

BEYOND

SMART CITIES

**CERTIFIED BUILDING COMMISSIONING
PROFESSIONAL - CBCP EXAM PREP**

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
COMMISSIONING SPECIALIST CURRICULUM

© KRISHNAJI PAWAR

ENERGY ENGINEERING FOR EBCX

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
COMMISSIONING SPECIALIST CURRICULUM

LEARNING OBJECTIVES

Utility Bill Analysis

Energy Engineering Calculation

EBCx Economics

Sample EBCx Project Results

Energy Star Technical Reference Materials

UTILITY BILL ANALYSIS

For EBCx projects that include energy savings/demand reduction components to meet the Owner's fiscal payback metrics, the CxP evaluates the facility's energy use from monthly utility bills and determines the facility's annual energy use intensity (EUI) and compares the EUI to the facilities industry peer group.

- ☑ Ideally, several years of energy data are evaluated in order to establish a trend. The monthly data are plotted in graphs and multiple years overlaid for comparison, creating load profiles. Identify whether energy use is increasing year over year for the same month.
- ☑ Monthly outside air temperature or cooling and heating degree days are also used to normalize or account for variations in the monthly and annual energy use. Demand data are also evaluated through graphing and inordinately large use during unoccupied periods and too early of starts and too late of equipment shut down are identified. Peak demand spikes are also identified and documented for further evaluation during the Investigation Phase.

ENERGY ENGINEERING CALCULATION

Commissioning can be used as a part of the energy management program in several different ways:

- ☑ As a standalone measure. Commissioning is probably most often implemented in existing buildings because it is the most cost-effective step the owner can take to increase the energy efficiency of the building, generally offering a payback under three years, and often 1-2 years.
- ☑ As a follow-up to the retrofit process. Continuous commissioning has often been used to provide additional savings after a successful retrofit and has also been used numerous times to make an under-performing retrofit meet or exceed the original expectations.
- ☑ As an ECM in a retrofit program. The rapid payback that generally results from EBCx may be used to lower the payback of a package of measures to enable inclusion of a desired equipment replacement that has a longer payback in a retrofit package.

EBCX ECONOMICS

We found that building commissioning can play a big and strategic role in reaching larger national goals for saving energy, which could save \$18 billion or more each year. As technologies and applications change and/or become more complex in the effort to capture greater energy savings, the risk of under-performance will rise and the value of building commissioning will increase. Indeed, innovation driven by the desire for increased energy efficiency may itself inadvertently create energy waste if those systems are not designed, implemented, and operated properly.

- ☑ For the commissioning of existing buildings, we found median energy cost savings of 15% [7% to 29% interquartile range, i.e., 25th to 75th percentiles] or \$0.27/ft²/year, and median payback times of 0.7 years [0.2 to 1.7 years]. For new buildings, median commissioning costs were 0.6% [0.3% to 0.9%] of total construction costs, or \$1.00/ft², yielding a median payback time of 4.8 years [1.2 to 16.6 years].
- ☑ These results exclude non-energy impacts. When non-energy impacts are included, cost-effectiveness increases considerably, and the net cost for new buildings is often zero or even negative. Cost-effective results occur across a range of building types, sizes, and pre-commissioning energy intensities.

SAMPLE

Our data collection efforts yielded 224 buildings (175 projects), spanning 21 states and representing 30.4 million square feet of floor area (73 percent in existing buildings and 27 percent in new construction). These projects collectively embody \$17 million (\$2003) of commissioning investment. The new-construction cohort represents \$1.5 billion of total construction costs.

The information represents the work of 18 known commissioning providers (Table 4). The provider is unknown (unreported in our source documents) for 16 percent of existing building project's floor area and for 62 percent of new construction project's floor area.

SAMPLE

Among the existing buildings projects we analyzed, the most common locations were Texas and California, while for new-construction projects the most common locations were Washington, Oregon, and Montana. The median building size was 151,000 square feet for existing buildings (95,101 to 271,650 square feet inter-quartile range, i.e. 25th to 75th percentiles) and 69,500 square feet for new construction (32,268 to 151,000 square feet inter-quartile range).

Except for "religious worship" and "vacant," all of the major building types listed in the US Energy Information Administration's periodic Commercial Buildings Energy Consumption Survey were included in our sample. Not all data elements were available for all projects.

ENERGY STAR TECHNICAL REFERENCE MATERIALS

☑ Commercial buildings all use different mixes of energy, including electricity, natural gas, fuel oil, district steam, and many others. To evaluate the energy performance of these buildings, we have to express all of these different energy types in a single common unit. Source energy is the most equitable unit of evaluation and enables a complete assessment of energy efficiency.

☑ You may be familiar with site energy, the amount of heat and electricity consumed by a building as reflected in utility bills. Site energy may be delivered to a facility in one of two forms. Primary energy is the *raw fuel* that is burned to create heat and electricity, such as natural gas or fuel oil. Secondary energy is the *energy product* created from a raw fuel, such as electricity purchased from the grid or heat received from a district steam system.

ENERGY STAR TECHNICAL REFERENCE MATERIALS



☑ A unit of primary energy and a unit of secondary energy consumed at the site are not directly comparable because one represents raw fuel while the other represents converted fuel. Ultimately, buildings require heat and electricity to operate, and there are always losses associated with generating and delivering this heat and electricity. Source energy traces the heat and electricity requirements of the building back to the raw fuel input, thereby accounting for any losses and enabling a complete thermodynamic assessment.

ENERGY STAR TECHNICAL REFERENCE MATERIALS



Figure 1 – Source-Site Ratios for all Portfolio Manager Energy Meter Types

Energy Type	U.S. Ratio	Canadian Ratio
Electricity (Grid Purchase)	2.80	1.96
Electricity (Onsite Solar or Wind - regardless of REC ownership)	1.00	1.00
Natural Gas	1.05	1.01
Fuel Oil (No. 1,2,4,5,6, Diesel, Kerosene)	1.01	1.01
Propane & Liquid Propane	1.01	1.04
Steam	1.20	1.33
Hot Water	1.20	1.33
Chilled Water	0.91	0.57
Wood	1.00	1.00
Coal/Coke	1.00	1.00
Other	1.00	1.00

BEYOND.
SMART CITIES

THANK
YOU

LEARN.BEYONDSMARTCITIES.IN


