Continuous Commissioning® of a Medical Research Facility

Greg Zeig
Tim Giebler
Song Deng, PE
Guanghua Wei, PE
W. Dan Turner, PE, PhD

Energy Systems Laboratory
Texas A&M University System

November 2007

Introduction

- 520,000 ft^2 medical research facility
- Contains offices, meeting space, and labs
- Includes critical areas and BSL 3 labs
- Began CC® in January 2004
- Completed CC® in March 2006

HVAC System (AHUs)

- 10 single duct VAV units
- AHUs 1-9 are 100% OA with heat exchangers
- AHU 10 uses RA & OA, serves offices
- SP sensors control fan speed
- DAT and SP setpoints are constant
- No unoccupied schedules

HVAC System (Air-to-Air HXs)

As Designed

- Use Exhaust air to precondition outside air for AHUs 1-9
- Dampers direct air to bypass or exchangers
- Summer and winter modes for damper control
- Indirect evaporative cooling for AHUs 1-9 were originally part of design

HVAC System (Terminal Boxes)

- AHUs 1-5 & 10 have VAV boxes, some reheat
- AHUs 6-9 have constant volume & reheat boxes
- No occupancy schedules

HVAC System (CHW System)

- Three 1200-ton chillers
- Three cooling towers with 2 dual speed fans each
- Constant speed pumps

HVAC System (HW System)

- Three steam boilers use natural gas or fuel oil
- Three steam to water heat exchangers for heating water for preheat coils
- One steam to water heat exchanger for reheat water
- Reset schedule on heating water, constant setpoint of 105°F for reheat

Problems Identified During CC® Assessment and Implementation

- High static pressures on most AHUs
- AHU 4 could not meet SP setpoint
- Neighbors complained about noise problems
- Leaking heating valves
- One chiller operates in winter even though economizer functions are available

Problems Identified (cont'd)

- Terminal box airflow readings were incorrect
- AHU-10 outside air dampers are stuck and one return air control damper is problematic
- Reheat water was a constant 105°F
- Air-to-air heat exchanger dampers not working
- Some dampers were frozen in various positions and could not move

Heat Exchanger Dampers

Bypass Damper Original condition, fully open

Problems Identified (cont'd)

- Airflow calculations for AHU-10 are not computed correctly in the software
- Chiller 2 had significantly less run time
- Preheat HW bypass valve never opened
- Reheat water expansion tank bladder leaked

CC® Measures Implemented

AHUs

- Calibrated sensors
- Facilities management repaired leaking heating valves on AHUs 5, 6, and 8
- Facilities management repaired damper linkages and actuators for AHU-10
- Implemented reset schedules for discharge air temperature (e.g. 55°F @ 70°F and 60°F @ 40°F)
- AHUs 1-5 & 10, lowered SP and gave reset schedules (e.g. 1.8” @ 90°F and 1.3” @ 40°F); previously were constant at 2.0” to 2.8”
- Nighttime setback strategy for AHU-10

CC® Measures Implemented

Air-to-Air Heat Exchangers

- Heat exchanger dampers fixed open
- Bypass dampers still able to modulate
- Modified control of dampers to be based on discharge temperature
- Discharge setpoint for damper control 73°F in summer, 1°F above supply setpoint in winter

Heat Exchanger Dampers

CC® Measures Implemented

Terminal Boxes

- Airflow sensors were clogged with dust, which caused them to read too low
- Corrected by blowing air backward through the sensor & adding a filter
- Facilities hired firm to clean all boxes and install a small filter in the inlet line
- With correct flow measurements, airflow was reduced, which reduced reheat and AHU fan power

CC® Measures Implemented

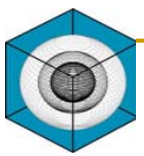
Chilled Water System

- Changed lead/lag sequence on chillers
- Optimized condenser water setpoint & cooling tower fan control
- Turn off chillers, pumps, and cooling towers when the outside temperature is below 50°F
- Reset system differential pressure setpoint
- Adjust control of cooling towers

