Commissioning: An Essential Part of a Comprehensive Energy Strategy

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Synopsis

Through proper assessment and planning, a comprehensive energy strategy that includes commissioning will serve as a roadmap to maximize building performance. A fragmented approach to commissioning can compromise the long-term health of the building; it is important to integrate commissioning into a facility’s energy management strategy. Depending on the building’s level of energy-efficiency, age, and use, the commissioning approach will be comprised of both one-time initiatives and ongoing services, and both are designed to reduce energy costs while enabling continuous performance improvements.

About the Author

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Prior to coming to Siemens, Mike directed energy conservation and sustainability projects for the University of Illinois at Urbana Champaign’s Business Innovation Services, provided energy engineering project management consulting for ComEd, and completed various independent energy management projects for clients across all building markets. For nearly 13 years of his career, he provided strategic business development and energy engineering expertise to the University of Illinois Energy Resources Center where he was one of three Principal Engineers and the Associate Director of the USDOE’s Industrial Assessment Center.

Mike is a licensed Professional Engineer in the states of Illinois and California, a Qualified Commissioning Process Provider (University of Wisconsin), and a Project Management Professional (PMI). He is a member of the Building Commissioning Association (BCA) and the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). He has a B.S. in Mechanical Engineering from the Milwaukee School of Engineering, an M.S. in Mechanical Engineering, and an MBA from the University of Illinois Urbana-Champaign.
Commissioning: An Essential Part of a Comprehensive Energy Strategy

While technological advances have certainly made it easier to optimize building performance, a comprehensive energy strategy can have a far greater impact on achieving operational savings. This strategic process, which is often overlooked, should include all major stakeholders and should leverage the expertise of well-trained professionals. An effective energy reduction plan will account for the business’ overarching goals and its operations, and will rely on a strong commitment to the entire strategic energy management process.

Definition: Comprehensive Energy Strategy

A comprehensive energy strategy is an energy management and sustainability solution designed to control the rising costs of energy, reduce environmental footprints, and increase the value and competitiveness of buildings and infrastructure.

An energy strategy helps building owners and managers determine energy savings goals and implement necessary energy conservation measures to achieve those goals. Of a typical building’s total lifecycle cost, approximately 32% is from energy consumption during the operational phase of the building; thus, even minor energy conservation projects can have a major financial impact.

The best way to maximize energy savings is to ensure alignment between the primary stakeholders and the technologies and services used as part of the energy strategy’s implementation. Employing Existing Building Commissioning (EBCx) and Monitoring-based Commissioning (MBCx) represents an excellent opportunity to improve the overall performance of a building and to reduce costly energy consumption. In other words, an effective comprehensive energy strategy requires commissioning and improves building performance and sustainability.

A Holistic Energy Strategy Includes Five Key Phases

The holistic nature of an energy strategy includes five phases that are inherently recursive and concurrent:

Each of the five phases should begin with several key objectives and will rely on a combination of people, processes, and technologies to be successful.

Strategy & Planning

Through the strategy and planning phase of an energy
strategy, companies will develop a plan with three core objectives: 1) to maximize efficiency and reduce energy consumption through energy benchmarking, demand-side energy planning, and infrastructure planning; 2) to optimize energy supply and mitigate risk through budgeting, price forecasting, and load forecasting; and 3) to enhance sustainability performance, including green building strategies, greenhouse gas (GHG) reduction strategies, and external reporting commitments.

A strategic plan will not only provide actionable plans to achieve these goals, it will also identify the organization’s return on investment and funding requirements, and serve as a foundation for long-term success. Ultimately, the company will create transparency throughout the organization and develop a plan for achieving overall business, energy, and sustainability goals.

**Evaluation & Assessment**

Through a series of solutions and services related to building performance analysis, three outcomes are achieved in the Evaluation and Assessment phase of an energy strategy: 1) identify opportunities to improve resource efficiency through energy and resource auditing; 2) reduce risks and costs related to energy procurement through supply analysis, delivery risk assessments, and renewable energy assessments; and 3) identify opportunities to increase sustainability through such actions as GHG emissions inventories, green building certification assessments, and indoor environmental quality surveys.

The analysis includes a deep look into how energy is both consumed and purchased, as well as the business’ environmental impacts, to outline a program roadmap that incorporates specific actions to implement. This phase is a crucial step in determining which capital-intensive solutions and services will help to cost-effectively achieve overall goals; it should also define financial options and available utility incentives, as well as calculate necessary metrics.

