Advantages of Financing Continuous Commissioning® As An Energy Conservation Retrofit Measure

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ABSTRACT

This paper presents a new financing approach for including fast-payback energy efficiency improvements like Continuous Commissioning®[1] (CC®) within a comprehensive energy retrofit package at Alamo Community College District, San Antonio, Texas. The impact on project paybacks, risk, facility energy use and occupant productivity will be examined. The advantages of including CC in retrofit financing packages for building owners, energy service companies, building commissioning firms and energy engineers, based on a comprehensive energy retrofit/upgrade project at a large community college in South Texas, is presented.

INTRODUCTION

Building energy-efficiency improvements are critical to the operating budgets of building owners and government institutions, vital to our nation's global economic competitiveness and a cost-effective tool for helping mitigate climate change and local clean air problems. While most environmental projects have little or no-paybacks, energy efficiency improvements are an exception since they reduce both energy use and air emissions. Numerous, highly cost-effective technologies and engineering techniques such as high-efficient lighting, integrated building automation systems and building optimization tools such as Continuous Commissioning have become available in the past ten years to lower the overall energy intensity of our nation's buildings.

Funds to finance private and public projects have also become increasingly abundant as lenders and equipment vendors better understand the potential of the energy efficiency market, the proven performance of well-engineered projects and techniques to lower risk and insure savings persistence. Numerous external energy efficiency financing options now exist such as:

- Short and long-term debt financing,
- Lease or lease purchase agreements,
- Municipal lease financing [tax exempt] for government entities, and
- Third-party financing such as vendor financing and energy service performance contracting (ESPC). [1]

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[1] The term Continuous Commissioning® and CC® are registered trade marks of the Energy Systems Laboratory, Texas Engineering Experiment Station, Texas A&M University System. To enhance readability, these marks will not be used for the remainder of the paper.

THE CHALLENGE

Since the first rapid rise in energy prices in the seventies, many obstacles have stood in the way of increasing the energy efficiency of our building stock. These barriers over the past thirty years have not changed significantly although the science and practice of improving building efficiency have increased significantly. Major barriers which still exist today include:

- Lack of awareness of products and services that lower energy use,
- Lack of fast-payback energy technologies and engineering services,
- Perception of high risk associated with energy efficiency projects, and
- Lack of internal funds to finance energy conservation projects.

One of the biggest obstacles to improving building energy-efficiency is readily available project financing that fits within the project scope in terms of payback and interest expense. At the same time, most capital intensive energy projects such as chillers, boilers and fenestration improvements benefit greatly from the inclusion of faster payback, lower-risk items such as lighting, building automation and building optimization. Efficient lighting and building automation systems have long been used to reduce the overall project payback period when a comprehensive retrofit approach is undertaken if someone hasn't already "cherry picked" the faster payback projects without looking at the facilities needs holistically.

However finding internal or external funds for fast payback building optimization engineering [non-capital] techniques such as CC remains a challenge. Even though CC would greatly lower the payback of most comprehensive retrofits, it is rarely included. Most facility owners are simply not aware of the practice of CC and the multiple benefits of increased comfort, reduced energy use and increased persistence of savings.

THE SOLUTION

The solution to increased energy efficiency financing of CC is twofold. First, building owner/operators and energy service providers/developers must become much more aware of building commissioning and retro-commissioning. The tendency is to just sell higher –profit "widgets" versus lower-cost energy engineering services. Secondly, project developers must learn how to price the energy savings and cost from CC into the overall project financing.

Then, two major obstacles to project financing – risk and the financing term -- can be readily alleviated by including CC as part of the overall project energy efficiency package. Project lenders as well as owners and third-party energy service companies are adverse to risk. CC helps reduce risk by clearly identifying the underlying causes of most comfort and energy use problems through analysis of how the building should be operating as currently configured. CC also helps lower project risk by continually assessing the performance of the building operations over the financing term.

All parties to an energy improvement project are sensitive to the length of time necessary for the stream of energy savings to pay for the overall project including principal, interest and management fees. Many projects never meet the internal investment:"hurdle rate" and thus are never implemented. The federal government and others are hard pressed to hold overall project terms under 10 years and remains a major obstacle as they attempt to replace aging infrastructure through energy savings alone. Since the average payback of most CC projects performed by the Energy Systems Laboratory as a stand alone energy improvement project is approximately 2 years[2], it is an excellent means to lower total project paybacks, often far exceeding other fast payback items such as high efficient lighting which averages 4 – 5 years depending on the application

CASE STUDY OF CC AS PART OF FINANCING PACKAGE

The use of CC in the Alamo Community College District in San Antonio, Texas provides an excellent example of the multiple benefits of its inclusion on project performance. [2]

ECRM/CC Project Overview

In 2002, the Alamo Community College District initiated a $3.5 million retrofit project to improve energy consumption at its four major campuses and two administrative office buildings. The total conditioned space included in this program was 2,350,000 conditioned square feet. Both fast and longer payback ECRMs were included in the financing package. These includes conversion of lighting to T-8 lamps and electronic ballasts, CC of all major building systems, cooling tower replacement at the main campus, building automation system (BAS) upgrades, roof-top package unit replacements, variable air flow and variable chilled water pumping, and other HVAC system replacements and retrofits.

