Monitoring-Based Commissioning: Tracking the Evolution and Adoption of a Paradigm-Shifting Approach to Retro-Commissioning

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ABSTRACT

Monitoring-based commissioning (MBCx) emphasizes permanent energy performance metering and trending—for diagnosis of energy waste, for savings accounting, and to enable persistence of savings. Emphasis on monitoring represents a paradigm shift for the retro-commissioning[1] (RCx) industry, which has traditionally relied upon test protocols and modeled savings estimates. Since 2004, a major monitoring-based commissioning program at twenty-five California university campuses has evolved to meet the changing needs of university and utility partners. More recently the monitoring-based approach has been adopted by third-party programs in California, and is being considered by the utilities for use in at least one more market sector. Retro-commissioning programs in other regions are adopting similar program design features.

We present information on the progression of program design and results for the multiple phases of the original program, along with a look at third-party and other programs adopting similar program features. We note substantial but still partial success in migration toward monitoring for problem diagnosis and savings accounting. Residual barriers are identified. Though the program has emphasized permanent performance trending capability along with training of staff, incentive payment structure design has not evolved to support these program features in enabling persistence of savings. Incentive payment structures still rely on snapshots of savings as opposed to longer term assessment. The simple internal incentive to reduce energy costs remains the main driver maintaining persistence of savings.

Background

Until recently, building RCx practice has relied heavily on test protocols and modeling for diagnosing problems and energy savings accounting. Persistence of energy savings from RCx over the long-term is a major concern (Bourassa et al. 2004). Prior to 2004, RCx lagged in finding its way into portfolios of energy efficiency incentive programs, including the large programs managed by California investor-owned utilities (IOUs).

Monitoring-based commissioning has emerged as a paradigm shift for owners and operators of large buildings and the commissioning industry that serves them. A monitoring-based approach can often deepen the scope of commissioning projects, provide savings accounting with more credibility, enable persistence of savings, and provide a platform for ongoing efforts to manage building energy use. The promise and remaining barriers for monitoring-based approaches to building commissioning are illustrated in this account of progress over decades.

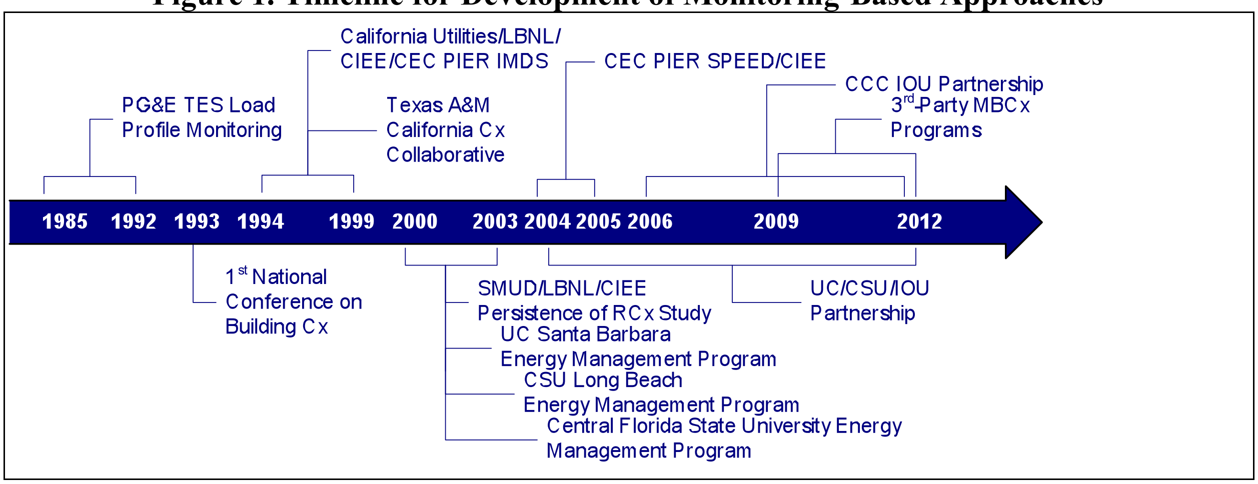
[1] Retro-commissioning is a process of ensuring existing building systems can be used to efficaciously meet operational needs.

Research, Development, and Demonstration History

Figure 1 shows a high-level timeline of key developments in the monitoring–based approach to building commissioning. The concepts and elements of MBCx are not remarkable in themselves. However, it took organized research, development, and demonstration efforts in the 1990s to illuminate the benefits of a monitoring-based approach and provide replicable models for mainstream implementation. In California, the California Energy Commission (CEC) Public Interest Energy Research (PIER) Program and Sacramento Municipal Utility District followed up with support to complete demonstration of what was then called an Information Monitoring and Diagnostics System (IMDS). This two-site demonstration effort spanned the transition from utility managed R&D to the CEC PIER Program, with the University of California (UC) California Institute for Energy and Environment (CIEE) and Lawrence Berkeley National Laboratory providing continuity in leadership for technology advancement (Piette et al 2000).

In the same time frame, Texas A&M University was also pioneering an approach to building RCx with an emphasis on monitoring for baseline determination and diagnostics (Claridge et al 2000). At the turn of the millennium, early adopters on university campuses in Florida and California incorporated monitoring-based approaches in their energy management programs (Motegi et al 2003, Haves et al 2005, Elliott and Brown 2010). The UC Santa Barbara effort led to one of the first campus energy "dashboards"[2] (UC Santa Barbara 2012).

