PART 3:

Forecasting the Value of Electricity

SOLAR ELECTRIC INVESTMENT ANALYSIS

Eric Romich • Milton Geiger • Benjamin S. Rashford

http://bit.ly/2bnNNUF • Elena Elisseeva

UW | EXTENSION

B-1291.3
August 2016

SOLAR ELECTRIC INVESTMENT ANALYSIS
PART 3: FORECASTING THE VALUE OF ELECTRICITY

By Eric Romich, Milton Geiger, and Benjamin S. Rashford

Solar Electtric Investment Analysis is a peer-reviewed publication.

Original available at: www.wyoextension.org/publications/pubs/b1291.3.pdf

Suggested acknowledgment: Geiger, Milton; Eric Romich, Benjamin S. Rashford. Solar Electric Investment Analysis. Part 3: Forecasting the Value of Electricity. B-1291.3. 2016.

Editor: Steven L. Miller, senior editor, College of Agriculture and Natural Resources, Office of Communications and Technology.

Graphic Designer: Tana Stith, College of Agriculture and Natural Resources, Office of Communications and Technology.

Issued in furtherance of extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Glen Whipple, director, University of Wyoming Extension, University of Wyoming, Laramie, Wyoming 82071.

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.

Forecasting the Value of Electricity

The average retail price of electricity (all sectors) in the U.S. increased from 7.29 cents per kilowatt-hour in 2001 to 10.45 cents per kilowatt-hour in 2014[1]. Investing in a PV solar system is essentially hedging against future energy prices. Electricity production from a system will displace electricity that would otherwise be purchased from a utility. Although seemingly simple to calculate the energy savings for a project, one must consider many important variables, including the details of your individual rate structure and the assumed energy escalation rate that influence the value of electricity your PV system produces.

This bulletin will help readers identify their utility rate structure, understand how the rate structure affects the value of electricity, evaluate energy escalation rates, and assess how these factors affect the assumed value of energy savings for a project. A better understanding of how to calculate energy savings will allow a more accurate financial analysis, fostering informed investment decisions.

UNDERSTANDING YOUR RATE STRUCTURE

There are more than 3,300 electric utilities in the U.S. and no standardized rate structure. Most electric consumers never consider the factors that influence the calculation of their electric bills; before assuming energy savings from a PV solar system, the rate structure of your home, farm, or business must first be understood. Common charges often included in farm or business rate structures may include a fixed (basic) charge, energy charge, demand charge, and a monthly charge. To determine specific charges, look up your utility rate structure and identify any cost that will remain after a PV solar system installation. The OpenEI Utility Rate Database

HOW ARE YOU CHARGED FOR ELECTRICITY?

Although the components of a bill vary by utility, the following charges are generally included:

- **Fixed monthly (Basic) charge** – This fee is a fixed dollar amount typically associated with infrastructure costs. A PV system will not reduce this charge.
- **Energy charge** – This charge covers the cost of producing energy (kWh). A PV install will reduce this expense.
- **Demand charge** – Covering peak demand (both daily and seasonal) requires power plants be available to provide energy for relatively short durations. A PV system may reduce this fee, but often PV does not align with peak demand charges.

[1] U.S. Energy Information Administration Electricity Data Browser

(www.en.openei.org/wiki/Utility_Rate_Database) provides a comprehensive list of utility companies in the United States that can be filtered by ZIP code and utility name to research details of your rate structure. You can further assess how different charges influence the value of your energy after determining the rate structure.

VALUING YOUR ELECTRONS

The value of all kilowatt-hours (kWh) produced from a solar array are not the same. When production occurs (time of day and season) and how a utility charges for electricity (fixed, demand, and energy fees) significantly influence how much solar-produced electricity is worth. Both factors can drastically alter the viability of a PV solar project.

Wholesale electricity prices (the price your utility pays for electricity before reselling it to you) vary throughout the day based on demand. For example, wholesale power produced at 10 a.m. is generally less valuable than electricity generated at 6 p.m., when people return home and residential loads surge. Similarly, production in the winter or summer, when heating or air conditioning loads are greatest, is often more valuable than production in autumn or spring. The day of the week also matters, as electric consumers typically use less electricity on weekends than weekdays.

The higher a utility's energy charge, the greater the value of PV-produced electrons. If your utility provider currently (or in the future) applies charges for services other than energy, such as demand, time-of-day rates or fixed charges, then the value of PV-produced electrons will be less.