CC® Measures Implemented

Heating Water System

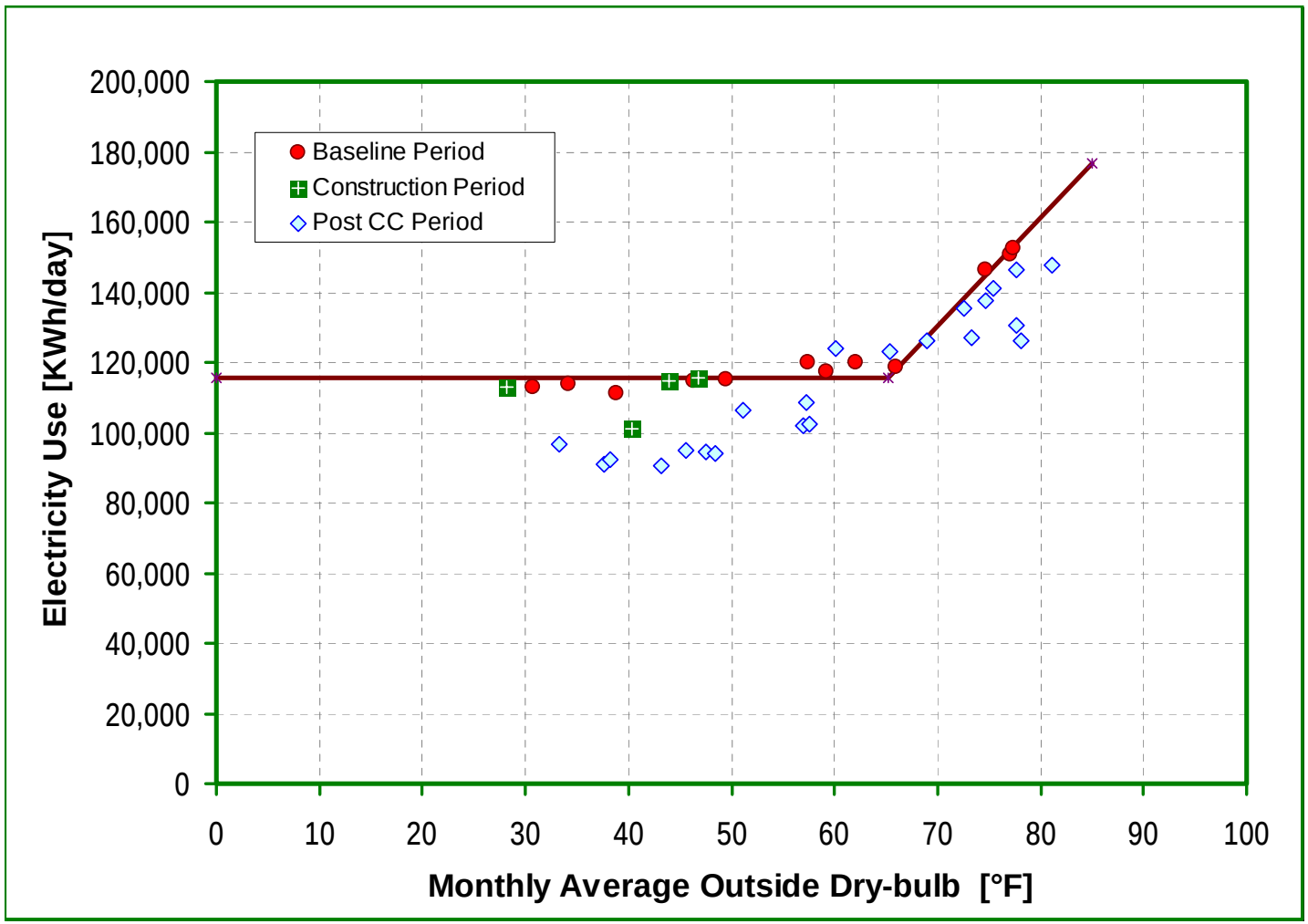
- Adjusted the preheat HW shutdown schedule
- Repaired preheat HW bypass control valve
- Replaced expansion tank bladder
- Implemented temperature & DP reset schedule for reheat water(25psi @ 10°F and 10 psi @ 60°F; 100°F @ 60°F and 160°F @ 10°F)



