PART OF A SERIES

Is a Rooftop Solar PV System For You?

By John Brodman

This article, the third part in a series about renewable energy, focuses on the costs and benefits of grid-connected, residential rooftop solar photovoltaic (PV) energy systems in our part of North Carolina. NC has a lot of sunshine; improvements are being made in solar technology; costs are coming down; and generous federal, state, and local incentives (subsidies) for solar remain in place. Everything you need for a residential solar system is readily available today, but you still can't go to Home Depot or Amazon, buy a home solar system, bring it home, attach it to your roof, and pull the plug on your monthly electric bills. It isn't that simple or inexpensive. Figuring out what is best, the type of system you need and what it costs is complicated, but with a little homework and help from other resources, you can determine if solar makes economic sense for you.

This article covers some of the main points you need to consider about the technology, your home and circumstances, the institutional and regulatory frameworks, and the economics of solar power. Hundreds of thousands, if not millions, of pages have been written on these issues, but space in this newspaper is limited. This article avoids getting into the weeds on technical and policy issues to focus on the bottom line, but it does provide links to additional information for those who are interested.

Kilowhats? Rooftop solar panels capture the sun's energy to produce direct current (DC). The DC is then routed through an inverter that changes it to alternating current (AC) that is sent to your main circuit box and used to power your household's electric appliances. The energy required to power a 100 watt light bulb for one hour is 100 watt hours. One thousand watts equals one kilowatt (kW). The energy required to power ten100 watt light bulbs for one hour is 1,000 watt hours, or one kilowatt hour (kWh). The average price of electric power in the US is about $0.12 per kWh, but we pay slightly less ($0.10 per kWh). The average home in the US uses about 1,000 kWh a month, which is about 12,000 kWh a year or 33 kWh per day, but few homes are average. You can estimate your own electricity consumption by looking at your monthly electric bill from your electric company—in our case, Carteret-Craven Electric Cooperative (CCEC).

On your bill you will see a chart of your electricity usage in kilowatt hours (kWh) per month over the previous 12 months. Notice how it fluctuates over time, with higher use during summer and winter months when we are running our air conditioners and heaters, and lower use during spring and fall months when the weather is mild and we have plenty of daylight hours. Average household usage also varies hour-by-hour during the day, with slightly higher use during the morning hours; a drop during the middle of the day; and peak usage during the late afternoon and evening when everyone is home and power systems are in use. In my case, last year's monthly use ranged from a low of about 700 kWh in May and November, to highs of 1,900 kWh in August and 2,400 kWh in December-January.

These daily and monthly fluctuations in electricity consumption are important when considering a solar power system because the power produced by solar panels during daylight hours, in different seasons, doesn't correspond to normal demand patterns. Solar output follows a bell-shaped curve, with lower output near sunrise and sunset, and peak power output for a few hours in the middle of the day. During winter months, with fewer hours of daylight, solar panels produce less power. They produce nothing at night, and less than their rated capacity on cloudy, rainy and overcast days. Solar panels in sunny places like Arizona produce about 30% more electricity than they do in cloudier places such as New York.

Advantages of grid connection. The challenge here becomes matching the fluctuating output of a rooftop solar system with your daily, monthly and seasonal fluctuations in electricity demand. The easiest way to even out these mismatched, supply/demand imbalances is to stay connected to the electric power grid. If you are connected, you can draw (buy) electricity from the grid when you need more than your solar system can produce, and you can send (sell) surplus power back to the grid whenever your solar system produces more than you need. This back-and-forth flow between you and the grid evens out the mismatches and ensures smooth operation.

Home energy storage systems (batteries) are also available today, but they are expensive to purchase and install and they only provide power for a few hours. Storing enough power to get you through a long winter night, or several days of cloudy weather, may require installation of multiple battery packs costing tens of thousands of dollars. It's also unlikely that your roof is large enough to accommodate all the panels you will need to simultaneously power your home and charge the batteries. While home battery systems can help offset fluctuations for short periods, they aren't technically capable of storing enough power to compensate for the larger, longer-term seasonal swings in your electricity supply and demand. A connection to the grid provides the same service as a home battery storage system, without limitations, and it is your best, if not only, option.

Metering. Customers planning on building a home solar PV system must work closely with their electricity provider to complete an interconnection and power purchase agreement (fees are involved) that spells out the details regarding purchases, buybacks, insurance requirements, and disconnection policies. In general terms, your electricity provider will give you a credit for any power your solar system supplies to the grid. This credit is then carried forward to the next billing cycle to offset the cost of the power you buy from the grid. This arrangement is generally referred to as *net metering*, but actual terms and conditions can vary from state to state, and utility to utility. *The rates and terms available from your electric provider will largely determine the financial attractiveness of an investment in residential solar power.*

The most favorable arrangement for consumers is *net metering at full retail rates*, where the utility buys the surplus power you send to the grid at the same price per kWh that they charge you to buy a kWh. This option was widely available at first, but it doesn't allow utilities to cover the overhead (or fixed) costs of metering, billing, and building and maintaining the transmission and distribution system. In this case, the utility is providing the customer with all the interconnection services at full costs, but it is selling the customer little or no net power on an annual basis, and overhead costs weren't being recovered. Many states, including NC, used to require their investor-owned, regulated public utilities to offer net metering at retail rates, but states are now moving away from this model to allow utilities to recover their full cost of service. No one in NC is required to offer this option today. Those lucky enough to have net metering at full retail rates in NC are grandfathered in at their favorable rates until 2027.

Another arrangement, *net metering at avoided costs*, has the customers buying what they need from the grid at retail rates and the utility buying any surplus their panels send to the grid at the same wholesale price they pay to buy power from other generators, which is usually much less than the retail rate. These *avoided* cost schemes are often coupled with monthly *fixed* or *demand charges* that allow the utility to recover an additional portion of their overhead costs. Another arrangement, called *buy-all, sell-all*, requires the customers to sell all the power their solar system produces to the utility at the avoided cost (wholesale) rate, and to buy all the power they need from the utility at the full retail rate. This is the arrangement currently offered by CCEC.

The industry is gradually moving toward *time of use* (TOU) rates where prices are high during periods of peak demand, when supplies are tight and wholesale power prices are high, and prices are lower during off-peak hours when supplies are plentiful and wholesale power prices are low. TOU schemes encourage customers to limit their demands during peak periods and to shift their consumption to off-peak hours when prices are lower (e.g. doing laundry late at night). Widespread adoption of TOU rate schemes would eventually mean that owners of residential solar systems will also be subject to TOU rates for whatever they buy or sell to the grid. Utility pricing is currently undergoing some evolutionary changes.

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