United States
Environmental Protection
Agency

Air and Radiation
(6202J)

EPA–430–B–97–002
June 1998

ENERGY STAR BUILDINGS℠ MANUAL

Business Analysis For Energy-Efficiency Investments

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Business Analysis

All organizations employ basic financial analysis tools to examine the value, risk, and liquidity impacts of investment opportunities competing for limited capital resources. To successfully compete against other business investments, energy-efficiency projects need to be evaluated on the same basis. Fortunately, an informed decision can be facilitated by understanding several basic financial concepts and applying basic analysis tools. This document explains the tools necessary to evaluate profitability, cash flow, and liquidity and presents a framework for using these tools to analyze building upgrade investments that are consistent with EPA Energy Star Buildings℠ Partnership guidelines.

Capital Budgeting Basics

Both for-profit and not-for-profit organizations evaluate potential investments based on the financial bottom line. To evaluate this bottom line, organizations use financial analyses to identify whether an investment passes a predetermined profitability hurdle rate while maintaining acceptable first cost and liquidity requirements. Profitability is typically measured by whether a project's internal rate of return passes the organization's investment hurdle rate. Cash flow and liquidity are evaluated by first cost and payback.

- *First cost* is the up-front cost that is incurred before the investment generates any savings. Large first costs put stress on an organization's balance sheet and may cause an investment to be rejected, even if it is profitable in the long run.
- *Net present value (NPV)* is the total net cash flow that a project generates over its lifetime, including first costs, with discounting applied to cash flows that occur in the future. NPV indicates what a project's lifetime cash flow is worth today.
- *Simple payback* is the amount of time, in years, necessary for future cash flows to return the original investment. Payback is an indicator of liquidity because it measures the speed with which an investment can be converted into cash. Payback is also used as an indicator of risk. As a general rule, short-term events can be predicted more precisely than events in the distant future; thus, assuming everything else is constant, projects with a shorter payback period are generally considered less risky.
- *Internal rate of return (IRR)* is the interest rate that equates the present value of expected future cash flows to the initial cost of the project. Expressed as a percentage,

IRR can be easily compared with loan or hurdle rates to determine an investment's profitability.

- *Hurdle rate* is the accept/reject criterion for determining if an investment passes the profitability test. If the IRR is higher than the hurdle rate, the investment is profitable. Hurdle rates are the marginal cost of capital, adjusted for a project's risk. The higher the cost of capital and risk, the higher the hurdle rate. ENERGY STAR Buildings recommends using a 20-percent hurdle rate for energy-efficiency investments.

Evaluating The Bottom Line

Evaluating investment in long-term building projects requires tools that both consider cash flow over the life of a project and account for the time value of money. Simple payback, although frequently used in the energy management industry, cannot be used as an indicator of profitability because it does not consider returns beyond the payback period and ignores the time value of money. The most powerful tools to evaluate profitability are IRR and NPV. IRR is useful for comparing a project's return against a hurdle rate to determine whether a project is profitable and worth pursuing. NPV is useful for comparing and prioritizing amongst competing projects. Together, they provide a comprehensive evaluation of a project's contribution to the bottom line.

Financial Evaluation Framework

Participants in ENERGY STAR Buildings voluntarily agree to complete, where profitable, a combination of energy-efficient operations and/or equipment upgrades that maximize energy savings while maintaining or improving facility comfort and indoor air quality. The ENERGY STAR Buildings Memorandum of Understanding (MOU) defines a profitable project as one that provides, after tax, an annualized IRR equivalent of at least *20 percentage points* over a period of 10 years. The following

Capital Budgeting Glossary

Cost of capital	The discount rate that is used in the capital budgeting process.
Discount rate	The interest rate used to discount future revenue streams.
Hurdle rate	The minimum acceptable internal rate of return for a project.
Internal rate of return	The interest rate that equates the present value of expected future cash flows to the initial cost of the project.
Net present value	The present value of the expected net cash flows of an investment, discounted at an appropriate percentage rate, minus the initial cost outlay of the project.
Simple payback	The number of years required to return the original investment from net cash flows.
Time value of money	Money received today is valued more highly than money received at a future date.

framework provides for a logical, systematic approach to evaluating energy-efficiency investments consistent with MOU guidelines, and should be applied to projects within each of the five stages of a comprehensive EPA ENERGY STAR Buildings upgrade.

1. Prepare a cash flow analysis for each upgrade option.
2. Calculate IRR for each option. Determine each option's profitability against the 20-percent hurdle rate.
3. Compare competing options and prioritize options within a package using NPV.
4. Maximize energy efficiency by packaging options where appropriate.

