3. Investment Analysis

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3.1 Overview

All types of organizations, for-profit and not-for-profit alike, should analyze prospective investments based on their expected cash flows. If a business is contemplating an investment to support a higher level of sales, it should weigh the cost of the investment and any related operating expenses against the additional cash benefits to the business from the projected incremental sales. Only if the expected cash inflow is more valuable than the expected outflow should the investment move forward.

Building upgrades for energy performance also generate cash flow, but not through sales; instead, they reduce the cash flowing out to pay for energy. In some circumstances, energy-efficiency investments can also produce non-energy cash benefits, such as maintenance savings. From the standpoint of the organization's financial health, reduced cash outflow—such as savings in energy and maintenance costs—is just as valuable as increased cash inflow from sales.

Organizations typically employ one or more financial analysis tools rooted in cash flow to study, rank, and choose among investment opportunities. To successfully compete for capital against other investments, building upgrades should be evaluated using the same tools.

3.2 Analytic Conventions

All of the analysis tools explained in this chapter share some conventions and simplifying assumptions. An investment is measured by its impact over time—positive or negative—on the organization's cash position. Positive cash flow indicates an inflow of cash or the equivalent reduction in cash expenditures. Negative cash flow designates an investment of cash or a reduction in cash receipts.

For straightforward energy-efficiency investments, an initial outlay, or *first cost* (a negative cash flow), is followed by energy savings (a positive cash flow). The savings can continue for several years.

Normally, savings from energy-efficiency investments occur more or less continually. For simplicity, however, it is customary to assume that all cash flows occur at one-year intervals, and that the first year's worth of positive cash flows is not received until one year after the initial investment. By convention, the time of the initial outlay is designated *Year 0*. Savings from the investment are then recorded as occurring in Year 1, Year 2, and so on.

Because corporate income taxes add significant complexity to investment analysis, taxes are omitted from the initial explanations of the analysis tools and taken up later in the chapter. Only for-profit businesses need concern themselves with including taxes in the analysis.

3.3 Cash-Flow Analysis Tools

Three cash-flow analysis tools—payback period, net present value, and internal rate of return—are commonly used to evaluate building upgrade investments that improve energy performance.

Payback Period

The most basic, and probably most common, financial gauge of a building upgrade investment is its payback period. It is defined as the time, in years, required for an investment's cumulative cash flow (including the initial outlay) to reach zero.

Suppose you are presented with a proposal to upgrade a building's shell for greater energy efficiency. The contractor says that the installed cost will be $20,000 and that you can expect annual energy savings of $4,000. Assume that your organization plans to occupy the building for at least another 10 years.

Table 3.1 shows the expected cash flow from this investment over 10 years. On a cumulative basis, cash flow is negative until reaching zero in Year 5, so this investment has a five-year payback.

Of course, the same result could be obtained by dividing the initial outlay of $20,000 by the annual savings of $4,000. Suppose, however, that savings were expected to increase after Year 1 due to rising energy prices. In that case, an accurate estimate of payback would require accumulating the yearly cash flows, as in Table 3.1, rather than simply dividing the outlay by the first year's savings.

Even with fluctuating cash flows, the payback period is easy to understand and calculate. Payback can also serve as a rough measure of investment risk: The shorter the payback, the lower the chances that something will interfere with the productivity of an investment before the initial outlay has been recovered.

As an investment analysis tool, however, payback has its shortcomings. It does not account for the cash flows that occur after payback has been achieved and thus does not measure the long-term value of an investment. Also, it treats all cash flows the same, whether they occur in Year 1 or in Year 5. In financial terms, payback ignores the *time value of money*: the principle that money received in the future is not as valuable as money received today.

Table 3.1: Calculation of payback period

Payback is achieved when the cumulative cash flow reaches zero. In this example, payback occurs in Year 5.

Year	Initial investment ($)	Energy savings ($)	Cumulative cash flow ($)
0	–20,000	—	–20,000
1	—	4,000	–16,000
2	—	4,000	–12,000
3	—	4,000	–8,000
4	—	4,000	–4,000
5	**—**	**4,000**	**0**
6	—	4,000	4,000
7	—	4,000	8,000
8	—	4,000	12,000
9	—	4,000	16,000
10	—	4,000	20,000

Courtesy: E SOURCE

Net Present Value

Net present value (NPV) is a measure of investment worth that explicitly accounts for the time value of money. Like payback period, NPV is computed from the stream of cash flows resulting from the investment. Unlike payback period, those cash flows are adjusted (or "discounted") so as to place relatively greater value on near-term cash flows and relatively lesser value on cash flows that are more distant in the future.

