Cash or Credit: What Works Better?
Comparing Utility Incentive Programs with LEED®

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ABSTRACT

Utility programs have long provided cash incentives to promote energy efficiency in new buildings. More recently, the US Green Building Council (USGBC) has been promoting energy efficiency through its Leadership in Energy and Environmental Design (LEED®) program. This paper compares projects motivated by LEED credits with those motivated by utility cash incentives. The process of achieving energy efficient designs is similar for the two sets of projects studied, consisting of energy modeling for a range of energy conservation strategies, but the models for market transformation are different. The utility projects receive free energy consulting, along with cash incentives to reduce the capital costs of conservation measures. In contrast, non-utility projects seeking LEED certification pay for energy modeling and absorb costs for conservation measures in the construction budget. Beyond energy conservation, the branding of LEED provides these projects national recognition. This study aims to answer the question "Is there a difference in the level of energy savings between Cash (utility) and Credit (LEED) projects?"

The analysis includes 26 utility projects and 14 LEED projects. Results show that the highest level of potential energy savings *considered* by the two types of projects was similar, but LEED projects *chose* to implement higher energy savings. Utility projects cover a wider range of energy savings than LEED projects, indicative of the utility programs reaching a wider audience. Participants in utility programs seek relatively risk free investment in energy efficiency (average payback of 0.4 years after factoring in incentives), while those participating in LEED show a greater willingness for more investment (average payback of 3.25 years).

Introduction

Two modes through which design teams and owners reach energy efficient building designs are a) participation in USGBC's (US Green Building Council) LEED® (Leadership in Energy and Environmental Design) certification program and b) participation in energy design assistance programs sponsored by utilities. This study aims to assess how energy conservation decisions differ between the two types of market transformation approaches. Here we study a set of new construction building projects, some that sought LEED certification, and some that sought utility incentives. All the projects considered went through an energy design consulting process administered by one single firm in a common manner. Analyzing projects that used a common consulting approach helps control factors related to consulting style that could lead to differences in the outcomes.

The consulting process emphasizes a whole building design approach, where conservation strategies that affect all energy end-uses are analyzed. The process facilitates integrated design by providing information to owners and designers early in the design process, generally at the end of schematic design or in the early design development phase. This information is primarily in the form of results from DOE-2 computer simulations of energy savings strategies. Incremental costs of the conservation strategies are presented to the design teams along with energy savings. The designers, owners and energy consultants together evaluate these results and assemble bundles of strategies. The bundles represent alternative solutions with a range of energy savings and incremental costs, and the owner-design team selects one of the bundles for implementation in the building.

For the utility projects considered here, the program incentives were structured such that energy savings beyond an energy code baseline determined the incentive amounts. These utility programs encourage participation by offering energy design assistance for free and cash incentives for technologies implemented that take the performance beyond the energy code. The incentive structure in these cases encourages higher savings by increasing the incentive rate for increased percent savings, with a cap on the rate but without any cap on the actual incentive amount[1].

For LEED projects, the energy design assistance consulting process was identical to that provided for the utility programs. These projects seek energy efficiency to gain points for the "LEED Energy and Atmosphere Credit 1, Optimize Energy Performance." The LEED projects that are analyzed in this study did not have access to utility incentive programs. These projects had to pay for the cost of LEED registration and certification; they also paid for the energy analysis and design assistance, and there were no cash incentives available to buy down the technologies.

The paper is organized as follows. First, background information on utility programs, LEED, and market transformation is given. Second, the methodology of the study for choosing and analyzing projects is described. Third, results for LEED and utility projects are presented, including the energy cost savings of building designs considered and, ultimately selected. Costs and accepted paybacks are also assessed. The fourth section provides the conclusions.

Background

Utility programs

Utility sponsored programs promote energy efficiency in buildings by providing rebates or incentives along with technical assistance in the form of analysis and design education. This form of market transformation for energy efficiency in commercial buildings has been a result of demand-side-management programs and those that grew out of state conservation improvement programs and other similar mechanisms. These programs operate partially on the premise that building owners and investors see energy-efficiency improvement as a first cost beyond the means of a building project budget. Investment in new technologies involves risk and requires a learning effort during design, construction, and operation of the buildings. Utility-sponsored energy efficiency improvement programs are intended to reduce risk and overcome the first-cost barrier by providing cash incentives to owners. The cash incentive also acts as a vote of confidence from the utility in the technology.

[1] One utility program caps the incentive amount such that the resultant payback is not reduced below one year. But within that constraint, there is no actual limit to the amount of incentive for any project.

LEED

In recent years, LEED has promoted energy efficiency along with other green building measures in new commercial buildings. The LEED rating system awards points in various categories of sustainable design. When buildings achieve threshold point totals they attain one of four LEED certification levels. The USGBC provides recognition for these buildings by presenting a plaque that can be displayed in the building and by listing the building and its information on their website. The points awarded for green measures in LEED are not necessarily in direct proportion to their ability to mitigate environmental impacts (Eijadi et. al., 2002). Consequently, it has been argued that project decision-makers will choose credits that are easiest to attain in their particular situation and maximize their point total. Eijadi et. al. (2002) further argued that such a rationale for investment in new building projects, where budgets are typically not generous, might drive investment away from energy efficiency measures in favor of easier, less costly green building measures that have the promise of easy LEED points. After five years and over 200 LEED certified buildings, the situation appears different.