Figure 1. Timeline for Development of Monitoring-Based Approaches



Source: Newcomb Anderson McCormick

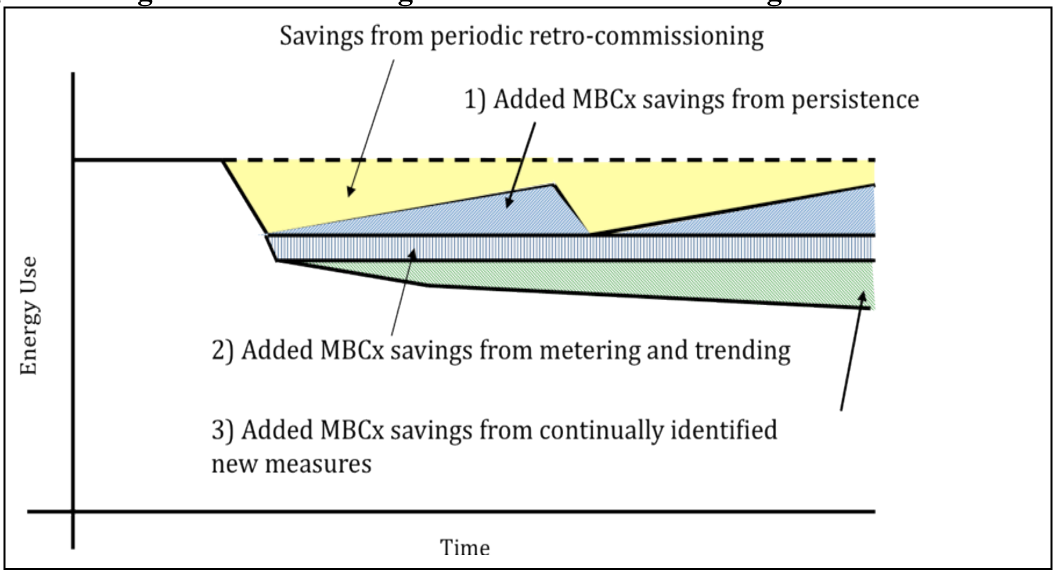
Evidence Revealing Lack of Persistence of Savings for Retro-Commissioning. Research in the early 2000s showed 35% diminishing of savings over time after one-time retro-commissioning intervention (Bourassa 2004). Some commissioning protocols recommended periodic re-commissioning at five-year intervals (see Figure 2).

The Paradigm Shift—To Monitoring. Around 2003, CIEE began thinking about the successful demonstrations of the IMDS as an opportunity to introduce building performance monitoring, not only to address the persistence issue, but also as an improvement in savings accounting and a

[2] An energy "dashboard" displays real time and/or trended energy performance information intended to assist operators or occupants in improving building energy performance.

path to deeper savings from RCx (see Figure 2). Such improvements could potentially justify increased initial cost for permanent monitoring and staff training, with ongoing staff costs potentially offset by avoiding repeated expenditure on RCx contracts.

Figure 2. Program Model—Marginal Benefits of Monitoring–Based Commissioning



Source: Mills and Mathew 2009

The UC/CSU/IOU Partnership Program Element

Pilot partnerships between California IOUs and their major customers were fostered during a period of innovation for program design within 2004-2005 California energy efficiency program portfolios—as funded by California utility customers under the auspices of the California Public Utilities Commission. The California State University (CSU) and UC made one of the first proposals for such a pilot partnership with the Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), San Diego Gas and Electric Company (SDG&E), and Southern California Gas (SCG)—which became known as the UC/CSU/IOU Energy Efficiency Partnership (the "Partnership"). The proposal included a groundbreaking element crafted around the research and early-adopter models for monitoring-based approaches to enhanced building operations, an element eventually dubbed monitoring-based commissioning (MBCx). The proposal was made with the assumption that the CEC PIER Program would be supportive through a parallel CIEE-managed program called *Energy Efficient UC/CSU Campuses* and later known as the *State Partnership for Energy Efficient Demonstrations.*

The Partnership MBCx element funds permanent upgrade of building-level energy meters, along with augmentation of energy information systems to facilitate trending and benchmarking of building energy performance. Metering of sub-systems is often funded. Both expert commissioning assistance and in-house staff effort are funded, as well as training for staff.

The Progression of UC/CSU/IOU Partnership Program Design

Table 1 tells the story of a program that has evolved from an ambitious pilot to a mainstream offering of the Partnership. In the beginning, many of the program characteristics were designed to encourage participation by campuses and demonstrate the value of MBCx to both campuses and utilities. The customization and flexibility in the early years gave way to consistency and scalability in later years. MBCx is now an accepted savings delivery mechanism, on par with retrofit and new construction measures that are traditionally the focus of utility programs and campus energy improvements.