Business Analysis Example

Prepare Cash Flow Analysis

Evaluating profitability with IRR and NPV requires the preparation of a cash flow analysis. A simple cash flow estimate (see Table 1) should be prepared for each potential energy-efficiency option suggested by an energy audit. This analysis lists the year-to-year costs and savings for all implementation, operation, maintenance, and disposal costs, and energy and demand savings, over the life of the equipment. For planning purposes, and to be consistent with the ENERGY STAR Buildings MOU, the investment is evaluated over a period of 10 years. Each option generally has a first cost and a stream of cost savings. In our example, the first cost is the installation cost estimate, which occurs in year zero. In the unusual case that the retrofit is planned over multiple years, provide an estimate of the cost for each year in which the work will be completed. Be sure to document the projected schedule in the list of key assumptions.

Project energy cost savings. Typically, an energy audit report converts your energy and demand savings into monetary savings based on your current energy rates and operating schedules. If you anticipate energy price changes, you may want to adjust the amount of savings in future years. Also, for a multiyear project, you will need to phase in the energy savings over the first few years as appropriate. Be sure to document the energy rates that are used for the calculation and the planned operating schedules in the list of key assumptions. In our example, the energy prices and operating schedules will remain constant over the 10-year life of the equipment.

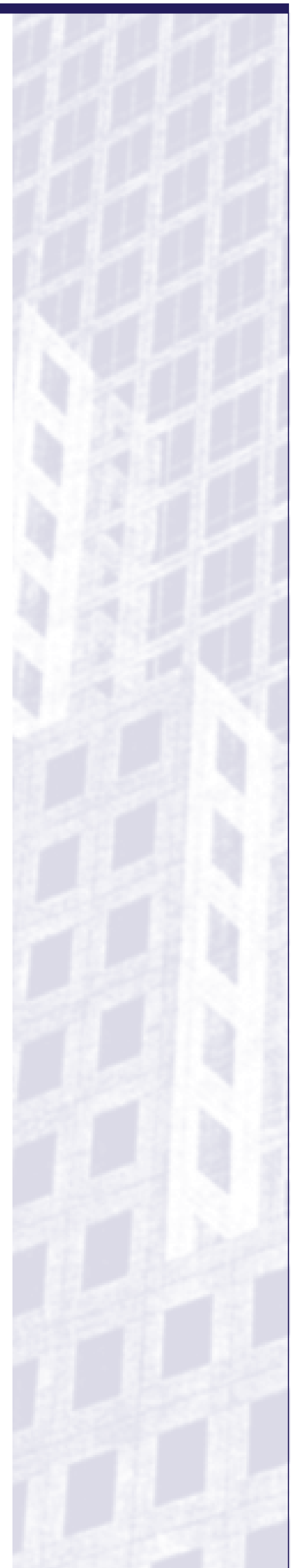

Table 1: Cash Flow Analysis For LED Exit Signs

Year	*Retrofit Cost*	*Energy & Demand Savings*	*Maintenance Savings*	*Omitted Savings*	*Risk Level*
0	$ 3,250	$ 0	$ 0	Neutral	Neutral
1	0	2,181	200		
2	0	2,181	200		
3	0	2,181	200		
4	0	2,181	200		
5	0	2,181	200		
6	0	2,181	200		
7	0	2,181	200		
8	0	2,181	200		
9	0	2,181	200		
10	0	2,181	200		

Key Assumptions:
1. Retrofit will be completed in 3 months.
2. LED exit signs have a 10-year life expectancy.
3. Energy savings are based on the current average energy rate of $0.078/kWh.
4. No changes in energy rates will occur during the 10-year period.
5. Maintenance savings are realized because lamps are changed less frequently.

Estimate the annual savings in maintenance costs. In our example, we are replacing incandescent exit signs with LED signs, and can thus realize substantial savings in labor and materials over the life of the equipment. In some cases, an energy-efficiency retrofit can require more maintenance than before, resulting in a negative maintenance savings entry. Document all key assumptions regarding maintenance savings.

Provide qualitative guidance. Additional savings or costs can be difficult to quantify. Potential savings that resist measurement include gains in worker productivity, increased sales attributable to the upgrade, and enhanced corporate image. Omitted savings/costs should simply be classified as having a negative, neutral, or positive influence on the net annual cash flow. For all six of the lighting options in the example, omitted costs/savings are neutral, even though evidence suggests that office lighting retrofits can increase worker productivity.