Of the 249 LEED certified buildings, 31 (12.5%) did not get any points for the Energy Optimization Credit (USGBC, 2006). Table 1 shows that LEED certified projects on average get 4.3 credits for energy optimization out of the 10 possible. This would translate to an average of 29% savings compared to the ASHRAE 90.1-1999 standard (USGBC, 2001). The average energy savings for LEED certified projects steadily increases as the certification levels themselves become more aggressive. Platinum certified buildings on average are 54% better than the ASHRAE 90.1-1999 standard. LEED projects, unless simultaneously participating in a utility program, have no cash incentives attached to reduce the risk or buy-down the first costs. These projects are motivated by the prospect of achieving LEED credits and recognition for their green building efforts, along with a desire to build healthier buildings with reduced operating costs.

Table 1. Summary of Energy Optimization (EO) Points for LEED Certified Projects as of February 2006 (USGBC, 2006)

	Total	Certified	Silver	Gold	Platinum
Number of LEED Certified Projects	249	110	76	57	6
Projects with 0 EO points	31	27	3	1	0
% Projects with 0 EO points	12.5%	25%	4%	2%	0%
Min EO points	0	0	0	0	6
Max EO points	10	10	10	10	10
Average EO points	4.3	2.9	4.5	6.1	9.3
Average % Savings[2]	29%	22%	30%	38%	54%

Market Transformation

There are two factors that can be used to measure the degree of market transformation, as illustrated in Figure 1. Market *penetration* deals with increasing the number of buildings that address energy efficiency. The other measure of transformation deals with increased efficiency per building or *level of savings*. In five years, LEED has achieved a nationwide market

[2] Estimated based on the points achieved for the energy optimization credit as compared to the ASHRAE 90.1-1999 standard (USGBC, 2001).

penetration of 5%. The utility programs we looked at have achieved penetration rates beyond 50% in their relevant markets; one program achieved this level of penetration within roughly the same five years. Penetration is increased by marketing, raising awareness and in general by reducing the barriers to participation. Economic incentives, such as tax credits and utility cash incentives are one way to reduce barriers to participation, and thus increase penetration.

Figure 1. Measures of Market Transformation

Market Transformation

Penetration	***Level of Savings.***
How many firms in the industry (repeatedly) practice energy conservation?	What is the amount of energy conservation for each participant?

Rather than examine *penetration,* this study looks at the impact of incentives on the *level*, or aggressiveness, of energy savings. The initial barriers to participation in LEED or the utility program have already been overcome in the set of projects studied. The basic question is the following: is there a difference in the level of energy savings for projects that participate in LEED vs. utility incentive programs?

Methodology

Project Selection

A set of projects completed by the same energy and sustainable design consulting firm (The Weidt Group, Inc.) serves as the dataset. This reduces many variables and resulting impacts of consulting style and process. The dataset contains 14 LEED projects and over 300 Utility projects.

For each LEED project, up to three corresponding Utility projects were chosen. The correspondence between the LEED and Utility projects is based on 4 conditions.

1. *Construction type:* All LEED projects were new construction projects with no elements of existing building retrofits. Retrofits and building renovation have reduced conservation opportunities when compared with new buildings where all building systems are available for energy design improvement. Thus, Utility projects chosen also had no retrofit or renovation elements.
2. *Building Type:* Chosen Utility projects matched the building type of LEED projects. In addition, all LEED projects were owner occupied and so Utility projects had that same characteristic. Both sets contain the same proportion of publicly owned buildings.
3. *Dedicated on-site heating and cooling plants:* None of the LEED projects were supplied by district heating or cooling. Projects that have district heating or cooling typically have had reduced opportunities for conservation since the choice of efficiency and type of plant lies outside the scope of the project design team. Thus Utility projects with district heating or cooling were disqualified.

4. *Year work was done on the project:* Year captures state of the construction market in terms of technologies and design expertise available and to a certain extent the perceived inflation in construction costs. Utility projects that matched the LEED projects in terms of start dates were chosen.

Filtering using the four conditions above resulted in 26 Utility projects in the dataset that matched the profiles of the 14 LEED projects. Table 2 shows the number of projects classified by building type in each set. The two sets represent independent market transformation modes as none of the Utility projects were seeking LEED certification, and none of the LEED projects participated in utility incentive programs.

Table 2. The Final Set of LEED and Utility Projects Studied in Each Category

	LEED Projects	Utility Projects
Elementary schools	1	3
Middle or high schools	3	9
Offices	8	11
College buildings	2	3

Savings, Incremental Costs and Payback Calculations

During the energy design assistance for each project, energy savings for bundles of strategies were calculated compared to an applicable energy code baseline. The term *bundle* refers to the entire set of energy conservation strategies considered as a candidate design for the building. Multiple bundles represented the range of possible energy efficiency solutions for each building as created by each design team. The *Lowest Savings Bundle* includes measures that the design team would have done as part of their standard practice. This bundle is thus defined as the zero incremental cost solution as perceived by the design team. The Lowest Savings Bundle may be considered as closest to what the design team might have implemented in the absence of any incentive – be it Utility or LEED . Incremental costs for other bundles were usually above, but in some cases below, this Lowest Savings Bundle. Equations 1, 2, and 3 represent the calculation method for savings (S_b), incremental construction costs (I_b) and payback periods (P_b).