Table 1. UC/CSU/IOU Partnership MBCx Design Elements by Program Cycle

Program Design Element	2004-05 Program Cycle	2006-08 Program Cycle	2009 Bridge & 2010-12 Program Cycle
Program Goals and Budget(1)	▪ Total Partnership incentives ~$13M ▪ Specific MBCx savings and budget goals	▪ Total Partnership incentives ~$23M ▪ MBCx savings and budget targets	▪ Total Partnership incentives ~$48M, ~29M paid thru 2011 ▪ No distinct MBCx savings goal or budget
MBCx Percentage of Program by Incentive Dollars and Number of Projects in Cycle (2)	▪ 41% MBCx ▪ 46 projects	▪ 19% MBCx ▪ 46 projects	▪ 25% MBCx thru 2011 ▪ 73 projects completed thru 2011 ▪ 70 additional projects planned for 2012 completion
Incentive Rate	▪ Customized based on proposed project scope, cost and energy savings	▪ $0.24 per planned kWh/yr saved ▪ $1.00 per planned therm/yr saved	▪ $0.24 per actual kWh/yr saved ▪ $1.00 per actual therm/yr saved
Incentive Payment	▪ Up to 100% of actual project cost	▪ Paid on <u>projected</u> savings, up to 80% of actual project cost	▪ Paid on <u>verified</u> savings, up to 80% of actual project cost
Incentive Payment Timing	▪ 50% upon executed agreement ▪ 40% upon installation ▪ 10% upon verified completion by IOU	▪ 60% upon executed agreement ▪ 40% upon verified completion by IOU	▪ 100% upon verified completion by IOU
Criteria for Acceptance of Project Proposals or Applications	▪ Meets portfolio cost-effectiveness criteria ▪ Addresses qualitative program goals	▪ Benchmarked energy use intensity (EUI) shows savings potential ▪ Savings expectation: o kWh: 5% to 15%+ o Therms:10% to 30%+	▪ Meets portfolio debt service criteria (UC only) ▪ Savings expectation: o kWh: 5% to 15%+ o Therms:10% to 30%+
Savings Accounting Protocols	▪ Customized by project	▪ IPMVP Option C – Whole Building (with accommodations) recommended	▪ IPMVP Option C – Whole Building (with accommodations) preferred ▪ Other IPMVP by exception
Accounting for Peak Electricity Demand and Peak Period Electricity Use	▪ kWh reduction measured for summer on-peak hours ▪ Peak kWh reduction incentivized	▪ Peak reduction incentive eliminated	▪ Adopted DEER peak demand definition to comply with CPUC requirement ▪ No peak reduction incentive
Measure Types (3)	▪ Most projects pure MBCx (Low cost/no cost measures)	▪ Expanded "hybrid" projects that combine Cx and retrofits	▪ Including both pure and hybrid projects
Partnership Management Structure	▪ Dedicated MBCx Project Team	▪ Combined MBCx/ Retrofit Project Team (partial cycle)	▪ No separate project team ▪ Management Team handles project issues

(1) In addition to incentives, the Partnership has non-resource elements such as training and education, not included in this total.
(2) Percentage is MBCx fraction of total Partnership incentives also including retrofit and new construction.
(3) See Mills and Mathew 2009 for details of typical MBCx measures

Proof of Concept/Pilot: 2004-2005. The MBCx element of the 2004-2005 UC/CSU/IOU Pilot Partnership was designed in a way that could build confidence in the approach and set the stage for more mainstream follow-on programs. First, a large set of twenty-four projects was maintained as commissioning-only or “pure” commissioning projects. No upgrades or enhancements to existing equipment were included, not even controls upgrades. This ensured that the savings achieved could be clearly attributed to commissioning and not to simultaneous retrofits. Among the many accomplishments of the 2004-05 MBCx portfolio was establishing a track record sufficient to continue the MBCx element in the 2006-2008 program cycle.

The CEC PIER program provided case studies and a needs assessment (Haves et al 2005), a description of monitoring system architectures, and detailed evaluation of twenty-four pure 2004-2005 MBCx projects including benchmarking analysis (Mills and Mathew 2009).

Normalization: 2006-2008. One of the biggest changes in 2006-08 was that MBCx projects were now incentivized in the same way as traditional retrofits in the Partnership. The incentive rate, cost cap and payment timing no longer gave special treatment to MBCx projects. Additionally, as comfort with the projects grew, the extra support provided by the now combined MBCx/Retrofit Project Team, a cross-functional group of engineers and program staff concerned with project development and review, began to diminish to the point that it was no longer needed at all, and the team was discontinued.

As a percentage of the total incentives, the MBCx project share dropped, but that is attributable to both the larger overall incentive pool and a reduced MBCx incentive level compared with 2004-05. Furthermore, the campuses started focusing on larger buildings, so the savings achieved were larger than the proportional increase in the number of buildings.

Scaling up: 2009-2012. The 2009 bridge year and subsequent 2010-2012 program cycle represent the most mature form of the MBCx program to date, incorporating the lessons learned from previous cycles and becoming a mainstream element of the Partnership. Special accommodation was no longer needed for MBCx at the program level. The Partnership MBCx team phased out in 2006-08 was not resurrected, classic and hybrid type projects are readily embraced, and the need to reserve, or even target, a portion of the incentive budget to MBCx to encourage projects has disappeared.

To prepare for 2009 and beyond, UC and CSU both performed planning exercises that identified hundreds of potential projects, a significant percentage of which were MBCx. This project development exercise was assisted by the track record of successful MBCx projects from previous cycles. Additionally, UC developed a system-wide financing approach where they authorized $178M in revenue bond financing to be combined with utility incentives and campus funds for energy efficiency projects, including MBCx (UC 2009).