The *discount rate* is an interest rate used to adjust a future cash flow to its *present value*: its value to the organization today, which normally corresponds to Year 0. The discount rate is expressed either as a percentage or as its decimal equivalent—for example, 10 percent or 0.1.

Mathematically, if r is the discount rate, then the present value (PV) of a single cash flow (CF) received one year from now—that is, in Year 1—is defined by this equation:

$$PV = CF \times 1/(1 + r)$$

For example, if the discount rate is 10 percent, then the present value of a $4,000 cash flow expected one year from now is:

$$PV = \$4,000 \times 1/(1 + 0.1) = \$3,636$$

More generally, for any cash flow received in Year t (where t represents the elapsed time in years), the present value is the product of the future cash flow and the *present value factor*, $1/(1 + r)^t$:

$$PV = CF \times 1/(1 + r)^t$$

For example, if the discount rate is 10 percent, the present value of $4,000 received five years from now is:

$$PV = \$4,000 \times 1/(1 + 0.1)^5 = \$4,000 \times 0.621 = \$2,484$$

You might find it useful to think of discounting as the inverse of earning interest. In fact, if you invested $2,484 today in a certificate of deposit (CD) that paid 10 percent interest annually, then in five years the CD would be worth $4,000.

The NPV of an investment is the sum of the present values of all the cash flows, including the initial outlay (expressed as a negative number). Refer to **Table 3.2**, which shows the calculation of NPV for the same investment example used in Table 3.1. The sum of the present values is $4,578.

Interpreting and applying net present value. NPV is a measure of the investment's financial worth to the organization, taking into account the preference for receiving cash flows sooner rather than later. An investment is financially worthwhile if its NPV is greater than zero, because the present value of future cash flows is greater than the outlay. In the rare case of an opportunity with a zero NPV, the organization should theoretically be indifferent between making or not making the investment. A positive NPV is the net gain to the organization from making the investment—assuming that the discount rate properly adjusts for the timing of the cash flows.

Besides helping to decide whether an investment is worthwhile, the NPV can be used to choose among alternative investments. If an organization has two or more investment opportunities but can only pick one, the financially sound decision is to pick the one with the greatest NPV.

Selecting the discount rate. The discount rate has a strong direct effect on the NPV. To illustrate this, **Figure 3.1** shows how the NPV for the example project in Table 3.2 varies for discount rates ranging from 0 to 20 percent. If the discount rate is high enough—in the example, just over 15 percent—the NPV turns negative and the investment flips from being financially attractive to unattractive. Obviously, the choice of a discount rate is an important matter.

Table 3.2: Calculation of net present value

The project laid out here is the same as in Table 3.1, with the additional assumption that the discount rate is 10 percent (0.1). The net present value (NPV) is the sum of the present values of all of the cash flows—in this case, $4,578.

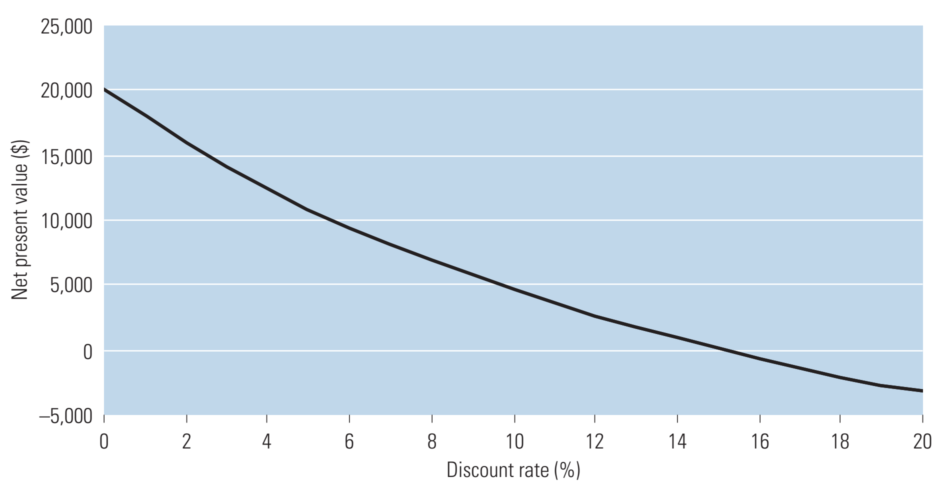
Year	Initial investment ($)	Energy savings ($)	Present value factor ($1/(1 + r)^t$)	Present value of cash flow ($)
0	–20,000	—	1	–20,000
1	—	4,000	0.909	3,636
2	—	4,000	0.826	3,306
3	—	4,000	0.751	3,005
4	—	4,000	0.683	2,732
5	—	4,000	0.621	2,484
6	—	4,000	0.564	2,258
7	—	4,000	0.513	2,053
8	—	4,000	0.467	1,866
9	—	4,000	0.424	1,696
10	—	4,000	0.386	1,542
NPV				**4,578**

