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M&V in Energy Performance Contracting Using ASTM BEPA Methodology

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Introduction

The commercial real estate industry is becoming increasingly aware of how building energy efficiency trends can impact the value of property. Moreover, the advent and growing popularity of building energy benchmarking and disclosure regulations in cities and states around the country[1] is anticipated to become a "game changer," with new negotiating power being placed in the hands of tenants and prospective purchasers. Sub-par building energy performance is already being viewed by some as a deficiency associated with the property, no different than a roof in need of repair or replacement. Studies are beginning to show that a building deemed to have relatively poor energy performance will have higher operating costs and be less valuable.[2] This is one of the principal reasons why property owners, prospective purchasers of commercial real estate, and lenders who provide financing are becoming increasingly concerned about a building's energy performance in their due diligence.[3]

The result has been a growing number of energy retrofit projects designed to increase building energy efficiency. The good news about such energy efficiency retrofits is the excellent project return on investment (ROI) that results from lower energy bills. Moreover, with certain types of financing structures, it is even possible to have an immediate and predictable positive cash flow. This can result, for example, when energy savings more than offset the cost of the energy efficiency retrofit, assuming the project capital cost is financed over an extended period of time. Since commercial building owners put a high premium on cash flow, an ability to make energy efficiency improvements on property with only a minimum, if any, upfront cost, can be especially attractive.

A key to making energy efficiency investment is the ability to project energy savings with a high degree of confidence, and then after the investment is made, verify performance in a technically supportable, consistent and transparent manner. To accomplish this, many energy service companies (ESCOs) rely on the guidance provided in the International Performance Measurement and Verification Protocol (IPMVP) document.[4] The recently published ASTM E 2797-11, Building Energy Performance Assessment (BEPA) Standard,[5] provides a prescriptive data collection and analysis methodology that readily supports the guidance provided in the IPMVP as it pertains to commercial, public and institutional (C/P/I) buildings.

Measurement and Verification Plan

In energy performance contracts with ESCOs, building owners require a guarantee of a specified level of cost savings and performance. They also want this guarantee to be measurable and verifiable in a cost effective, consistent and transparent manner.

A building owner's initial preference might be to hold the ESCO responsible for achieving the energy savings and guaranteed performance under all conditions. However, this clearly is not possible as ESCOs cannot assume responsibility for factors beyond their control. Such factors might include, for example, the weather; the number of hours in which energy savings equipment is used; equipment operation and maintenance practices, including preventive maintenance and repair/replacement (unless the ESCO has this responsibility); how equipment is used, such as the control settings used in an energy management system; building changes that can increase energy use, such as the addition of a data center in an office building; and the number of people occupying the space. On the other hand, ESCOs have little problem accepting responsibility for the performance of the energy savings equipment itself, since they were responsible for its selection, application, design, engineering and installation. As such, in energy performance contracts, project risks and responsibilities need to be allocated between the ESCO and the building owner in a mutually agreeable manner. The Measurement and Verification (M&V) Plan, an integral part of the energy performance contract, prescriptively defines how verification of guaranteed energy savings will be determined in a measurable, verifiable, cost effective, consistent and transparent manner. It is absolutely essential to give investors the confidence to finance energy efficiency retrofits. In fact, the quality of the M&V plan can impact the terms and conditions of the financing. Development of the M&V plan should be a joint exercise between the ESCO and the Owner (and their consultant), and initiated early in the energy auditing process. M&V best practice requires an open dialogue that focuses on realistic targets, with all aspects of the risk allocation being clearly documented.

The IPMVP guidance document presents a framework for developing an M&V Plan and today is generally recognized as the industry best practice standard.

IPMVP

The first edition of the IPMVP, entitled the North American Energy Measurement and Verification Protocol, was published in 1996 under U.S. DOE sponsorship. It was modified in 1997 and renamed the International Performance Measurement and Verification Protocol. In 2002, IPMVP, Inc. was incorporated as an independent non-profit U.S. corporation in order to include the international community and relieve U.S. DOE of its responsibilities as the organizer. In 2004, IPMVP, Inc. was renamed the Efficiency Valuation Organization (EVO), headquartered in Sofia, Bulgaria. EVO now has responsibility for maintaining the IPMVP under a broad coalition of stakeholders and volunteers from around the world.[6] EVO is dedicated to providing tools to quantify the results of energy efficiency projects. To this end, EVO has published the IPMVP (now in its sixth edition since inception in 1996) and the International Energy Efficiency Financing Protocol (IEEFP). Revisions to the IPMVP are targeted every five years.

