MODELING THE PRIVATE FINANCIAL RETURNS FROM GREEN BUILDING INVESTMENTS

Brian Ross,[1] Mario López-Alcalá,[2] and Arthur A. Small, III[3]

INTRODUCTION

We analyze the financial returns to a green building renovation project for a small commercial office building in the urban Midwest. Compared with a comparable conventional renovation, the LEED renovation required additional building costs of approximately $7.41 per square foot. This additional up-front investment, or "green premium," promises to generate an estimated $1.38 per square foot in annual savings, mostly from reduced energy expenditures. Viewed strictly in financial terms as an investment opportunity, the LEED renovation offered an expected Internal Rate of Return (IRR) of approximately 12%. A sensitivity analysis suggests that this estimate is relatively robust across a range of alternative model assumptions. The findings suggest that LEED renovations could be very attractive to organizations with relatively low capital costs, such as government agencies, but might prove marginal or unattractive to smaller private firms with high costs of capital.

DEVELOPING ANALYTIC TOOLS TO UNDERSTAND PRIVATE RETURNS EXPECTED FROM PAYING THE "GREEN PREMIUM"

Green buildings and renovations are increasingly touted as solutions that reduce the environmental impact of building construction and operation, while also cutting operating costs for owners and tenants. Green buildings are typically more expensive to construct than are comparable conventional buildings. Yet designers and enthusiasts argue that this cost differential, or "green premium," can be recovered from the operating savings generated by green features. For example, lower energy bills as a result of higher building insulation or increased employee productivity resulting from indoor air quality or thermal comfort are revenue inflows directly attributable to the investment in high performance features.[1]

Notwithstanding the popularity of these claims, relatively few studies have examined rigorously the financial returns to private owners from green building projects. Those studies that have appeared carry features that limit their applicability to private or not-for-profit builders and developers.

One problem with many previous studies on the economics of green building concerns the metric used to evaluate financial success. Previous benefit-cost studies in green building included exhaustive analysis of projects' *payback period*—the number of years required for (undiscounted) project-related savings to recover the up-front investment charges. Generally, cost-benefit studies claim that the buildings' savings pay back the green premium within a decade, if not sooner. However, evaluations based on project payback period do not appropriately account for the opportunity costs that green investment premiums impose on developers' scarce capital resources. When not all desirable projects can be undertaken, what arguments call for undertaking a green building project, to the exclusion of other attractive opportunities? The payback period criterion cannot address this vital question.

A few studies have appeared that deal appropriately with the cost-of-capital issue, by discounting future savings to compute the *Net Present Value* (NPV) of the project. This strand of the literature includes one of the most comprehensive and careful studies to date on green building finance, by Kats et al.[2] The au-

1. Lexecon Inc., Chicago, IL. LEED Accredited Professional. Master of Public Administration in Environmental Science and Policy from Columbia University's School of International and Public Affairs, 2006. Mr. Ross can be reached at bross@lexecon.com.
2. MPA in Environmental Science and Policy. Mr. López-Alcalá may be reached at mal2113@columbia.edu. The author would like to thank Eric Mehlhoff for his insightful comments on this study.
3. Arthur A. Small, III, is Associate Professor, Department of Meteorology, The Pennsylvania State University. The authors wish to thank the staff of the organization identified herein as Verde.

thors examined the costs and benefits of green design for thirty-three building projects in California, mainly government buildings and "showcase" projects by large private firms. They found that the decision to expend the "green premium" needed to secure LEED certification generally does generate positive NPV. However, these NPV calculations assume a very low cost of capital of under 6%. This figure could be argued as appropriate for a state government (especially one with the ability to offer tax-exempt bonds), but is clearly too low for any private concern.

A third major limitation of previous studies concerns the degree to which they incorporate *socialized* benefits into their analysis. The analysis by Kats et al. includes as benefits several environmental factors that are not readily captured by the private developers who must bear the cost of building to premium construction standards. These social benefits include, for example, the monetized value of decreased emissions, lessened strain on the electricity grid, and reduced heat island effects. These external benefits are, without question, quite real: it is indeed appropriate to incorporate them into a *social* cost-benefit analysis, such as might be used for government planning. It is less clear what salience they will have for a private builder, owner, or tenant. Even an organization that finds value in creating environmental public goods will likely want to analyze the degree to which green construction can generate operating savings within its own, internal budget.