Partnership MBCx Program Performance Statistics By Cycle

Quantitative program results are shown in Table 2. The percent of project target achieved (realization rate) drops in 2009-2012 with the shift to payment based on actual as opposed to targeted savings. Less scrutiny is currently given to initial savings proposals. Selection of buildings with higher energy intensity per unit floor area in 2006-2008 was accompanied by an increase in hybrid projects including more expensive investments (variable frequency drives, control upgrades). Project costs are higher than some RCx programs primarily because of the frequent need to install building-level energy meters—often including expensive chilled water, hot water and steam meters in campus district heating and cooling scenarios.

Table 2. UC/CSU/IOU Partnership Monitoring-Based Commissioning Results

All Projects		2004-2005 Pure (1) MBCx Projects (Mills and Mathew 2009)	2004-2005 (2)	2006-2008 (2)	2009-2012 through 2011 (2,3)
Savings	Electricity (million kWh/year)	7.7	12.2	17.9	20.0
	Realization Rate (5)		134%	125%	90%
	Natural Gas (million therms/year	0.4	0.8	1.7	1.7
	Realization Rate (5)		139%	130%	97%
	On-Peak Electricity (million kWh/year)	0.6	0.9	0.9	
	Peak Demand (kW)				2,014
Incentives	Electricity (million $)				4.2
	Natural Gas (million $)				1.5
	Total (million $)	2.9	5.2	4.3	5.7
Project Cost (million $)		2.9 (4)	5.2 (4)	7.1	15.4
Project Count		24	46	46	73
Building Projects Only (6)	Building Area (million gsf)	3.4	5.8	4.9	9.2
	Project Count	24	37	41	72
	Savings (kWh/yr-gsf)	2.26	1.65	2.86	2.12
	Savings (therm/yr-gsf)	0.12	0.13	0.16	0.19
	Project Cost per gsf	$0.85	$0.70	$0.99	$1.64

(1) 2004-2005 "Pure" MBCx projects include projects in buildings with only no-cost/low cost measures.
(2) All MBCx projects include plant projects and hybrid projects combining MBCx with equipment upgrades.
(3) Around 70 additional projects are planned for 2012, with around $6M of additional incentive funds.
(4) 100% incentives were available in 2004-2005 and incentives are considered a good proxy for total costs.
(5) Realization Rate is verified savings divided by initially proposed savings.
(6) Does not include central plant projects included in top section.
(7) gsf = Gross Square Feet

Capturing Reductions in Peak Period Energy Use—A Lost Opportunity. Program proposers intended that MBCx projects maximize value by emphasizing measures that reduced high-cost peak-period energy use. Incentives were originally offered for peak period energy reduction in addition to overall energy use reduction. The "per kW" incentives were actually for average demand reduction during the time-of-use peak period, equivalent to reductions in annual peak period kWh and well aligned with billing. Though significant reductions in peak period energy use were sometimes observed, program-wide they were smaller than hoped. The authors observe that this could have been due to lack of experience in accounting for on-peak waste from common problems like simultaneous heating and cooling or stuck-open chilled water valves.

In the 2006-2008 Partnership cycle, incentives for peak period electricity use reduction were eliminated for program simplification. Peak reduction was still encouraged, and again measured as peak period kWh reduction. In the 2009 and 2010-2012 cycles, peak reduction was again encouraged, but there was still no incentive tied to it. The peak demand definition from the Database for Energy Efficiency Resources (DEER) was adopted for consistency with other IOU programs. Unfortunately, this definition moved the accounting away from the originally envisioned emphasis on peak-period energy use and alignment with billing.

Beyond the UC/CSU/IOU Partnership

PG&E initiated one of the largest core utility retro-commissioning (RCx) programs beginning in 2006 based partly on their experience with MBCx. The RCx projects emulated MBCx to varying degrees, except they tended to be at individual buildings (rather than campuses) where whole building metering already existed. The RCx program required metering of pre- and post-implementation whole building energy use, or monitoring of equipment parameters such as economizer operation. The RCx program evolved to have shorter pre- and post-implementation monitoring periods where the monitoring data for key parameters was used to confirm that modifications had been successfully implemented and for savings accounting.
Starting in 2009, California IOUs accepted a number of new Third-Party energy efficiency programs, including several employing retro-commissioning and monitoring-based commissioning measures, either as their main offering, or one of a comprehensive set of measures. Some new programs were offered by firms that had participated in Partnership MBCx projects. These projects typically were focused on a specific population of buildings (hospitals, for example) and often had MBCx as a part of the program name (Monitoring Based Persistence Commissioning). Although Table 3 is not an exhaustive list, one can conclude that MBCx and RCx have now found their way into the mainstream of energy efficiency efforts in California.

