

Making LEED® Work for You

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Synopsis

While many Architects and Engineers design buildings with sustainable features, post-occupancy data that provides measurable results on the effectiveness of the design are usually absent. A strong disconnect exist between the design intent and the actual building's operation and performance.

A recent global survey of buildings energy codes found that the majority were ineffective because of limited or non existent enforcement¹. Similarly, Green labels only mean that buildings have the “potential” to be efficient or “green,” but most LEED® certified buildings or buildings designed to comply or exceed energy code requirements may or may not function efficiently or meet the forecasted energy consumption targets after occupancy has taken place.

Since sustainability is often measured in terms of economic returns as well as environmental benefits, when buildings fail to achieve their energy (or green) targets, they also fail to provide the promised financial paybacks.

Two case studies, one of a new construction project aspiring to achieve LEED® silver rating and the another a retro-commissioning project performed on four LEED® certified buildings served by a common central plant one year after certification, are presented to attest how rated buildings often fail to deliver the set targets.

This paper provides information and recommendations for building owners who are serious about sustainability, and what their roles should be in order to maximize the effectiveness of the commissioning process. Additionally the paper provides ideas for making the LEED® rating system more credible and effective in influencing how buildings will perform after occupancy.

About the Author

Rick Lasser has more than 20 years of engineering experience in the design and construction industries. Rick has led the Arup Controls and Commissioning Group for the past six years.

Rick participated in the design and construction of several Landmarks in the Los Angeles area, notably, the Getty Centre, The Disney Concert Hall, and Hollywood & Highland/Kodak Theatre and the New San Francisco Federal Office Building where Mr. Lasser developed the sequence of operation and participated in the commissioning of the Natural Ventilation System.

Rick is a specialist in the design and commissioning of Building Automation and Smoke Control Systems.

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Introduction

The objective of this paper is to raise awareness on the important role that building owners play in the success of the commissioning process as it is not enough for an owner to hire or pay for commissioning in order to get the expected results.

This is demonstrated with two case studies. In both case studies commissioning was originally pursued to secure a LEED® rating on the project.

The first case study consists of a new construction project at a college campus in Southern California. The district's board of trustees hired a program manager who then hired a project manager. The project manager hired a design team and later a construction team. The board of trustees mandated that all new construction projects shall receive a LEED® certification as a minimum. In order to comply with LEED® certification requirements, the commissioning authority was hired by the program manager and contracted to the district directly. The commissioning authority was instructed to interact with the project manager who was designated as the "owner's representative." The commissioning scope for this project included, in addition to the standard LEED® prerequisite, the "Enhanced Commissioning point."

The second case study consists of the retro-commissioning of eight newly purchased buildings that the owner had occupied for several years in the San Diego area. To make the company more profitable, the owner was seeking a reduction in operating cost, and understood the simple concept that "saving energy = more money in the bank". Four of the buildings retro-commissioned were recently commissioned per LEED® certification requirements.

Case Studies

Case Study #1: LEED® Commissioning for Maintenance & Operations Building and Sheriff Station

The Maintenance & Operations Building and Sheriff Station consists of three wings, grouped about a central service yard. The maintenance wing consists of offices, shops and storage; the operations wing consists of offices, and meeting rooms, and the sheriff station consists of a reception area, offices, interview rooms, meeting rooms and an armory.

The total floor area is approximately 26,792 gross square feet. Maintenance is 86% of the GSF, (23,089 GSF). Operations are 5% of the GSF, (1,250 GSF). The sheriff's station is 9% of the GSF, (2,453 GSF).

To put it in perspective, the new version of LEED® (V2.2) for Energy and Atmosphere Prerequisite 1, "Fundamental Commissioning of the Building Energy Systems", would categorize this project as a small building (under 50,000 square feet) and would not require that commissioning be carried out by an independent third party commissioning authority.