The goal of the present analysis is to expand the set of analytic tools available to builders and developers, including developers who need to understand the *private* returns they can expect from paying the "green premium" needed to secure LEED certification for their projects. The focus, therefore, is on returns that can be captured by the sponsoring organization itself—either the building tenant that secures savings in operating costs, or an owner who can (therefore) command premium rents. We consider the green premium the same as any investment that results in a stream of cash flows—in this case, cash flows in the form of operating savings resulting from the green building. In short, we consider building to LEED standards in strictly financial terms.

We used project cost estimates from a green building project to determine the green premium between a conventional project and a green project, and then we calculated an internal rate of return (IRR) on this green premium. We rely on the IRR financial metric as a threshold for the client's opportunity cost of accepting the project.[3]

PROJECT DETAILS

For this research we used data from a construction renovation certified by the US Green Building Council (USGBC) Leadership in Energy and Environmental Design EB (LEED) green building rating system. This is the most widely accepted certification program available for green buildings, and it was recently called the most credible in a report prepared for the US General Services Administration.[4] We acknowledge that green buildings can exist without LEED certification, but LEED certification provides a credible third-party verification of what constitutes a green building.

Our research subject was a mid-sized organization that outgrew their existing facilities. They were gracious hosts, allowing us to browse their project finances, accounting books, and LEED certification presentation materials. We thank our collaborators by respecting their right to remain anonymous, and will henceforth refer to them as Verde.[5]

Verde considered several options to expand their facilities, but settled on pursuing a renovation of their existing facilities. In considering the decision to invest in green building, they looked at cost estimates and projected operating savings resulting from the green building. They also considered the intangible positive effects of green building—responsible environmental stewardship; worker health, satisfaction, and reduced absenteeism; and good publicity. We wanted to replicate Verde's decision from a financial perspective and see what lessons could be learned about the cost analysis needed to invest in green building.

Our first step was to determine project costs. Verde completed most of this work, but not in a standard format. We consolidated invoices, receipts, bills, estimates, and learned our first lesson: tight accounting of project costs is essential to tracking the budget. Considering our goal of creating presentation-worthy information, we consolidated all information into summary tables that effectively present project costs to a prospective project financier.

TABLE 1. Project construction costs.

	Materials	Labor	Total
Metals, Masonry, Misc. Materials	$95,269	$157,113	$252,381
HVAC	$126,471	$96,583	$223,054
Electrical	$54,037	$98,891	$152,928
General Construction	$36,692	$51,926	$88,618
Thermal/Moisture Protections	$26,636	$40,165	$66,801
Plumbing	$19,539	$33,556	$53,095
PV Array	$35,000	$15,000	$50,000
Doors and Windows	$19,507	$3,945	$23,452
Misc. Costs	$3,070	$6,211	$9,281
Site Work	$2,058	$1,372	$3,430
TOTAL	**$418,279**	**$504,762**	**$923,041**

TABLE 2. Design team costs.

Architect	$45,000
HVAC Engineer	$25,000
Energy Commissioner	$14,600
Energy Architect	$8,740
Light Design	$6,000
Site Planner	$4,679
Misc. Fees	$52,919
TOTAL	**$156,938**

Table 1 presents the construction costs for the project, including materials and labor for different features of the building.

Next, we consolidated the costs of the project design team into Table 2.

We accounted for costs specific to obtaining LEED certification in Table 3.

LEED Administration Fees include project registration with USGBC and Verde's costs of documenting, preparing, and filing evidence of LEED credits. Renewable Energy Credits (RECs) represent electricity created using renewable fuel sources like solar energy, wind, or biomass. RECs are accepted in lieu of direct use of renewable energy to satisfy LEED's

TABLE 3. LEED costs.

LEED Administration Fees	$1,850
Renewable Energy Credits	$4,314
TOTAL	**$6,164**

TABLE 4. Total green building project costs.