The IPMVP is a guidance document (not a standard) intended for use by energy professionals as a basis for establishing energy savings (water savings are also addressed in the document). It is a guidance document because rather than prescribing how to perform M&V, it delineates the components and activities that constitute an acceptable plan for M&V in proportion to the level of risk and uncertainty associated with the savings expected from an energy efficiency project. As such, the IPMVP presents a framework and defines terms needed to determine energy savings after implementation of a project. It also specifies the contents of the M&V Plan that must be prepared, adhering to the principles of accuracy, completeness, conservativeness, consistency, relevancy and transparency. It is the responsibility of the user to establish a project-specific M&V Plan that prescriptively addresses the unique characteristics of a particular project.

For ESCOs and building owners, the primary purpose of an M&V Plan is to define the methodology that has to determine verification of performance and verified savings to prove guaranteed actual monetary performance of an energy retrofit project. The M&V Plan becomes part of the energy performance contract, and defines the measurements and calculations to determine payments or demonstrate compliance with the guaranteed level of performance.

IPMVP Framework

The IPMVP's fundamental concept stems from the fact that energy savings cannot be measured directly. Savings effectively are the absence of energy use (or "avoided energy use") that would have occurred without the energy conservation measures (ECMs) installed.

To properly document the impact of ECMs, a baseline energy use profile needs to be established prior to installation of the ECMs. Following installation of the ECMs, this baseline relationship can be used to estimate how much energy would have been used each month had the ECMs not been installed (referred to as the "adjusted baseline energy"). The savings, or "avoided energy use," is the difference between the "adjusted baseline energy" and actual energy use in the "reporting period," i.e., the period of time following implementation of the ECMs when energy savings are to be measured and verified (refer to Figure 2).

The "adjusted baseline energy" is determined from a mathematical model developed for the baseline period that relates actual energy use with appropriate independent variables. Independent variables are defined as parameters expected to change regularly and have a measurable impact on energy use. Common independent variables governing building energy use might include, for example, weather, occupancy (or vacancy) and hours of operation.

Options

The IPMVP provides four options for determining energy savings. These include:

- Option A. Retrofit Isolation: Key Parameter Measurement
- Option B. Retrofit Isolation: All Parameter Measurement
- Option C. Whole Facility
- Option D. Calibrated Simulation

Options A and B focus on the performance of specific ECMs that can be measured in isolation from the rest of the building. In Option A, the key energy use parameter is measured, but other minor effects can be estimated. For example, Option A might include a lighting retrofit, where an electric meter can isolate and measure electricity use for the lighting, but where the relatively minor interactive effect of less cooling in summer and more heating in winter is estimated. Reduced lighting loads will reduce air conditioning energy consumption (a cooling bonus), but increase heating consumption (a heating penalty). In Option B, all parameters necessary to evaluate energy use are measured. This might, for example, be the case with installation of a variable speed drive and controls to a motor, with a power meter installed on the electrical supply to the motor.

Options C and D are used when energy use of the ECMs installed is not easily measured in isolation from the rest of building operations, or there is little measured baseline energy data, among other reasons. The Option C approach assesses savings at the whole facility level by analyzing utility bills before and after implementation of the ECMs. Option C is commonly applied in C/P/I building retrofits when multiple ECMs are installed that often may be interactive. Option D uses computer simulations and building modeling (e.g., U.S. DOE 2.2- based software), usually when base year energy data are not available or reliable. An example might include analysis for a new building, or multiple existing buildings such as might be the situation on a college campus having central utility metering (and no metering at individual buildings).

IPMVP Option C for ECMs in Commercial/Public/Institutional Buildings

For many C/P/I buildings, Option C is usually the most applicable option for energy efficiency retrofits. Typically, not only are there many types of ECMs installed as part of a retrofit project, but the ECMs often involve activities whose individual energy use may be difficult to separately measure and where interactive effects may exist. Moreover, reasonable correlations can generally be found between energy use (the dependent variable) and the independent variables such as heating degree days, cooling degree days, occupancy, building operating hours, etc. Option C specifies that continuous energy use data be collected for complete years in the baseline period, i.e., 12, 24 or 36 months. It is also very important that the baseline period over which data are collected be long enough to provide representative building performance.