Equation 1, Bundle Savings $S_b = E_0 - E_b$
Equation 2, Incremental Construction Cost $I_b = C_b - C_0$
Equation 3, Bundle Payback in Years $P_b = (E_b – E_1)/I_b$
Where
S_b = Savings for a bundle
E_0 = Annual energy cost of code baseline
E_b = Annual energy cost of a bundle
E_1 = Energy cost of Lowest Savings Bundle
I_b = Incremental construction cost of a bundle
C_b= Construction cost of a bundle
C_0 = Construction cost of Lowest Savings Bundle
P_b = Payback period for a bundle

Utility projects fell in three different utility programs with local energy codes as the baselines; Utility projects in Iowa and Colorado used ASHRAE 90.1-1989, and Utility projects in Minnesota used the Minnesota Energy Code, which is a more stringent variation of ASHRAE

90.1-1989. All LEED projects used the ASHRAE 90.1-1999 Standard as the baseline, which is more stringent than the baselines used for the Utility projects (Eley 2001). Energy cost savings compared to the applicable baseline for each project are seen by the design teams when making decisions. Thus while comparing their commitment to a level of savings it is important to look at these energy savings, even though they are not all normalized to the same baseline. The analysis in this paper is presented without any baseline adjustments.

The geographical location of a building determines the weather conditions and energy rates that influence the energy savings. In addition, variation in the local construction markets could also cause variations in the incremental costs reported for the conservation strategies. We have not normalized energy savings or incremental costs for these variations; we present the analysis in terms of the energy cost savings and construction incremental costs that the design teams looked at while making their decisions.

Results and Discussion

We compare the overall energy cost savings for each project as seen by the design team. We look at the frequency distribution of the choices of energy cost savings for each project set. The savings for each project normalized by gross building area is compared between the sets. We look at how much energy savings each project “left on the table”. In addition, we look at the incremental construction cost reported by the design team and the resultant simple payback periods. Finally we look at how much more incremental cost would have been incurred to achieve the bundle with the highest savings for that project. The small sample size of LEED projects in our study prevents a statistically significant analysis at this time; absolute numbers are presented instead.

Overall Energy Cost Savings

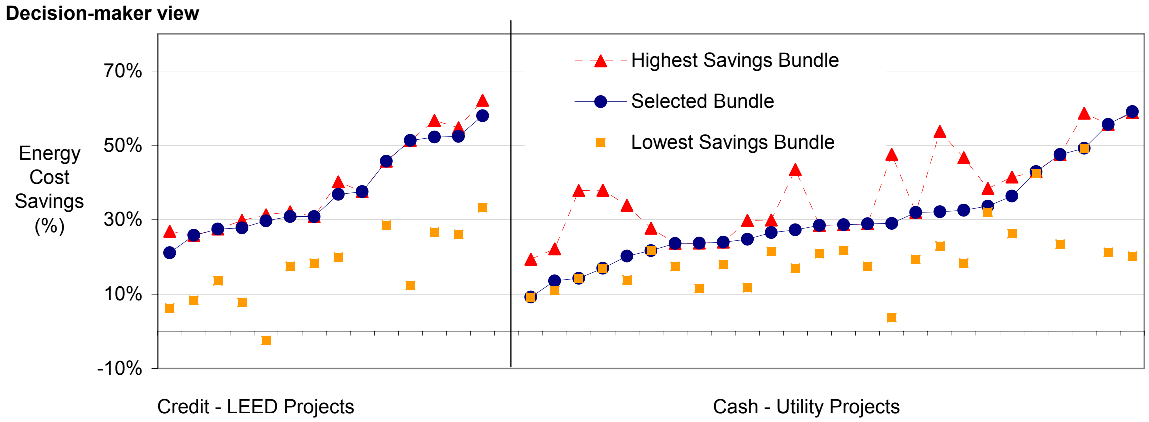
The energy cost savings as a percentage of the applicable code baseline, for the two types of projects are shown in Figure 2. Results are shown for the Highest, Selected, and Lowest Savings Bundle of energy conservation strategies for each project. The numbers shown in Figure 2 represent the information that decision-makers used, as they are calculated using the code baseline applicable to each project. The appendix reports the savings normalized to a common energy code.

The first notable observation, looking at the range of savings for each project set in the decision-maker view (Figure 2), is that the high end of the savings for Selected Bundles of both sets of projects are at approximately 60% energy savings. However, at the low end of the ranges, Utility projects have lower values for Selected Bundles than LEED projects (10% energy savings vs. 20%).

