

Monitoring-Based Commissioning: 2008 Update

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UC/CSU/IOU Energy Efficiency Partnership Monitoring-Based Commissioning (MBCx) Program Element Key Features

Funding for:

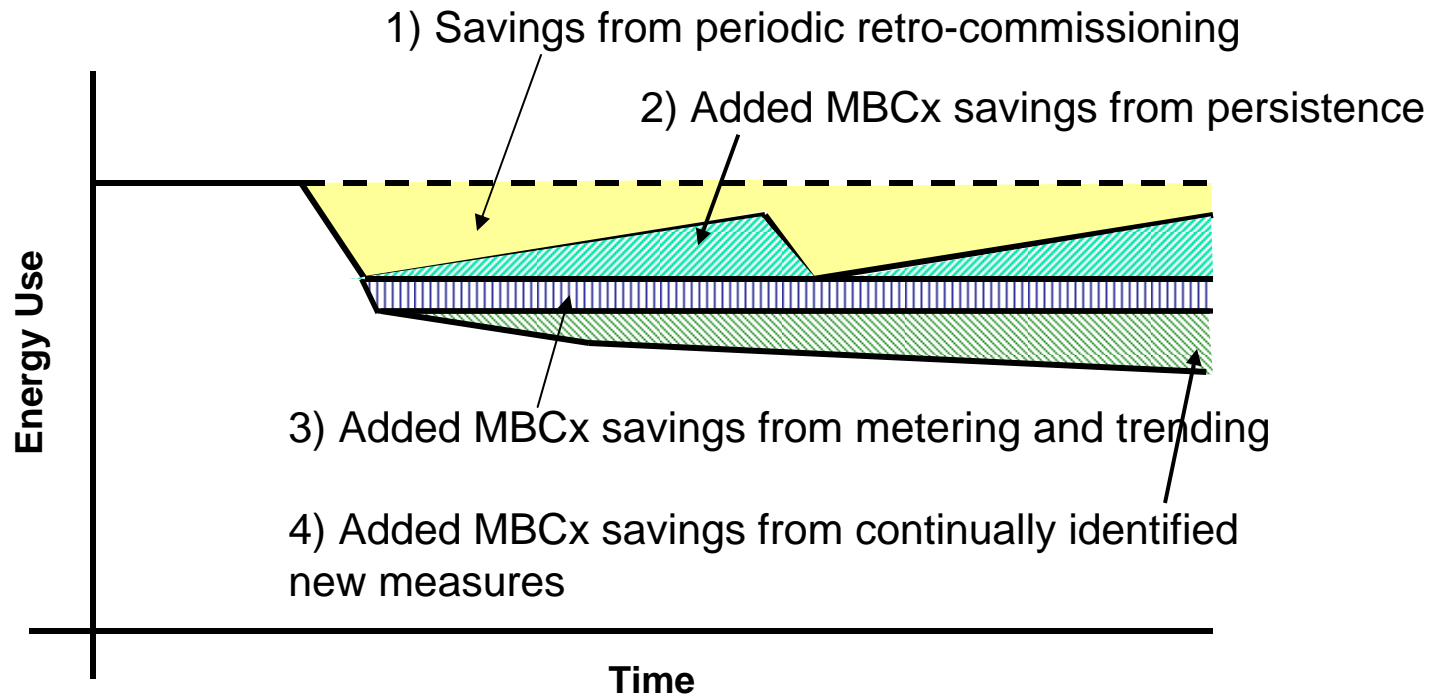
- **Permanent Monitoring**
 - Meters
 - **Whole-Building Energy**
 - **Sub-System**
 - Telemetry
 - Trending Software
- **Commissioning Consultants**
 - Emphasis on Training for Campus Staff
- **In-House Staff (Limits)**

2004-05

- **25 Campuses**
 - 37 Building Projects
 - 9 Plant System Projects
 - over 7 million gross square feet
(~ half laboratory or other energy intensive buildings)



Marginal Benefits of MBCx: Persistent Savings, Deeper Savings



Cost Comparison:

Increased initial cost for permanent monitoring and staff training.
Repeated Cx consultant fees replaced by ongoing staff costs?

Key Innovative MBCx Program Design Features (Paradigm Shifts?)

- **Efforts to Achieve Persistence**
 - Permanent Monitoring/Trending
 - Staff Training
- **Diagnostics through Trend Analysis**
 - Expands potential beyond measures engineers are comfortable estimating
- **Portfolio Approach**
 - Confidence based on track record of program approach
- **Savings Targets (vs. Estimates)**
 - Potential to exceed goals
- **Savings Accounting Based On Measurement**
 - Observed savings (as opposed to assumed savings)
- **Targeting Reduction of Peak Electricity Use**
 - Aligned with Reducing Customer Energy Costs
 - Lots of waste on-peak

2004-05 MBCx Program Results (Cx plus Hybrid Projects) vs. Program Goals

	Reduction in Energy Use			Nominal Annual Cost Savings	Total Project Funding	Simple Payback on Funding (years)
	Total Electricity (kWh/year)	Demand (average during peak period) (kW)	Natural Gas (therms/year)			
Program Commitment	7,387,726	919	302,560	\$987,308	\$5,200,000	4.8
Sum of Project (Portfolio) Targets	9,146,082	1017	579,793	\$1,438,415	\$5,200,000	3.3
Sum of Project (Portfolio) Results	12,229,376	1,370	807,550	\$2,155,637	\$5,200,000	2.4
% of Program Commitment	165%	149%	266%			
% of Portfolio Target	135%	135%	139%			