Energy Audit

The IPMVP specifies that an energy audit be used to document the building's baseline conditions. Baseline documentation includes identification of the baseline period, collection of energy use data in the baseline period, and collection of independent variable data coinciding with energy use in the baseline period, among other data. The energy audit will typically follow guidelines established by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). ASHRAE Level II or Level III energy audits are commonly relied upon by ESCOs to establish this baseline.

ASTM BEPA Methodology and the Energy Audit

Until recently no consistent standardized methodology existed in energy auditing for the collection and analysis of building energy use data to establish a mathematical regression model baseline. While it may seem relatively straightforward to simply collect utility data, the devil is in the details. For example, prior to the adoption of the ASTM BEPA Standard, there was no standard time period over which building energy use data had to be collected. Energy professionals commonly used anywhere from one to three years. Also, there was no standard on how partial month data collected from a utility should be "calendarized" or converted to a calendar month basis. Some energy professionals used daily averaging, while others utilized complicated weighing factors such as weighting by heating or cooling degree days. If a building had undergone a major renovation, there was no standard on how this should be taken into consideration, if at all. There was not even a standard definition as to what constituted a major renovation. There were no standards on how weather conditions should be analyzed and taken into consideration, how building operating hours should be factored into the analysis, or how building occupancy should be considered.

These and other related issues had generated considerable marketplace confusion and resulted in the commercial real estate industry approaching ASTM in 2009 to develop a standardized methodology. The methodology was developed over two years through the ASTM consensus process by a dedicated Task Group of more than 220 professionals, including engineers, architects, attorneys, real estate investors, owners, managers, bankers, energy equipment manufacturers, software providers, educators, government officials and professional associations. The standard was published in February of 2011 as ASTM Standard E 2797-11 for Building Energy Performance Assessment (commonly referred to as the ASTM BEPA).[5]

The ASTM BEPA established a standardized methodology for the collection, compilation and analysis of building energy use data. As such, use of the methodology fills many of the holes in existing energy audit guidelines. It also complemented existing building rating systems and will facilitate better benchmarking and building performance labeling initiatives by introducing standardization to the data collection and analysis process, thereby enabling a more "apples-to-apples" comparison of building energy use data.

The ASTM BEPA methodology standardized a number of major variables associated with data collection and analysis including:

- *the time frame over which data should be collected* [three years or back to the last "major renovation" if completed in less than three years, with a minimum one year if reliability criteria can be met]
- *the criteria that should be met for collecting reliable building energy use data* [see Table 1]
- *what constitutes a "major renovation"* [defined as a building renovation that either involves expansion (or reduction) of a building's gross floor area by 10% or more or that impacts total building energy use by more than 10%]
- *how partial month data should be calendarized* [by determining average daily energy usage during each partial month covered, and summing the daily average usage over the number of days in the calendar month]
- *what building energy metrics should be used* [energy use in kBtu/yr and kBtu/SF-yr; energy cost in $/yr and $/SF-yr]
- *how building energy use should be normalized* [by gross floor area in square feet and by using the mean value of the statistically evaluated independent variables that impact energy use in the building energy use equation]
- *how the building energy use equation should be determined* [using ordinary least squares regression of monthly energy use data against the associated monthly values of the independent variables that impact building energy use such as heating and cooling degree days, occupancy, building operating hours, etc.]
- *what weather data needs to be collected, over what time period and how it is to be statistically analyzed* [heating degree days and cooling degree days should be collected for a minimum 10 year period from the weather station nearest to the building with historical data available, and statistically analyzed to determine the 25th percentile, mean and 75th percentile values]
- *what constitutes an appropriate range for the building's energy use* [upper and lower limit scenarios are determined based upon 25th percentile and 75th percentile values for the independent variables in the building energy use equation]
- *what the most representative (unbiased) values are for building energy use and energy cost for benchmarking purposes* [the ASTM BEPA standard defines these as the "pro forma building energy use" and "pro forma building energy cost"]

ASTM BEPA Methodology Complements the IPMVP Option C Approach

The IPMVP guidance assigns the user responsibility to establish a project-specific M&V Plan that prescriptively addresses the unique characteristics of a particular project. The ASTM BEPA complements the IPMVP by providing the user with a prescriptive methodology to accomplish this for energy efficiency retrofit projects in C/P/I buildings using Option C for M&V.

