

PART 5:

Conducting a Financial Analysis

SOLAR ELECTRIC INVESTMENT ANALYSIS

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PHOTO: ERIC ROMICH



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**B-1291.5
August 2016**

SOLAR ELECTRIC INVESTMENT ANALYSIS PART 5: CONDUCTING A FINANCIAL ANALYSIS

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Solar Electric Investment Analysis is a peer-reviewed publication.

Original available at: www.wyoextension.org/agpubs/pubs/B-1291-5.pdf

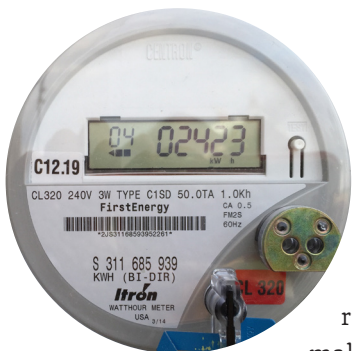
Suggested acknowledgment: Geiger, Milton; Eric Romich, Benjamin S. Rashford. Solar Electric Investment Analysis. Part 5: Conducting a Financial Analysis B-1291.5. 2016.

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Introduction

Photovoltaic (PV) panels are an increasingly common sight on urban rooftops and rural properties across the U.S. The declining cost of equipment and installation makes installing a behind-the-electric-meter (net metered) solar electric system enticing for many homeowners, businesses, non-profits, and agricultural producers. Evaluating the financial prudence of an investment in solar requires careful consideration of installation costs, the value of production, and operation and maintenance costs.

Unfortunately, some installers are not forthcoming with information necessary to make fully informed investment decisions. Third-party ownership structures, such as leases, further increase the challenge of understanding the viability of an investment. This six-part series distills the information collection and decision process into six parts:

- **Part 1: Estimating System Production** – Site-specific factors can influence the amount of electricity produced by a PV installation.
- **Part 2: Assessing System Cost** – From initial costs to incentives to ongoing insurance expense, the present and expected costs dominate the decision to install a PV system.
- **Part 3: Forecasting the Value of Electricity** – Utility and governmental policies affect how much electricity is worth. Not all electrons are created equal.
- **Part 4: Understanding Incentives** – Federal, state, and local incentives can greatly affect the financial viability of a PV installation.
- **Part 5: Conducting a Financial Analysis** – Accurately evaluating the viability of a PV system requires understanding financial concepts, such as simple payback, net present value, and the levelized cost of energy. Preferences for risk, environmental attributes, and independence also inform these measures of viability.
- **Part 6: PV Solar Example** – The importance of accurate evaluation is clear when applied to a hypothetical project.

What about small wind, solar thermal, ground source heat pumps, and other renewable energy sources?

Solar electric is now the dominant type of distributed renewable energy system, but other renewable energy technologies, such as small wind, solar thermal, micro-hydropower, ground source heat pumps, and efficiency upgrades, require similar scrutiny. Systems that provide thermal energy, as opposed to electricity, have less regulatory and policy considerations, but the analysis framework is the same.

We highlight in each part critical questions you must ask yourself and your installer. You will be empowered in the ultimate goal of making an informed decision about whether PV is right for you.



Conducting a Financial Analysis

Understanding your solar production resource, PV system cost, value of electricity, and available incentives enables a robust financial analysis. To make an informed decision, investors need to understand the key components of a PV proposal and how to determine if the system is a sound investment. This bulletin empowers you to make that informed decision.

THE IMPORTANCE OF PRE-TAX AND POST-TAX

Another key consideration is to make sure the proposal accounts for the tax benefits and any tax increases due to the reduction in utility costs. Many proposals present the system cost after all of the tax benefits while listing the electric savings on a pre-tax basis. Energy savings on agricultural or commercial solar systems (not residential) may lower the value of tax-deductible operating expense or “write offs” of electricity purchases from a utility provider.

For example, a proposal with a total system cost of \$45,000 may show the cost as \$8,500 after applying all the grants and tax benefits, yet it will present the electric savings as \$1,224 per year; however, if the taxpayer is in the 39.6 percent federal tax bracket, the after-tax cost of the electric savings is only \$739. Although excessively simplistic and not accurate, the installer/developer may divide the after-tax cost of the system (\$8,500) by the before-tax cost of the electric savings (\$1,224) and claim that the payback is 6.9 years. However, when evaluating everything on an after-tax basis and dividing \$8,500 by \$739, the result is a significantly longer payback period of 11.4 years. In summary, ensure proposals are consistent in how they apply tax affects.