Note: r = the discount rate; t = the elapsed time in years.

Courtesy: E SOURCE

Figure 3.1: How the discount rate affects net present value

The project in Table 3.2 is shown here with varying discount rates. With no discounting—a discount rate of zero—the net present value of a project is the simple sum of all of its cash flows, including the initial outlay as a negative cash flow. As the discount rate is increased, the NPV declines and eventually turns negative.



Courtesy: E SOURCE

As the starting point for the discount rate, most organizations use their *cost of capital*—the rate of return that must be earned in order to pay interest on debt (loans and/or bonds) used to finance investments and, where applicable, to attract equity (stock) investors.

Suppose an organization could obtain a loan to finance the entire cost of an energy-saving building upgrade and that the loan carried an interest rate of 8 percent. The cost of capital for this project would be 8 percent. If, using an 8 percent discount rate, the NPV were greater than zero, the project would be financially worthwhile, because the cash flows would be sufficient to pay off the loan and have some money left over.

Some organizations use discount rates slightly higher than their cost of capital in order to lend a conservative bias to investment analyses. A higher discount rate serves to make risky projects less attractive and to screen out investments that are only marginally profitable. On the other hand, a lower discount rate might be used for investments that are perceived as less risky than the organization's normal business activities. A *risk-adjusted discount rate* is one that has been tailored to the risk characteristics of the project being analyzed.

Building upgrades typically involve proven technologies and generate predictable savings. This makes them, in most cases, fairly low-risk investments. Where an organization's overall business activities are riskier than its energy-efficiency opportunities, a discount rate below the organizational cost of capital would be appropriate.

When multiple capital sources—loans, bonds, internally generated funds, and stock—and varying levels of project risk are involved, determining the cost of capital and the appropriate discount rate can get quite complicated. Rather than trying to select the discount rate yourself, you should consult financial experts within your organization to determine if there is a standard discount rate or a standard methodology for selecting the discount rate.

Computing NPV. With spreadsheet software, computing NPV is not difficult. Following Table 3.2, it can be done using year-by-year present value factors. Built-in NPV calculators in some spreadsheet software (including Microsoft Excel) can make the evaluation even easier.

Alternatively, NPV can be computed using certain handheld calculators. Both Hewlett-Packard and Texas Instruments make several models of financial calculators that can store a series of cash flows and compute the NPV.

Internal Rate of Return

The *internal rate of return* (IRR) is an alternative cash-flow analysis tool closely related to NPV. IRR is a percentage figure that describes the yield or return on an investment over a multiyear period. For a given series of cash flows, the IRR is the discount rate that results in an NPV of zero.

In Figure 3.1, the IRR is the point where the curve crosses the horizontal axis: slightly above 15 percent. It would be possible—though extremely tedious—to determine the exact IRR (15.1 percent, in this case) through a trial-and-error procedure, testing different discount rates until homing in on the one at which NPV equals zero. Fortunately, this task can be automated using spreadsheet software or a financial calculator.

Once a potential project's IRR is in hand, the question becomes, is it high enough to justify the investment? The answer, unsurprisingly, is that it depends on the organization's discount rate: If the IRR is greater than the discount rate, the investment is financially worthwhile. If no formal discount rate has been established, try comparing the IRR for the project in question to the IRRs for other projects that the organization has recently funded. Or if project-specific financing will be used, compare the IRR to the interest rate on the financing.

When used as the threshold for an acceptable IRR, the discount rate is often called the *hurdle rate*. As with NPV, it may be appropriate to apply a hurdle rate greater than the cost of capital to prospective investments that are especially risky—or one below the cost of capital to investments of low risk. Energy-efficiency projects that rely on proven technologies are often in the latter category. As with the selection of a discount rate, it is important to consult with financial experts within the organization in order to determine an appropriate hurdle rate.