A summary of how ASTM BEPA's prescriptive methodology complements the IPMVP is presented in Table 2 and is summarized below.

Principles

The IPMVP identifies the fundamental principles of good M&V as accuracy, completeness, conservativeness, consistency, relevancy and transparency. The ASTM BEPA standard specifically recognizes the importance of consistency, transparency, reasonableness and practicality. The ASTM BEPA also recognizes that uncertainty cannot be eliminated in the analysis and that the scope of work for the investigation cannot be exhaustive. Effectively, the ASTM BEPA strives to balance the competing goals of accuracy and cost, recognizing that if a methodology is designed to provide absolute certainty, the cost will be significant and it will be so complicated that the industry will not likely use it. When ASHRAE Guideline 14-2002,(7) for example, was first published, the industry found it much too onerous (particularly the extremely high restrictions required in evaluating and discussing measurement uncertainties) and consequently the guideline did not find widespread use.(8)

Applicability

While the IPMVP is applicable to all types of facilities, the ASTM BEPA was developed principally for C/P/I buildings undergoing energy efficiency retrofits.

Qualifications

While there are no special qualifications placed on individuals conducting M&V using the IPMVP, the Efficiency Evaluation Organization has a Certified Measurement and Verification Professional (CVMP) program for energy professionals who pass a test demonstrating their knowledge of the IPMVP and have appropriate training and experience. The certification program is conducted in cooperation with the Association of Energy Engineers (AEE).

The ASTM BEPA standard has a specific requirement that the individual performing the BEPA have the education, training and professional experience necessary to conduct the investigation. This is elaborated on in an Appendix to the standard.

Establishing the Baseline

The IPMVP relies on an energy audit to establish the baseline, including collection of energy use data and all independent variable data coinciding with energy use. The IPMVP defines an independent variable as a parameter that is expected to change regularly and have a measurable impact on the energy use of the building. Examples might include degree days or occupancy or building operating hours. Complete years (12, 24 or 36 months) of continuous data (for Option C) need to be collected over a baseline period determined by the professional to be representative. Regression analysis, which correlates energy use to one or more independent variables (impacting energy use) can be used to develop the building model for the baseline.

The ASTM BEPA standard is more prescriptive in establishing the baseline. Thirty-six (36) months of energy use and coinciding independent variable data needs to be collected, or back to the last major renovation (as defined in the ASTM BEPA standard) if completed in less than 36 months, with a minimum of 12 months. These data are then used in regression analysis to develop the building energy use equation. Data reliability criteria are also identified in the standard (refer to Table 1).

Development of the Building Energy Use Equation

The IPMVP identifies regression analysis to correlate energy use with the independent variables and establish a mathematical model for building energy use. The ASTM BEPA is more prescriptive and identifies ordinary least squares regression as the method to establish the building energy use equation. A single equation of whole building energy use as a function of the independent variables can be developed or separate equations for each form of energy use, e.g., electricity and fuel(s), can be used.

Uncertainty Analysis

The IPMVP specifies that the M&V Plan needs to include an evaluation of the expected accuracy associated with measurement, data capture, sampling and analysis. However, for Option C, the energy data are often derived from utility meters, i.e., electricity meters and gas meters, and/or invoices for energy delivered to a building (such as for oil or propane). The IPMVP considers utility meter data as 100% accurate for determining savings because these data define the payment for energy. The uncertainty (or error) is more closely associated with the building energy use equation and represents the difference between observed and true energy use (commonly referred to as "model error"). For C/P/I buildings, error is inherent in the baseline energy use equation for a number of reasons:

(1) Rarely is it possible to identify every independent variable impacting a building's energy use, particularly those activities associated with occupants (such as the open window in conditioned space or the electric heater in a work space).

(2) Some baseline energy use data rely on delivery invoices rather than meters, e.g., fuel oil delivered for heating, which when averaged over the use timeframe may not coincide precisely with actual use.

(3) Utility invoices may include estimates for a specific period.

(4) Electric meters may be misread.

To reflect uncertainty, it is common to express energy savings in conjunction with confidence and precision levels. Confidence level is the probability that the savings will fall within the precision range (or the range in which the true value is expected to occur). [Note: With respect to development of the building energy use equation by regression analysis, there is no universal standard for minimum acceptable coefficient of determination or R^2 (a measure of how well the independent variables explain the variation of the dependent variable). Values of R^2 range from 0 to 1. A value of 0 indicates that the independent variables do not explain any of the variation in the dependent variable (energy use). A value of 1 indicates that the model explains 100% of the variation in the dependent variable. An R^2 value of 0.75 is not considered unreasonable for models built to determine energy use in C/P/I buildings. Notwithstanding, models should not be accepted or rejected solely on the basis of R^2.]

