Quantifying Monitoring-Based Commissioning in Campus Buildings:
*Utility Partnership Program Results, Lessons Learned, and Future Potential*

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UC/CSU/IOU Energy Efficiency Partnership Program

- Funded by California Investor Owned Utilities under the Auspices of the California Public Utilities Commission
- University Systems
  - University of California (10 Campuses)
  - California State University System (23 Campuses)
- Investor Owned Utilities – 2004 First Statewide Partnership
  - Pacific Gas and Electric
  - Southern California Edison
  - Southern California Gas
  - San Diego Gas and Electric
- Program Management and Overall Coordination
  - Newcomb Anderson McCormick
UC/CSU/IOU Energy Efficiency Partnership Program

- 2004-05 Program
  - $15 Million
  - Retrofit Projects
  - Monitoring Based Commissioning (MBCx)
  - Training and Education

- Continuing in 2006-08
  - $30 Million
Submit Project Application
- Stipulate reasonable anticipated savings based on site conditions; typically 5-20% of metered use

Utility Completes Due Diligence Review
- Application and results reviewed at each payment milestone
- Final measured results are tracked against original application; overall reconciliation is on a portfolio approach

Incentive Rates:
- $0.24/kWh and $1.00/therm annual savings
- Incentive cost cap at 100% of project cost for 2004-05 and 80% for 2006-08

Payment Schedule
- 2004-05 Program: 50% acceptance / 40% controls installed / 10% final report
- 2006-08 Program: 60% acceptance / 40% final report
MBCx Process

- Select Appropriate Buildings
  - Benchmark Comparison with Campus Buildings
  - Complex Systems
  - History of Problems
  - Incomplete Commissioning
  - Direct Digital Controls
  - High Air Change Rates
  - Dedicated Facilities Manager

- Select Team
  - Mix of In-House Staff and Consultants
MBCx Process

- Monitoring
  - Install Permanent Whole Building Metering for Electricity, Gas, Steam, Hot Water, Chilled Water (or Central System Metering)
  - Install System Submeters where Warranted
  - Collect Load Profiles in Energy Information System
  - Establish Energy Use Baseline
  - Trend Points from Energy Management System
MBCx Process

- Commissioning with Monitoring
  - Functional Testing and Calibration
  - Review Sequence of Operations
  - Review Energy Use Profiles
  - Review EMS Trend Points
  - Identify Modifications
  - Review with Campus
  - Implement Commissioning Changes
MBCx Process

- Documentation and Persistence
  - Measure New Energy Use and Calculate Savings
  - Project Energy Savings to Annual Basis
  - Document Process
  - Train Staff
  - Identify Potential Retrofit Projects
  - Set Alarm Points in EIS for Persistence
  - Report Results to Partnership Program
MBCx vs. RCx

- Whole Building Metering
- Energy Information System
- Continuous Monitoring and Optimization
- Long Term Trending
- Alarming
2004-05 MBCx Projects

- Projects on 25 Campuses
- 37 Building Projects
- 9 Plant Projects
- Reports from all but one campus
MBCx Cost vs. Building Area

UC CSU IOU 04 05 MBCx
MBCx Cost vs. Building Area
Average $0.68 per sf

- $0
- $50,000
- $100,000
- $150,000
- $200,000
- $250,000
- $300,000
- $350,000
- $400,000

- 100,000
- 200,000
- 300,000
- 400,000
- 500,000
- 600,000

- $2 per SF
- $1 per SF
- $0.50 per SF
Project Cost and Savings by Building

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Project Costs and Savings By Building
Simple Payback 2.2 Years

MBCx Project Costs

- Conventional MBCx Projects
- MBCx Projects Combined with Some Capital
- 3 Year Payback
- 2 Year Payback
- 1 Year Payback
Building Gas Savings vs. Gas Use

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Building Gas Savings vs. Gas Use
14.1% Total Savings

14% Total Savings

Annual Gas Use (th/yr)

Annual Gas Savings (th/yr)

- 100,000 200,000 300,000 400,000 500,000 600,000 700,000 800,000 900,000 1,000,000

- 20,000 40,000 60,000 80,000 100,000 120,000 140,000 160,000 180,000 200,000

Buildings 10% Savings 20% Savings 30% Savings
MBCx Annual Electric Savings

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Building and Plant Electric Savings

- Program Target: 7,387,726 kW
- Individual Project Proposals: 8,899,033 kW
- Reported Results: 12,409,009 kW
MBCx Demand Savings

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Building and Plant Demand Savings

- Program Target
- Individual Project Proposals
- Reported Results

W kW

919 1,017 1,201
MBCx Annual Gas Savings

UC CSU IOU 04 05 MBCx
Building and Plant Natural Gas Savings

- Program Target: 302,560
- Individual Project Proposals: 579,793
- Reported Results: 906,639
Lessons Learned

- Initial Screening
  - Benchmarking for All Campus Buildings
  - Direct Digital Controls
- Extended Monitoring Periods (Months vs. Weeks)
- Campus Manpower and Training Commitment
- Experienced Commissioning Agent
- 60/40 Payment Schedule
- Significant Benefit Beyond Traditional RCx Programs
Next MBCx Steps

- 2006-08 UC/CSU/IOU Partnership Program
- 2006-08 California Community College IOU Partnership Program (Pilot program serving 112 campuses)
- Planning for 2009, 10, 11 Statewide Utility Partnerships
MBCx UC/CSU/IOU Energy Efficiency Partnership

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