Table 3. 2009-2012 Retro-Commissioning Programs in California

Utility	*RCx Program*	*Delivery*	*Scope*
PG&E	Core RCx (suspended for 2012)	Utility	All Customers
	Monitoring Based Commissioning	3rd Party	Commercial Sector
	Monitoring Based Persistence Commissioning	3rd Party	Commercial Sector
	Enhanced Automation Initiative	3rd Party	Commercial with BAS
	Ozone Laundry Energy Efficiency	3rd Party	Hospitality/Commercial
	Industrial Retro-commissioning	3rd Party	
	Comprehensive Retail Energy Management	3rd Party	
	Lodging Savers	3rd Party	Hospitality Sector
	Healthcare Energy Efficiency	3rd Party	
	Medical Building Tune Up	3rd Party	
SCE	Commercial RCx	Utility	Commercial
	Monitoring Based Commissioning	3rd Party	Commercial Sector
SDG&E	Commercial RCx	Utility/3rd Party	Commercial
	Comprehensive Industrial Energy Efficiency	3rd Party	Industrial
	Healthcare Energy Efficiency	3rd Party	Health Care
	Lodging Energy Efficiency	3rd Party	Hospitality
	Optimizing Pump Utilization Systems	3rd Party	Agricultural & Non Res
	Premium Efficiency Cooling	3rd Party	Commercial
SCG/ SDG&E	SaveGas	3rd Party	Hospitality
PG&E/SCG/SCG/SDG&E	California Community Colleges Partnership (MBCx approach modeled after UC/CSU)	Partnership (started in 2006)	

National Programs

California's expansion of RCx and MBCx programs is starting to be matched nationwide with new and expanded programs in other states. Table 4 highlights some of these programs around the US. One of the original providers of MBCx services to Partnership campuses now has a nationwide portfolio of over one hundred and twenty buildings in its MBCx-like program including buildings in nine utility programs spanning the country (Hand 2012).

Table 4. Representative RCx and MBCx Programs Across the Nation

State	*Utility*	*Delivery*	*Scope*
AR	AEP SWEPCO	3rd Party	RCx - Commercial, Industrial
AZ	SRP	Utility	RCx - Commercial, Industrial
CO	Black Hills Energy	Utility / 3rd party	RCx - Commercial
	Xcel Energy	Utility	RCx - Commercial
CT	Energy Efficiency Fund	Utility	RCx - Commercial
	Northeast Utilities	Utility / 3rd party	RCx - Commercial, Educational, Govt.
IA	Linn County Rural Electric Coop	Utility	RCx - Commercial
IL	ComEd	Utility / 3rd party	RCx - Commercial
	Nicor Gas	Utility / 3rd party	RCx - Commercial
	Ameren Illinois (Gas & Electric)	Utility/ 3rd party	RCx - Commercial, Healthcare
	City Water Light and Power	Utility	RCx - Commercial
	SEDAC	State / 3rd Party	RCx - Educational, Govt.
LA	Entergy New Orleans	3rd Party	RCx - Commercial, Industrial
MD	Baltimore Gas & Electric Co.	Utility	RCx - Commercial
MD	Delmarva	Utility / 3rd Party	RCx - Commercial
MD	Pepco	Utility / 3rd Party	RCx - Commercial
MN	Dakota Electric Association	Utility	RCx - Commercial
MN	Xcel Energy	Utility	RCx - Commercial
MO	Ameren Missouri	Utility / 3rd party	RCx - Commercial
NC	Progress Energy Carolinas	Utility / 3rd Party	RCx - Commercial
NE	Lincoln Electric System	3rd Party	RCx - Commercial, Industrial
NJ	PSE&G	Utility	RCx - Grocery Stores (initial focus)
NY	NYSERDA	State / 3rd Party	MBCx - Commercial
OR	Portland General Electric (PGE)	3rd party	RCx - Commercial
TX	Centerpoint Energy	Utility / 3rd party	RCx - Commercial, Industrial, Educational
WA/ID	Avista	Utility	RCx - Commercial
WI	Focus on Energy	Utility	RCx - Commercial, Industrial, Educational, Govt.

Progress in the Paradigm Shift

A partial shift toward a monitoring-based approach has occurred for both problem diagnosis and savings accounting. The shift is progressing steadily for savings accounting, and haltingly for problem diagnosis. There is intent to enable more persistence of savings, but progress cannot be measured within a standard incentive program timeframe.

Migration Toward Monitoring for Savings Accounting

The shift for savings accounting is supported by a general desire for more credibility and a related program design progression to pay incentives on actual savings instead of pre-estimates or targets. Standard-setting efforts for this maturing industry have also helped (IPMVP 2012). The Partnership developed consensus protocols balancing the need for quick turn-around of projects with time to capture the benefits of a monitoring-based approach. Protocols are based on IPMVP Whole Building Option C, modified to fit the timing needs of the Partnership.

Strong cultural inertia in the commissioning industry made the shift to monitoring for savings accounting challenging at first. In 2004-2005, the strong modeling culture resisted, with perhaps half only of the projects reporting truly measured savings. Some savings accounting described as “measured” was actually modeled, with a model calibrated by measurement but still calculating savings based on assumptions that the modeled measured were actually implemented. However, with the 2009-2012 program cycle, the vast majority of projects are doing savings accounting through measurement before and after measure implementation.

Limited Progress Toward Monitoring for Problem Diagnosis

Use of monitoring for problem diagnosis was originally enabled by the pilot program’s emphasis on in-house implementation of projects. Several of the projects in the original project set were conducted by in-house staff who naturally took to monitoring as a way to integrate RCx with their energy management efforts. Examples of problem diagnosis through monitoring were prominent in the early set of 2004-2005 projects (Mills and Mathew 2009). However, the evolution of the program design and the realities of budget cutbacks in California higher education have not always supported this outcome.