The average energy savings of the Selected Bundles for the 14 LEED projects is 38%, while the average of the 26 Utility projects is 30%. Thus, on average, decision-makers for LEED projects chose greater energy savings.

Note that the LEED projects included in this study also achieve a higher average energy savings at 38% compared to the overall population of LEED certified buildings from Table 1 which is at 29%. This shows the importance of analyzing projects that used the same consulting team and process when comparing the two transformation modes, so that the effect of the consulting style and technologies presented can be controlled for.

Figure 2. Energy Cost Savings for LEED and Utility Projects Relative to Applicable Codes. Results are Shown for Each Design Team's Highest Created, Selected, and Lowest Created Bundles of Energy Savings Strategies.

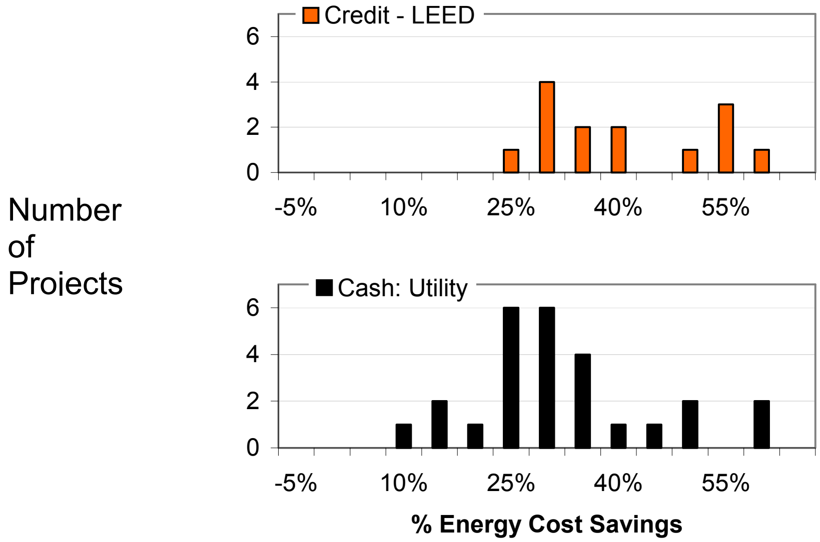


Analysis of the savings for the Highest Savings Bundle provides insight on potential aggressive solutions being considered by design teams. The average for the Highest Savings Bundle savings is 39% for LEED projects and 37% for Utility projects. Thus, on average, the level of savings on a percentage basis for the Highest Savings Bundles is comparable for the two project sets. The upper end of the range of the Highest Savings Bundle is also approximately the same for both projects (60%). Given the common consulting process and technologies being considered, both sets of design teams assembled upper end solutions that had similar percent energy cost savings.

6 out of 14 LEED projects and 10 out of 26 Utility projects chose the Highest Savings Bundle. Regardless of project type, approximately 40% of all projects chose the Highest Savings Bundle. However, LEED projects do not show appreciable spread between the Highest and Selected bundles for the 8/14 projects that did not choose the Highest Bundle (up to 6 percentage point difference). LEED projects seem to be maximizing energy savings. In contrast, for Utility projects, the spread between the Selected and Highest Savings bundles for the 16/26 projects that did not choose the Highest Savings Bundle goes up to 24 percentage points. Thus, many Utility projects still have the opportunity to achieve more energy savings with available strategies by selecting bundles that perform closer to the Highest Savings Bundles.

Figure 3 presents a frequency distribution of energy cost savings for the Selected Bundles by both types of projects. Both distributions have a similar shape, but the Utility projects have a wider distribution than the LEED projects. This may be due to the greater number of projects in the Utility group (26) than in the LEED group (14). However, assuming that the data sets are representative, the frequency distributions indicate that Utility projects covered a wider range of energy savings. Design teams for Utility projects also considered solutions on the lower end of the scale.

Figure 3. Comparison of the Frequency Distributions of the Choice of Energy Cost Savings (Selected Bundles) between Project Types



LEED projects typically have specific energy efficiency goals in the form of LEED points from the beginning of the design process. The building form and fenestration are often designed with energy goals in mind, and the architectural designs strive to achieve a LEED point by giving daylight access to 75% of the building spaces. The early focus on energy optimization and the high daylighting potential of these projects is a possible cause for higher savings.

Energy Cost Savings Normalized to Gross Building Area

Figure 4 shows the energy cost savings for each project normalized to gross building area. Energy savings are presented as seen by the decision-maker, relative to each project's relevant baseline code. Savings for the Selected Bundles for the LEED projects range from $0.26-1.01/SF, whereas the range is $0.07-1.07/SF for Utility projects. On average, the building-area normalized savings of the Selected Bundle for LEED projects is approximately 50% higher than the Selected Bundle for Utility projects. For the Highest possible bundles, the difference is 35%, again with LEED projects higher than Utility projects, on average. Figure 5 shows the difference in energy cost savings between the Highest and Selected bundles for each project. This figure represents the energy savings "left on the table," by the design team by not opting to implement the Highest Savings Bundle. The average savings "left on the table" for LEED projects is 5% ($0.03/SF), whereas the average for Utility projects is 20% ($0.07/SF).

