# A Solar-Powered Home: Will It Pay Off?

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## What Is Solar Power for the Home?

Homeowners who install photovoltaic power systems receive numerous benefits: lower electric bills, lower carbon footprints, and potentially higher home values. But these benefits typically come with significant installation and maintenance costs, and the magnitude of the gains can vary widely from one house to another. This article will help homeowners make the financial calculations required to determine the viability of solar power in their homes.

### KEY TAKEAWAYS

- Those seeking to go green may want to consider equipping their home with solar panels.
- Not only is solar power good for the environment, but you can earn money selling back excess power to the grid.
- Solar panels are best-suited for homes that receive ample sun exposure throughout the year.
- Before committing to solar power, be sure to understand both the social and economic factors.

## Understanding Solar Power

Photovoltaic (PV) solar technology has been around since the 1950s, but thanks to declining solar module prices, it has only been considered a financially viable technology for widespread use since the turn of the millennium.[1]

Solar panel size is quoted in terms of the theoretical electrical output potential in watts. However, the typical output realized for installed PV systems—known as the "capacity factor"—is between 15% and 30% of the theoretical output.[2] A 3 kilowatt-hour (kWh) household system running at a 15% capacity factor would produce 3 kWh x 15% x 24 hr/day x 365 days/year = 3,942 kWh/year, or roughly one-third of the typical electricity consumption of a U.S. household.

But this calculation may be misleading because there is little reason to speak of "typical" results; in fact, solar may make sense for one household, but not for the house next door. This discrepancy can be attributed to the financial and practical considerations considered in determining viability.

TIP: Before getting solar panels, get quotes from several reputable installers to compare their equipment recommendations and the expected energy production over 25 years.

# Solar Power for the Home: Costs

Solar power is capital intensive, and the main cost of owning a system comes upfront when buying the equipment. The solar module will almost certainly represent the largest single component of the overall expense.

Other equipment necessary for installation includes an inverter (to turn the direct current produced by the panel into the alternating current used by household appliances), metering equipment (if it is necessary to see how much power is produced), and various housing components along with cables and wiring gear.

Some homeowners also consider battery storage. Historically, batteries have been prohibitively expensive and unnecessary if the utility pays for excess electricity that is fed into the grid (see below). The installation labor cost must also be factored in.

In addition to installation costs, there are some further costs associated with operating and maintaining a PV solar array. Aside from cleaning the panels regularly, inverters and batteries (if installed) generally need replacement after several years of use.

While the above costs are relatively straightforward—often a solar installation company can quote a price for these for a homeowner—determining subsidies available from the government and/or your local utility can prove more of a challenge. Government incentives change often, but historically, the U.S. government has allowed a tax credit of up to 30% of the system's cost.[3]

More details on incentive programs in the U.S., including programs within each state, can be found on the Database of State Incentives for Renewables & Efficiency (DSIRE) website. In other countries, such information is often available on government or solar advocacy websites. Homeowners should also check with their local utility company to see whether it offers financial incentives for solar installation, and to determine what its policy is for grid interconnection and for selling excess power into the grid.

> **97.7 gigawatts**
> *The U.S. installed 19.2 gigawatts of solar PV capacity in 2020 to reach 97.7 GWdc of total installed capacity, enough to power 17.7 million American homes.*[4]

# Solar Power for the Home: Benefits

A significant benefit to PV installation is a lower energy bill, but the magnitude of this benefit depends on the amount of solar energy that can be produced given the available conditions and the way in which utilities charge for electricity.

The first consideration is the solar irradiation levels available in the home's geographical location. When it comes to using solar panels, being closer to the equator is generally better, but other factors must be considered. The National Renewable Energy Laboratory (NREL) produces maps for the U.S. showing solar irradiation levels; the tools on its website provide detailed solar information for specific locations within the U.S.[5]

Similar maps and data are available in other countries as well, often from government environmental agencies or renewable energy organizations. Equally important is the home's orientation; for rooftop

arrays, a south-facing roof without trees or other objects obstructing sunlight maximizes the available solar energy. If this is not available, panels can be mounted on external supports and installed away from the house, incurring additional costs for the extra hardware and cables.

The second consideration is the timing of solar power production, and how utilities charge for electricity. Solar power generation occurs primarily during the afternoon and is higher during summer, thus corresponding relatively well to overall electricity demand in warm climates because it is at these times that air conditioners consume the most energy. Consequently, solar power is valuable because the alternative methods of energy production (often natural gas power plants) used to meet peak energy demand tend to be expensive.

But utilities often charge residential consumers a flat rate for electricity, regardless of the time of consumption. This means that instead of offsetting the expensive cost of peak electricity production, homeowners' solar power systems merely offset the price they are charged for electricity, which is much closer to the *average* cost of power production.

However, many utility companies in the U.S. have introduced pricing schemes that allow homeowners to be charged at different rates throughout the day in an attempt to mirror the actual cost of electricity production at different times; this means higher rates in the afternoon and lower rates at night. A PV solar array may be very beneficial in areas where this sort of time-varying rate is used since the solar power produced would offset the most costly electricity.

Exactly how beneficial this is for a given homeowner depends on the exact timing and magnitude of the rate changes under such a plan. Similarly, utilities in some locations have pricing schemes that vary over different times of the year due to regular seasonal demand fluctuations. Those with higher rates during the summer make solar power more valuable.