Barriers to Monitoring for Problem Diagnosis. Reduction in in-house staff available to implement or even manage projects has limited scaling of MBCx efforts on campuses. Efforts to build in-house commissioning capability have been confounded on most campuses by a State budget crisis and corresponding reductions in maintenance staffing. Supported by incentives and robust bond-financed co-funding available to UC campuses, Partnership energy efficiency project portfolios continue to scale up, but with increased reliance on commissioning consultants to implement MBCx projects. Reverting to outsourcing has inhibited adoption of monitoring-based approaches to diagnosis, as part of the commissioning industry remains more comfortable with traditional test protocol-based diagnostic methods—and cultural inertia is strong.

The generally positive program design change to paying of incentives on actual savings has had one unintended side-effect—increased conservatism in project proposals driving more reliance on existing knowledge of savings opportunities for the proposed building. Though not a Partnership requirement, campuses are favoring project proposals based on the existence of known problems with building operation. The focus of the commissioning phase is thus capturing the savings from those known problems rather than identifying previously unrecognized modes of energy waste. So, the monitoring capability established by the project may not be fully utilized to its intended potential.

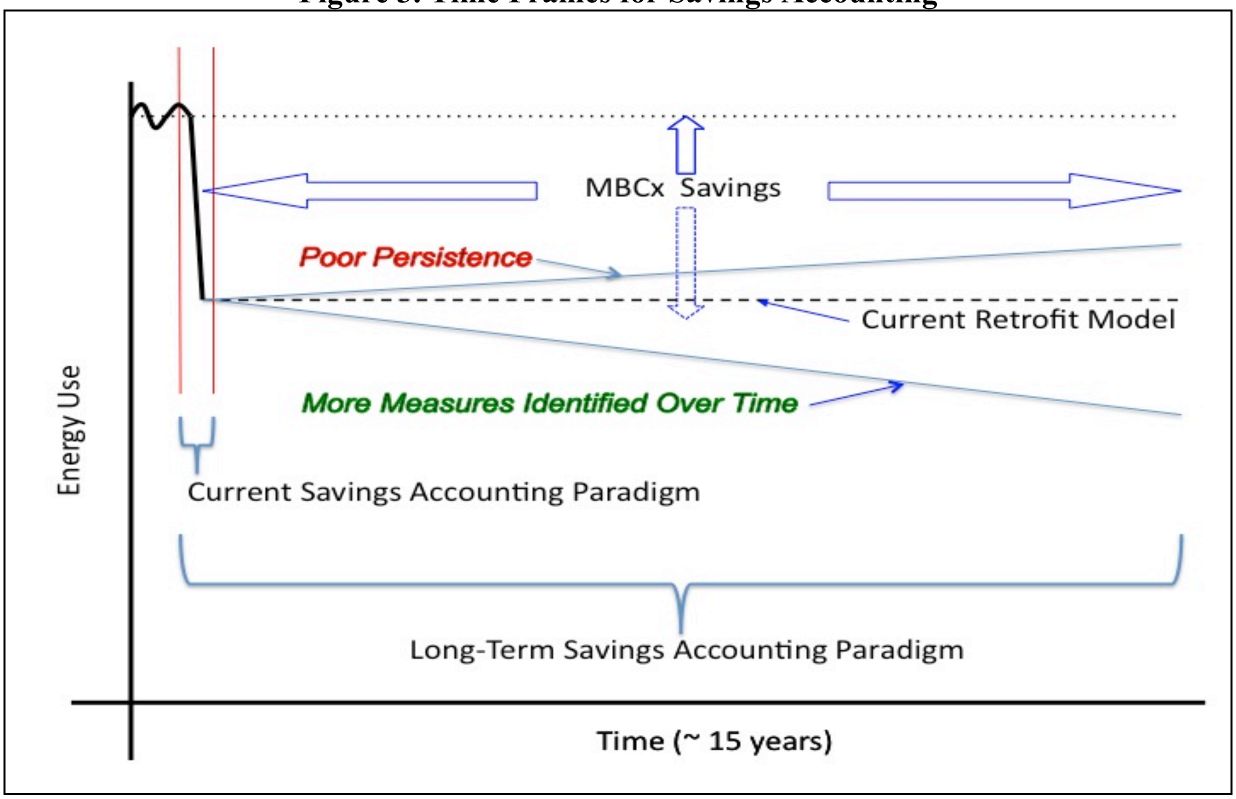
A portfolio approach to goal setting and project development, once an innovative aspect of the program which encouraged exploration of maximum potential for energy savings, has been undercut by the financial pressure to justify the initial project investment in every implemented project. Potential savings may go unidentified not only in the buildings without obvious savings opportunities, but also in the buildings selected for projects—as the habit of diagnosis by predetermination is preferred over discovery in the course of conducting the project. Evidence of this scenario was exemplified by a recent project which “reinvented” itself in the course of implementation, exploring potential controls adjustments identified by monitoring, but who’s campus sponsors represented the project’s course change as being “unusual” and “remarkable” rather than as intended by the program design.