Insurance is a critical topic, yet it is sometimes overlooked and excluded from a proposal. For example, PV system owners who use the Federal Business Energy Investment Tax Credit (ITC) must retain ownership and operate the system for five full years after the original project commission date. Insurance can ensure you have the financial resource to replace a PV system in the event of a natural disaster. When reviewing proposals, PV system owners should contact their insurance providers and get a quote to add the PV solar system to the their policy. While this will most likely lead to an increase in insurance rates, it is important to accurately consider insurance costs in the project cash flow analysis and perhaps more important to ensure the investment is fully protected. A common way to calculate the insurance cost is to multiply the insurance rate by the total system cost. Insurance costs also increase annually by the inflation rate selected for the project analysis. For farm and business applications, the insurance cost is a tax-deductible operating expense.

In addition, for residential applications contact your home insurance provider and add the PV system to your homeowner policy to include the cost of a replacement solar system in the event of a catastrophe.

EVALUATING THE FINANCIAL RETURN

While the decision to purchase a PV system is seldom based on costs alone – social and environmental criteria matter, too (how much do you value energy independence? how much do you value clean electricity?) – purchasing a PV system is a significant financial investment. Sound investment decisions require more than just understanding the production of a PV system and interpretation of a system proposal. Sound investment decisions require thorough economic analysis of expected costs and benefits.

Simple payback is one of the most requested measures of a PV system's economic feasibility. Simple payback determines the number of years for the energy savings from the PV system to offset the initial cost of the investment:

$$\text{Payback (years)} = \frac{\text{Initial Cost (\$)}}{\text{Annual Production (kWh/year)} \times \text{Value (\$/kWh)} - \text{O\&M (\$/year)}}$$

Simple payback is an attractive calculation because the calculation is straightforward and easy to understand. Investors can assess how quickly an investment might pay back (the smaller the simple payback, the better the investment) and whether the investment might pay back within the expected lifetime of the project. However, because of the simplicity of the simple payback calculation, there are limitations when assessing the economic feasibility of PV projects. The simple payback calculation ignores several critical investment characteristics, including the time value of money, energy price escalation, variable rate electricity pricing, alternative investment options, and what happens after payback.

An important concept in investment analysis is the time value of money. The time value of money is usually positive – a dollar today is worth more than the same dollar in the future. Positive time value occurs for three reasons:

- Inflation – rises in the overall price of goods and services implies that every dollar in the future will purchase less than it can today – \$1 may buy a candy bar today but because of inflation it will not 20 years from now;
- Opportunity cost – every time you wait to receive a dollar, you give up the chance to use that dollar right away, such as investing that dollar and earning interest. For example, if you invest \$10,000 in a PV solar system, you forgo the chance to earn interest from keeping your money in a bond, stock, or savings account;
- Risk – there is always a chance you won't receive the money in the future.

Ignoring the time value of money leads to an underestimation of a project's real payback time. Just as interest rates are used between lenders and borrowers to capture money's positive time value, thereby compensating the lender for foregoing alternative investment opportunities and risk, a discount rate is used to equate a future dollar amount to its present value. Benefits and costs of PV investments that occur in the future should be discounted to accurately analyze the investment decision. No single



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discount rate makes sense for everyone (personal discount rate is based on an individual's risk and time preferences), but in general the discount rate is the minimum rate of return required from an investment. As an example, a low discount rate (0-4 percent) would indicate a tolerance of risk and a high willingness to accept benefits in the future. A high discount rate (4-12 percent) would suggest the opposite.

So what does this mean for energy investments? Energy savings 10 years from now are worth less than the same savings today because of inflation, the lost opportunity to earn interest, and risk. In simple payback, the energy savings in the future are valued the same as energy savings in the present. For low discount rates (e.g., 4 percent), the error in the payback calculation may be small because energy savings today are valued similarly to savings in the future; however, for higher discount rates (e.g., 10 percent) simple payback can severely underestimate the true payback period.

Simple payback also does not account for electricity price escalation (an increase in the real – inflation adjusted – price of electricity). This is an important economic consideration as expected electricity price increases are one of the most common reasons people consider renewable energy. If energy prices increase over the life of a PV investment, then the true payback period will be shorter than predicted by the common simple payback formula.

Simple payback also cannot easily accommodate variable rate electricity prices. The value of electricity generated, used in the denominator of simple payback, is typically calculated by assuming the same price for each unit of electricity produced. Many utilities, in contrast, have variable rates (tiered or block pricing). The cost per kWh depends on the number of kWh consumed – in some cases, the price per kWh may increase or decrease with greater consumption. A grid-connected PV system could offset the highest-priced electricity by bringing a household down to a lower pricing tier. This added benefit of renewable energy systems is not easily captured in the simple payback calculation. Ignoring variable pricing will tend to overestimate the actual payback period.