Figure 4. Energy Cost Savings Normalized to Gross Building Area for LEED (Credit) and Utility (Cash) Projects. Results are Shown for Each Project's Selected and Highest Savings Bundle of Energy Savings Strategies Relative to the Code Baselines as Viewed by the Decision-Makers.

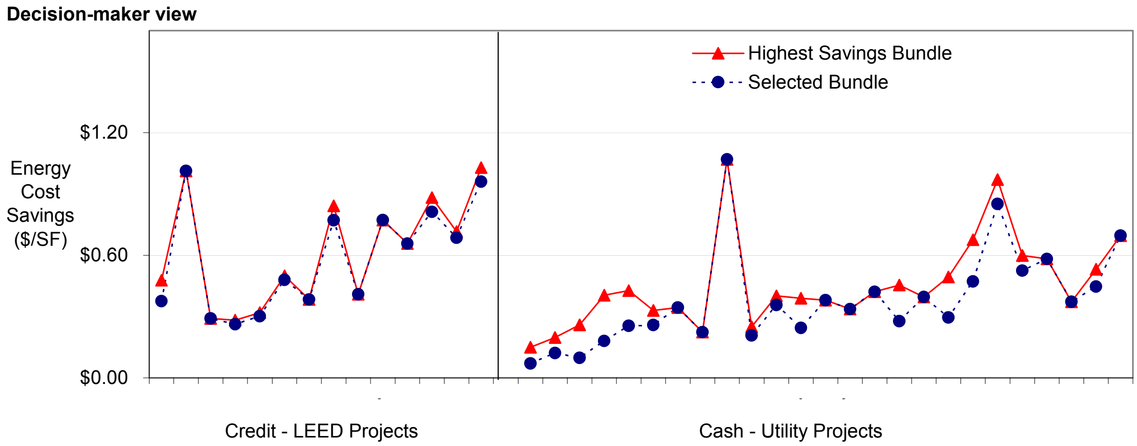
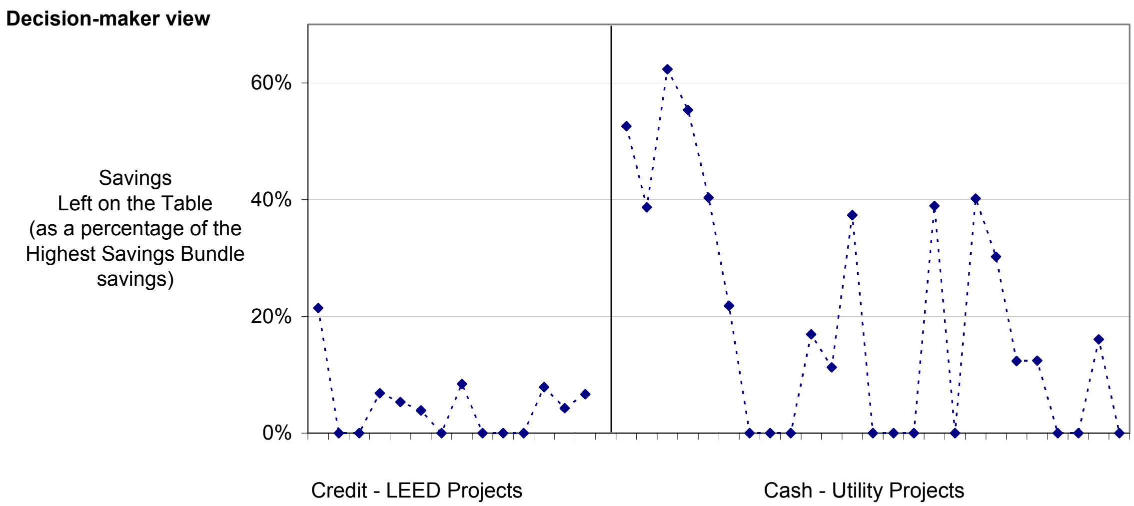


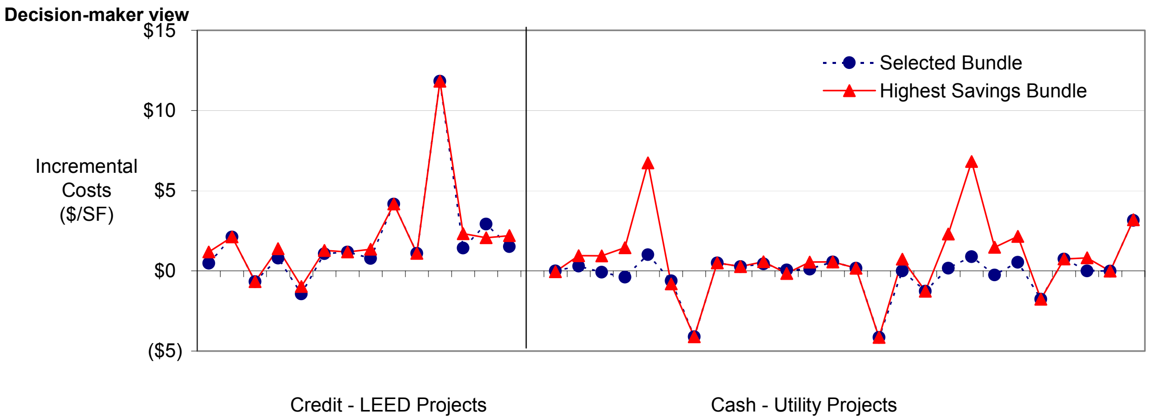
Figure 5. Energy Cost Savings Left on the Table. This Graph Shows the Difference between the Highest Savings Bundles and Selected Bundles as a Percentage of the Energy Costs Savings of the Highest Savings Bundle.