3.4 Selecting an Analysis Tool

Which financial analysis tool should you use to evaluate energy-saving building upgrades: payback period, net present value, or internal rate of return? The short answer is to use whichever tool your organization normally applies to evaluate investments. For instance, if all investment decisions in your organization are evaluated using payback period, then you should at least include the payback period in any proposal to fund a building upgrade.

Be aware, however, that relying solely on payback may result in forgoing building upgrades that will more than pay for themselves if given enough time. It is not uncommon for organizations to have informal rules that restrict discretionary investments to projects with two-year or better payback. That means a building upgrade costing $7,500 and yielding $2,500 in savings for 10 years would be rejected—even though the cash-flow stream provides an impressive 31.1 percent IRR.

If there is leeway to choose the evaluation tool or to present more than one result, either NPV or IRR is a better choice than payback period. Both measures are rooted in time value of money concepts and account for the benefit stream over the entire useful life of an investment. There are some circumstances, however, in which IRR analysis might yield misleading or confusing results. One such situation involves choosing between mutually exclusive investments—that is, when faced with an either/or decision. The option with the higher IRR is not necessarily the better choice, because the other option might provide greater total worth.

Table 3.3 illustrates this situation. Suppose an organization is considering two ways to turn off unneeded lights. Option A, using occupancy sensors, costs $42,000 and will save $12,200 annually in energy. Option B, using a central time clock, costs less up front ($9,000) but also saves less ($3,550 annually). Considering only the IRRs, option B looks better: It provides a 37.9 percent return, well above the 26.2 percent return from option A. The NPVs, however, show that option A is worth over twice as much in present value terms as option B.

Another issue with IRR is that some cash-flow streams may have indeterminate IRRs, or even two or more IRRs. These anomalous results can occur when one or more negative cash flows occur following some years of positive cash flows. Because of these and other issues with IRR, NPV is generally considered the superior analysis tool. Although the circumstances in which IRR might yield misleading results are fairly uncommon, NPV will always point to the financially correct decision.

ENERGY STAR, in partnership with Building Owners and Managers Association (BOMA) International and the BOMA Foundation, developed the Building Upgrade Value Calculator, a Microsoft Excel–based tool designed specifically for analyzing the financial impact of energy-efficiency investments in commercial office buildings. It projects cash flows and computes IRR, NPV, and other investment measures commonly used in the real estate industry. The Building Upgrade Value Calculator is available as a free download from the ENERGY STAR web site (www.energystar.gov/index.cfm?c=comm_real_estate.building_upgrade_value_calculator).

Table 3.3: Use NPV to choose between mutually exclusive investments

Faced with a choice between two upgrades, use net present value (NPV) rather than internal rate of return (IRR) to guide the decision, because NPV measures the total value of the investment to the organization.

	Option A: occupancy sensors		Option B: central time clock	
Year	Initial investment ($)	Energy savings ($)	Initial investment ($)	Energy savings ($)
0	–42,000	—	–9,000	—
1	—	12,200	—	3,550
2	—	12,200	—	3,550
3	—	12,200	—	3,550
4	—	12,200	—	3,550
5	—	12,200	—	3,550
6	—	12,200	—	3,550
7	—	12,200	—	3,550
8	—	12,200	—	3,550
9	—	12,200	—	3,550
10	—	12,200	—	3,550
IRR		**26.2%**		**37.9%**
NPV (10% discount rate)		**80,000**		**26,500**

Courtesy: E SOURCE

3.5 The Investment Analysis Process

Whether IRR or NPV is the basis for making investment decisions, several principles should be followed in constructing a cash-flow analysis.

Choose the Right Time Frame

The analysis should cover as many years as an organization can reasonably expect to receive the benefits of the investment. That period often corresponds to the useful life of the equipment involved, but it might be shorter, depending on the certainty of plans for future use of the building. If, for example, the organization has a 10-year lease on a building in which upgrades are to be installed, it should probably limit its analysis to 10 years, even if the equipment is capable of generating savings beyond that point.

Do not shortchange a project by cutting the analysis short when a longer time frame can be justified. Consider, for example, that the cash-flow stream shown in Table 3.1, which has a 15.1 percent IRR, would have an 18.4 percent IRR if the benefits continued for another five years. If the organization's hurdle rate were 16 percent, those additional years could be decisive.

Consider All of the Impacts on Cash Flow

The cash-flow examples used so far in this chapter follow a very simple pattern: A single investment is followed by several years of steady cash flows from energy savings. In the real world, building upgrades are not always so simple, and there are additional impacts on cash flow that must be taken into account.