Barriers to Ensuring Persistence of Savings Through Monitoring

No strong need has been perceived for evaluation, measurement, and verification over the life of the measure (i.e., persistence). It has traditionally been acceptable to provide the entire incentive to the customer up front, in return for savings delivered over the long term. This conveniently eliminates the burden on the customer of financing the amount of the incentive, and limits project management effort to a period on the order of a year. This makes a lot of sense for retrofit measures for which the uncertainty in savings can be nearly fully resolved in conjunction with project installation and has low dependence on operational variations over the life of the measure. The pilot cycle of the MBCx program design retained these vestigial attributes of the program model developed for conventional retrofit projects. Figure 3 illustrates the current retrofit model. Figure 4 illustrates a project where medium-term persistence is evident in raw power monitoring.

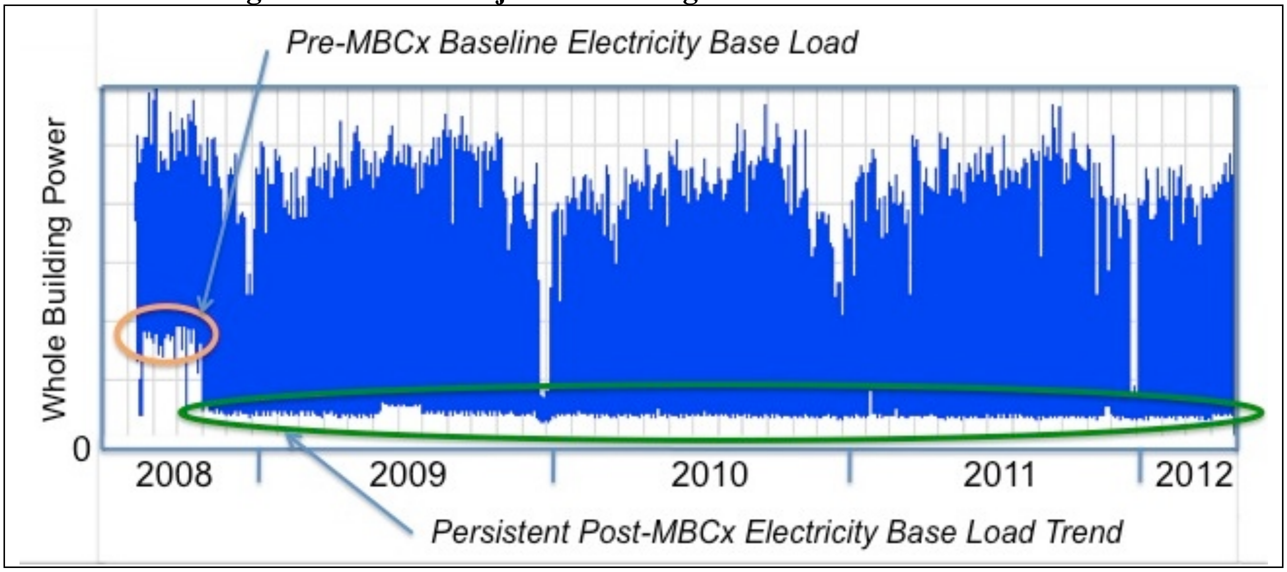
A long measure life of fifteen years was assigned to MBCx, based on provision of capability to monitor energy performance over the long term, along with staff training in using the monitoring to maintain reduced levels of energy use. However, the administrative traditions of the underlying energy efficiency programs dictate program cycles of a few years at most, and project turnaround in a year or less. So the provisions to ensure persistence cannot be validated.

Figure 3. Time Frames for Savings Accounting



Source: University of California—California Institute for Energy and Environment

Figure 4. MBCx Project Exhibiting Medium-Term Persistence



Source: University of California—California Institute for Energy and Environment

Revisiting the "Snapshot" Retrofit Program Model for Savings Accounting. Given the traditional assumption about the savings trend, for many retrofit scenarios the currently used savings "snapshot" is not only more convenient, but the low risk also justifies the low cost. However, a more realistic, wider range of long-term outcomes suggests the assumed persistence of the savings "snapshot" may not be justified for many scenarios, and a longer-term savings accounting approach may be preferable.

Potential Future Directions in Program Design

Toward Longer-term Program Design

Tradition, need for a recognizable program model, and difficulty in establishing new program models led to the retrofit model being applied to the pilot monitoring-based program element in 2004-2005. However, it is possible to envision a longer-term delivery model that would provide even more assurance of persistence of savings. For instance, incentives could be paid on actual savings over the fifteen-year life of the measure, and on-bill financing could be provided to fund the project up-front for the customer.

It is understandable why consideration of such a "full duration" program design would fail to gain traction with utilities, regulators, or customers. It would increase program accounting uncertainty for regulators and the utilities, and would not provide the "closure" demanded by current administrative models. It could increase project management costs for utilities and customers due to the long-term tracking requirements.

The benefits of a longer-term approach could outweigh the drawbacks. The return on the investment of the incentive would certainly be more reliable. This might be attractive to regulators and utilities. However, this may not be the biggest advantage of a longer-term approach. A larger benefit might be that the incentives are more fully aligned with the other benefits to the customer in long-term cost savings. This creates the potential for larger savings from ongoing monitoring and identification of measures that appear as the use of the building changes over the fifteen-year or longer life of the "measure".