CC Payback Ranking

Continuous Commissioning had the shortest payback period of any of the ECRMs implemented in the $3.5 million ACCD project. The CC paybacks at various campuses ranged from a low of 2.3 years to 3.7 years with an average 3.0 year simple payback which also included $140,000 for deferred maintenace or almost 20 percent of the CC budget. The retrofit paybacks for individual lighting replacements, cooling tower, HVAC replacements, and upgraded building automated controls ranged from 4.0 years to 20 years.

Program Savings for CC and ECRMs

The estimated total annual retrofit and CC savings were $450,000 per year or roughly 21% of the base year energy costs. The majority of the expected savings (62%) come from CC, followed by the lighting retrofits (22%) and the remaining upgrades and retrofits (16%). Because of CC's dominance in total savings and its relatively short payback (3 years in this case), some capital intensive upgrades with relatively long paybacks were possible, while still keeping the overall project payback at 5.9 years including financing and deferred maintenance [7]. The project was financed with a bank loan of 4 percent by ACCD.

The total project payback was 5.9 years, including the cost for deferred maintenance and interest cost of financing. ACCD management's decision to include CC in the approved list of improvements helped to significantly lower the total project payback [7].

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[2] The Energy Systems Laboratory has provided CC services in over 300 buildings since 1992 with a total estimated savings of over $70 million in avoided utilities, including over $30 million in savings on the Texas A&M campus since 1996. The average payback of hundreds of projects is approximately 2 years.

CC As Energy Conservation Retrofit Measure (ECRM)

Major CC opportunities at each site were identified during the initial assessment process. These measures were prioritized during the detailed CC plan development phase. The CC engineers began implementation of the CC measures at the three main campuses during the summer of 2002. This was a logical choice because these three campuses represent 75% of the total floor area and each had a relatively modern building automation system (BAS), allowing control strategies to be implemented quickly to reduce peak electric demand and electricity and gas usage.

Major CC Activities

Major CC activities are outlined below with a brief description of each measure. [3]

Optimize Chiller Control

Criteria and set points for chiller start/stops were fine-tuned to improve the staging sequences. Reset schedules for the chilled water supply temperature set points were modified to improve part-load chiller efficiency.

Optimize Boiler Control

Boiler start/stop sequence and existing hot water supply temperature set point reset schedules were refined to minimize simultaneous heating and cooling.

Chilled/Hot Water Loop Delta Pressure (DP) Resets

Most of the building chilled water pumps for the three campuses were equipped with VFDs. Their differential pressure set points were reset based on existing load conditions. Similarly, DP reset schedules were implemented on the campus hot water loops and building hot water loops for all three campuses. Reducing and resetting the DP set points saved a significant amount of pumping power. This measure also helped reduce the simultaneous heating and cooling due to over pressurization of the chilled water loop.

Air Handling Unit (AHU) Temperature Resets

Supply air temperature and cold/hot deck temperature set points were reset to reduce simultaneous heating and cooling energy consumption. This measure was implemented in both variable and constant air volume air handling units.

AHU Duct Static Pressure Resets

By resetting the AHU duct static pressure set points, significant fan power reductions were achieved. The Library Building at SAC is a good example. The duct static pressure set point used to be so high (3.5 inches of water column) that it drove all three supply air fans to full speed in the middle of the winter. One of the main supply air ducts literally came apart, apparently due to over-pressurization. By reducing and resetting the duct static pressure set point, it was estimated that approximately 150 kW of peak fan power demand was saved in that building alone [3]. Like the water loop DP reset, this measure also helped reduce simultaneous heating and cooling.

Improved Economizer Operation

The range and set points of economizer operations for the single-duct Air handling units were optimized to take advantage of free cooling. Since the supply air temperature set points were reset based on outside air temperature, the economizer set points were chosen to follow the same reset schedule.

Calibration and Repair of Sensors

Key sensors, such as the outside air temperature sensor, AHU cold and hot deck temperature sensors, duct static pressure sensors, and water DP sensors, were checked and calibrated when necessary. In some cases, the sensors were relocated to obtain better readings.

Repair of Malfunctioning Devices

The CC engineer generated a list of deferred maintenance items, and prioritized the items based on their impacts on building comfort and system efficiency. Typical items include broken VFDs, leaky valves, broken dampers, dirty coils, etc. Most of these items fall into the deferred maintenance category. They were dealt with separately, as discussed in the section on “Deferred Maintenance.”

Improved Start/Stop Schedules

Room-by-room surveys were performed to determine the occupancy schedules, especially during the evenings and weekends. AHU start/stop schedules were optimized accordingly to minimize the runtime.