Classifying the risk level of the project can also be difficult. Because of uncertainty about future events (for example, the price of electricity in the year 2003), anticipated cash flows may be difficult to estimate. However, compared with other investments that a company may make, such as new product development, energy-efficiency projects are widely considered to be low risk. If you do not know the risk levels of other investments your organization is considering, you may want to classify the risk of energy-efficiency investments as neutral to be conservative.

Cash flow analyses for most options will follow this simple example, in which the initial cost occurs in year zero, savings estimates are constant over a 10-year life, and risk and omitted cost/savings are neutral. In our example, cash flows for all six of the Stage One lighting options were evaluated using this simple framework.

Cash Flow Assumptions

Estimating cash flow is the most difficult part of any financial analysis. While initial retrofitting costs are relatively easy to estimate with certainty, estimates of energy savings and operation and maintenance costs savings are based on more extensive assumptions that may be affected by numerous variables. Because future events may not occur as anticipated in your assumptions, the IRR realized for the project may vary considerably from your original estimate. Recognizing this uncertainty, you should explicitly list the assumptions underlying your cash flow estimates, and reach a consensus with other staff that these assumptions are reasonable. At a minimum, assumptions that should be documented are the future prices of energy and your basic operating conditions.

Taxes can also affect your cash flow estimates by increasing depreciation, decreasing energy and maintenance expenses, and, if your project is debt financed, increasing the amount of your interest deduction. If you are unfamiliar with these tax implications, simply omit them from your analysis and express your results in pre-tax terms.

The Profitability Test

If all the options have a single-payment first cost, cash flows that are uniform for the entire time horizon, and equal-length lifespans, you can easily determine IRR using a calculator and Table 2: Project IRR After Simple Payback. Under these assumptions, a 20-percent IRR hurdle would result in a simple payback of 4.2 years. Thus, any option with less than a 4.2-year simple payback would be considered profitable.

If any of the options do not meet these assumptions, then you will need to calculate IRR directly using a financial calculator or spreadsheet software (see the sample formulas on page 6). Free software is available from EPA to perform these calculations, and the most popular commercial spreadsheet packages include IRR financial functions. In our example, as in most cases you will encounter, these three assumptions are valid for all options.

Having calculated the IRR for each project option, simply compare each option's IRR with the chosen hurdle rate of 20 percent. If the option clears the hurdle rate of 20 percent, the option is considered profitable and should be included in your project upgrade package. Remember, IRR should be used to indicate a "go" or "no go" decision for each option. It should not be used to compare or prioritize options; this approach can lead to profit "cream skimming"; in other words, an approach that minimizes first cost rather than maximizing energy efficiency and long-term savings.