Issues Identified During the Design Phase

Per the requirements of LEED® V 2.1, Energy and Atmosphere Credit 3, "Additional Commissioning", two design reviews were performed on the design team's submittals. LEED®

requires that one review be performed prior to starting the construction documents phase and another review at near completion of the construction documents and prior to issuing the contract documents for construction. The first review was performed on the 100% design Documents and another review performed on the 95% construction documents. The following are the key issues identified by the review process:

Commercial vs. Residential Roof Top Units

In order to comply with LEED[®] requirements for Energy & Atmosphere Credit 4, HVAC equipment had to be free of HCFCs. Unaware that commercial roof top packaged units (DX units) were available with the required refrigerant, the design team selected residential grade roof top packaged units with R410a refrigerant. We recommended changing the specified residential roof top packaged units with available commercial units.

The commercial units, although slightly more expensive (\$4,385 total additional cost for eleven units) as a first cost, were cheaper when considering life cycle cost. Also, these units are built to accommodate MERV 13 filters, required by LEED[®] Indoor Environmental Quality Credit 3.1 targeted by the design team. The commercial unit's design also allowed easier access to components for maintenance and repair.

More importantly the recommended commercial units have a Seasonal Energy Efficiency Ratio (SEER) of 14 vs. an SEER of 12 of the previously selected residential units. This saves the college approximately \$1500/year. For the 15 years estimated usable life of the units², the additional energy cost to the college is \$22,500 (approximately five times the cost of upgrading from residential to commercial units). In summary, the commercial units "added value" to the project.

Hydrogen Detection System

To comply with code requirements related to charging station for vented batteries, a hydrogen detection and purge system was designed and specified for each workshop in the maintenance wing of the building. Each system was comprised of an exhaust fan, a motorized make-up air louver, hydrogen detectors installed and spaced similar to smoke detectors, local and remote audible and visual annunciation and a control panel with all relays, power supplies and other switches required to make the complete system function.

A total of seven systems were designed at a cost of approximately \$50,000 for mechanical and electrical installations only. The added architectural and structural costs not mentioned would include the cost of framing the roof openings for fans and dampers, roof curbs, waterproofing and others.

The Owner's Project Requirements (OPR) documentation prepared by the architect and his engineering team and the Basis of Design provided at a late stage in the project did not include any information regarding these systems except that "a hydrogen detection system was provided."

The purpose and need for the Hydrogen detection was clarified much later and the rationale behind having seven systems instead of one was explained. The facilities personnel were using electric carts to move around the college grounds. The carts were powered by vented batteries

² ASHRE Handbook – HVAC Applications Table 3 Ch. 36.

and every technician wanted to park and charge his electric cart in his own shop everyday, after hours.

The first suggestion to the college was to park the carts in a single, central location. This suggestion was met with great resistance, and not deemed acceptable by the users. The next recommendation was the replacement of the vented batteries with sealed batteries. The sealed batteries would not require the hydrogen detection system. Although the sealed batteries require more frequent charging this was not assumed to be an issue due to the small usage expected at the college. The cost for replacing the vented batteries with sealed batteries was estimated at a total of \$8,400. This seemed an option worth considering since the total cost of installing the hydrogen detection systems would be in excess of \$50,000.

Campus Chilled Water vs. DX Units

As part of the campus-wide improvements, money was set aside to expand and upgrade the existing central plant for the new buildings. It seemed appropriate then to connect the M&O building to the campus chilled water and hot water loops instead of providing roof top packaged DX units. Typically, the DX units have a higher temperature fluctuation, lower efficiency and are more expensive to maintain in comparison to chilled water units. The life cycle costing for this option was performed for a one on one replacement of the thirteen DX units showing a payback period of approximately 6 years.

Natural Ventilation

Each maintenance shop had a roll up door. The installation of a door switch was recommended in order to positively shut down the air conditioning units serving each shop when the shop door was open, hence avoiding energy waste. The door switch would be wired as an input (DI) to the DDC controller dedicated to the unit. When the door is open (open contact) the controller would shut down the units. The BAS operator would know that the units were OFF because the door was open.