Incremental Construction Costs Results

Incremental first costs for energy efficiency measures normalized to building area are presented in Figure 6. The incremental costs accepted by decision-makers for LEED projects range from -$1.50 to $12.00/SF. For Utility projects, the range is -$4.00 to $3.00/SF, after including the utility cash incentive. LEED projects accepted higher incremental costs than Utility projects on average (approximately $2.00 vs. $0.00). Negative incremental costs for several LEED projects arise from the inclusion of strategies in the Selected Bundle that are more cost effective than those that the design teams would have included without the benefit of the analysis, i.e. strategies included in the Lowest Savings Bundle. For Utility projects, 3 of the 9 instances of negative incremental costs are similarly explained, and the other 6 are explained by the reduction in incremental cost due to the incentive. The negative costs for higher savings show the value of the optimization exercise in allowing the design team to create alternative solutions or bundles after they have seen the energy performance results of the individual strategies. For both sets of projects, when incremental costs for the Highest Savings Bundles were negative, design teams selected the Highest Bundle for implementation (Selected Bundle coincides with the Highest Savings Bundle).

Figure 6. Incremental Costs Normalized to Building Area for the Selected and Highest Savings Bundles of Each Project Type



It is apparent from these results that many Utility projects made choices that did not result in significant incremental costs to the project. A $1.00/SF incremental cost on a new construction project can translate to a 1% increase in incremental cost. Energy efficiency typically was an additional feature to utility projects, and was often considered after the project budget and building program had been fixed. LEED projects on the other hand had clearly stated LEED certification and energy efficiency goals at the inception of the project. Thus the owners and design teams considered energy efficiency cost as an important aspect of the building. This difference in approach, with the timing and clarity of goals, made a difference in the way design teams look at the incremental costs of energy efficiency.

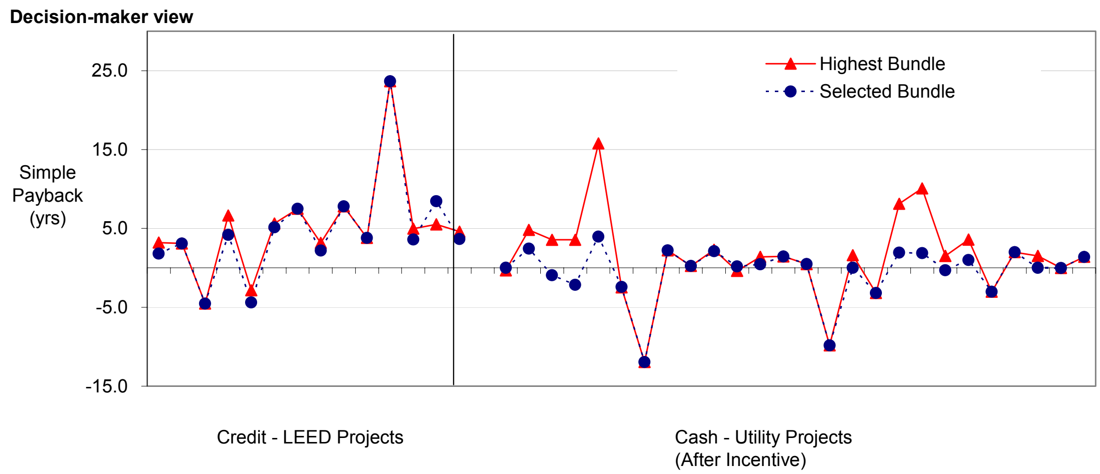
Simple Payback Analysis

The simple paybacks, as seen by decision makers, are shown in Figure 7. On average, the Selected Bundle for LEED projects had a simple payback of 3.25 years; the Highest Savings Bundle for LEED projects had a slightly higher average payback of 3.73 years. In contrast, the average payback for Utility projects was 0.4 years, after incentive, meaning that the investment in energy efficiency paid for itself almost immediately. Without including the incentive in the payback, the average payback of Utility projects was 2.37 years. The Highest Savings Bundle of Utility projects had an average payback of 2.34 years with the incentive included, and 4.6 years without. LEED projects accepted a much wider range of paybacks, from -5 to 9 years[3], while Utility projects accepted paybacks in the range of -12 to 4 years. The two Utility projects with

[3] The longest payback project (24 years), a Credit project can be considered an anomaly since it used an underfloor air distribution system that was reported to have much higher incremental costs than a standard ceiling duct system and the entire cost of the underfloor air distribution system was included in the payback analysis.

large negative paybacks are cases in which the baseline lighting system chosen as the reference to evaluate energy savings not only used more energy, but also had much higher capital costs. Both of these projects had the same owner. Substituting other efficiency measures for added insulation also contributes to negative paybacks in some cases.