Materials	$418,279
Labor	$504,762
Design Team	$156,938
LEED Costs	$6,164
TOTAL	**$1,086,143**

Green Power credit, and were purchased by Verde for this purpose. We added the REC purchase to Table 3 because it was separate from construction and purchased solely to obtain a LEED point.

The total project costs are summarized in Table 4.

GREEN BUILDING PROJECT BENEFITS

In order to compare the initial costs with potential return on investment, we determined the operating savings expected as a result of the green features to continue our financial analysis. The LEED rating system awards points in five environmental areas: Sustainable Sites (14 possible points), Water Efficiency (5), Energy and Atmosphere (17), Materials and Resources (13), and Indoor Environmental Quality (15).[6] It is no surprise that Energy and Atmosphere offers the greatest point potential, accounting for nearly half of the necessary credits for LEED certification, given the growing concern about climate change and poor air quality resulting from emissions of electric utilities. For instance, coal power plants are the primary source of electricity demanded from buildings in many municipal areas. Energy efficiency credits also offer the highest potential for operating savings in the current environment of rising municipal energy prices. Indeed, while Verde obtained credits from every LEED category, they obtained the most of potential awards from the Energy and Atmosphere category (about 82% of the total LEED points obtained).

In this study we included only empirical savings in the energy consumption for the building for the revenue stream. Although previous studies have shown the potential value of benefits such as increased worker productivity and improved air quality, we did not have sufficient information to accurately measure these benefits. Further studies could include possible metrics to incorporate these benefits into empirical savings.

Verde completed a Building Energy Simulation (BES), required for LEED certification. The BES estimates energy use of a building through three sections: Building Loads calculates space heating and cooling; Air Handling Systems calculates energy used to move heating and cooling in a building; and Central Plants calculates fuel required to produce heating and cooling. The BES is run to determine a baseline value for the energy consumption of the building without incorporating high performance features. The user can compare differences in energy use and model the expected operating savings.[7]

Verde projected over a 50% reduction in energy use resulting from green features, and to model their savings they appropriately discounted their current energy bills, as shown in Table 5.

TABLE 5. Annual building energy savings.

Baseline Use			Per Unit Rates		Baseline Costs
Gas (therms)	5,619	x	$1.40	=	$7,866
Electric (kWh)	319,863	x	$0.10	=	$31,986
				Total	**$39,853**
Efficient Use			**Rates**		**Efficient Costs**
Gas (therms)	2,697	x	$1.40	=	$3,776
Electric (kWh)	153,534	x	$0.10	=	$15,353
				Total	**$19,129**
				Efficiency Savings	**$20,723**

Note: Analysis assumes 52% energy savings from Baseline building model.

FINANCIAL VIABILITY OF THE GREEN PREMIUM

In this section, we analyze whether investing in a green premium would have a positive return. First, we will calculate the green premium as the differential in costs between a conventional building and Verde's building.

Verde estimated that a conventional alternative would cost between $60/ft^2–$70/ft^2, so we modeled a conventional building project at $65/ft^2. That gave us a green premium of about $111,143. We summarize the information in Table 6.

As we can see from Table 6, the project's cost per square foot for the LEED case is $72.41. This represents an additional cost of $7.41 over the conventional baseline. The decision of investing this premium in the renovation should obey the fact that the expected rate of return of this investment will be greater than or equal to Verde's Weighted Average Cost of Capital (WACC). Broadly speaking, a company's assets are financed by either debt or equity. WACC is the average of the costs of these sources of financing.[8] Therefore, we can consider the WACC as the specific cost of capital for a particular company.

In calculating the expected returns of the LEED renovation premium, we looked to its Net Present Value (NPV). We used as the discount rate the interest rate from the loans that Verde acquired for financing the renovation. This rate was 5.72%. We acknowledge that this is a limitation of the analysis, since in defining a discount rate one needs to determine Verde's WACC. Unfortunately, Verde did not furnish adequate information to perform this analysis.

The premium's NPV was calculated on the generated cash flow from energy savings resulting from the renovation.[9] Verde's BES depicted an overall energy use reduction of over 50%, and in constructing our model we simply used this figure to estimate the sav-

TABLE 6. Project financial analysis.