**Program Implementation**

Using the roadmap developed during the evaluation and assessment phase, the program implementation phase involves the turnkey execution of energy efficiency, energy supply, and sustainability improvement actions. This phase typically involves hands-on work and/or applied expertise, and can generate substantial improvements in building performance.

Through this phase, businesses seek to reduce energy consumption through such facility improvement measures as the installation of building automation systems, lighting and electrical improvements, and other operational upgrades. Additionally, implementation programs strive to reduce energy risk and supply costs with procurement and hedging policies, as well as utility bill management history and setup. Other objectives involve improving energy security and reliability with demand response and intelligent load initiatives, onsite generation, and renewable energy, as well as the improvement of environmental performance, corporate image, and company reputation through obtaining ENERGY STAR, LEED, or other green building certifications.
Throughout this phase, companies must navigate funding processes while demanding on-time and on-budget delivery.

**Ongoing Services & Optimization**

Implementing a comprehensive energy strategy without ongoing service and optimization is not sufficient to maintain sustainable operations because buildings can become less efficient over time. Implementing a project will deliver results, but the impact is finite in time unless the improvements are monitored so deviations in performance can be noted and remedied. Through the ongoing services and optimization phase, which often employs measurement and verification protocols (e.g. ASHRAE 14P), companies can help ensure that energy and operational savings persist over time while delivering continuous building performance improvements.

There are other objectives for the ongoing services and optimization phase, including: reducing or maintaining low energy consumption with preventive maintenance, as well as building personnel and occupant training/education; maintaining or reducing energy use and risk with commodity risk, utility bill, and load management; and reducing environmental impact through training and education, awareness programs, and ongoing certification management. Maintaining, measuring, and protecting the financial investment are also core objectives of the ongoing services and optimization phase of the comprehensive energy strategy.

**Measurement & Reporting**

The ongoing services and optimization phase is designed to perpetuate energy and operational savings, and to improve the performance of a given building. Many organizations will rely on software applications and other technologies to deliver continued measurement and reporting. Technology plays a key role in any comprehensive energy strategy, particularly through the measurement and reporting phase but also through continuous data analysis that is used through each of the five phases. By applying technology, companies can help meet savings goals and identify continued improvement measures.

Additionally, the measurement and reporting phase closes the loop to provide feedback that ensures building performance through data monitoring, measurement and verification (M&V), metering, and sub-metering. Measurement and reporting should also monitor energy markets and consumption to mitigate risk and reduce costs. Budgeting and forecasting, utility data and invoice management, and data analysis also play important roles here. The measurement and reporting phase will track actual results to let the facility achieve and maintain goals, key performance indicators (KPIs)\(^1\), and other targets set during the Strategy & Planning and Evaluation & Assessment phases.

Another core objective of this phase is to help ensure environmental performance with reporting, sustainability information systems, and portals that allow the public to monitor a company’s data. By validating and reporting on energy savings, building performance KPIs, and

\(^1\)For example, the number of hot and cold calls per month by air handling system may be one KPI facility engineers track.
sustainability KPIs, the measurement and reporting phase can identify continued improvement opportunities for a facility, helping companies improve competitiveness in today’s market.

**A Comprehensive Energy Approach**

An energy strategy that includes all five phases promotes developing high performing and sustainable buildings. By integrating building commissioning, people, processes and technologies into the five phases, an energy strategy becomes far more impactful. Businesses can achieve maximum energy and operational savings, improve their return on investment, and maximize impact on building performance and sustainability.

**Commissioning Definition**

The definition of commissioning demonstrates how it is an essential part of a comprehensive energy strategy. The BCA defines “commissioning” as the process to ensure that systems are designed, installed, tested, and deemed capable of being operated and maintained according to the owner’s project requirements.

Commissioning is a quality-focused process for optimizing the performance of buildings. According to Mills’ 2011 article in *Energy Efficiency*, “At the highest level, building commissioning brings a holistic perspective to design, construction, and operation that integrates and enhances traditionally separate functions. It does so through a meticulous ‘forensic’ review of a building’s disposition to identify suboptimal situations or malfunctions and the associated opportunities for energy savings.” Mills continues to say that, due to commissioning’s holistic nature, it is fundamentally different than “constructing or retrofitting facilities with better energy using equipment (. . .) [and] complements these relatively familiar practices by ensuring and maintaining building energy performance . . .”