VAV Box Calibration

Minimum and maximum variable air volume [VAV] box airflow settings were adjusted based on current space function and occupancy schedules. Also, broken pneumatic and DDC box controllers were replaced and/or repaired and recalibrated.

Deferred Maintenance

One of the many challenges facing CC and re-commissioning engineers during building optimization is the handling of deferred maintenance issues. Any delay in quickly resolving these issues would result in unrealized/lost savings opportunities since many of those issues directly impact system performance.

Cumulative Savings

By the summer of 2003, most of the CC measures had been implemented at three campuses, while the rest of the ECRMs were just getting started after the completion of the design and competitive bid processes. Therefore, it was possible to separately evaluate the savings that are largely attributed to the CC efforts.

Using monthly utility bills, a baseline was established for each campus based on the 2001-2002 base period. Based on the pre-CC energy consumption models, actual CC savings of $315,566 [20% savings were achieved from June 2002 through September 2003 from CC]. This represents 105% of the original estimated commissioning savings at these three campuses through commissioning. By May 2005 [34 months], the cumulative electricity, electric demand, and gas avoided cost savings from actual utility bills at these three campuses totaled approximately $1,096,636 or a 15.3 percent reduction. See Figure A below. [9]

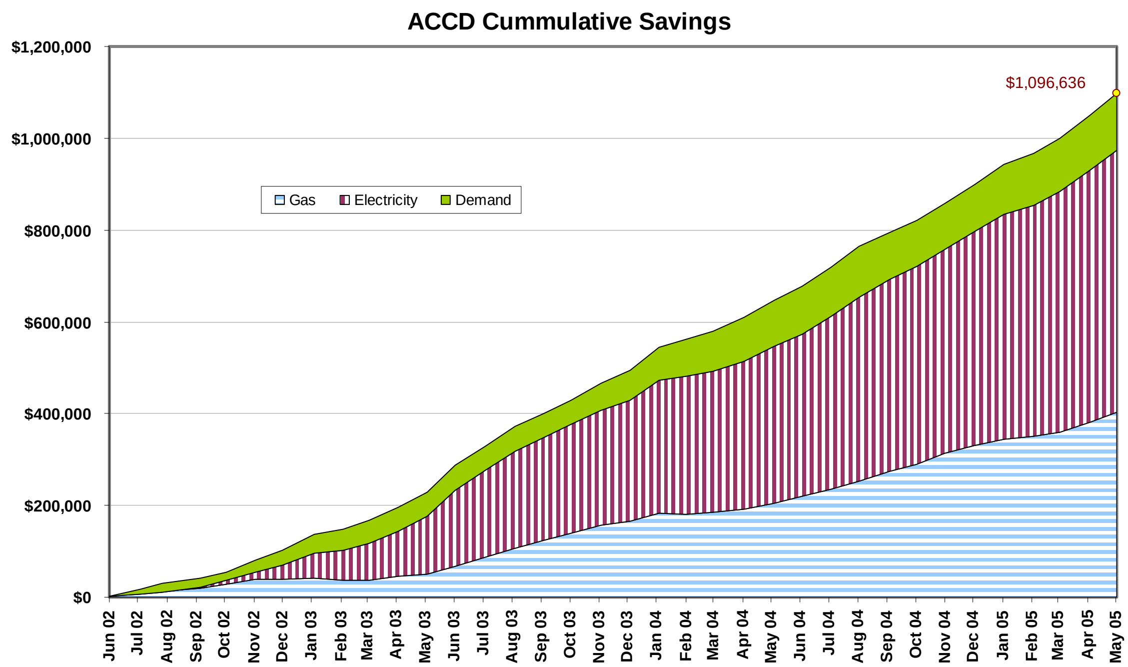

Figure A. Cumulative Energy Cost Savings at PAC, SPC, and SAC [calculated from normalized utility bills].

SUMMARY/CONCLUSIONS

The multiple advantages of including CC in retrofit financing packages for building owners, energy service companies, building commissioning firms and energy engineers, based on a comprehensive energy retrofit/upgrade project is evident from the $3.5 million energy efficiency retrofit program at the Alamo Community College District in central Texas with a CC payback of approximately 3 years [ACCD payback is higher than average since high deferred maintenance expenses were included]. Financing Continuous Commissioning as an energy conservation measure has positive benefits from both a financial and technical basis such as a higher return on investment [typically 2 yr. paybacks] and a sound technical approach to reducing persistent operational issues and helping insure persistence of savings over the life of the loan.

ACKNOWLEDGEMENTS

The authors wish to thank Juan-Carlos Baltazar-Cervantes and Yiwen Zhu for their on-going contributions to the monthly CC savings calculations of this CC project. We also extend our appreciation to ACCD facilities staff and senior management for assistance provided during the project which contributed greatly to its success and for their wisdom of including CC in their financing package to lower payback and enhance persistence of savings.

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