Project Economics Comparison		
	Total Cost	**Cost/ft^2**
Conventional	$975,000	$65.00
LEED	$1,086,143	$72.41
Premium	$111,143	$7.41

TABLE 7. Green premium cash flow.

Year	1	2	3	4	5	6	7	8	9	10
Cost	($111,143.68)	$0	$0	$0	$0	$0	$0	$0	$0	$0
Savings	$0	$20,723.82	$20,723.82	$20,723.82	$20,723.82	$20,723.82	$20,723.82	$20,723.82	$20,723.82	$20,723.82

ings cash flow. The cash flow from which we calculated the green premium's NPV is in Table 7.

Table 7 shows that the difference in estimated annual cash flow between the green building and the conventional building are the initial green premium—a negative outflow, ($111,143.68)—and the recurring operating savings—positive inflows, $20,723.82. This implies annual savings of $1.38 per ft^2.

There are some notable assumptions in this cash flow. First, we included all project construction costs in the initial year, with no additional costs in subsequent years. Second, we assume construction will begin and end in this initial year, but there could be project delays. Third, we modeled a constant stream of unchanging operating savings, even though we know the revenue is sensitive to fluctuating energy prices or changes in occupant energy demand. By doing the latter, we were conservative since energy prices are expected to increase over time. This increase would be a result not only from the escalating uncertainty in the energy market (e.g., non secure fuel supply and imminent regulations to mitigate climate change, among others), but also from inflation. Therefore, any inaccuracy that this analysis may lead from increased energy prices, will work towards augmenting the savings from the project.[10] In this sense, in a subsequent section we analyze the financial sensitivity of the project to changes in energy prices.

We will show that if operation of the building results in at least its modeled energy savings, at modeled cost of energy, then it will become a viable investment option. Finally, just as there are savings directly attributable to investing the green premium in high performance features, there may also be additional maintenance, staff training, or other operating costs. Verde did not model any of these additional features in their analysis, so this potential was not taken into account.

The time horizon of our model is also worth an explanation. Some investment models use a shorter horizon since market risk increases and reliability of data decreases over time. Simply, it is hard to tell the future. However, we are comfortable with a ten-year time horizon for modeling this investment decision. The long lifespan of a building makes it a long-run investment, and several previous benefit-cost studies in green building looked at project payback over the span of about a decade.

NPV AND IRR

Bearing in mind the above mentioned assumptions, we calculated the expected returns of the renovation premium. For doing this, we calculated the Net Present Value of the green premium, ($111,143.68), for discount rate of 5.72% and a 10-year scenario. We found it to be NPV = 29,841.24. The positive NPV implies the financial feasibility of the project. In other words, investing in a green premium for this specific case study was a financially reasonable decision.[11]

To know the exact return on our investment, or green premium, we need to calculate the IRR. The internal rate of return (IRR) is the discount rate that results in a Net Present Value equal to 0 for the investment, indicating that the discounted cash flow yielding from the investment is sufficient to pay off the capital outlay. Looking at the IRR on the difference in cost and revenue of the two separate projects is an effective way to use this analysis, as it avoids some of the common problems with IRR as an investment metric.[12] A general rule of thumb for interpreting the IRR is that, if it is greater than the discount rate, then it is a financially viable decision. The IRR for Verde's green premium was 11.83%, which is bigger than the discount rate, 5.72%, therefore it points out that it is a feasible project also.

We have seen in this section that financing the green premium is worthwhile (i.e., NPV ≥ 0 and IRR ≥ 5.72%). Our analysis assumed constant energy prices; however, most of the evidence indicates that these costs are actually volatile. In order to understand how this will affect the feasibility of the project, in the following section we will discuss how the decision of investing in a green premium can change if the cost of energy changes.

SENSITIVITY ANALYSIS

The decision to pay the LEED premium is comparable to borrowing capital to finance a stream of future energy savings. The project pays off (NPV ≥ 0) where the IRR of the project is equal to or greater than the WACC. In this sense, we found that the cash flow resulting from green building projects and its return on investment is sensitive to energy costs: the return on investment increases as energy prices increase and decreases if energy prices fall.