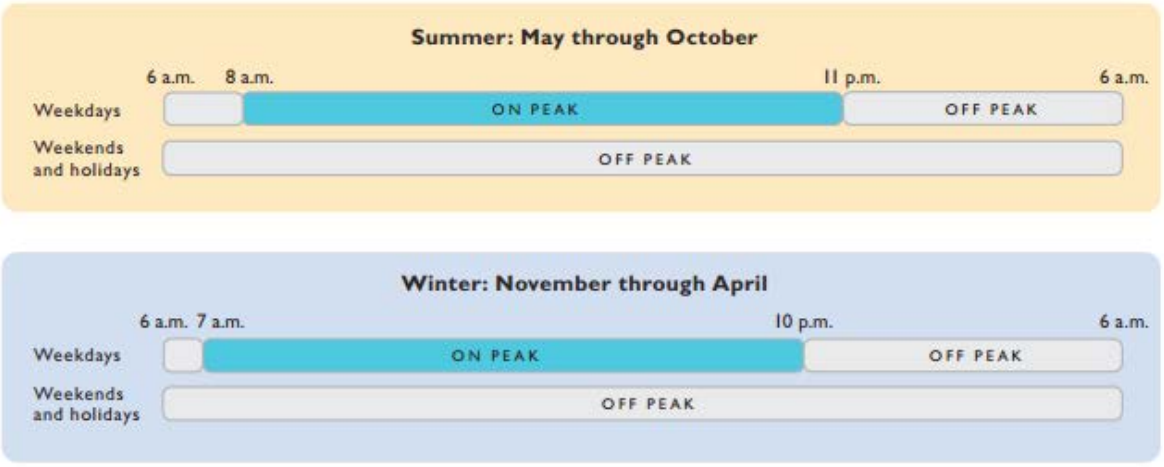
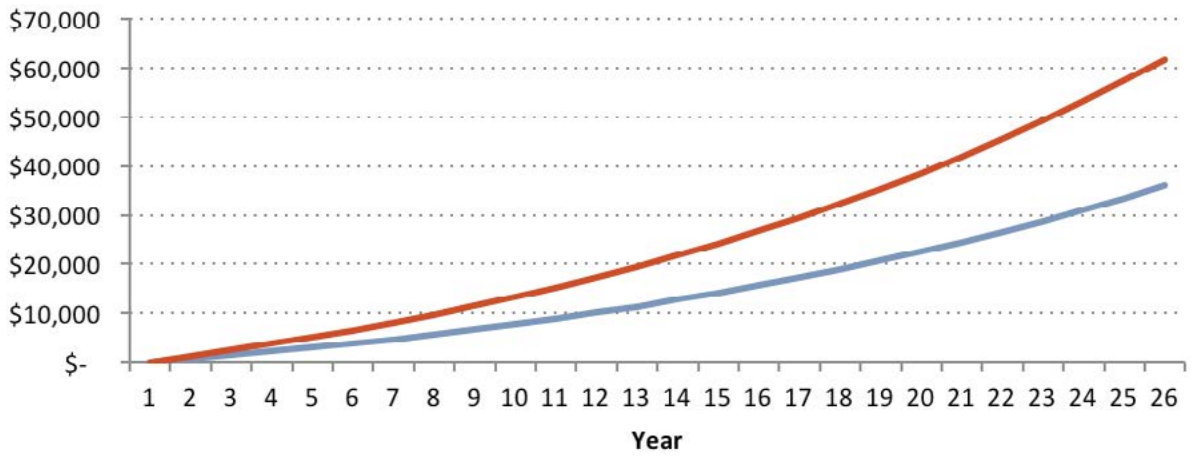


Figure 1: Example of daily, weekly, and season peak rates (Source: Rocky Mountain Power, Idaho)

An example helps illuminate the importance of understanding the value of PV-produced electricity. Consider a farm with average annual electric usage of 32,745 kWh. If a 10 kW solar system with an estimated annual output of 16,253 kWh is installed, the amount of electricity (kWh) purchased from the utility will be reduced by roughly 49 percent. However, the value of that electricity will vary depending on the utility's rate structure. Simulation models such as the System Advisory Model (SAM) help illustrate how different rate structures affect the value of electricity produced by a PV solar system. The SAM model is a computer model developed at the National Renewable Energy Laboratory to estimate system performance and financial impacts of renewable energy projects. This financial model considers the value of electricity generated by the system, incentives, the cost of installation, operation



28 - General Service - Single Phase Primary
Demand Max: 20.5 kW
Energy Max: 5000 kWh

Fixed Charge: $39.00
Energy Charge (buy rate): $0.0352
Demand charge per kW: $16.20

25 - Small Gen Service - Single Phase Primary
Demand Max: 20.5 kW
Energy Max: 5000 kWh

Fixed Charge: $27.25
Energy Charge (buy rate): $0.0726
Demand charge per kW: N/A

Figure 2: Value of Utility Bill Savings (Cumulative) 10 kW PV Solar System Calculated by the System Advisory Model (SAM)

and maintenance, taxes, and debt to simulate a detailed cash flow over the system's lifetime. Figure 2 shows the SAM summary results for the utility bill savings of installing a 10 kW solar system from two separate simulation models.

