

Best Practices for Enhancing Performance Contracts with Monitoring-Based Commissioning

The Federal Energy Management Program (FEMP) promotes best practices for impactful utilization of Energy Management Information Systems (EMIS) at federal facilities. This fact sheet highlights best practices for incorporating monitoring-based commissioning (MBCx), a type of EMIS, in performance contracts. It draws from the FEMP report, *Enhancing Performance Contracts Using Monitoring-based Commissioning*.¹

Primary Benefits

The primary benefits of utilizing MBCx in performance contracts are:

- **Increased energy savings:** Implementing MBCx accesses additional savings traditionally left on the table in performance contracts.
- **Energy conservation measure (ECM) and whole-building commissioning (Cx):** MBCx can enhance the normal ECM Cx process for new equipment, as well as providing a more thorough and fruitful means to conduct whole-building recommissioning (RCx) as a separate, quick-payback ECM.



Figure 1. Integrating monitoring-based commissioning into energy performance contracts can increase project savings and improve the long-term performance of building systems. *Photo by Dennis Schroeder, NREL 51061.*

- **ECM savings persistence:** Continuous monitoring of facility data enables early detection and mitigation of ECM performance degradation over the performance period.
- **Increased precision and automation of many measurement and verification (M&V) functions:** Remote monitoring combined with additional parameters measured and automated analysis and reporting can increase M&V precision while reducing costs.
- **Empowering the owner and contractor with tools to improve operations and maintenance (O&M) performance:** Operational and performance issues are identified and diagnosed so they can be addressed in order of priority.

MBCx Provides Ongoing Commissioning for Buildings and Energy Systems

Effective energy system Cx is critical to ensuring that system performance meets its design intent. MBCx is traditionally defined as the continuous application of the Cx process to a building or energy system. It is an effective method to keep

Types of Facility Commissioning

Cx: Commissioning is the process of planning, documenting, scheduling, testing, adjusting, verifying, and training to provide a facility that operates as a fully functional system per the owner's design requirements. Commissioning is applied to new equipment installed in a performance contract or to an entire facility after construction and prior to project acceptance.

MBCx: Monitoring-based commissioning is the continuous application of the commissioning process to a building or energy system and is an effective method to keep energy costs low and minimize system problems that may be caused over time by building performance deterioration and changes to building operations.

RCx: Recommissioning is the application of the commissioning process to projects that were previously commissioned. RCx can also mean **retro-commissioning**, or the application of the commissioning process to buildings or systems not previously commissioned.

¹ Federal Energy Management Program (2021). *Enhancing Performance Contracts Using Monitoring-based Commissioning (MBCx)*. <https://www.energy.gov/eere/femp/articles/enhancing-performance-contracts-monitoring-based-commissioning>.