Economizers

Malfunctioning economizers can be an energy drain instead of energy savers³. In hot inland regions such as California's Central Valley, a worst case scenario, for instance, is that a failed economizer might cause a total annual electric consumption to increase by nearly 50%. If it had worked as intended, it may have saved 5% of the annual building electrical consumption⁴.

The thirteen roof top packaged units for the M&O building were specified with an economizer. For eleven of the thirteen units, the economizer was specified from a separate manufacturer, and shipped as a self contained sheet metal, damper, controller actuator and sensors package and attached to the DX units on the job site.

The OPR stated that the roof top packaged units should be controlled by the campus Direct Digital Control (DDC) system (the programmable thermostats, normally provided with the packaged units will be replaced with a standalone programmable DDC controller). However, there was no mention of the economizer's control. Typically, the economizer for these types of units would be controlled by the controller and sensors shipped with the economizer by the

³ Guideline for Energy Efficient Commercial Unitary HVAC Systems – White Paper prepared for Consortium for Energy Efficiency, Inc. (CEE) Boston MA.

⁴ Energy Design Resources – Design Brief - Economizers

economizer kit manufacturer. With this type of systems, economizer failures often go undetected due to the lack of monitoring and poor quality of the economizer components and sensors.

Several studies conducted in the Pacific Northwest and California revealed that economizers failed or required adjustments on an average of 64% of the units⁵. This was due to various reasons including failed sensors (snap discs typically with an accuracy of $\pm 5^{\circ}\text{F}$) that cannot be calibrated or adjusted.

It was recommended that the economizers controlled using the DDC and low cost temperature switches (snap discs) provided with the units be replaced with temperature sensors that can be checked, calibrated and monitored by the DDC system. Measurements of outside air temperature, return air, mixed air, supply air temperature and damper's position would allow more reliable operation and most importantly the ability to constantly monitor the economizer's performance and make adjustments and repairs as needed.

In addition, this arrangement would also allow for expanding the economizer operation by several hours everyday. The snap discs provided with the economizer package restricts the economizer operations by disabling it whenever outside air temperature rose above $70^{\circ}\text{F} \pm 5^{\circ}\text{F}$ and enabling it again when the temperature dropped below $60^{\circ}\text{F} \pm 5^{\circ}\text{F}$. Using the DDC sensors would allow for sequence and set points to be user defined and the DDC temperature sensors are far more accurate and reliable than the snap discs.

Smoke vs. Heat detectors

To comply with the district's requirement, full coverage area smoke detection was provided in all spaces including maintenance shops. For the wood shop and welding shop as well as the automotive shop, it was recommended substituting the smoke detectors with heat detectors. Smoke detectors installed in these spaces would cause false alarms and would require extensive maintenance.

Lighting Control System

Review of the design drawings indicated that the lighting control system specified did not meet the owner's project requirements. The system required had to be integrated with the Building Automation System (BAS). The lighting control system shown on the documents was a standalone proprietary system with no connection to the BAS. Also, some mechanical time clocks were specified for the yard and perimeter lighting control.

We recommended the elimination of the mechanical clocks and the use of the lighting control system to control the yard and perimeter lighting. We also provided information on the system that would meet the owner's project requirements, i.e., using the same language (BACnet) as the BAS and therefore "integratable" with the BAS.

DDC System Wiring Diagrams

The DDC system design, including the sequence of operations, was prepared by a DDC system contractor and copied onto the construction documents by the engineer. The design information consisted of incomplete wiring diagrams and a canned incomplete sequence with little or no

⁵ Review of Recent Commercial Roof Top Unit Field Studies in the Pacific Northwest and California - New Buildings Institute.

relevance to the project. This would most likely generate change orders and/or result in a system that would not meet the OPR.