ASTM BEPA methodology allows for error analysis, specifically around the building energy use equation. The error can be represented by the difference between the actual energy use associated with each month in the baseline period and the calculated energy use determined by the building energy use equation that was developed to represent the baseline period. These errors can be statistically analyzed and the standard deviation determined. Once a confidence level, and therefore a precision, is specified, the tolerance around a calculated energy use can be established. For example, if a 95% confidence level is specified, this corresponds to 1.96 standard deviations. Hence, the energy use range around the calculated value at the specified confidence level can be determined.

Uncertainty and risk associated with energy savings can be mitigated directly using energy savings insurance.[10] Such insurance may provide a solution that can facilitate the financing and eliminate underperformance concerns of the building owner.

Energy Cost

The IPMVP identifies that the energy prices used to value the savings need to be specified in the M&V Plan, along with whether and how savings will be adjusted if prices change in the future. The ASTM BEPA provides an averaging methodology to deal with energy pricing, principally because of the different types of energy often used in buildings and the variability of energy pricing structures. As such, the ASTM BEPA determines a building energy cost multiplier ($/kBtu), defined as the total energy cost over the most recent 12 month (pre- or post-ECM installation) period ($/yr) divided by the actual energy use over this same period (kBtu/yr). Hence, if the energy cost was required for a 12 month period post-ECM installation, it would be determined by the product of the actual energy use in the 12 month period post-ECM installation and the building energy cost multiplier for this same period.

Notwithstanding, the M&V Plan must be specific on exactly what energy pricing will be used to determine the energy cost savings. For example, there may be a preference to use marginal rates and stipulated escalation rates, rather than averaged rates as used in ASTM BEPA methodology.

Projecting Building Energy Use and Savings With and Without Planned ECMs

Both the IPMVP and ASTM BEPA use the baseline building energy equation to project energy use (referred to as the "adjusted baseline energy" in the IPMVP) over a future period of time (referred to as the "reporting period" in the IPMVP) assuming the planned ECMs are not installed. The ASTM BEPA methodology would use the mean values of the independent variables to project this energy use each month. For building-related independent variables such as building operating hours and occupancy, the mean would be determined from data collected over the baseline period (36 months). For weather-related independent variables, the ASTM BEPA methodology uses heating degree day and cooling degree day data collected and statistically analyzed over a minimum 10 year period from the nearest weather station to the building having such historical data.

The expected energy use impact (reduction) of each of the planned ECMs must then be determined. This is accomplished by subtracting the expected energy use reduction associated with the ECMs from the energy use that would have existed had the ECMs not been installed. The end result is the expected energy use during the specified "reporting period" assuming the planned ECMs had been installed.

The difference between the "adjusted baseline energy" and the expected energy use assuming the planned ECMs had been installed is the expected energy savings ("avoided energy use"). These may be considered "normalized savings" since they are based on mean values for the independent variables.

Actual Energy Savings With ECMs Installed

After the ECMs are installed, 12 months of actual building energy use data and coinciding actual independent variable data is typically collected to verify performance. According to the IPMVP, this represents the "reporting period measured energy." The difference between the actual measured energy use in this "reporting period" and the calculated "adjusted baseline energy," only now re-calculated using the actual independent variables measured each month in the "reporting period," represents the energy savings (or "avoided energy use"). Uncertainty around the "adjusted baseline energy" can also be factored into the analysis by establishing a confidence level (and therefore the associated precision).

If a "non-routine adjustment" (defined in the IPMVP as an unexpected change that can impact the energy use of the building, such as an increase in building size) occurs in the "reporting period" (post-ECM installation), this would need to be considered in the energy savings determination. This would also hold true with use of the ASTM BEPA.