Aligning Program Incentives With the Customer Incentive to Reduce Energy Costs.

Customers might capture more energy cost savings and more societal benefits could accrue to MBCx programs if program incentives were better aligned with customer rate structures. Part of the current electricity incentive could be offered for savings achieved during the time-of-use peak period. If more expensive peak electricity is targeted, more cost savings would be available to pay down loans for the balance of project costs, reducing the need for the incentives, making more incentive funds available for additional projects, and overall creating more favorable project economics. More savings and higher-value savings would mean more societal value from incentive funding. Protocols for accounting of peak-period savings would be relatively easy to fashion, with models including the 2004-2005 UC/CSU/IOU Partnership MBCx protocol and time-dependent valuation protocols in California Energy standards.

Savings accounting in conjunction with customer billing information could capture benefits of both long-term savings accounting and alignment of incentives with rate schedules.

Learning From the BC Hydro Program. British Columbia Hydro has offered its Power Smart Continuous Optimization Program to customers for a number of years. The program provides a commissioning expert to review building operations and make recommendations for improvement, as well as installation of an Energy Management Information System (EMIS) to continuously track the building's electric use at the utility meters. Additional meters can be added at the customer's expense. The EMIS is used by building operators to track usage toward realistic performance targets, adjusting for schedules and weather. The EMIS provides the owner with load profiles, benchmarking, bill analysis, exception reporting, and savings accounting.

The customer must commit to implement measures that provide a bundled two-year simple payback. The customer receives no additional incentive payment, but receives the benefits of the monitoring program indefinitely as long as they are responsive to the Continuous Optimization program and maintain low energy use. The utility selects the commissioning service providers and the EMIS software. This unique service leverages relatively low and ongoing costs to provide a continuous incentive for the customer to maintain documented efficiency levels over a period of many years (Henderson 2011).

Related Campus Initiatives

Campus Energy Dashboards. Other campuses have now followed UC Santa Barbara in implementing campus energy dashboards. Student and research-led efforts have taken advantage of the monitoring funded by the Partnership to establish public repositories of campus energy performance information (UC Berkeley 2012a, UC Berkeley 2012b, UC San Diego 2012).

User Incentives Come to One Campus: UC Berkeley Energy Management Initiative. A major energy management initiative is a key part of a campus reorganization for UC Berkeley (UC Berkeley 2012c). One facet of this initiative is an incentive program intended to reward campus departments for saving energy. While campus auxiliary units such as housing and parking have traditionally been recharged for energy use, academic (or "state-funded") departments have had their energy centrally funded. Though "free" to the departments, the cost of their energy use has had a big impact on campus finances. Full recharge of academic departments is not practical, but a creative incentive program has been crafted to reward departments for saving energy, and in extraordinary cases recharge them for excess energy use. Metering capability established through MBCx projects will be used for building dashboards to assist departmental units in tracking and reducing energy use, as well as for savings accounting.

"Living Laboratory" Research Initiatives. Also at UC Berkeley, research initiatives focusing on information technology for building energy efficiency and demand response are synergistic with MBCx efforts. The Cory Hall Building-to-Grid test bed project and the Distributed Intelligent Automated Demand Response (DIADR) project in Sutardja Dai Hall are exploring the use of a simple monitoring and actuation profile (sMAP) that could facilitate open-source horizontal building monitoring architecture (Dawson-Haggerty, Krioukov, and Culler 2011). Promising innovative MBCx measures are another result (Peffer 2010, Peffer et al 2012).

Future of the UC/CSU/IOU Partnership

Preliminary information about the next California energy efficiency program cycle indicates it will be a two-year cycle, covering 2013-2014, and is to be a transition to a more comprehensive, deeper, and focused set of programs in 2015 and beyond. The UC/CSU/IOU Partnership is planning for the continuation of its successful program. MBCx will remain an important program element of the Partnership by which campuses can reduce their energy use, improve the operations of their buildings, and ultimately make progress toward their greenhouse gas reduction goals. MBCx will undoubtedly continue to evolve within the program, incorporating improvements learned first-hand, as well as the best practices emerging from the ever-increasing number of MBCx and RCx programs run by others. For example, one specific area under investigation is improving the method by which measured savings over a period of months can be more consistently extrapolated to annual values and perhaps assigned a confidence level related to how much data the extrapolation is based upon.

Conclusions and Recommendations

Monitoring-based commissioning represents a paradigm shift built on a strong foundation of research, development and demonstration. Delivering cost-effective savings at a significant scale, MBCx has matured though a unique partnership between California universities and IOUs. It has evolved with ongoing research support from an ambitious pilot to a mainstream component of utility offerings with elements influencing other commissioning programs throughout California and the nation. The most significant advances have been in savings accounting through monitoring.

Opportunities for improvement in program design remain, including capturing greater peak electricity use reduction and providing even more assurance of persistence of savings through longer-term accounting and longer-term incentive payments. Realizing the full potential of monitoring for problem diagnosis may require more risk-taking by customers, commissioning consultants, and incentive program managers, including a portfolio approach to encourage mining of deeper savings and exploration for savings in more buildings. Innovations in energy information technology will be synergistic with further advancement of the monitoring-based paradigm for enhancing building operations.

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