

- Broad agreement that building performance degrades
  - Commissioning measures can be disabled
  - Components fail
- Less agreement on the impact and how this should be addressed

Persistence of Savings from CC

- 10 Buildings at Texas A&M University, ChW and HHW supplied by central plant
- 1st round EBCx 1996-97
- Persistence of savings studied through 2009
- Metering system upgraded for eight of the buildings, beginning in 2005



Savings Persistence – 10 Bldgs.

First Year Savings:	$1,191,999
2 years later:	$ 984,516
Decrease:	$ 207,483

Looking Deeper – After 2 Years

After 2 years

- 4 Bldgs – Savings increased by $31,507
- 4 Bldgs – Savings decreased by $88,774
- 2 Bldgs – Savings decreased by $150,216

Looking Deeper – After 2 Years

After 2 years

- 4 Bldgs – Savings increased by $31,507
- 4 Bldgs – Savings decreased by $88,774 due to controls changes
- 2 Bldgs – Savings decreased by $150,216 due to component failures

Savings Persistence (cont.)

For each $100 in 1997 savings, savings for the most recent year are:

Year	CHW	HW	Electricity
1997	$100	$100	$100
Most recent data year	$87	$96	$183
Building Years Data	82	57	95

10 Building Summary

- Savings persisted well for 11 years with follow-up
- Without follow-up, if initial savings were $1,000, they declined on average to $750 after:
  - 3 years for heating
  - 5 years for cooling

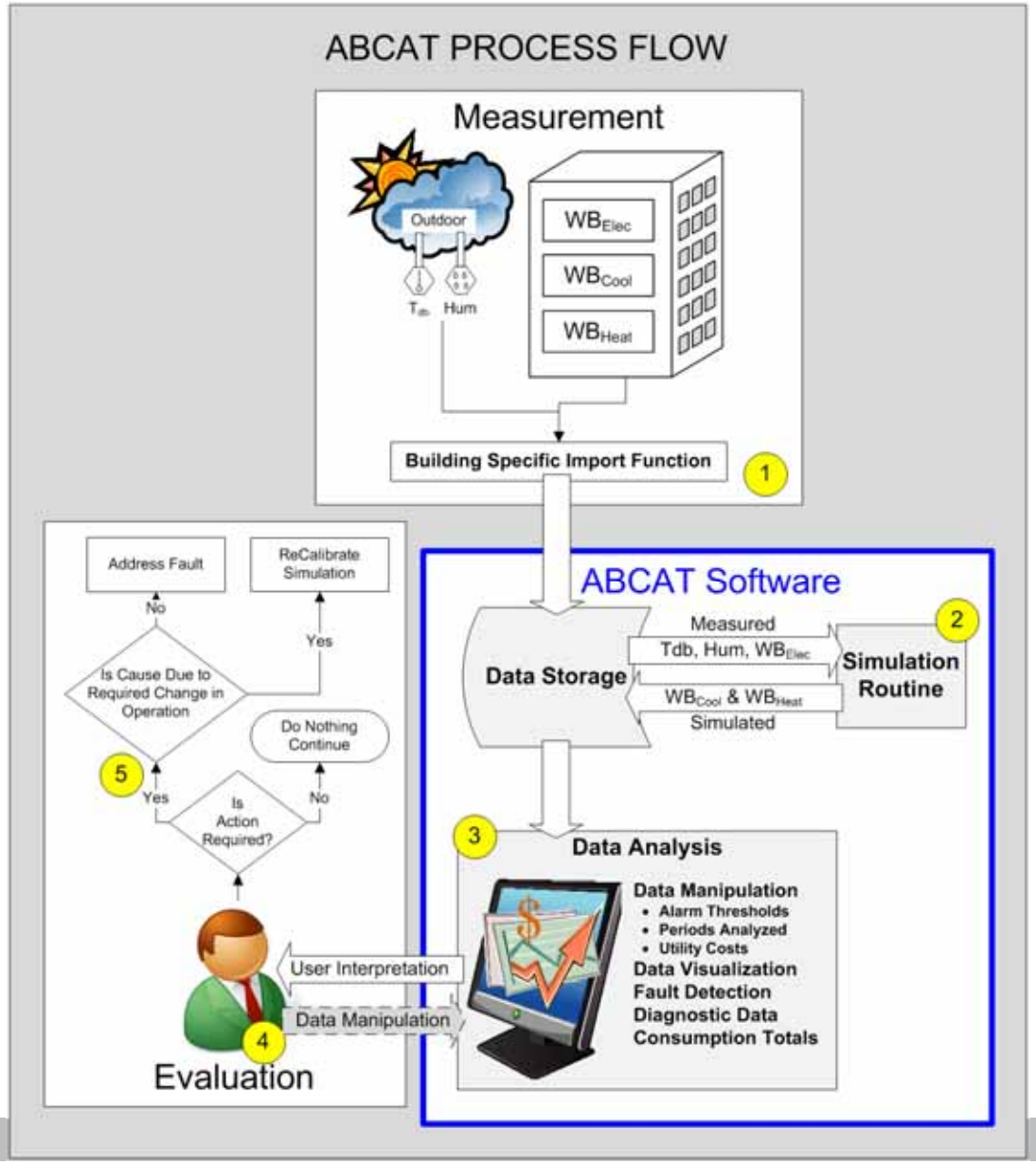
On-going Commissioning Methods

- Periodic examination of the building and systems by an experienced engineer
- Use of tracking software to indicate when savings have decreased enough to pay for some follow-up
- Use of continuous fault detection and diagnostic software