Suppose, for example, that an organization is considering replacing conventional light fixtures that use incandescent bulbs with hard-wired compact fluorescent lamp (CFL) fixtures throughout a building. There will be an initial outlay for the fixtures and the CFLs themselves, followed by multiple years of energy savings, because the wattage used for lighting will be cut by roughly two-thirds. But there will be additional impacts on cash flow. If the analysis applies a 10-year time frame (because the new fixtures will last at least that long), it will also need to take into account:

- *The avoided cost of incandescent bulbs.* Because such bulbs normally last only about 1,000 hours, over a 10-year period quite a few replacement bulbs would have been purchased. Money not spent on these bulbs should be recognized as a positive cash flow.
- *The cost of replacement CFLs.* CFLs typically last 8,000 to 10,000 hours, so several replacement lamps might be needed over 10 years (depending, of course, on the hours the lights are in operation). The cost of those replacements would be a negative cash flow.
- *Labor savings from fewer changes.* Although either type of bulb needs periodic replacement, the CFLs would be changed much less often. If an organization pays $20 per hour for maintenance tasks and a worker can change, on average, 12 bulbs per hour, then the average change-out is costing $1.67 per bulb. The difference between the costs of two change-out schedules—that is, the value of the changes avoided each year by the switch to CFL—should be counted as a positive cash flow attributable to the upgrade.

The additional components of the cash-flow analysis are merely illustrative. For any measures added or removed through the upgrade, you need to think through all the ways in which expenditures could be increased or reduced and then quantify and include those cash flows in the analysis. For example, if the performance of an energy-saving upgrade is expected to degrade over time, the value of the savings should be reduced accordingly.

Account for Interactions Among Measures

As explained in Chapter 1, this manual recommends looking at the building as a whole and pursuing upgrades in a way that considers interactions among measures. Interactions can have a material effect on energy savings and consequently on the projected cash flows for a package of measures.

Take, for example, a lighting retrofit. More-efficient lighting produces less heat, thereby lowering the building's HVAC load. If that factor is ignored, the actual savings will not match the estimate: If cooling is the dominant HVAC load, the actual savings will be higher; if heating is the dominant HVAC load, the actual savings will be lower.

Interactions can also have important consequences for equipment selection. The reduction in cooling load resulting from an energy-efficient lighting system, for example, may be sufficient to justify a reduction in the size of the ducts, pipes, pumps, chillers, and cooling towers that serve that load. "Rightsizing" equipment in this way can produce additional savings, because smaller equipment is generally less expensive. The stages presented in the ENERGY STAR Building Upgrade Manual are designed to maximize savings by accounting for interactions among building systems. Each stage identifies changes that will affect the upgrades performed in subsequent stages, in an overall process that will yield the greatest energy and cost savings.

When considering multiple measures, building simulation software is the recommended approach. Simulation modeling will produce more-accurate estimates of the combined savings of a package of measures than merely summing up individual measure-by-measure analyses, and it can facilitate optimal sizing of the components of the package.

Include Anticipated Price Changes

Even if the physical energy savings attributable to an upgrade are expected to remain constant over the period of analysis, the value of those savings may vary due to changing energy prices. Rising energy prices will, of course, increase the cash flow from energy-efficiency investments. If an organization has access to price forecasts that are specific to its energy suppliers, it makes sense to factor those price changes into the analysis. Long-run national and regional price trends are forecast by the Department of Energy in its *Annual Energy Outlook* and are available online from the Energy Information Administration (www.eia.doe.gov). Price forecasts can also be purchased from a variety of business-information and specialty consulting firms.

Adjust for Taxes

Organizations that are required to pay corporate income taxes should analyze investment opportunities on an after-tax basis. Including the effects of taxes, unfortunately, requires several adjustments to cash-flow analyses.

First, the savings in energy expenses resulting from building upgrades count as taxable income. Paying taxes on that income reduces the net cash benefit to the business. When the effects of federal and state taxes are combined, many businesses' income tax rates are in the range of 30 to 40 percent or higher. This means, for example, that $100 in energy savings might be worth only $60 to the company after taxes have been paid. In general, pretax cash flows resulting from changes in operating and maintenance expenses (including energy expenses) must be reduced by an amount equal to the tax rate times the pretax cash flow.