Figure 7. Simple Paybacks of LEED and Utility Projects. For Utility Projects, the Paybacks are Calculated after Subtracting the Incentive from the Incremental Costs.



Marginal Cost-Benefit Analysis

The marginal increase in cost, $Cost_{Margin}$, to go from the Selected to Highest Savings Bundle, is calculated by subtracting the incremental cost[4] of the Selected bundle, $C_{Selected}$, from that of the Highest Savings Bundle, $C_{Highest}$, and normalizing by $C_{Selected}$.

$$Cost_{Margin} = (C_{Highest} - C_{Selected})/C_{Selected}$$

The marginal increase in savings between the Selected and Highest Savings Bundle is calculated similarly, where $S_{Highest}$ is the energy savings of the Highest Savings Bundle and $S_{Selected}$ is that of the Selected Bundle:

$$Savings_{Margin} = (S_{Highest} - S_{Selected})/S_{Selected}$$

The payback at the margin is the ratio between the Highest and Selected bundle differences in costs and savings:

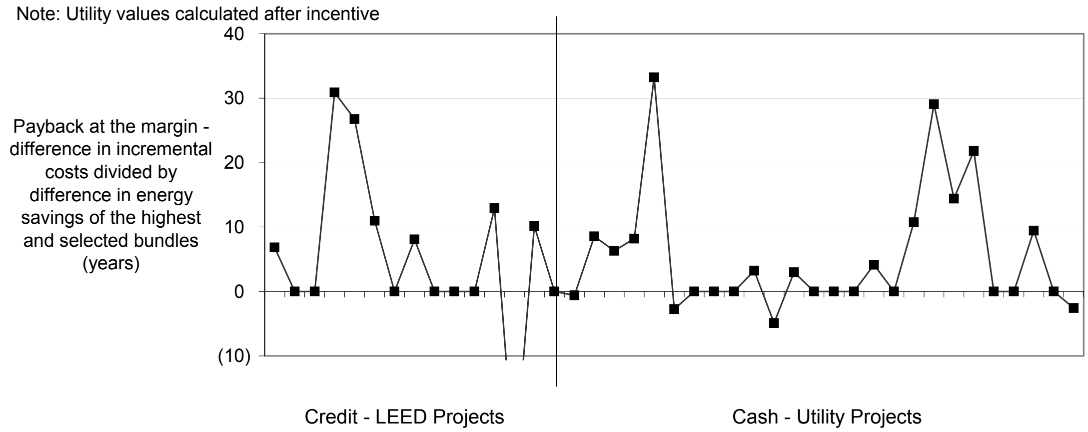
$$Payback_{Margin} = (C_{Highest} - C_{Selected})/ (S_{Highest} - S_{Selected})$$

The marginal payback results are shown in Figure 8. For LEED projects, the marginal increase in costs would be 31% to achieve a marginal increase in savings of 5%, on average. The average payback at the margin is 10 years (range -27 to +31 years). A 10-year payback at the margin is about three times as long as the average simple payback accepted by the design teams

[4] Incremental costs include incentives from the utility on Utility projects.

for the selected Bundle on LEED projects (3.25 years). For Utility projects, paying an average incremental cost of 233% more would achieve a 35% increase in annual energy cost savings. The average payback at the margin is 9 years for Utility projects (range -5 to +33years). A 9-year payback at the margin is much longer than the simple payback of the Selected Bundles (nearly immediate payback on average) on the Utility projects. This could explain the reluctance of both sets of design teams to select the Highest Savings Bundle in all cases.

Figure 8. Marginal Payback between the Highest and Selected Bundles



Summary

The larger spread in the savings for Utility projects (Figure 3) is likely to be explained by the larger population of projects i.e. penetration, reached by the utility programs. The adoption of conservation technologies will have a technology adoption curve similar to the adoption of hi-tech products (Moore 2002), where design teams seeking LEED certification who consider themselves to be market leaders will be more aggressive. At the same time, utility programs that address the market leaders, the mainstream population, as well as the laggards will have a larger spread by the nature of the market they address. By this reasoning, as long as LEED is portrayed as a moving target for market leaders, it may only penetrate that smaller section of the market. For the overall building energy efficiency market, the two forms of market transformation have complementary roles. LEED moves the market leaders and helps to demonstrate the technologies, while utility programs act as the transfer mechanism to involve the rest of the market in efficiency measures. This complementary role is also evident when we look at the savings left on the table. Utility programs with cash incentives bring more participants to the table; at the table of energy efficiency improvements, LEED projects leave very little savings behind.

