Persistent Commissioning, Persistent Value

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ABSTRACT

This case study showcases the energy savings, operational insights, and continuous economic benefits that end-use customers realize by employing persistent commissioning (PCx) tools and practices through a strategic utility program. EnerNOC and Pacific Gas and Electric Company (PG&E) collaboratively developed and deployed an energy efficiency incentive program targeting commercial real estate and high-tech office customers. The program employs a combination of monitoring based commissioning (MBCx) tools, diagnostic software, and O&M best practices which enable customers to make intelligent energy management choices and ensure persistent savings. PG&E's MBCx Program funds EnerNOC to provide both a software as a service (SaaS) platform, called EfficiencySMART™, and MBCx engineering services for a full twelve months at no cost to the customer, based on installed energy savings. Thus far, the program identified over 3million kWh, 150 kW, and 200,000 therms in savings. One third of the savings is currently installed and the remainder is expected to complete within the next year.

INTRODUCTION

Energy Efficiency (EE) is implemented in many ways, addresses both isolated and integrated systems, and requires varying levels of investment in order to properly deliver and assure savings. The key to robust EE implementation is reliable and replicable opportunity identification and measurement and verification (M&V). The M&V tends to be, however, one of the biggest challenges for both customers and implementers. Without a reliable mechanism for quantifying these improvement opportunities throughout complex building systems, decisions makers will continue to discount the value in comprehensive and persistent energy efficiency business practices.

In order to take a truly strategic approach to EE as an institutionalized and reliable business practice, the decision makers controlling operations and maintenance (O&M) and capital budgets need to view EE as a standard line item in their ledgers. This means treating them the same way they do insurance costs, internet services, and of course, their utility bill. One of the most frequent responses from a building manager, energy manager, or chief engineer to a proposal for an EE project is "we just don't have the money". Additionally, there is often the unaddressed issue of how much money is left on the table, in the form of energy savings and utility incentives, by failing to do the project. This frequent deficit of quantitative insight is the target of the PG&E MBCx incentive program which is built around EnerNOC's platform and its ability to analyze utility spend, develop energy use baselines, identify EE opportunities, monitor the resultant savings, and keep customers engaged on an ongoing basis. This powerful combination of utility incentives and computing analytics drives the immediate need to address a building's current maladies as well as preventive building care.

PROJECT RESULTS

The use of a medical metaphor is a very apt in this case study on MBCx/PCx. It is indeed a happy coincidence that the short hand for a doctor's prescription is Rx and thus very similar to the abbreviation for retro-commissioning (RCx). The subject, or patient, here is a PG&E customer and a sizable commercial real estate campus of nineteen low rise office buildings (1.15 million GSF) in the southeastern part of the San Francisco Bay Area, Climate Zone 4. This zone is characterized by

clearly defined seasons with cool but not cold winters and warm to hot, dry summers.

EnerNOC performed an energy audit on this campus in early April of 2012. The primary purpose of the audit was to gather information about the equipment, systems, and operational requirements and occupancy patterns of each building. These data were then used as initial inputs for the initial modeling and ongoing analysis through the software platform. After conducting the audit, analogous to a patient visiting a doctor's office, and analyzing historical utility billing, the analysts identified a handful of energy efficiency measures (EEMs). Then, after using the platform to collect and analyze weeks of continuous energy use data, analogous to heart rate, temperature, and blood gas monitors one sees connected to hospital patients, the analysts identified more energy EEMs not readily visible during the site visit.

It is the platform's ability to provide deeper insights that separates this type of MBCx/PCx practice from more typical approaches which rely on temporary data loggers and have no ongoing diagnostic capabilities. PG&E's progressive programmatic designs are also remarkable because they fully support the cost of EnerNOC's products and engineering services for one full year in addition to providing implementation incentives. This allows customers to realize the immediate benefits, through MBCx, and ongoing value, through PCx, by reducing first costs, and then, as benefits are realized by the customer, institutional inertia is overcome and a paradigm shift takes place. In the case of this customer, more sites in their portfolio were nominated for expanded services by the time the first phase of this particular project completed.

The expected savings at this first site is approximately $315,000 in annual cost reductions. The EEM implementation, or prescription, was split into three phases in order to clearly quantify savings from particular measures and accommodate the schedules of the customer and contractors. All EEMs included in the three phase implementation are shown in Table 1 below.