2004-05 MBCx Program Results: Cx-Only Projects

(Comparison with 2004 Cx Meta-Analysis)

	UC/CS U/IOU Partnership Complete 2004-05 Portfolio N=24 (median)	2004 Cx Meta Analysis (Mills et al 2004)	2004 Cx Meta Analysis (Mills et al 2004) CA/OR/WA On ly
Reduction in Energy Use:	Median / Project Average / Aggregate (Range)	Median / Project Avg.	Median / Project Avg.
Electricity	9% / 8% / 9%	9% / 11% (N=4 6)	
Peak Electricity	5%/ 6% / 6%	2% / 7% (N= 3)	
Fuel	9% / 15% / 13%	6% / 13% (N=1 9)	
Chilled Wa ter	17% / N/A / 22%		
Hot Water/Steam	12% / 23% / 18%		
Total Thermal		36% / 37% (N=1 6)	
Total Source Energy	10% / 9% / 10% (0% - 30%)	13% / 16% (N=46)	8% / 9% (N=24)
Total Site Energy	11% / 11% / 11%	15% / 19% (N=46)	8% / 9% (N=24)
Simple Pay back Period	2.2 / N/A / 2.1 (0.8 - 6.8)	1.0 / 2.1 (N=98)	1.5 / 2.7 (N=36)

Notes: Aggregate savings results exclude failed sites with no savings and no baseline information

One project resulted in a large shift of energy use from the building to the plant, rendering the average of values for chilled water meaningless

Simple payback project average cannot be calculated with a few projects having no savings.

Key MBCx Program Design Improvements for 2006-08

- Benchmarking to assist project selection (UC)
- Savings accounting requirements have more emphasis on IPMVP Option C—Whole Building Measurement

Preliminary Partial 2006-08 MBCx Program Results

(Comparison with 2004-05 and 2004 Cx Meta-Analysis)

	Prelim. Partial 2006-08 N=7 (median)	UC/CS U/IOU Partnership Complete 2004-05 Portfolio N=24 (median)	2004 Cx Meta Analysis (Mills et al 2004)	2004 Cx Meta Analysis (Mills et al 2004) CA/OR/WA On ly
Reduction in Energy Use:		Median / Proj. Avg./ Aggregate (Range)	Median / Proj. Avg.	Median / Proj. Avg.
Electricity	13%	9% / 8% / 9%	9% / 11% (N=4 6)	
Peak Electricity	TBD	5%/ 6% / 6%	2% / 7% (N= 3)	
Fuel	36%	9% / 15% / 13%	6% / 13% (N=1 9)	
Chilled Wa ter	39%	17% / N/A / 22%		
Hot Water/Steam	55%	12% / 23% / 18%		
Total Thermal			36% / 3 7% (N=1 6)	
Total Source Energy	28% (17-42%)	10% / 9% / 10% (0- 30%)	13% / 1 6% (N=4 6)	8% / 9% (N=24)
Total Site Energy		11% / 11% / 11%	15% / 1 9% (N=4 6)	8% / 9% (N=24)
Simple Payback Period	1.4 (1.0-2.3)	2.2 / N/A / 2.1 (0.8 - 6.8)	1.0 / 2.1 (N=98)	1.5 / 2.7 (N=36)

Notes: Aggregate savings results exclude failed sites with no savings and no baseline information

One project resulted in a large shift of energy use from the building to the plant, rendering the average of values for chilled water meaningless

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Monitoring-Based Commissioning: How Successful in Shifting Paradigms?

- **Efforts to Achieve Persistence**
 - Do necessary steps fit current program models?
- **Diagnostics through Trend Analysis**
 - Progress: trends often used, sometimes embraced by consultants
- **Portfolio Approach**
 - Progress: confidence based on successful 2004-05 program
- **Savings Targets (vs. Estimates)**
 - Progress: protocols established for 2006-08
- **Savings Accounting Based On Measurement**
 - Limited: calibrated modeling often used in 2004-05 (“assumed” savings)
- **Targeting Reduction of Peak**
 - Disappointing: incentive eliminated for 2006-08, fewer sites targeting peak

BC Hydro Power Smart Partners Continuous Optimization for Commercial Buildings

Pilot Program in 2008

Major Themes: Feedback and Quality Assurance

- Whole Building Interval Meter Upgrades
 - Electricity
 - Fuel
 - District Steam
- Energy Information System (EIS) Software Service
- Investigation (Providers Qualified By Program)
- Implementation (Funding and Organization by Customer)
- Building Operator Training
- Coaching
- Ongoing Support tied to Customer Response to Exception Reporting

BC Hydro Power Smart Partners Continuous Optimization for Commercial Buildings

Paradigm Shifts?

Including Monitoring in Investigation/Diagnosis

Optional

Persistence of Savings

Inherent in Program Design ü

Targeting Peak Electricity Use

N/A

Shift from Estimated to Measured Savings

Savings Accounting = Avoided Energy Use/Cost for
Customer ü

IPMVP Option C—Whole Building Measurement

Monitoring-Based Commissioning Contacts and References

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Background/ Previous Documents:

Anderson, et al. 2007 NCBC

Brown, Anderson, and Harris 2006 ACEEE Summer Study*

Brown and Anderson 2006 NCBC*

Brown 2006 ACEEE MT Symposium (presentation only)*

* Posted on CIEE website <http://ciece.ucop.edu/>