We recommended replacing the wiring diagrams by process & instrumentation diagrams (P&ID) showing the required scope and a point list. We prepared a sample diagram and sequences for the engineer to use at his discretion.

Metering

No metering was provided for the building. The utilities were measured at a central campus location. We recommended that an electrical meter be provided to measure and trend the building's electrical consumption. We also recommended metering the water and gas service and connecting the photovoltaic array meter to the BAS system for metering and trending

Case Study #2: Retro-Commissioning at a Pharmaceutical Company Research & Development Campus

The pharmaceutical company being described here owns nine buildings on campus, CB-1 to CB-8 and CB-10. Campus building CB-10 is currently being renovated while campus building CB-9 is planned for future construction.

Previously, the pharmaceutical company leased these buildings, which sit on a 33-acre site in Southern California. The company employs more than 1,500 scientists and support staff.

The campus improvements consisted of approximately one million square feet of laboratory and office space. Each building is split between office and support areas and laboratories with fume hoods, and other lab equipment. CB-8 is the only exception as this building is comprised of 100% office space. Additionally, within CB-4, there is a staff restaurant and kitchen, a company store and fitness center for employees, a Vivarium and a subterranean garage.

Buildings CB-4 to CB-7 are served by a common central plant, with chillers located in the basement of CB-4 and the cooling tower located towards the back of the building. All other buildings are self contained each with its own central plant consisting of chiller, boilers, cooling towers and associated pumps. The only exception is CB-8, which has two air cooled chillers.

The buildings were designed and constructed by the same design and construction firms. This provided a welcomed level of consistency between the different buildings in regards to design philosophy, type of systems used, equipment selection and operation.

With the exception of CB-8, each building is divided into zones. Each zone consists of labs, offices and support spaces occupying approximately 50% of the floor area. Each zone is served by a 100% outside air air handling unit and a set of laboratory exhaust fans. Labs, offices and support spaces are all connected to the same supply and exhaust systems.

The advantage for retro-commissioning this particular project was that the opportunities found in one building could be carried out to all other buildings. The disadvantage for the owner is that the issues identified in one building likely occurred at all the other buildings as well.

High quality equipment was selected and installed, including chillers, pumps, boilers, air handlers and fans. All equipment and installations were relatively new and were found to be in good condition.

Buildings CB-4 to CB-7 received recognition from the United States Green Building Council (USGBC) with a Leadership in Energy and Environmental and Design (LEED®) certification, in October of 2004, approximately six month before the start of the retro-commissioning process.

The purpose of the paper is not to describe in detail all the technical aspects of the retro-commissioning work or the energy conservation measures recommended and implemented on campus but to describe the opportunities for improvement that existed and the success of the project in achieving the owner’s goal, of reducing campus-wide energy consumption.

The majority of the energy conservation measures (ECMs) identified consisted of reprogramming the building automation system (BAS) with an improved sequence of operations and revised set points. For the measures that involve physical modifications and/or field measurements and testing, the work required was minimal in comparison to the energy savings that would be achieved after implementation.

Energy Conservation Measures Identified by the Retro-Commissioning Process.

ECM-1: Condenser Water Setpoint

Observed Operation	Energy Conservation Measure
<p>The cooling towers (both cells), were enabled to run regardless of the number of chillers in operation. In addition, cooling tower fans ran at full speed most of time trying to satisfy an unachievable condenser water temperature set point. Based on the cooling tower theory of operation, the condenser supply water temperature cannot be lower than the outside air wet bulb temperature plus the cooling tower approach (11°F based on the cooling tower design parameters installed on campus).</p> <p>At time of observation the condenser water temperature set point was set at 57°F while the current outside air wet bulb temperature was 58.9°F.</p>	<p>Match cooling tower operation with chiller operation. i.e., when one chiller is running, only one cooling tower is enabled.</p> <p>Reset condenser water temperature based on outside air wet bulb and cooling tower approach.</p> <p>For the condition observed, the set point should be: Wet bulb temperature (58.9°F) + 11°F = Set point (69.9° F).</p>