Summary of Option C M&V Approach Enabled by ASTM BEPA Methodology

To be consistent with the IPMVP Option C for C/P/I buildings undergoing an energy efficiency retrofit, ASTM BEPA methodology can be applied as follows in the M&V Plan:

Pre-ECM Installation

(1) Collect monthly energy use and independent variable parameters in the baseline period (36 months, with a minimum of 12 months if judged representative and reliable);

(2) Collect a minimum of 10 year's weather data from the nearest weather station (having these data) to the building and statistically analyze;

(3) Develop the building energy use equation using ordinary least squares regression;

(4) Use the baseline building energy use equation to project energy use into the "reporting period," only assuming the ECMs have not been installed, and using the *mean* values for the independent variables;

(5) Determine the *net* impact (reduction) on monthly energy use in

the "reporting period" of the planned ECMs (for example, in a lighting upgrade there will be a baseline electricity savings each month, and then, depending on the month (or season), there will be a slight increase in fuel usage in the heating months (due to the lower heat output associated with the more efficient lighting), and a slight decrease in electricity usage in the air conditioning months (again due to the lower heat output associated with the more efficient lighting)

(6) *The difference between the projected energy use had the ECMs not been installed and the projected energy use assuming the planned ECMs have been installed represents the expected energy savings in the reporting period (refer to Figure 1).*

Post-ECM Installation

(1) Collect actual energy use data and actual data associated with the independent variables for each month in the "reporting period";

(2) Again, use the building energy use equation to determine expected energy use in the "reporting period" assuming the ECMs have not been installed, only now using actual values collected in the "reporting period" for the independent variables, and incorporate precision at the specified confidence level to identify an energy use range;

(3) Compare the expected energy use in the "reporting period," assuming the ECMs had not been installed, to the actual energy use in the "reporting period;"

(4) *The difference between the projected energy use had the ECMs not been installed and the actual energy use in the "reporting period" after the ECMs had been installed (factoring in confidence level as appropriate) represents the "verified" energy savings (refer to Figure 2).*

Conclusion

For M&V today, the industry relies on the IPMVP framework. To establish the baseline for building energy use, the IPMVP relies on an energy audit. The energy audit is integral to ECM identification and eventual performance measurement. The ASTM E 2797-11 BEPA Standard's methodology is an integral part of the energy auditing process, filling many of the data collection and analysis shortcomings and tying many of the loose ends in existing guidelines.[9] ASTM BEPA methodology also establishes a technically sound, consistent and fully-transparent mathematical model of baseline energy use (pre-ECM retrofit), facilitates projection of energy savings before actual installation of ECMs, and enables cost effective performance measurement and verification after ECMs are installed. As such, ASTM BEPA methodology complements the IPMVP Option C approach for C/P/I buildings and adds value by providing the necessary depth and prescriptiveness to the pre-ECM and post-ECM evaluation process.

With building energy efficiency fast emerging as another important and fundamental component in the management, acquisition and ongoing operation of commercial and public real estate, an ability to determine energy savings in a reliable, cost effective, technically sound, consistent and transparent manner is expected to help unlock the full potential of monetization opportunities in real estate portfolios.

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Biographies

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Anthony Buonicore is a past president and Fellow Member of the Air & Waste Management Association, a Diplomat in the American Academy of Environmental Engineers, a Qualified Environmental Professional and a licensed professional engineer. He is a member of the ASTM Property Environmental Due Diligence committee, former chairman of its ASTM Phase I Task Group, and currently chairs the ASTM Task Group that developed the U.S. standard for vapor intrusion screening for properties involved in real estate transactions. In addition, Mr. Buonicore is chairman of the ASTM Task Group responsible for developing the new Building Energy Performance Assessment and Disclosure Standard.

Mr. Buonicore has been a leader in the energy-environmental industry since the early 1970s, serving as General Chairman of the American Institute of Chemical Engineers' First National Conference on Energy and the Environment in 1973 and as founder and first chairman of the Air Pollution Control Association's Energy-Environmental Interactions Technical Committee in 1974. He pioneered the use of refuse-derived fuel pellets (a bio-fuel) mixed with coal in stoker-fired boilers and has written extensively on energy and environmental issues.

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Table 1. ASTM E2797-11 QA/QC Criteria Applicable to Building Energy Use Data Collection and Analysis

(1) No "major renovation" (defined as involving expansion (or reduction) of the building's gross floor area by 10% or more, or as impacting total building energy use by more than 10%) should have occurred in the 12 month period over which the data was collected.

(2) Proper calculation of building gross floor area.

(3) Weather normalization based upon at least 10 years of heating degree day and cooling degree day data from the nearest weather station to the building having this historical data.