Some utilities have tiered pricing plans in which the marginal price of electricity changes as consumption rises. Under this type of plan, the benefit from a solar system can depend on the electricity use of the home; in certain areas subject to rates that increase dramatically as consumption increases, large homes (with large energy needs) may benefit most from solar arrays that offset high-cost marginal consumption.

Another benefit of a solar system is that homeowners can sell solar-generated electricity to utilities. In the U.S., this is done through "net metering" plans, in which residential consumers use the power that they put into the grid (when the rate of electricity generation from the solar array is greater than the rate of household electricity consumption) to offset the power consumed at other times; the monthly electric bill reflects net energy consumption. The specific net metering regulations and policies vary across regions. Homeowners can refer to the DSIRE database and should also contact their local utilities to find more specific information.

The final benefit is the potential effect on a home's value due to the addition of a solar array. In general, it is reasonable to assume that solar panels would raise the value of most homes.

First, there is an undeniable financial benefit to having lower electricity bills because of a solar array. Second, the trend toward "green" living means there is a growing demand for homes that have a smaller carbon footprint and are powered by renewable sources. Finally, buying a home with solar already installed means the investment is financed (for the homebuyer) through the mortgage. This ease of financing potentially makes solar more affordable for a homebuyer than buying a house without solar and subsequently adding a solar array.

# Calculating Solar Power Costs

To calculate simple payback or a “break even” evaluation is to divide the cost of the system, minus any rebates (federal, state and utility) and financial incentives by the annual amount you’ll save on utility bills. Please note, this is a simple evaluation not taking into consideration the future cost of money, the average increase in electricity costs have been 2.2%/year (EIA), include minor solar power system degradation or consider tax depreciation opportunities.

Another financial evaluation method once the above costs and benefits are determined, a solar system can theoretically be evaluated using the discounted cash flow (DCF) method. Outflows at the beginning of the project would consist of installation costs (net of subsidies), and inflows would arrive later in the form of offset electricity costs (both directly and through net metering).

Rather than using DCF, the viability of solar power is usually evaluated by calculating the levelized cost of electricity (LCOE), then comparing it to the cost of electricity charged by the local utility. The LCOE for household solar will typically be calculated as cost/kilowatt-hour ($/kWh or ¢/kWh) - the same format commonly used on electricity bills. To approximate the LCOE, one can use the following equation:

*LCOE ($/kWh) = Net Present Value (NPV) of the Lifetime Cost of Ownership ($) / Lifetime Energy Output (kWh)*

The useful life of a PV solar module is generally assumed to be 25-40 years.[6] The cost of ownership includes the maintenance costs, which must be discounted to find the NPV.

The LCOE can then be compared to the cost of electricity from a utility; remember, the relevant price is that which occurs during times at or near peak PV solar production.

# Pros and Cons of Solar Panels for Your Home

Like most things, solar power has its benefits and drawbacks. At the same time, some economic costs may be defrayed by the social benefits to the environment and lowering your carbon footprint, which exceeds pure monetary evaluation.

Pros

Green energy that lowers your carbon footprint
Net metering allows you to sell back excess energy produced
You may be eligible for certain tax breaks
25 year warranty on all components including labor
Solar plus Storage systems store unused production for later use

Cons

Installation and maintenance costs still high (warranty dependent)
Solar only works when the sun is out (depends on solar plus storage options)
Parts of the system need to be replaced every few years (warranty dependent)
Some tax breaks may have expired or will be decreasing/expiring

# Frequently Asked Questions

## Can a House Run on Solar Power Alone?

Practically, it is not often possible. This is because solar only works when the sun is shining - which means when it is cloudy or nighttime, they do not generate electricity. There are hybrid inverters which now allow the solar system to run some devises when the sun is shining.  Some systems incorporate solar battery storage solutions to provide power when the sun is not shinning, adding to the system costs.  Most homes with solar panels still rely on the grid from time to time.

### Do You Really Save Money With Solar Panels?

Depending on where you live, it is possible that the system can pay itself back and more over time. This is because you won't be spending as much money buying electricity from your utility, and if net metering is in place, you can reduce your bills even further.  Eventually becoming energy independent, only paying your utility for an interconnection charge.

### How Much Does a Solar Panel Cost?

Prices have been coming down steadily over the years. The total cost will depend on how many kilowatts of power your array will generate. According to consumer reports, after solar tax credits are accounted for, the cost for a solar panel system on an average-sized house in the U.S. in 2021 ranges from $11,000 to $15,000.[7]

### How Long Will It Take for Solar Panels To Pay for Themselves?

Depending on where you live and the size of your system, if you include a solar plus storage system or EV charging infrastructure, it can take on average anywhere from 4 to 15 years to breakeven on a solar installation.

# The Bottom Line

Determining whether to install a PV solar system may seem like a daunting task, but it is important to remember that such a system is a long-term investment. In many locations, solar power is a good choice from a financial perspective.

Even if the cost of solar power is found to be marginally more expensive than electricity purchased from a utility, homeowners may wish to install solar power to avoid future potential fluctuations in energy costs or may simply wish to look beyond their personal financial motivations and use solar for "green" living.  The quest to charge your EV using your renewable energy or to become energy independent can be achieved with a solar solution.




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