Several solutions and resources are available to assist in the commissioning process, including existing building commissioning, monitoring-based building commissioning, and fault detection and diagnostics (FDD).

**EBCx**

Existing building commissioning optimizes building systems performance according to its current facility requirements. It supplants other evaluation and assessment tools in a comprehensive energy strategy due to its quality-driven process focus. EBCx is a cost-effective tool, regardless of building type, size, age, or location/climate. It provides a thorough assessment of both the supply side and the demand side of the energy equation, but requires the added support from ongoing services and metrics that are inherent in MBCx to be the most effective.

**MBCx**

Monitoring-based commissioning (MBCx) provides a persistence of savings through technology-based analysis of building operations data. MBCx assumes that a building was previously
commissioned as part of the comprehensive energy strategy. Operations that deviate from the “baseline” implemented during an EBCx project are quickly identified and remedied.

**FDD**

Fault detection and diagnostics (FDD) can support EBCx and MBCx by detecting and diagnosing system faults. By using mobile device data collectors, spreadsheets, data loggers, analytic engines, and near real-time dashboard reporting, FDD serves commissioning consultants by collecting data in real time, identifying operational exceptions and issues through analysis of the building data, reducing labor costs, shortening timelines, and generating higher returns on investment to create smart buildings. FDD can be used as a tool during the Evaluation and Assessment phase to increase efficiency of data analysis, during Ongoing Services and Optimization to detect new faults that appear, and as output as part of Monitoring and Reporting.

**Commissioning Offers Many Benefits to Organizations**

By systematically investigating, analyzing, and optimizing building performance, corporations can take advantage of many commissioning benefits, including greater building and occupant comfort, improved employee productivity, and enhanced sustainability efforts.

As seen in Figure 2, building operating costs increase over time. EBCx can generate some relatively quick energy and operational savings by taking corrective actions that reduce energy demand and consumption. But without a holistic commitment to maintaining these corrective actions (which could be identified in a comprehensive energy strategy), building costs can begin to creep upward, sometimes back to their pre-EBCx levels. Adding MBCx to the approach can instead perpetuate savings generated by EBCx, and even generate new energy and operational savings by identifying and implementing new facility improvement measures (FIMs).

EBCx and MBCx require some up-front cost and investment of time and resources, but the cost of these measures will be lower than the value they present to the holistic energy strategy.

Mills also confirms that commissioning must be “well integrated with the rest of the building lifecycle and associated services,” which include “benchmarking performance to identify

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2Smart buildings improve the productivity of people and processes by leveraging technology and actionable information to help companies make their facilities smart, efficient, and sustainable.
baseline performance and savings opportunities, and a monitoring-based paradigm for identifying and quantifying opportunities on an ongoing basis.”

**How Commissioning Fits into a Comprehensive Energy Strategy**

Consider the five phases of an energy strategy: strategy and planning, evaluation and assessment, program implementation, ongoing services, and measurement and reporting. As these phases are both recursive and concurrent, and result in a synergistic approach to building performance, commissioning plays a crucial role throughout each phase.

First and foremost, commissioning identifies both demand and supply side concerns with respect to energy and operational performance. With EBCx, companies can create a strategic approach and plan for building performance, evaluate and assess existing performance, and execute the roadmap for effective implementation, and support the measurement and reporting phase. MBCx supports the implementation phase and provides the insights necessary for ongoing service and measurement.

**Current Options in the Marketplace**

Today’s companies have a variety of options available to help achieve optimal building performance and sustainability. Some provide EBCx, others FDD and MBCx, and still others focus on technological aspects of reporting.

**IT Consultants**

IT consultants have the necessary resources and skills to examine buildings’ IT networks and disparate data sources to help customers implement an IT architecture (network and software) that enables analysis of the data through technology. In recent years, IT consultants have begun adding analysts to examine energy and operations performance to further identify actions that can be taken based on the data. Consultants can provide trending data, analyze it in near real time through established models, and develop protocols for ongoing reporting. Because of their access to resources and skilled professionals, IT consultants can often provide detailed reports in a matter of days.