Since, in general, savings generated by investing in a green premium are a function of energy prices, we tested the sensibility of the project's financial viability to fluctuations in energy prices. In order to do this, we iterated the cash flow model explained previously, for different combinations of the input values (in this case, energy prices) and retrieved the corresponding IRRs to each input value. With these results, we will generate a matrix with the inputs and corresponding IRRs to assess the sensitivity of the investment to changing energy prices.

As a first step for doing this, we determined the main energy sources for the building. Verde's building uses two main sources of energy: electricity and gas for heating. The prices for these commodities at the moment of the renovation were: $0.10 per kWh—electricity; and, $1.40 per therm—gas, as provided by Verde's utility provider.

Once we identified the energy sources of the building, we ran a series of simulations to determine the effects of changing energy prices on the IRR. However, we must note that both components, electricity and gas, have different prices and, moreover, are related to different energy potentials per unit.

As noted above, electricity and Therms have a different cost as well as a different contribution to the total energy consumption of the building. Since high performance improvements contribute to savings in both electricity and natural gas, it is necessary to convert these energy sources to an equal unit of measure. This study uses the BTU, or British Thermal Unit, which is a unit of energy used in North America with equivalences for both watts/h and therms, the respective units for expressing electricity and gas utilization.[13] First, we will calculate the specific price per BTU Verde faces (taking into account gas and electricity usage), and then we will calculate the different IRRs associated with different energy prices.

The relationship between BTU, therms, and watts, is the following:

1 watt = 3,412 BTUs
1 therm = 100,000 BTUs

We used these equivalences to convert the total kWh and therms used by Verde in terms of BTUs before the project implementation and after it. We did this by simply multiplying the total amount of watt/hs and therms by their correspondent BTU equivalences. The results appear in Table 8.

We found that from the building's total energy consumption, approximately two-thirds were from electricity and the rest from gas. Since Verde does not use the aforementioned energy sources in the same proportion, we weighed both prices by their respective participation in Verde's energy consumption mix in order to calculate Verde's aggregated energy cost per BTU. This is shown in Table 9.

For generating the sensitivity matrix, we decided to change BTU prices by intervals of 2.4%. This variation is the result of the combined annual average change of the prices of electricity (0.32%) and gas (6.45%) during the ten-year period that preceded the

TABLE 8. BTU equivalences for kWh and therms.

	Before	After	Energy % Usage by Source
Total kWh annual consumption	319,863	153,534	
Total therms annual consumption	5,619	2,697	
BTUs equivalence from electric usage	1,091,372,556	523,858,008	66.01%
BTUs equivalence from gas usage	561,900,000	269,700,000	33.99%
Total BTUs	**1,653,272,556**	**793,558,008**	**100.00%**

TABLE 9. Aggregated energy cost per BTU.

	BTU/h	Original Units $	BTU Unit Cost by Energy Source	Weigh in Total Energy Consumption	Relative Energy Prices per BTU in Verde's Energy Consumption
kWh	3,412	0.1	0.00002931	66.01%	$0.0000193
Therm/h	100,000	1.4	0.00001400	33.99%	$0.0000048
Verde's Aggregated Energy Cost per BTU					**$0.0000241**

initiation of the project. Again, we weighed these price changes with the respective participation of gas and electricity in Verde's energy consumption. This simple multiplication allows us to account for reasonable expected changes in both prices, according to the available information at the time Verde invested in the green premium.

It is important to note that we are not accounting for changes in energy prices after the project was initiated, since we are trying to simulate the financial analysis that Verde could have done at that time with the available information.[14] In Table 10, we derived several IRR related to different energy costs.

From Table 10 we can see that the IRR fluctuates as the energy prices change. The project becomes more attractive (bigger IRR) as the energy prices increase and less attractive (smaller IRR) as the energy prices decrease. In fact, the project becomes financially unfeasible when BTU prices drop 11.4% below the project's baseline scenario.