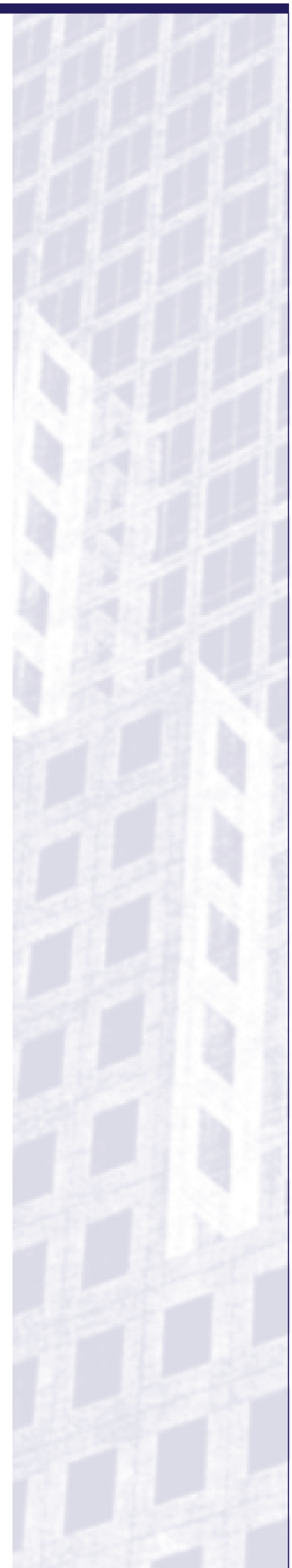

Table 2: Project IRR After Simple Payback

Payback (years)	***Time Horizon (years)***														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1.0	0.0%	61.8%	83.9%	92.8%	96.6%	98.4%	99.2%	99.6%	99.8%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%
1.5		21.5%	44.6%	55.2%	60.4%	63.1%	64.6%	65.5%	66.0%	66.3%	66.4%	66.5%	66.6%	66.6%	66.6%
2.0		0.0%	23.4%	34.9%	41.0%	44.5%	46.6%	47.8%	48.6%	49.1%	49.4%	49.6%	49.7%	49.8%	49.9%
2.5			9.7%	21.9%	28.6%	32.7%	35.1%	36.7%	37.8%	38.5%	38.9%	39.2%	39.5%	39.6%	39.7%
3.0			0.0%	12.6%	19.9%	24.3%	27.1%	29.0%	30.2%	31.1%	31.7%	32.2%	32.5%	32.7%	32.9%
3.5				5.6%	13.2%	18.0%	21.1%	23.2%	24.6%	25.7%	26.4%	26.9%	27.3%	27.6%	27.9%
4.0				0.0%	7.9%	13.0%	16.3%	18.6%	20.2%	21.4%	22.3%	22.9%	23.4%	23.7%	24.0%
4.5					3.6%	8.9%	12.4%	14.9%	16.7%	18.0%	18.9%	19.6%	20.2%	20.6%	20.9%
5.0					0.0%	5.5%	9.2%	11.8%	13.7%	15.1%	16.1%	16.9%	17.6%	18.0%	18.4%
5.5						2.5%	6.4%	9.2%	11.2%	12.7%	13.8%	14.7%	15.3%	15.9%	16.3%
6.0						0.0%	4.0%	6.9%	9.0%	10.6%	11.8%	12.7%	13.4%	14.0%	14.5%
6.5							1.9%	4.9%	7.1%	8.7%	10.0%	11.0%	11.8%	12.4%	12.9%
7.0							0.0%	3.1%	5.3%	7.1%	8.4%	9.5%	10.3%	11.0%	11.5%
7.5								1.5%	3.8%	5.6%	7.0%	8.1%	9.0%	9.7%	10.2%
8.0								0.0%	2.4%	4.3%	5.7%	6.9%	7.8%	8.5%	9.1%
8.5									1.2%	3.1%	4.6%	5.7%	6.7%	7.5%	8.1%
9.0									0.0%	2.0%	3.5%	4.7%	5.7%	6.5%	7.2%
9.5										0.9%	2.5%	3.8%	4.8%	5.6%	6.3%
10.0										0.0%	1.6%	2.9%	4.0%	4.8%	5.6%

Calculating IRR And NPV Using Spreadsheets

A variety of spreadsheet programs calculate IRR and NPV using @ functions. The formulas for three of these programs are identified below. For lighting upgrade calculations, the rate used in each formula is the discount rate, and the range/block/values used are expected cash flows. When calculating IRR, you must have at least one negative value (representing the initial investment). For all three formulas, "guess" represents your best estimate of the IRR. If your estimate is not within an acceptable range, you will receive an error message.

Sample Formulas

Lotus 1-2-3™
IRR = @IRR(guess, range)
NPV = @NPV(interest, range)

Excel™
IRR = @IRR(values, guess)
NPV = @NPV(rate, values)

Quattro Pro™
IRR = @IRR(guess, block)
NPV = @NPV(rate, block)

Compare And Prioritize Options

To compare two competing options or to prioritize options, net present value analysis should be used. NPV discounts the future total net cash flow over a project's life, and thus tells you what a project's future cash flow is worth today. As with IRR, NPV is calculated by using a financial calculator or spreadsheet, using the 20-percent profitability hurdle rate as the discount rate for future cash flows. Note that IRR and NPV are related; a negative NPV indicates that the option generates less than a 20-percent rate of return.

In our example, we have the option of controlling the lighting with either a central time clock or individual occupancy sensors. As indicated in Table 3, even though using a time clock results in a higher IRR and quicker payback, NPV analysis would lead to the selection of occupancy sensor installation to maximize energy savings and the net cash flow value to your organization. Similarly, NPV can be used to prioritize and rank the value of options within a package of upgrades (see Table 4).

Maximize Energy Efficiency By Packaging Upgrades

What about options that are considered marginally unprofitable, but can still contribute to maximizing the energy efficiency of a project? In our example, improving office task lighting, when evaluated individually, does not meet our 20-percent hurdle rate. However, when task lighting is packaged with the other efficiency measures, the project IRR only slips from 27 percent to 26 percent.