(4) All non-weather independent variables (such as vacancy rate and building operating hours) collected each month in the 12 month period should be within 15% of the average monthly value determined by statistical analysis of three year's worth of data, assuming the data is available.

(5) Space where a tenant has left but continues to pay the rent in accordance with the lease should be viewed as vacant space.

(6) Partial month energy data should be "calendarized" by determining average daily usage during each partial month covered and summing the daily average usage over the number of days in the calendar month.

(7) (7) Confirmation of building data and characteristics by a qualified professional.

Table 2. ASTM BEPA Methodology Complements the IPMVP Option C Approach

IPMVP		ASTM BEPA	
Principles			
Accuracy, Completeness, Conservative	Consistent, Relevant, Transparent	Reasonable, Consistent, Practical,	Balance competing goals of accuracy and cost, Transparent
Applicability			
Commercial/ Public/ Institutional (C/P/I) Industrial	Options A,B,C,D	Commercial/ Public/ Institutional (C/P/I)	Option C
Qualifications			
None (but have CVMP certification in cooperation with AEE)		Education, training & experience necessary to conduct a BEPA	Elaborated on in Appendix

IPMVP		ASTM BEPA	
Baseline			
Energy use as a function of independent variables	Regression (General)	Reasonable, Consistent, Practical,	Balance competing goals of accuracy and cost, Transparent
Complete years continuous data	12, 24, or 36 months	Commercial/ Public/ Institutional (C/P/I)	Option C
Data Collection			
Little said			Very Specific
Independent Variables			
General	No specifics for data collection		Specific

IPMVP		ASTM BEPA	
Projecting Energy Use			
Building energy use equation	General analysis	Building energy use equation	Detailed analysis
Verifying Energy Savings			
"adjusted baseline energy use" minus actual energy use		Follows IPMVP	
Uncertainty Analysis			
Must be factored in		Can easily be factored in	