OCx - Periodic Examination

- 5 buildings had additional rounds of EBCx performed
- 3 buildings had significant follow up investigation performed
- New Metering Installed in 6 Buildings in 2005-2006.
- Major Lighting Retrofits:
  - 6 Buildings in 2006
  - 3 Buildings in 2008
- Large Mainframe Computer at Zachry
  - Removed sometime between 2001 and 2006
- Major Addition to Wehner in 2002

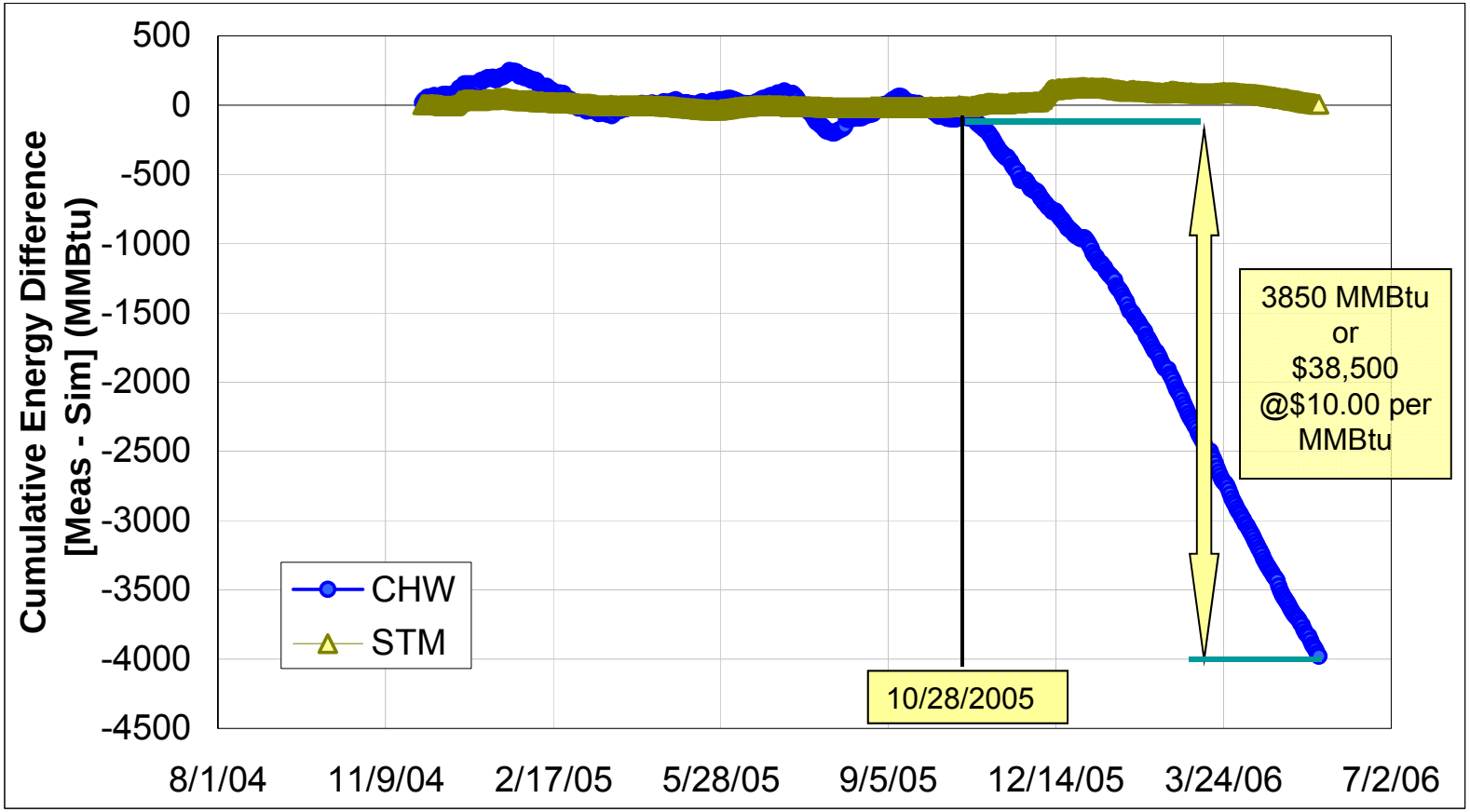
OCx with Tracking Software



Fault Detection

- Intended to detect
  - Excessive cooling energy consumption
  - Excessive heating energy consumption
  - Errors in energy metering
- Cumulative differences between measured and simulated consumption found to be a key indicator of faults
- Excess consumption measures in multiple forms (%, $, Btu)
- Additional data visualization and manipulation option
  - User can define several trigger levels, utility costs, view different periods, compare to past data to determine fault condition

Computing Services Building



Live Tracking Results

Bldg	Site	Time	Results and Findings
82,000 ft² dining	College Station, TX, USA	29 mo.	**Detected excess cooling energy fault**
480,000 ft² computing services	Austin, TX, USA	27 mo.	**Detected 10% decrease in cooling energy** **Detected excess cooling energy**
180,000 ft² Office	Albany, NY, USA	7 mo.	**No faults identified**
189,000 ft² high-rise office	Omaha, NE, USA	6 mo.	**Identified HW metering failure**
280,000 ft² office-class room	Eindhoven, Netherlands	24 mo.	**Identified 5% increase in heating consumption**

Conclusions

- Energy savings will persist for long periods of time in SOME buildings without OCx
- $100 savings will decline to $75 ON AVERAGE in 3-5 years without OCx
- OCx can make commissioning savings persist indefinitely

NCBC 2012

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