KEY SIMPLE PAYBACK TERMS

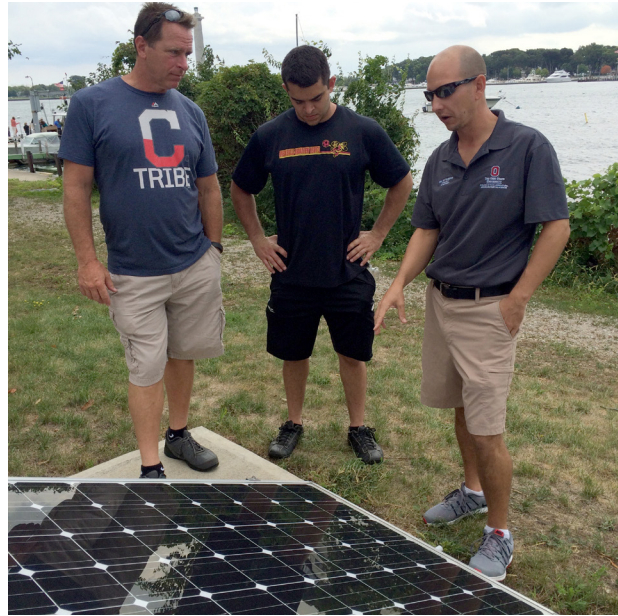
Initial Cost: Total price paid for PV installation

Annual Production: Amount of energy produced per year (kilowatt-hours per year for electric systems)

Value: Price paid for energy from utility or conventional source if not provided by PV system

O&M: Operations and maintenance, including repairs and updates over the life of the system.

Consumers should evaluate both PV and energy efficiency options to make the most financially sound investment decision (compare a PV system to the savings from energy efficiency improvements). Simple payback is not well-suited to comparing alternative investments. For instance, simple payback cannot meaningfully compare alternative investments that have different expected useful lives – payback treats a wind turbine with an expected life of 15 years and solar PV system with a life of 25 years as equal. The economic worth of an investment, however, is actually determined by the net benefits after payback. You invest in stocks hoping to make a return above and beyond your initial investment, right? Simple payback does not factor in the energy savings (benefits) and costs that occur after the payback period. As a result, two investments that have identical payback periods but vastly different useful lives (one will continue to produce benefits much longer than the other) will be incorrectly judged the same by the simple payback criterion.



Despite simple payback's several drawbacks, it can be used to effectively screen clearly undesirable investments that have extremely long payback periods compared to the life of the PV system. For instance, a system with an expected life of 25 years but a simple payback of 40 years is unlikely to be a sound investment decision regardless of whether you account for the drawbacks to simple payback.

Fortunately, investment analysis has several alternative metrics that, while requiring more effort, solve most of the drawbacks of simple payback. These metrics, particularly net present value and levelized cost of energy, consider important factors, such as time value of money and escalation. The National Renewable Energy Lab's System Advisor Model (SAM), which is used for the example in Part 6, calculates both measures as part of project analysis.

Net present value (NPV) considers both the savings and cost of PV project. The savings and costs are also both discounted. In general, a positive net present value reveals an economically feasible project, but there are nuances to this assessment. The greater the NPV, the better, but a positive NPV does not necessarily mean the investment should be made. The opportunity cost of the capital is also important. Are there better ways (higher NPV) to invest? The lifespan of the investment matters, too, making comparison of investments that have different time frames difficult.

Levelized cost of energy (LCOE) expresses the cost of the energy produced from a PV system. The measure includes construction and operation costs, and if shown as real LCOE, is closely related to the net present value. The principal advantage of LCOE is that comparisons are possible between different electricity sources, such as utility-provided electricity and roof-mounted PV. You can also make comparisons across different system lifespans. However, be cautious when using LCOE to compare different types of renewable energy generation to that of a dispatchable energy source such as a natural gas or coal generator. While LCOE can help inform the decision, it should be noted that

because PV solar electricity is a variable resource, other energy sources are required for the PV solar to take advantage of a low LCOE. Although seemingly the best option for comparing alternatives, LCOE is not immune to the effects of poorly considered discount and energy escalation rates. Be careful with your choices!

The take-home message is that simple payback can provide an initial indication of economic viability but does not provide enough information to make a sound decision on such a large investment. Purchasing a PV system based on the simple payback alone may result in very disappointing returns. Net present value and levelized cost of energy offer more complex, but more complete, measures of economic viability. Part 6: PV Solar Example provides examples of simple payback, net present value, and levelized cost of energy in action.

Still a bit perplexed about how to conduct a financial analysis on a proposed PV project? Please contact a local extension office.