Second, many building upgrades are subject to depreciation for tax purposes. In calculating income taxes, businesses are allowed to deduct depreciation charges for eligible investments from their taxable income. Those depreciation charges are governed by a complex set of rules and schedules that allocate the deductions over a period ranging from 3 to 39 years, depending upon the nature of the equipment or building.

Depreciation is not a cash expense—no money changes hands when an investment is depreciated—but it reduces the amount of taxes due and therefore increases cash flow. Specifically, the tax-related cash benefit from depreciation in any year (sometimes called the *depreciation tax shield*) is equal to the depreciation deduction times the tax rate.

Third, income taxes affect the cost of some types of capital and thus affect the discount rate. Interest paid on debt, including loans or bonds, is deductible from a firm's taxable income; as a result, the true cost to the firm, after taxes, is less than the stated interest rate. For example, a loan at a 10 percent interest rate has an after-tax cost of only 6 percent if the firm pays income tax at a 40 percent rate.

Fourth, tax deductions or credits may be available for certain types of energy-efficiency investments. A useful resource for investigating tax benefits is the Database of State Incentives for Renewables & Efficiency (www.dsireusa.org), which despite its name covers incentives at both the state and federal levels. It is beyond the scope of this manual to provide details on all of the tax implications of building upgrade investments. Organizations subject to corporate income taxes should consult a tax specialist for assistance in capturing all of the tax-related effects in the cash-flow analysis of investment opportunities.

Consider Sensitivity Analysis

Consider conducting *sensitivity analysis* around critical assumptions, especially ones that are highly uncertain. Suppose, for example, that you are considering an investment in an energy-saving measure that the manufacturer projects to have a useful life of 20,000 operating hours. If you do not have a high level of confidence in that projection, you might explore whether the investment would still be worthwhile if the useful life were only 10,000 hours. This type of analysis can shed light on the riskiness of the investment. It can also help pinpoint assumptions that merit further research before committing to an investment.

3.6 Other Considerations

Although this chapter strongly advocates analyzing building upgrades based on their cash flows, other considerations may be brought into the picture and might help sway decision-makers who are on the fence about building upgrades.

Qualitative Assessments

Frequently, the benefits of building upgrades extend beyond energy savings to other areas such as improvements in employee comfort and productivity or corporate image. If these benefits can be projected and expressed in monetary values, it is best to factor them into the cash flows. Often, however, they are difficult to quantify. In such cases it is advisable to describe the benefits in words and include that information as a supplement to the financial analysis.

Similarly, it may be worthwhile to present qualitative information on the relative investment risk of the proposed building upgrades. Most energy equipment is dependable; the savings can be predicted accurately through careful engineering analysis and the value of savings will remain constant or increase, except in the unlikely event of a downturn in energy prices. This is not to say that building upgrades are totally risk-free: A decision to close down a facility prematurely may zero out several years of expected benefits. But in contrast to other investment opportunities that often hinge on highly unpredictable market forces, building upgrades generally carry low risk. Applying a lower discount rate is one way to adjust for risk; qualitatively highlighting the investment's low-risk profile may be used instead of, or in addition to, a risk-adjusted discount rate.

Effect of Energy Performance on Shareholder Value

A large-scale organizational commitment to building upgrades for energy performance can have a favorable impact on profits, earnings per share, and—ultimately—shareholder value. The U.S. Environmental Protection Agency (EPA) has developed a spreadsheet tool, the Financial Value Calculator, which uses a company's price-to-earnings ratio to project the market value of increased earnings from energy efficiency. The output from the Financial Value Calculator can be presented to senior management as further support for a proposed building upgrade strategy. The calculator is available as a free download from the ENERGY STAR web site (http://wewww.energystar.gov/index.cfm?c=tools_resources.bus_energy_management_tools_resources, under Financial Evaluation).

3.7 Summary

To compete for investment capital, building upgrade projects should be evaluated using standard financial analysis tools that evaluate cash flow. Although reliance on payback period is widespread, other tools such as NPV and IRR are better choices, because they take into account the time value of money and the full stream of benefits over the life of the project.

Constructing a valid building upgrade investment analysis requires careful attention to several steps:

- Choosing an appropriate time frame
- Identifying and quantifying all of the contributing elements to cash flow, both positive and negative
- Considering interactions among measures
- Accounting for future energy price changes
- Adjusting for taxes, where applicable
- Examining the sensitivity of results to changes in key assumptions

The EPA's ENERGY STAR program provides several downloadable spreadsheet tools that can assist in analyzing upgrade opportunities and demonstrating their value to the organization.

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