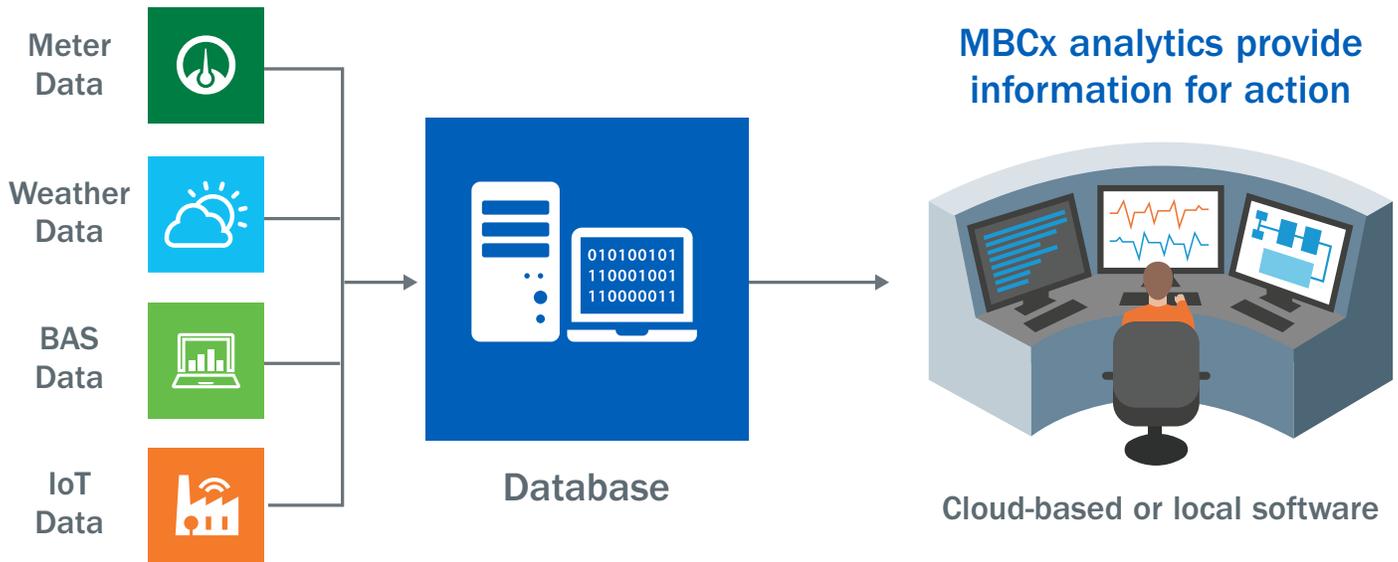


Figure 2. MBCx data flow, including metering, weather, building automation system (BAS), and internet-of-things (IoT) data. *Original illustration from Celeste Cizik, Group14 Engineering, recreated by Fred Zietz and Jesse Dean, National Renewable Energy Laboratory.*

energy costs low and minimize system problems that may arise over time due to building performance deterioration and changes to operations. MBCx relies on software tools that collect data from a building automation system (BAS) and advanced metering infrastructure (AMI) to perform analytics that identify performance improvement opportunities. It also includes processes for implementing and verifying improvements made based on the analytics.

MBCx software tools collect and record building data and perform real-time diagnostics, reducing the effort required to process large numbers of BAS trend logs to identify sub-optimal performance. Automated fault detection and diagnostics (AFDD), the primary capability in MBCx software tools, adds value to facility operations by proactively finding hidden issues and using programmed "rules" to automatically detect "faults" and diagnose their root causes. Fault prioritization then helps identify issues with the greatest potential for energy savings. This ongoing performance monitoring helps identify and prioritize new ECMs and can improve M&V by automating data collection and portions of the reporting process.

MBCx is commercially available, yet is underutilized in performance contracts. MBCx can result in significant benefits for both the facility and the performance contractor.

Integrating MBCx in Energy Performance Contracts Is a Largely Untapped Opportunity

Greater U.S. market adoption of MBCx software tools presents a unique opportunity to integrate MBCx into energy performance contracts to increase project savings and improve the long-term performance of building systems. Full RCx has only been included in a very small percentage of federal energy savings performance contracts (ESPCs) and utility energy service contracts (UESCs). There is significant energy savings potential for implementing MBCx, which streamlines RCx, in these projects. What's more, federal agencies are required by the Energy Act of 2020 to increase use of third-party financed projects, and incorporating MBCx can satisfy the Act's commissioning requirements.

The U.S. General Services Administration's MBCx program has shown a 15.9% whole-building energy savings across a portfolio of 60 GSA buildings (Loftness et al. 2020; Katipamula 2020). Similarly, the Pacific

GSA Achieves Major Savings with MBCx

GSA's aggressive energy reduction goals for their large portfolio of buildings led them to be an early adopter of MBCx software platforms. In 2012 GSA created a national program to implement GSALink, a centralized MBCx software platform that is deployed nationwide. MBCx has been implemented in over 100 GSA buildings, with metering added to over 60 more. A sample of 60 buildings showed \$7 million annual energy savings, 15.9% whole building energy savings, 24.7% annual peak demand reduction, with an additional \$4 million in annual maintenance savings (Loftness et al. 2020).