As illustrated in Figure 2, the expected utility bill savings over the 25-year life of a system is $61,827 for a farm that is on a rate structure (25) with no demand meter charges. In comparison, the same PV solar system would only generate a utility bill savings of $36,138 if the farm had a rate structure (28) that includes demand charges and higher fixed charges. In summary, two PV solar systems that have the same electrical production (kWh) may experience very different energy bill savings based on the rate structure used to calculate their bills.

ENERGY ESCALATION

The final consideration for evaluating the value of PV-produced electricity is to identify the assumptions used to calculate the annual energy escalation rate. The nominal energy escalation rate estimates the annual rate energy prices will increase including overall inflation. The real energy escalation rate is the rate of change in energy prices with the overall inflation rate subtracted. For example, a nominal 3 percent energy escalation rate with 2 percent inflation results in a 1 percent real energy escalation rate. The distinction between nominal and real can significantly influence the expected value of PV-produced electricity in alternative proposals, and you must understand how each potential installer calculates energy savings to properly evaluate alternatives.

Accurately forecasting the energy escalation rate is difficult. Figure 3 shows how real and nominal residential electricity prices have changed since 1960. Around 2000, the real price of electricity began to increase, so most PV proposals assume real prices will continue to grow. Real escalation rates

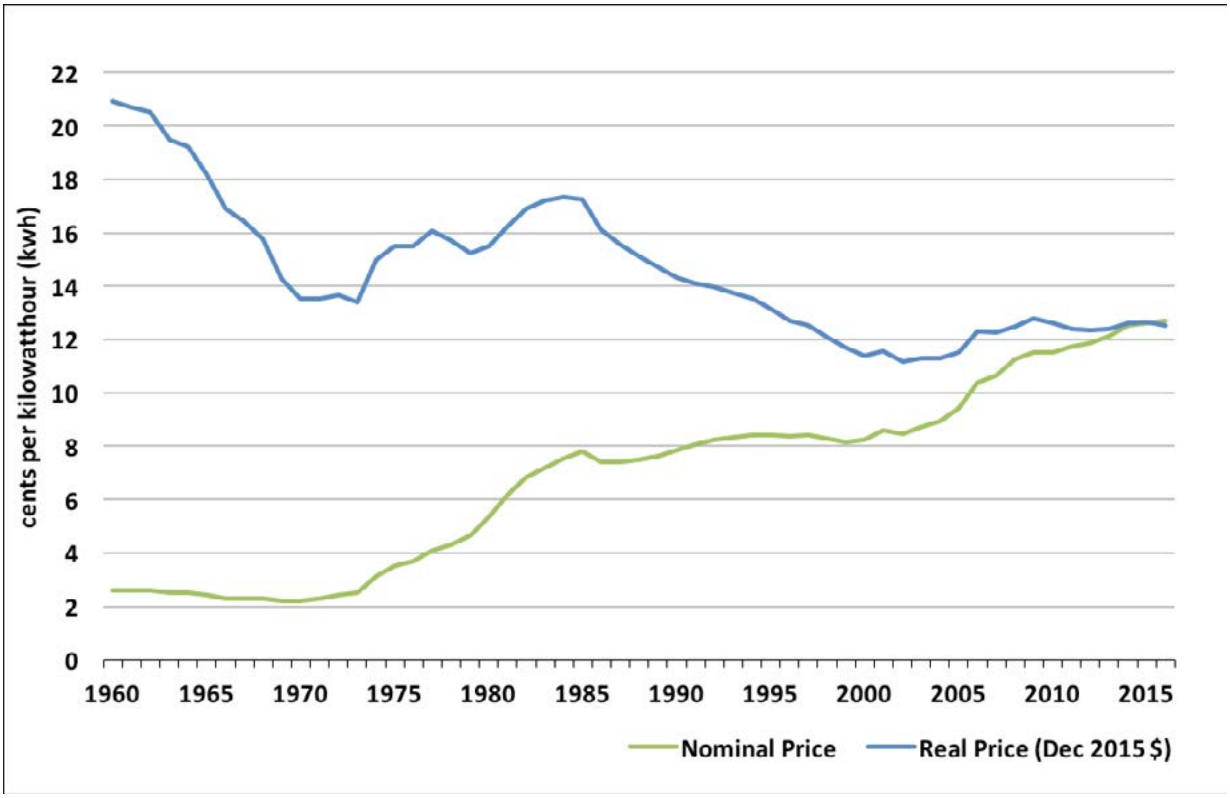


Figure 3: Annual Average Residential Electricity Price (Source: EIA Short-Term Energy Outlook, December 2015)

between 0.5 percent and 2 percent are commonly assumed. You can express your beliefs by changing this value. If you believe policy or environmental concerns will drastically increase electricity prices, use a higher value. If you believe technology will lead to reductions, use a lower factor.

Please contact a local extension educator for assistance if you have questions about how to value the production from your proposed PV installation.

KEY QUESTIONS:

- Is the value of electricity based on an average utility rate, or are fixed fees, demand changes, and energy charges evaluated separately?

- What is the escalation rate used to calculate energy savings? Is it real or nominal?