Conclusions

The results from our data set of 14 LEED projects and 26 Utility incentive program projects for energy cost savings show that LEED projects aimed for higher energy savings and accepted higher incremental costs and longer paybacks, on average. It is notable that some Utility projects were also highly motivated. The results show that the level of savings for the highest, or most aggressive, bundle of strategies considered for both types of projects was similar, but LEED projects were more likely to choose a design that was very close to the highest savings bundle, leaving very little savings "on the table." In contrast, many utility projects could have improved simply by choosing a more aggressive bundle of strategies from existing technologies. Both type of projects rejected moving to the highest savings bundle when the marginal improvement implied a much longer marginal payback. We propose that the difference in the two types of projects in their ability to accept incremental costs could be a result of the difference in timing and clarity of energy efficiency goals set by the building owners. A future study could investigate this preliminary observation.

The results also show that the Utility projects represent a wider range of energy savings, reaching the same maximum as LEED projects, but also exhibiting lower savings in some projects. LEED market penetration is currently low compared to utility programs; however LEED projects likely represent the market leaders in energy efficient buildings. If subsequent versions of LEED raise the bar to maintain it as a moving target, it may only penetrate the section of the market that holds the leaders. Future studies would be better able to establish these trends.

Future research questions also include the following. Are design firms and owners more likely to repeat energy conservation practice having participated in a utility cash incentive program vs. LEED, causing a ripple effect in the market? What mechanisms could be exchanged between the two types of programs to make them both more effective?

LEED and utility programs can work in concert to make use of their strengths in market transformation; LEED establishes the market leaders and provides examples of aggressive savings, utility programs help move the whole market upwards.

Informative Appendix

Utility projects in Iowa and Colorado used ASHRAE 90.1-1989; those in Minnesota used the Minnesota (MN) Energy Code. All LEED projects used the ASHRAE 90.1-1999 Standard as the baseline. This informative appendix normalizes the results for all the projects to a single baseline, ASHRAE 90.1-1999. To accurately normalize energy savings as compared to a common baseline, we compared the impacts of the energy codes on building types, and heating-cooling systems, with DOE2 simulations of the code compliant buildings and energy efficient bundles of strategies. These findings are summarized in Table 3.

Table 3. Percent Reduction in Energy Savings of Utility Projects for Normalizing to ASHRAE 90.1-1999 Level.

Building Type	System Type	MN Energy Code Level Building	MN Bundles	ASHRAE 90.1-1989 Code Level Building	ASHRAE 90.1-1989 Bundles
Office	DX Cooling, gas fired heating	8%	6%	18%	12%
Office	Water-cooled chiller, gas boiler	8%	6%	20%	12%
School/ Classroom	Air-cooled chiller, gas boiler	2%	2%	9%	5%

Code compliant simulations show that annual energy consumption for ASHRAE 90.1-1999 versions is between 2% to 8% less than the MN Energy Code versions, and between 9% to

20% less than ASHRAE 90.1-1989 versions. These results agree with the finding in Eley, 2001. However when energy efficient bundles of strategies are compared against the codes the differences are smaller. Bundles savings compared to the MN Energy Code are reduced by 2% to 6% when compared to the ASHRAE 90.1-1999 and those compared to ASHRAE 90.1-89 are reduced by 5% to 12% when compared to ASHRAE 90.1-1999.

Figure 9. Energy Cost Savings as in Figure 2, but with Both Sets of Projects Compared to a Single Baseline (ASHRAE 90.1-1999).

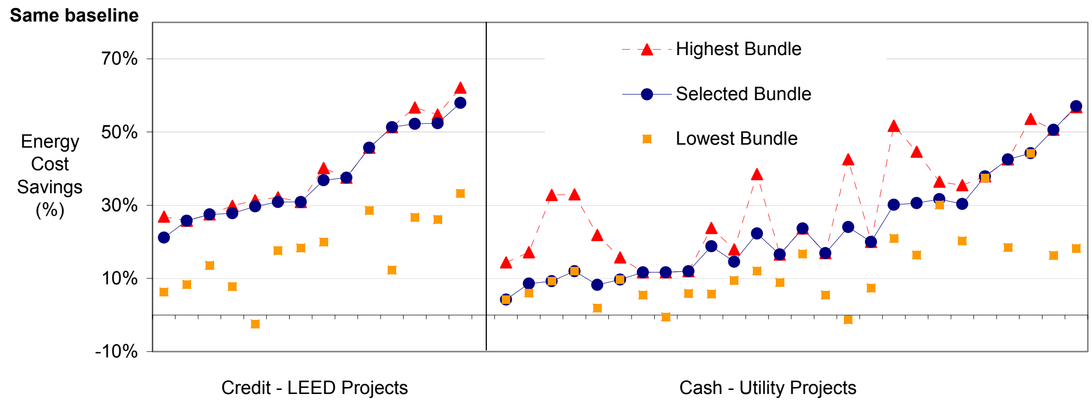


Figure 9 shows the same results as Figure 2, except that Utility projects are corrected to the same baseline as LEED projects (ASHRAE 90.1-1999) based on data in Table 4. These results for the Utility projects are adjusted retroactively and were never seen by the design teams. Hence they cannot be used to draw any conclusions about the design teams' intents or aggressive behavior towards energy savings. If the design teams had been presented with percent savings related to ASHRAE 90.1-1999 it is entirely possible that some of them would have selected bundles with higher percent savings.

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