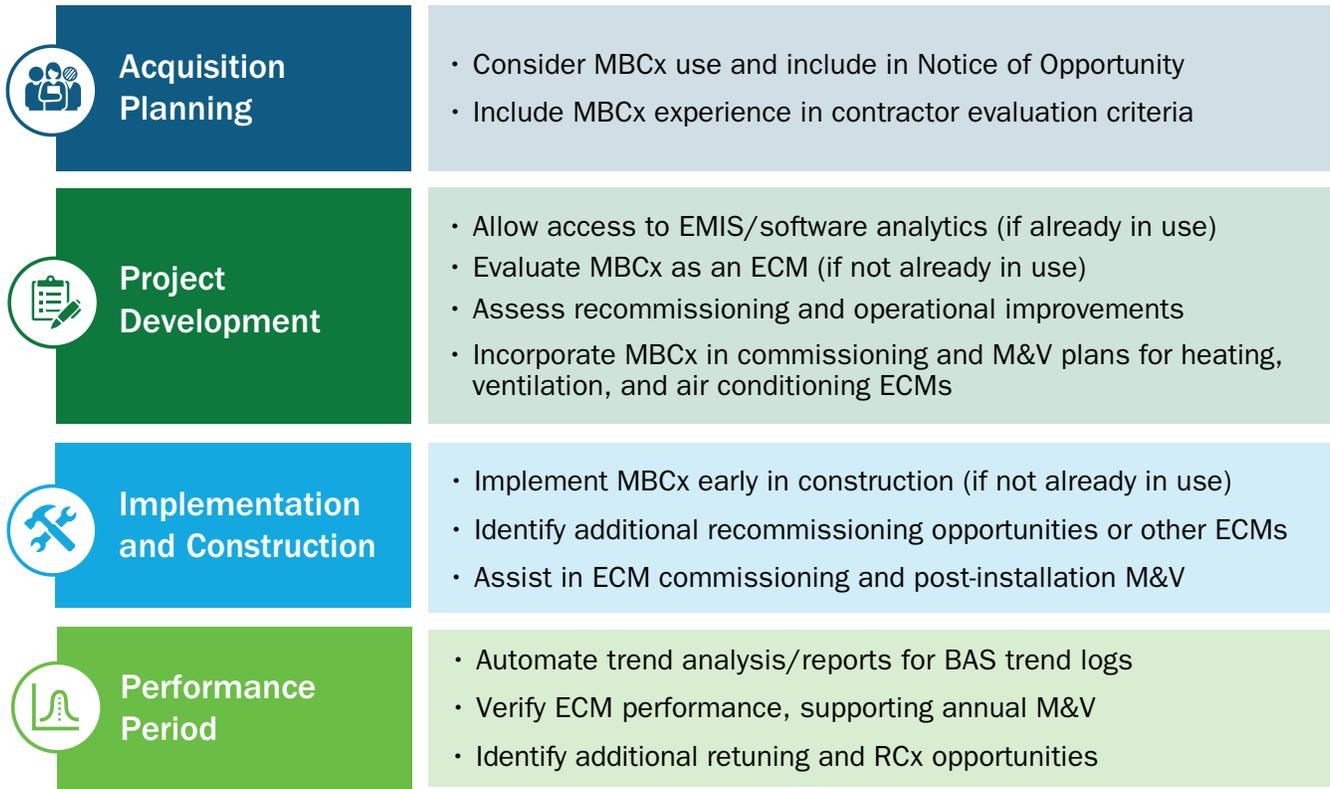


Figure 3. Best practices for planning and implementing MBCx. *Illustration by James Dice and Fred Zietz, NREL*

Northwest National Laboratory Building Retuning™ program has demonstrated a 15% median whole-building energy savings across 24 federal projects (Katipamula 2020). The short payback period and significant energy savings would free up capital in performance contracts to help finance longer-payback but desired ECMs, including deep efficiency and decarbonization measures, advanced metering/submetering infrastructure, renewable energy, resilience, and emerging technologies like on-site battery storage, waste heat reuse, and grid-interactive efficient buildings.

Best Practices for Enhancing Performance Contracts with MBCx

MBCx offers benefits at every stage of the performance contracting life cycle, from ECM identification to performance verification. The following are some

best practices when planning and implementing MBCx in an ESPC or UESC project.

Acquisition Planning

Facilities that already have an MBCx system in use should consider how it could be used in the performance contract early in the project planning phase. If MBCx is not currently installed, have the contractor evaluate its potential as an ECM. In either case, require potential contractors to describe their experience implementing and using MBCx in response to the notice of opportunity to aid in contractor selection.

Project Development

MBCx can be leveraged during the project development phase for more accurate baselining and identification of additional ECMs if used in the preliminary assessment or early in the investment grade audit. Facilities with

MBCx software already in place should provide the contractor with access to the software. MBCx data collection and analysis can be used as a cost-effective means of developing and verifying baseline energy consumption of existing building systems, as well as identifying ECM opportunities, particularly RCx measures and operational improvements. The contractor may also work with the facility to evaluate benefits of installing MBCx during the investment grade audit.