ECM-2: Hot Water System Design

Observed Operation	Energy Conservation Measure
The typical hot water system included 3	Convert the hot water system to constant

<p>boilers, two boilers of the same size and the third smaller for reduced demand operation. The system is configured as a constant flow primary only system with a mixture of 3-way and two way valves controlling air handler's and terminal boxes re-heat coils.</p> <p>The amount of flow being bypassed is high enough to require two pumps and two boilers operational all times.</p> <p>Temperature difference (Δt) between supply and return water temperatures almost never reached design conditions and at times reached as low as 4°F indicating a small building load easily satisfied by only one boiler, the small one.</p>	<p>flow primary, variable flow secondary arrangement by installing a bypass (de-coupler) with a pressure control valve between the supply and return lines and converting the 3-way re-heat coil control valves to two way valves.</p> <p>This will allow the proper staging of boilers and a wider temperature difference (Δt) between supply and return water temperatures thus increasing overall system efficiency and reducing gas consumption and pumping energy.</p>
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ECM-3: Chilled Water System Sequence of Operations

Observed Operation	Energy Conservation Measure
<p>The chilled water system is a conventional constant flow primary, variable flow secondary system, was suffering from an acute case of low Δt syndrome caused by improper staging of chillers and 3-way valves installed in the secondary loop.</p>	<p>Convert 3-way valves to two way valves and install a flow meter in the primary loop in addition to the flow meter already installed in the secondary loop.</p> <p>Review chilled water valves authority and replace low authority valves as required.</p> <p>Revise sequence of operations and use primary and secondary loops flow sensors to prevent reverse flow in the de-coupler and allow for proper staging of the chillers based on flow measurements, matching building loads with the proper number of chillers.</p>

ECM-4: Constant Volume vs. Variable Volume Operation

Observed Operation	Energy Conservation Measure
<p>Intermediate Distribution Frame (IDF) rooms as well as some office spaces are served by Constant Volume Terminal Boxes with reheat coils.</p> <p>This contributes to increase fan energy to deliver additional air quantities and increase in the heating energy to re-heat cold supply</p>	<p>Changing the operation of the terminal boxes from Constant Volume with reheat to Variable Volume with reheat would reduce air flow requirements when space loads can be satisfied with reduced air volume</p>

air.

ECM-5: Support Areas Space Temperature

Observed Operation.	Energy Conservation Measure.
<p>Support areas like IDF rooms, Electrical and Mechanical rooms as well as Storage rooms are ventilated by terminal boxes with re-heat coils set to maintain a space temperature set point of 72°F ±0.5°F</p>	<p>IDF rooms, Electrical and Mechanical rooms as well as Storage rooms are considered unoccupied areas and typically never require heating specially when located in the interior zone of the building and when the air conditioning systems are running continuously.</p> <p>Increasing space temperature set point to 80°F would reduce air flow requirements and save fan energy. The hot water coils should be locked-out.</p>

ECM-6: Occupied Spaces Temperature Setpoint

Observed Operation.	Energy Conservation Measure.
<p>Occupied space temperature set points for offices and laboratories were set at 72°F with virtually no dead band (±0.5°F).</p>	<p>Increasing the dead band between heating and cooling set points to 5°F as required by California T-24 Energy Conservation Code would reduce heating and cooling energy to a minimum when the space temperature is within the dead band region. Set point should be set at 72°F ± 2.5°F</p>

ECM-7: Un-occupied Spaces Temperature Set Point

Observed Operation.	Energy Conservation Measure.
<p>Due to the laboratories pressurization requirements, the air systems (supply and exhaust) run continuously.</p> <p>Unoccupied mode space temperature set point was set unnecessarily at 72°F ± 0.5°F same as for occupied mode.</p>	<p>During unoccupied hours, air flow supplied to the spaces can be reduced by widening the temperature sensor dead band. The recommended set point is 65°F for heating and 80°F for cooling or a dead band of 10°F.</p> <p>Also, air flow to office and support areas (except for IDF and mechanical and electrical rooms) could be completely cut-off during the night and on weekends.</p> <p>In addition to air flow, reduction in cooling and/or heating load on the central plant is</p>

reduced.