The first phase, completed in late 2012, focused on the optimization of economizer lockout setpoints and air handler operating hours, and saved 680,000 kWh and 39,000 therms annually. At a high level, the programming changes were simple in concept, though the practical application reveals the underlying challenges. In order to fully realize the savings potential , the EnerNOC energy services team, controls contractor, and building staff had to map, test and commission many thousands of points throughout the campus. This is similar to a doctor prescribing a particular medication at a certain dosage and then, depending on how the patient responds, increasing or decreasing the dosage in order to achieve the best result and minimize negative side effects. Again, the platform provided the diagnostic and automated fault detection tools necessary to identify and ultimately verify the fine tuning resulted in optimal savings. It will also, via monthly scorecard reports, allow facilities staff to keep these measures performing as intended.

The second phase, completed in early 2013, was comprised of five EEMs and saved over 410,000 kWh and almost 90,000 therms. Additionally, a permanent demand reduction of over 55 kW was realized. This set of measures included another set of schedule changes which, as previously noted, required more fine tuning. However, this phase also included a static pressure reset strategy requiring multiple iterations in order to ensure the strategy was implemented correctly. This involved changes to the sequence of operations programming, changing AHU setpoints, and then waiting a week or more to collect trend data, confirm whether the changes were having the intended effect, and then refine the strategy for each set of air handlers throughout the nineteen buildings.

The final phase, currently nearing completion, includes a special measure only implemented at three of the nineteen buildings at this campus. This set of three buildings implemented a control system to dynamically reset the VAV boxes' minimum air flow setpoints to satisfy both indoor air quality (IAQ) requirements and achieve energy savings. It was observed, in these three buildings, that a great deal of simultaneous heating and cooling was occurring and that many VAV boxes had minimum air flow settings that were far too high for the associated space size and occupancy rates. Using this dynamic reset system in conjunction with the static pressure reset

strategy (EEM 1) this phase is expected to yield an additional 300,000 kWh and 50,000 therms of energy savings for the customer at this site. It should be noted that the measures implemented in the first two phases were implemented in this subset of three buildings as well. While awaiting the completion of the special measure at the last subset of three buildings, data continues to be collected and analyzed for all other measures at all other buildings. Each month scorecards are presented to the customer and the customer is alerted whenever a measure does not meet the expected performance criteria. This in turn alerts facility staff to simple repair issues such as sensor calibrations or damper repairs. Additionally, new measures can be identified via the automated fault detection and diagnostic capabilities of the platform. So as the building continues to age, tenants move in and out, and occupancy patterns change, updated control strategies and maintenance requirements are recommended to the customer in order to maintain optimum performance.

CONCLUSIONS

Implementing the recommended measures clearly saved the customer a great deal of energy and cost. In fact the customer will realize more than 1.3 million kilowatt hours of annual energy savings within the next year. In addition to the annual energy cost savings, the customer has already received nearly $90,000 from PG&E in the form of implementation incentives. This is analogous to getting a monetary bonus from one's employer upon receiving a clean bill of health. However, how do we keep the patient, or in this case, the building, healthy on an ongoing basis? The answer is simple: good diet, exercise, and regular doctor visits. The facilities management version of this low cost approach to proactive building health care is to train the building staff on the changes made to the BMS, review and improve the O&M practices/schedules, and continuously monitoring the buildings' performance via the platform. Additionally, alerts and alarms may be set up by the staff to notify them when performance drifts out of specified tolerances. This will be put into practice as soon as the last phase is complete by November of this year.

EnerNOC energy engineers will provide a detailed training for the customer's facilities management staff and contractors. The training will include a review of the project, the measures implemented, and the manner in which the staff and contractors may regularly use the ongoing monitoring tools, reports, alert functions, and scorecards to ensure persistence of the associated savings. In PCx, it is this continual practice of monitoring, assessment, reporting, and proactive maintenance that provides customers, as well as utilities, great confidence in a return on their investment.

Table 1.

EEM	Electricity Savings (kWh/yr)	Gas Savings (therms/yr)	Cost Savings ($/year)	Implementation Cost ($)	Payback (years)
1 - Static Pressure Reset	351,476	-3,866	$48,497	$17,700	0.36
2 - Maximum and Minimum Positions on RTU Economizers	86,083	-2,360	$8,326	$0	0
3 - Economizer Lockout Setpoints	511,190	0	$76,614	$13,200	0.17
4 - Boiler Schedule	34,891	71,763	$54,305	$4,500	0.08
5 - Optimize Boiler Lockout Setpoints	2,521	1,121	$1,158	$0	0
6 – Exhaust Fan VFD	45,589	0	$3,191	$46,708	14.64
7 – AHU Scheduling	226,283	97,437	$102,357	$0	0
BesTech Measures	213,882	18,080	$21,118	$119,100	5.63
Total	**1,471,915**	**182,173**	**$315,565**	**$201,200**	**0.64**