The performance contract should clearly define how MBCx is to be used, including responsibilities of both the contractor and the facility managers. MBCx should be used for continuous tracking of key performance indicators to sustain performance and savings over time. This adds rigor to M&V and can reduce risk to both the contractor and the customer. Use of remote monitoring and automation of data collection, analysis, validation, and reporting should reduce the M&V effort and costs. Diagnostics

combined with fault alarms allows real-time detection of problems that can be corrected quickly, reducing risk for both the facility owner and the performance contractor.

Implementation, Construction, and Commissioning

MBCx should be used for RCx of existing equipment and Cx of new equipment during the construction period of the contract to reduce costs and increase Cx quality. RCx details should be included in the commissioning plan. When possible, MBCx should be implemented within the first few months of the construction phase to analyze how the facility is operated and to identify additional RCx measures and ECMs right away, while it is still possible to include them. The contract may be modified to include the costs and associated savings of additional measures selected by the customer.

Performance Period

During the performance period, MBCx should be used to:

- Generate automated reports and performance verification of each ECM
- Assure that facility staff are operating equipment according to the project's contractual requirements
- Provide remote analysis of system performance
- Diagnose O&M problems
- Compare whole facility energy use to expectations.

Automated reporting and performance tracking simplifies the M&V reporting process and may allow for more frequent reporting than the current practice. If facility staff modify control sequences, setpoints, or schedules to be out of compliance with project specifications, AFDD notifications will alert both facility and contractor staff, allowing for quick corrections. MBCx analysis

should also help determine if ECM performance issues led staff to override control settings. Remote access and analysis of ECM performance eliminates the need for site visits to view or download data for analysis. These reports can provide additional transparency into the ongoing operational performance of ECMs. Finally, AFDD rules in the MBCx platform constantly monitor system performance and identify O&M issues and additional optimization opportunities, potentially even beyond the performance contract's ECMs and scope.

ECM-level reports and analysis are visible to the MBCx provider, performance contractor (which may also be the MBCx provider), agency or organization, and facility. This offers transparency for performance verification, corrective action recommendations, and identification of new savings measures. This transparency helps to supplement the on-site witnessing of ECM Cx, RCx, and performance verification activities—a requirement in federal contracts—by facility staff.

References

Katipamula, Srinivas (2020). *Improving Commercial Building Operations through Building Re-tuning: Meta-Analysis*. https://buildingretuning.pnnl.gov/documents/PNNL-SA-156277_Re-tuningMeta-Analysis_2020-09-05.pdf.

Loftness, Vivian, Azizan Aziz, Chenlu Zhang, and Yujie Xu (2020). *Executive Report on the Evaluation of GSA Total Estimated Cost Impact (TECI) Metrics and Building Benchmarking*. <https://sftool.gov/Content/attachments/Iswg/iswg-case-studies/GSA%20CMU%20TECI%20ISWG%20October%202020.pdf>.

Congress.gov (2020). "Public Law No: 116-260, Energy Act of 2020." Accessed February 16, 2022. <https://www.congress.gov/bill/116th-congress/house-bill/133/text>. ■

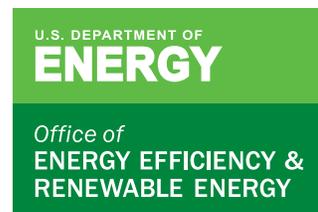
Learn More About Monitoring-Based Commissioning

Download the FEMP Technical Report, Enhancing Performance Contracts Using Monitoring-based Commissioning (MBCx) at energy.gov/eere/femp/articles/enhancing-performance-contracts-monitoring-based-commissioning-mbcx.

For questions about MBCx, email Jason Koman at Jason.Koman@ee.doe.gov.

More information about O&M, retuning, and retrocommissioning in federal facilities is available at energy.gov/eere/femp/operations-and-maintenance-federal-facilities.

For questions about O&M and retrocommissioning, email Nael Nmair at Nael.Nmair@ee.doe.gov.



For more information, visit: energy.gov/eere/femp

DOE/GO-102022-5677 • March 2022