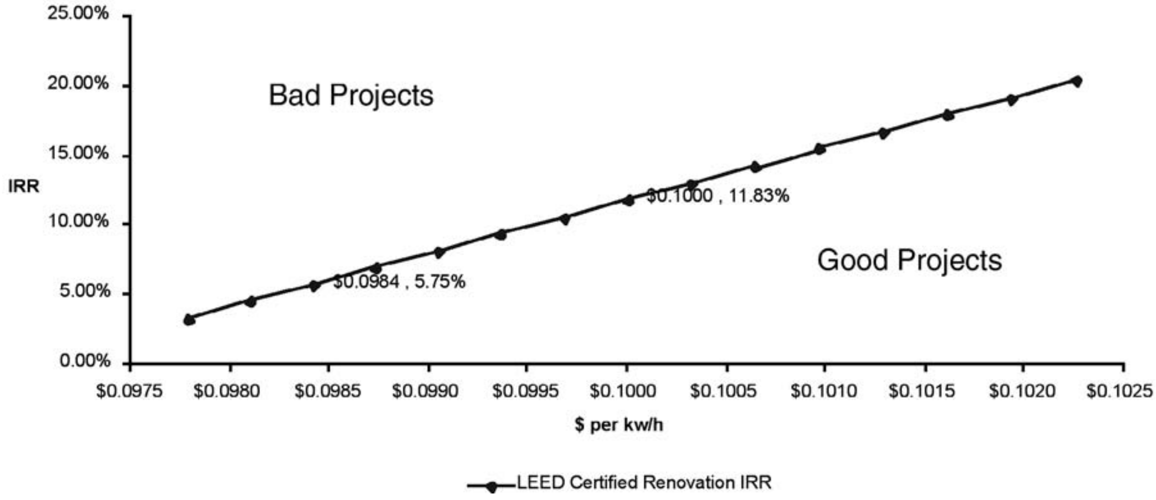
Another way to depict the above mentioned, is to plot LEED Certified Renovation IRR against energy prices. For the sake of a clearer exposition, we chose to plot the Cost per kWh as the independent variable. It is worth to mention, that plotting either cost—BTU/h, kWh, or therm—would be equivalent, since all of them are indexed to the same changes. The resulting graph is shown in Figure 1.

The way to interpret this graph is very intuitive. We have previously defined as a rule of thumb that a financially feasible project will fulfill the condition where IRR ≥ discount rate—which in this case, will be equivalent to Verde's WACC. All projects that lie to the right of the LEED Certified Renovation IRR line are "good" projects, in the sense that they fulfill this condition. All projects that lie to the left of the LEED

TABLE 10. Sensitivity matrix.

LEED Certified Renovation IRR	Cost per BTU/h	Equivalent Cost per kWh	Equivalent Cost per Therm	BTU Price % Change from Project's Baseline Scenario
3.32%	$0.0000203	$0.0978	$0.878	–15.7%
4.53%	$0.0000208	$0.0981	$0.939	–13.6%
5.75%	$0.0000213	$0.0984	$1.003	–11.4%
6.96%	$0.0000219	$0.0987	$1.072	–9.3%
8.17%	$0.0000224	$0.0990	$1.146	–7.0%
9.39%	$0.0000230	$0.0994	$1.225	–4.7%
10.61%	$0.0000235	$0.0997	$1.310	–2.4%
11.83%	$0.0000241	$0.1000	$1.400	0.0%
13.03%	$0.0000247	$0.1003	$1.490	2.4%
14.23%	$0.0000253	$0.1006	$1.586	4.9%
15.45%	$0.0000259	$0.1010	$1.689	7.4%
16.67%	$0.0000265	$0.1013	$1.797	10.0%
17.90%	$0.0000271	$0.1016	$1.913	12.6%
19.15%	$0.0000278	$0.1019	$2.037	15.3%
20.40%	$0.0000285	$0.1023	$2.168	18.1%

FIGURE 1. LEED certification IRR vs. energy cost ($ per kWh).



Certified Renovation IRR line are "bad" projects, in the sense that they do not fulfill this condition.

For example, for a project with a discount rate of 5.75%, only energy prices that are greater or equal to $0.098 per kWh will make it financially feasible (and it would lie to right of the IRR line). Another example would be a project that has a discount rate of 11.83%. For this rate, only energy prices that are at least $0.10 per kWh will make it viable.

