

## **PART 1:**

# Estimating System Production

# **SOLAR ELECTRIC INVESTMENT ANALYSIS**

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PHOTO: ERIC ROMICH



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**B-1291.1  
May 2016**



# SOLAR ELECTRIC INVESTMENT ANALYSIS PART 1: ESTIMATING SYSTEM PRODUCTION

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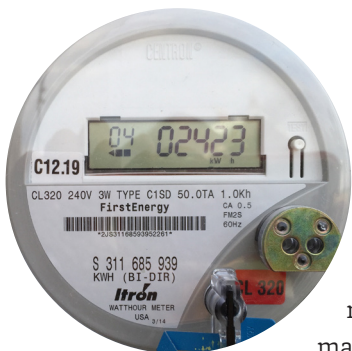
Solar Electric Investment Analysis is a peer-reviewed publication.  
Original available at: [www.wyoextension.org/agpubs/pubs/B-1291-1.pdf](http://www.wyoextension.org/agpubs/pubs/B-1291-1.pdf)

Suggested acknowledgment: Geiger, Milton; Eric Romich, Benjamin S. Rashford. Solar Electric Investment Analysis. Part 1: Estimating System Production. B-1291.1. 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.

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.

***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.



# Estimating System Production

Producing renewable energy is much like gardening or farming – the quantity produced and the net value of the product determine profitability. If you grow more tomatoes, more tomatoes can be sold at the farmers market. Similarly, if you have tomatoes for sale when others do not, then the tomatoes can be sold at a higher price. The profit earned on tomatoes must consider the capital put into growing them (e.g., a high tunnel) and the ongoing inputs (e.g., labor and fertilizer) during the growing season.

Two similar components drive the return from a PV system – total amount of electricity produced and net value of that production. Since electricity is measured in kilowatt-hours (kWh), the value of a solar installation is dictated by the number of kWh produced and how much they are worth after expenses. The more kWh generated from an installation and the higher the net value, the better the rate of return.

## YOUR SITE-SPECIFIC SOLAR RESOURCE

PV installers should provide an estimate of production, typically separated into average monthly production. On a flat landscape, the climate, elevation, and temperature determine the amount of energy produced by a PV solar system. Generally, the resource decreases as one moves from the equator to the poles, but local factors can significantly influence production. For example, Laramie, Wyoming, is at approximately the same latitude as Cleveland, Ohio, but Laramie is sunnier, colder, and higher; the same PV array produces 26 percent more electricity in Laramie than in Cleveland.

Site-specific factors are most critical to determine production, and the ultimate value, of a solar investment. Shading has the most visible negative impact on production. Shading effects will vary by season, often increasing as the sun angle becomes lower in winter months. Departure from true south also affects production, as panels facing east or west will generally produce less than the same installation facing due south. The tilt, often roof slope, of the panels also influences production, as flatter angles will increase production in summer

but decrease production in winter. Temperature can also affect production as increased temperatures increase electrical resistance and reduces PV efficiency.



Most PV panels carry at least a 25-year warranty, but like most man-made objects, the sun will degrade PV panels over time. A typical warranty guarantees that production declines will be less than 0.5



percent a year. A 25-year old panel will produce at least 87.5 percent of original rated capacity of the system – a 10 kW system would be 8.75 kW in year 25. These calculations are considered in the National Renewable Energy Lab’s PVWatts and System Advisory Model (SAM), but an installer should also account for these losses. The National Renewable Energy Lab’s tools and resources can quickly verify an installer’s estimates.

Please contact a local extension educator for additional information regarding estimating the production of a proposed PV system.

## KEY QUESTIONS:

- Is shading, orientation, angle, and temperature included in production estimates?
- Does the lifetime production include annual declines from degradation?

## NATIONAL RENEWABLE ENERGY LAB’S PVWatts

PVWatts is the most commonly used tool for evaluating solar resource. Novices and experts can use the easy-to-use platform. PVWatts even allows customized sizing of a solar array and variations based upon slope and orientation. The tool also offers rudimentary financial analysis. [pvwatts.nrel.gov](http://pvwatts.nrel.gov)