IT consultants can contribute to the evaluation and assessment, ongoing services and optimization, and measurement and reporting phases of a comprehensive energy strategy. Because their expertise is focused on data, however, they lack the feet on the ground--the people who understand the mechanical and automation systems sufficiently to identify building issues or implement performance improvement programs. In addition, because of the lack of mechanical and automation system knowledge, the analysts are limited in their ability to interpret the data during the evaluation and assessment or ongoing services and optimization phases. Companies that engage IT consultants will have a great amount of easily-accessed data, but will need to determine whether and how to implement the changes required to achieve facility goals. The next steps to executing a comprehensive energy strategy can be relying on already overburdened in-house resources, issuing a request for proposal, or retaining another consultant as project manager or general contractor.
Software Companies

Software companies can develop fault detection and diagnostic protocols for a company’s building systems. These tools can analyze data, determine whether or not each system is operating efficiently, then create a fault for any out-of-range operating states. Gathering information and creating alerts or alarms in this way is a relatively easy process for software companies whose expertise for energy strategy fits well as a tool within the evaluation and assessment, ongoing services and optimization, and measurement and reporting phases of a comprehensive energy strategy. Today’s FDD software leverages advancements in technology such as in-memory analytic engines, distributed cloud computing platform as a service, rich user interface and visualization, and/or mobile accessibility. These technologies enable companies to have information at their fingertips like never before.

Focusing on those aspects of the overall strategy, however, means that software companies must rely on additional third parties with the requisite knowledge of data integration to fully understand what is causing these out-of-range issues. If there is a pumping process fault or deficiency in the air handler operation, as two examples, outside user agencies will need to support software companies in order to interpret the data output to ensure a holistic approach to building performance and sustainability.

FDD comes up short in its inability to analyze the full building, measure building and occupant comfort, and implement solutions; it provides a partial picture. It is also important to note that faults are not necessarily issues. FDD involves rules-based analysis, root cause failure analysis, and automatic failure recognition—all driven by various technologies to make automatic recommendations. Technology must be supported by having the right people in the process loop to finish the analysis, interpret the faults and recommendations, and determine whether or how to move forward.

In-House Efforts

Facility and engineering managers can be an excellent resource for identifying building issues and implementing changes because they are familiar with the building, its systems, and operation. These resources can be inexpensive because these in-house resources are already committed to the building and its operations, and their attention could be diverted toward commissioning activities without incurring additional upfront costs or investments for the company.

Conversely, in-house facility and engineering managers can be biased towards representing the building as operationally efficient due to their inherent interest in protecting their employment status, an effect that can result in missed or overlooked opportunities. Furthermore, facilities engineers and managers may lack the time and resources to implement changes in a timely manner. Depending on managers’ training and experience, they may also lack the full range of expertise necessary to optimize building performance.
Commissioning Providers

Today’s building managers may approach commissioning directly by engaging vendors and partners who specialize in building commissioning. A range of providers is available in the marketplace.

Full-Service Commissioning Partners

Full-service commissioning partners are those whose services and expertise can affect every phase of a comprehensive energy strategy. These partners can provide planning and evaluation, as well as EBCx, MBCx, and FDD when it is appropriate. Full-service partners also have the resources necessary to “walk the floor” and communicate with building personnel to understand where challenges exist, how to overcome them, and then verify improvements through ongoing M&V.

Although this approach to commissioning is the most comprehensive and offers the greatest opportunities to maximize building performance and sustainability, it often requires the greatest up-front investment.

Partial Commissioning

Many commissioning vendors can coordinate with companies to provide the strategy and planning, as well as the evaluation and assessment phases, of a comprehensive energy strategy. These vendors have the bench strength necessary to “kick off” a performance improvement initiative. In these cases, vendors are providing partial commissioning, which can be defined as any commissioning project that involves three or fewer phases of work and falls short of implementing a comprehensive energy strategy.

Partial commissioning is often selected when facilities managers are under pressure to implement performance improvement measures, but are not supported by a strategic plan or roadmap to help ensure successful, effective commissioning. Short-circuiting the strategic planning process means that there is suboptimal investigation completed to help decide how to respond to faults and deficiencies within the building.