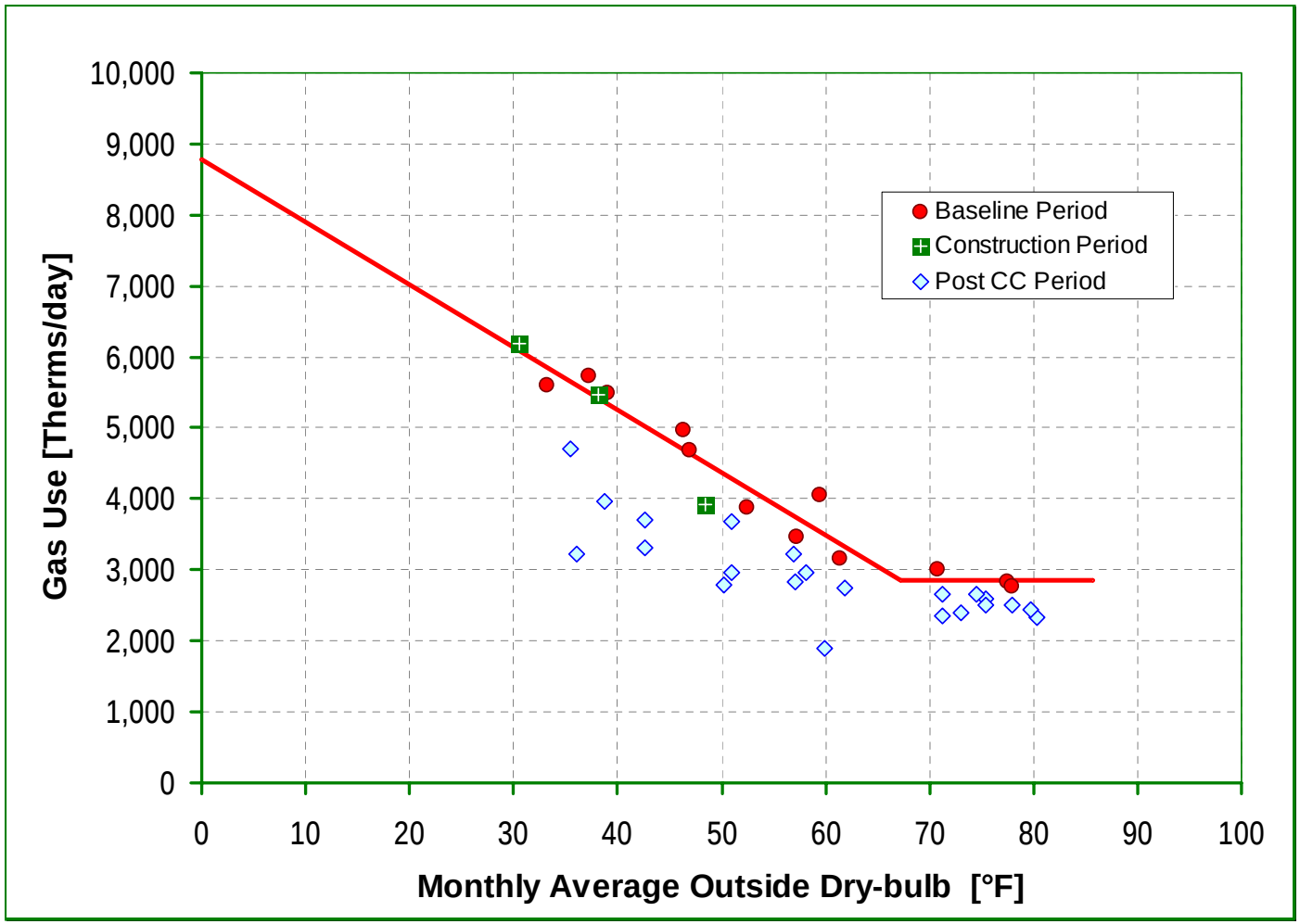
Savings From CC®

- Developed a baseline model
  - Based on utility bills and outside air temperature
  - Beginning FY 2002 for electricity and FY 2003 for gas
- Savings determination
  - Difference between baseline estimate and actual utility bills
  - Utility rates of $0.0641 - $0.1193 /kWh and $0.8147 - $1.1654 /therm
  - Savings were determined from April 2004 Through July 2006