ECM-8: Supply Air Static Pressure Setpoint

Observed Operation.	Energy Conservation Measure.
<p>The air handling unit static set points are currently set to maintain 1.5" wg static pressure 2/3 way down the supply system. The setpoint of 1.5"wg appears to be too high. Too much pressure is being generated by the fan and this excess pressure will have to be taken out by the VAV boxes and laboratory Air Valves.</p>	<p>Typically a set point of 0.6" for laboratory control air valves and 0.4" for terminal boxes is all that is required to operate the valves and boxes per the manufacturer's recommendations. If the ductworks is sized, and most importantly installed properly, the static pressure set point can be reduced from 1.5" to 1". Per the fan laws, pressure varies with the square of the speed ration and power varies with the cube of the speed ratio. This is a significant reduction in fan power.</p>

ECM-9: Exhaust Air Static Pressure Setpoint

Observed Operation.	Energy Conservation Measure
<p>The exhaust fans static pressure set points are currently set to maintain -1.5" wg static pressure 2/3 way down the supply system. The setpoint of 1.5"wg appears to be too high. Too much pressure is being generated by the fan and this excess pressure will have to be taken out by the VAV boxes and Laboratory Air Valves.</p>	<p>Typically a set point of 0.6" for laboratory control air valves and 0.4" for terminal boxes is all that is required to operate the valves and boxes per the manufacturer's recommendations. If the ductworks is sized, and most importantly installed properly, the static pressure set point can be reduced from -1.5" to -1". This is a significant reduction in fan power.</p>

Conclusion

In case study #1, with the exception of the door switches used to disable the Roof Top Units when the maintenance shops rollup doors are open, none of the recommendations were implemented. The smoke detectors were changed to heat detectors and the electrical meter was installed towards the end of the project with a change order.

Case study #2 proves that matching an interested and committed owner with a competent commissioning provider will produce results. At time of writing this paper, ECMs 4, 5, 6, 7, 8, and 9 were implemented and energy savings of approximately \$1,023,913 annually was verified by a third party. Payback period is estimated at less than a year.

It is not enough for an owner to hire or pay for commissioning in order to get the expected results. Building owners seeking return on investment should engage in the commissioning process and demonstrate their understanding and commitment in order to attract competent commissioning providers for their jobs and reap the benefits set forth.

In case study #1, the owner was not engaged in the process and left the decision making with a project manager for whom, the commissioning process was a mandated-from-above process. For the project manager, the commissioning process was seen as an obstacle only tolerated with the goal to complete the project on schedule, within budget, and with the rewarded “plaque” at the end of the project.

The two case studies can also be used to demonstrate the importance of design phase commissioning. It is important to note that in case #2, the four LEED® certified buildings the commissioning process was implemented during the design phase (EA Credit 3 “Additional Commissioning” was not pursued). Almost all the ECMs in case study #2 could have been addressed during the design phase.

To LEED® or not to LEAD

As mentioned earlier in the paper, in case study #2, four of the buildings retro-commissioned on campus were commissioned as part of the LEED® requirements. This helped the buildings to achieve recognition and be awarded the LEED® plaque. Building materials with recycled contents were used, a bike rack was installed, a bus stop was located nearby, charging stations for electrical carts used on campus by the facilities personnel made available, low emitting material were selected (carpets and adhesives) and a few other points requiring paperwork were secured. It is unknown to us what the motivation was behind pursuing LEED® certification for these buildings, but if it was for marketing purposes, the effort was successful.