Table 3: Comparing The Profitability Of Upgrade Options

Year	*Upgrade Option 1A Occupancy Sensors*		*Upgrade Option 1B Central Timeclock*	
	Initial Cost	*Savings Generated*	*Initial Cost*	*Savings Generated*
0	$ 42,000	$ 0	$ 9,000	$ 0
1	0	12,200	0	3,550
2	0	12,200	0	3,550
3	0	12,200	0	3,550
4	0	12,200	0	3,550
5	0	12,200	0	3,550
6	0	12,200	0	3,550
7	0	12,200	0	3,550
8	0	12,200	0	3,550
9	0	12,200	0	3,550
10	0	12,200	0	3,550
		Cumulative Savings		
Over Ten Years		$ 122,000		$ 35,500
Simple Payback		3.4 years		2.5 years
IRR		26%		38%
NPV		$ 7,623		$ 4,903

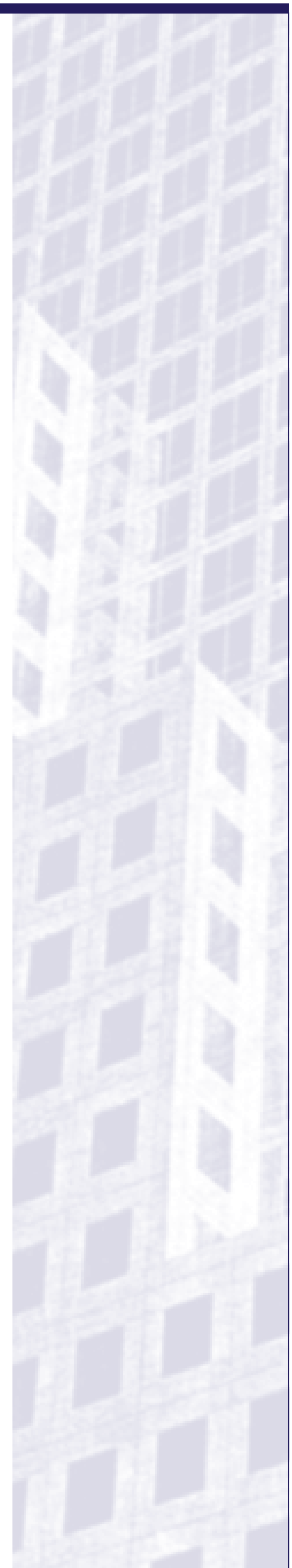

Table 4: Assemble A Profitable Package

	Stage One Green Lights Options	*NPV*	*IRR*	*First Cost*	*Annual Net Cash Flow*	*Omitted Savings*	*Risk*
1a	Install Occupancy Sensors	$ 7,623	26%	$ 42,000	$ 12,200	Neutral	Neutral
1b	Install Central Timeclock	4,902	38%	9,000	3,550	Neutral	Neutral
2	Install LED Exit Signs	5,606	73%	3,250	2,380	Neutral	Neutral
3	Improve Corridor Lighting	5,106	38%	9,490	3,725	Neutral	Neutral
4	Improve Office Lighting	4,751	23%	57,605	15,100	Neutral	Neutral
5	Upgrade Task Lighting	(929)	16%	9,500	2,000	Neutral	Neutral
6	Install Daylighting Controls	(26,524)	2%	59,080	6,500	Neutral	Neutral

Package Results

Options 1-4	$ 23,091	27%	$112,345	$ 33,405	
Options 1-5 (Include Task Lighting)	22,161	26%	121,845	35,405	
Options 1-6 (Include Daylighting)	(4,363)	19%	171,425	39,905	Does not pass hurdle

When evaluated as a package, this option could be combined with the other options and still allow the project to be profitable under the MOU guidelines.

However, in our example, including daylight dimming would not be pursued, as it proves to be unprofitable both when evaluated on its own and as part of the overall upgrade package. Still, high incremental costs alone should not dissuade the specifier from including an option that is marginally profitable, particularly if the option can significantly improve aesthetics or lighting quality, or provide other non-quantifiable benefits such as were noted in the example of the task lighting option.

Other Considerations

Remember that these financial calculations are based on key assumptions. If any of your assumptions change, analyze all of the options again before going forward with a proposed package of options. Another important factor that may affect the decision to pursue an energy-efficiency investment is the manner in which the project is financed. Financing options affect the balance sheet in different ways and can be a determining factor on whether to accept an investment proposal. See Financing Your Energy-Efficiency Upgrade in this manual for more information on loans, leasing, and performance contracting.

To learn about EPA's ENERGY STAR Buildings Partnership,

visit our Web site at
http://www.epa.gov/buildings.

To request a catalog of available materials or for more information, call the ENERGY STAR hotline at 1-888-STAR YES.