Figure 1. Presentation of Expected Energy Savings Before Installation of ECMs

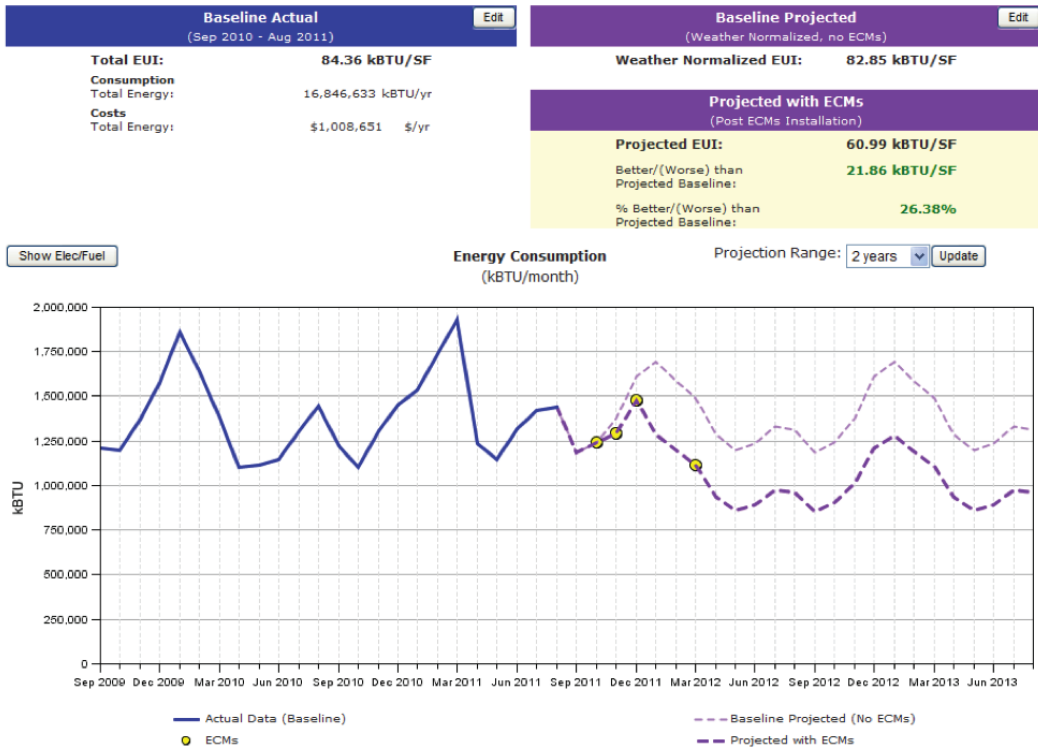
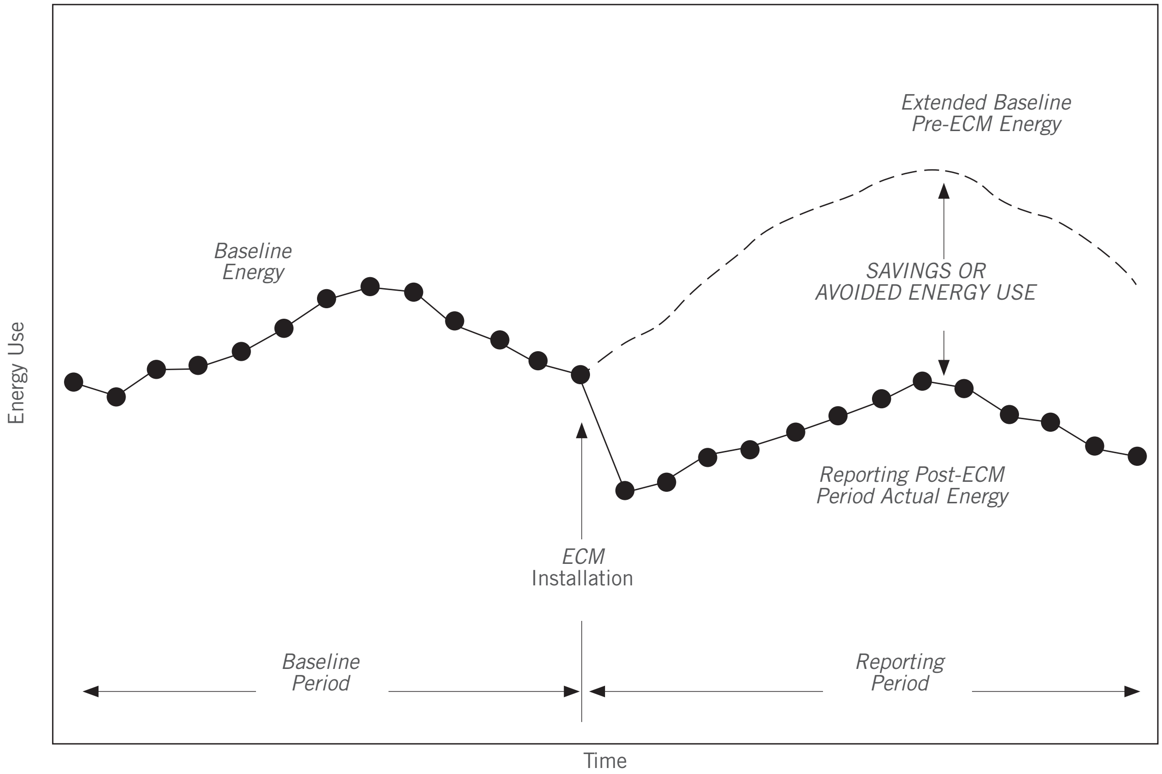


Figure 2. Presentation of Energy Savings After Installation of ECMs.



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SRS delivers Sustainable Real Estate Manager® an Internet-based, software-as-a-service workflow platform enabling building owners, operators, investors, lenders, tenants and consultants assess, benchmark and optimize the energy and sustainability performance of their properties.

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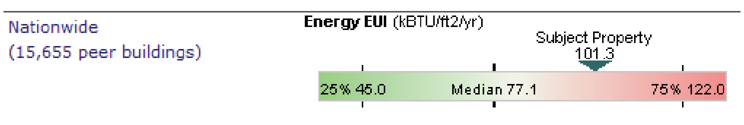
Sustainable Real Estate Manager® (SRM) seamlessly integrates leading industry standards, benchmark and rating system protocols with proprietary data and workflow automation enabling the capture of your energy and sustainability-related opportunities.

The SRM guided workflow solution has reinvented industry best practice methodology for building energy efficiency benchmarking with its Peer Building Benchmarking™ database, encompassing 120,000 buildings across 15 property types, 3.3 billion square feet, over $7.8 billion in annual energy costs and $635 million in annual water/sewer costs.



The SRM workflow 'wizard' facilitates the comparison of your subject property's energy and water key performance indicators to its peer group's performance across multiple geographic areas resulting in unparalleled visibility to performance assessment and benchmarking analytics.

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