It was only when the pharmaceutical company decided to purchase the buildings from the developers, that a mandate to conserve energy and reduce operating costs were adopted as company policy. Only then the energy efficiency promoted and targeted by LEED® was finally achieved.

The Cost of Not Commissioning

To simplify the calculations, if we assume, in theory, that the \$1,023,913 in annual energy savings was equally divided between the eight buildings retro-commissioned (\$128,000 approximately per building), per year, the total amount of money that would have been saved if the buildings were properly commissioned and operating as they should from day one, is as follows:

Table 1: Estimated cost of not commissioning

Building	Occupancy date	Month in operation before ECM implementation	Calculations \$128,000/12 = \$10,666.6 per month	Unnecessary Energy Cost @ \$128,000 per year
CB-1	20-Nov-99	78	78 month X \$10,666.6	\$832,000
CB-2	26-Sep-01	57	57 month X \$10,666.6	\$608,000

Building	Occupancy date	Month in operation before ECM implementation	Calculations \$128,000/12 = \$10,666.6 per month	Unnecessary Energy Cost @ \$128,000 per year
CB-3	10-Dec-01	54	54 month X \$10,666.6	\$576,000
CB-4	12-Sep-03	33	33 month X \$10,666.6	\$352,000
CB-5	20-Oct-03	32	32 month X \$10,666.6	\$341,333
CB-6	29-Jan-04	29	29 month X \$10,666.6	\$309,333
CB-7	13-Feb-04	29	29 month X \$10,666.6	\$309,333
CB-8	28-Jun-02	48	48 month X \$10,666.6	\$512,000
Total:				\$3,840,000

Not all of the savings that could have been realized during design can be duplicated during retro-commissioning. In the case of the pharmaceutical company, several energy conservation opportunities were identified but not pursued due to cost or feasibility. For example:

- 1- A better performing glazing system could have been selected.
- 2- Return air from offices could have been used to reduce the amount of outside air required.
- 3- Heat recovery from the exhaust system could have been used to preheat or pre-cool the outside air.

In the case of the M&O building, from case study #1, capital was available for new construction or renovation projects only. It is unlikely that that any repairs, modifications or improvements to the building would be implemented after the fact. And even if funds were available, replacing the residential A/C units with commercial A/C units, for example, would not be an ECM option until the end of the unit's life cycle.

What could be done?

As currently structured and practiced, the LEED[®] rating system is based on two types of sustainable features: Those that can be easily proven, such as recyclable materials and low VOC content finishes, and those features based on theoretical models such as energy performance that cannot be guaranteed.

In existing building commissioning, some of the opportunities that exist in new construction cannot be duplicated. For example, installing bamboo flooring in a new construction project would not make sense for an existing building. Ripping out the existing wood flooring and replacing it with bamboo flooring would defeat the purpose. Therefore LEED[®] for new construction should be pushed to the maximum, and awarded on this basis.

However, it should not be enough for a newly constructed building to achieve a LEED[®] rating for new construction before Measurement and Verification is performed. This can be done with consumption data available from the buildings metering data in conjunction with utility bills to

evaluate the buildings performance after occupancy. The hope is that the energy efficiency features would not be the first to be “Value Engineered Out” of a project in favor of upgraded finishes and that commissioning would be taken more seriously.

Therefore, in order to keep the achieved LEED® rating, some provisions of the LEED® for existing buildings should be required a year or two after occupancy. Otherwise, the building should lose its certification and the plaque installed at the entrance of the building be removed.

Also, LEED® would benefit in putting more emphasis on energy related points. Achieving only one point for Enhanced Commissioning, as for adding a bicycle rack, sends a questionable message. For committed bicycle users, the lack of a designated “secure bicycle rack” does not cause a deterrent effect. However, the reverse is also false, that the availability of a “secured bicycle rack” by itself, encourages people to ride their bicycles to work. Enhanced Commissioning adds a value to the building that may be many times not visible from the outside, but more often than not, is beneficiary to all building occupants, regardless.