There can be a disconnect between the end of investigation and the start of implementation, and most partial commissioning vendors are not equipped to provide the ongoing service and optimization that is a necessary component of continued building performance improvement. Moving into the program implementation phase will require a thorough request for proposal and procurement process to uncover and vet potential vendors—a process that often involves great time and expense, and one that may need to be repeated to find ongoing service providers.

Decentralized Commissioning Approach

Taking a system-by-system approach to commissioning is another option for today’s companies. In this case, there are advantages to relying on an expert for each building system: mechanical service providers, electrical service providers, energy engineers, and so on. Because they
specialize in these systems, these vendors bring dedicated knowledge and expertise to these systems, particularly for the program implementation phase of the overarching energy strategy process.

Taking a decentralized approach means that the company cannot get a holistic view of the building’s performance and sustainability because improvements to each system exist in their own silos throughout the organization. An ongoing, comprehensive view of the building and its systems not only helps integrate information, it keeps all systems operating synergistically over the life of the building. Under a decentralized approach, one system will undergo improvements, but the others may continue degrading. The building as a whole will never reach a harmonious state when taking commissioning on a case-by-case basis.

**Summary of Marketplace Options**

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<th>Option</th>
<th>Advantages/Benefits</th>
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| IT Companies                  | • IT and integration knowledge  
                                | • Provides detailed data ready for trend analysis                                   |
| Software Companies            | • Ease of building fault detection protocols  
                                | • Advanced technology for analysis                                                  |
| In-House Efforts              | • Staff already available  
                                | • Low up-front expense                                                              |
| Full-Service Commissioning Partners | • Services for every phase of comprehensive energy strategy  
                                | • Resources available to gather and analyze data and faults, then recommend strategic solutions  
                                | • Maximum impact on building performance and sustainability                         |
| Partial Commissioning Providers | • Bench strength to kick off investigations relatively quickly                      |
| Decentralized Commissioning Vendors | • Specialized knowledge of specific building systems  
                                | • Effective program implementations                                                 |

Even with a full-service partner and comprehensive energy strategy in place to maximize building performance, the most effective commissioning strategies and processes require guidance from the right people and support from the right technologies. It is a holistic approach that brings the “bigger picture” into focus.
People, Process, and Technology Provide the Best Commissioning Approach for a Comprehensive Energy Strategy

A fragmented approach to commissioning can compromise the long-term health of the building and may in fact create higher long-term costs for the building. It is therefore important to create a baseline and set performance improvement goals. Depending on the building’s existing level of energy-efficiency, age, and use, the commissioning strategy will be comprised of both one-time initiatives and ongoing services; both are designed to reduce energy costs, while enabling continuous performance improvements.

Taken individually, people, processes, and technology all offer advantages for companies looking to commissioning as part of a comprehensive energy strategy. Like any synergistic approach, however, no single element represents a complete solution to a complicated problem.

- **People:** A necessary resource for any building initiative. Facilities need the right resources, trained and available to plan, design, and implement any energy strategy for facility improvement initiatives. It is more than a one-person effort, though; getting the right people means bringing together a team from your own facility, engineering and commissioning resources, controls and mechanical subcontractors, and more. Multiple partners and vendors must work together to effectively implement your energy strategy and commissioning efforts. But even the best team of people will not be enough without the right processes and technology.

- **Process:** A strategic method requiring the right people and technologies. A comprehensive energy strategy involves a multi-phased, recursive process for planning, evaluating, implementing, servicing, and reporting to achieve its core objectives. No single phase can stand alone, and the whole is greater than the sum of its parts. Effective processes still demand the right people and technologies to work efficiently.

- **Technology:** An important tool to be used by people and processes. Technology plays a critical but supporting role in delivering a comprehensive energy strategy, and can help identify specific actions to take. Developing business practices around technological platforms can help companies recognize and take advantage of energy and operational savings, but operational expertise and effective processes are required to make informed decisions and generate results.

Ultimately, the right people, process, and technology will combine to help companies and managers make effective decisions about their energy strategy and commissioning objectives.

**Conclusion**

The best way to maximize energy savings and optimize building performance is to ensure alignment between the building’s primary stakeholders and the technologies and services used as part of the overall energy strategy. Any effective energy management strategy will leverage the combination of a detailed commissioning plan along with the people, processes, and technologies needed to generate impactful and ongoing results. The results are actionable and achievable.
strategic plans, decreased operating costs over the building’s lifecycle, and maximized system and facility efficiency.