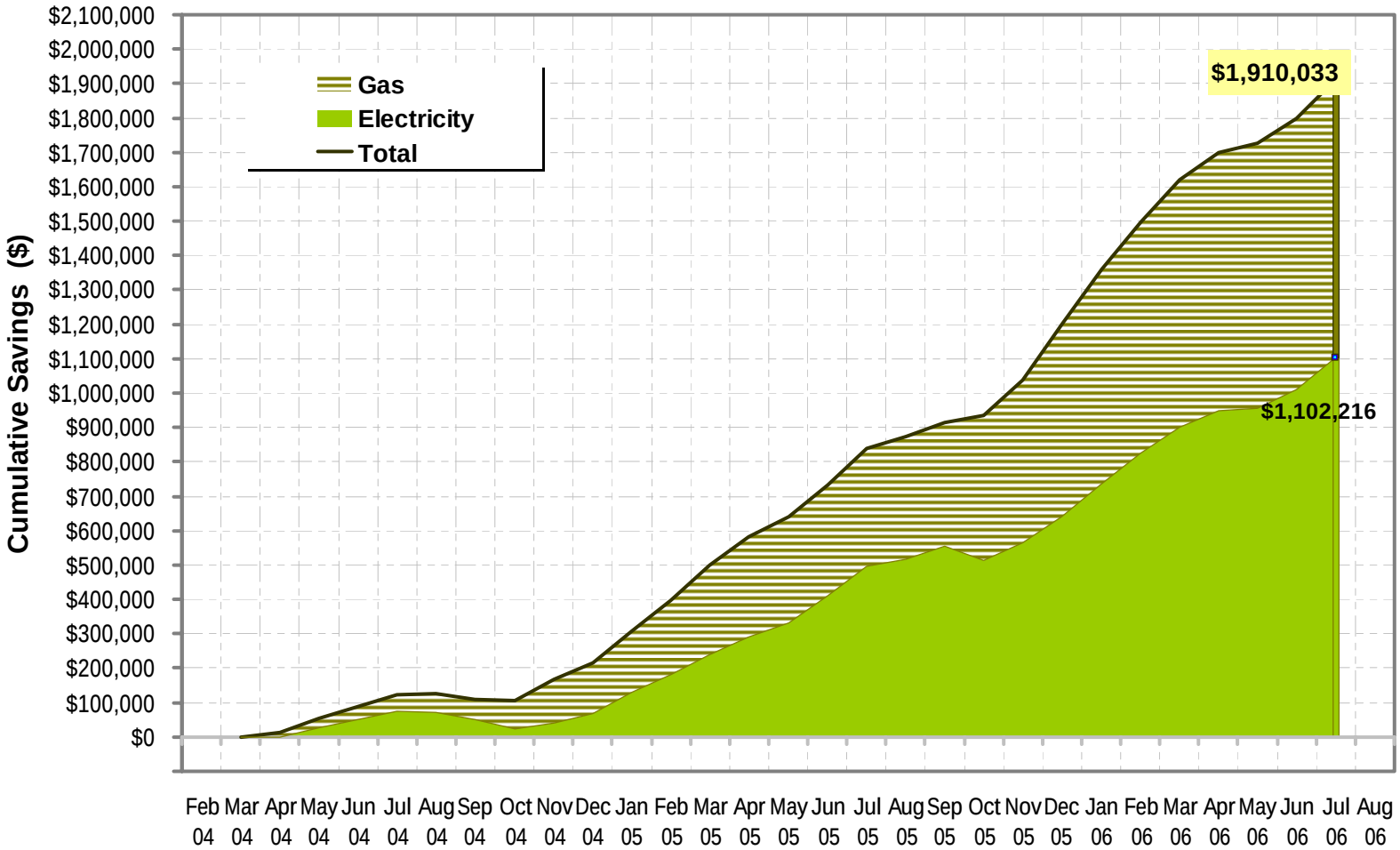
Savings From CC®



Savings From CC®



Savings From CC®



Savings From CC®

- Total savings estimate: $1,910,000
- $1,102,000 from electricity
- $808,000 from gas

Summary of CC® Measures

- Air-to-air heat exchangers were reconfigured
- Terminal box airflow readings were corrected
- Chillers and cooling tower control were optimized
- $1,900,000 in energy savings were achieved in 28 months, based on actual utility bills and price

Questions?