From the above analysis, we can conclude that projects lying to the right of the IRR curve imply relatively low cost of capital and high cost of energy; and, projects lying to the left of the IRR curve imply a relatively high cost of capital at low cost of energy.

CONCLUSIONS

We want to highlight a few conclusions from this research. First, we want to reiterate that we support the benefits of green building and hope that it becomes a more prevalent option in the construction industry. However, this transition will never take place without candid scrutiny of the design and construction technologies, and the ability of this investment to produce significant returns. We hope to see improved collection of project cost and savings data and additional empirical research into the financial benefits of green building.

Second, if green building enthusiasts plan to argue that green building costs are paid by resulting operating savings, the industry must improve monitoring of baseline and resulting monitoring costs. Additional reliable data will provide for empirical analysis and strengthen the case for green building. In doing this case study, a major obstacle was the poor accounting practices and records Verde had. We consider that following the generally accepted accounting principles will suffice to keep proper records and will facilitate further financial planning in the organizations.

It is also important to note that the revenues we modeled were only those savings in energy costs directly resulting from green building features. These savings are probably the most significant, but there are other savings unaccounted for—including water savings, the previously mentioned intangible benefits of worker productivity, and demonstration value that add to the intrinsic value of the project.

This is a guiding point for policy makers interested in supporting green building. Municipal policies on other environmental externalities will add to the green premium's revenue stream and improve returns. For example, storm water runoff taxes are imposed in some communities, and green building features could reduce or avoid compliance payments. Also, subsidies and tax credits could help pay down the green premium, making the operating savings more significant and improving returns from investment.

Finally, it is important that green builders distinguish between total project costs and the green premium. Future savings do not need to pay for the total project, just for the incremental cost of LEED certification. In this sense, green buildings may provide significant returns in comparison to other building options.

NOTES

1. This point is drawn from several sources, including Kats et al. and others found on the US Green Building Council's research page. These reports were accessed 12.16.2006 at http://www.usgbc.org/DisplayPage.aspx?CMSPageID=78&.
2. Kats, Greg et al. "The Costs and Financial Benefits of Green Buildings: A report to California's Sustainable Building Task Force." October 2003. Accessed 2.7.2007 at web site of California Integrated Waste Management Board, http://www.ciwmb.ca.gov/greenbuilding/Design/CostIssues.htm#Cost&Benefit.
3. For further discussion of IRR, we recommend Brealey, Richard A., and Stewart C. Meyers. *Principles of Corporate Finance,* 7th edition. McGraw Hill Companies. pp. 96–105.
4. Fowler, K.M., and E.M. Rauch. "Sustainable Building Rating Systems Summary." US General Services Administration. Accessed 12.16.206 at https://www.usgbc.org/ShowFile.aspx?DocumentID=1915.
5. In this sense, we were also asked to omit the LEED certification level that Verde attained.
6. US Green Building Council. "LEED-NC V2.2" October 2005. Accessed 12.16.2006 at https://www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=1095.
7. Chalifoux, Alan. "Using Life Cycle Costing and Sensitivity Analysis to "Sell" Green Building Features." *Journal of Green Building*, Spring 2006. Vol. 1, No. 2: 39–48.
8. Brennan M., and W. Torous, "Individual Decision-Making and Investor Welfare," in: Economic Notes 1999, Heft 28(2), S. 119–143.
9. Savings resulting from reduced water consumption were not included in this analysis. These savings amount to approximately $300 annually from the pre-renovation water cost of $550—roughly, 53% less.
10. Chalifoux, A., 2006, op. cit.
11. To find the NPV of any given cash flow, standard software packages can be used that have integrated NPV as automatic functions in their spreadsheets. This same applies to the IRR that follows the discussion.
12. Brealey, Richard A., and Stewart C. Myers. 2000. *Principles of Corporate Finance,* 6th ed. New York: Irwin McGraw-Hill.
13. A BTU is defined as the amount of heat required to raise the temperature of one pound avoirdupois of water by one degree Fahrenheit.
14. The source of the data is the Energy Information Administration at http://www.eia.doe.gov/emeu/steo/pub/contents.html.