

*ProVision Technologies, Inc.
Presents:
The Quick Guide to
Grid-Connected Solar Electric Systems for Hawai'i*



Aughe residence, HPP, 2.15 kW



Big Island Suzuki, Hilo, 22 kW

Solar energy is an abundant renewable energy resource in Hawai'i. ProVision Technologies, Inc. has installed the majority of the utility-connected solar electric systems on the Big Island and we have developed this primer to help you understand the basics and to be more prepared to embrace this exciting technology.

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Why go solar?

We need to change the way we consume energy. Our power sources are largely derived from oil, coal and gases that were placed on this planet millions of years ago. They offered us a hundred-plus years of cheap energy, allowing us to become the fantastic civilization we now are. But we now find that there are limits to the availability of this cheap energy, and that there are likely to be severe consequences to our environment from the use of these fossil fuels. Solar electricity offers Aloha State residents a proven, reliable and cost-effective alternative to electricity generated from fossil fuels.

Hawai'i has the highest electrical utility rates in the country. Living on a chain of small islands in the Pacific has created an electrical distribution system that is heavily dependent on imported fossil fuels. The outer islands also have relatively small populations spread over a large area. These large electrical grids have fewer people to pay the infrastructure and maintenance costs compared to more densely populated areas on the mainland. These two issues – imported fuel and high maintenance costs – conspire to keep electricity rates high on Maui, Kauai and the Big Island.

Using solar generated electricity will reduce your contribution of greenhouse gases and reduce your dependence on imported fossil fuels. It will also save you money. How long the system takes to break even will depend on the value of the solar energy produced, the value of a variety of state and federal incentives, and the benefit we place on the idea of generating electricity with the clean energy of the sun. When ProVision Technologies provides an economic analysis of a proposed installation, we typically ignore the green value of the solar system, because it has not yet become a valuable enough commodity in our society. Consider that burning a gallon of petroleum (like gasoline or diesel) will generate almost twenty pounds of carbon dioxide, or that we generate 1.34 pounds of carbon dioxide for each kilowatt-hour we use. Many homes on the Big Island use an average of 300 kilowatt-hours per month (about \$100) and this usage will generate over 5,000 pounds of carbon dioxide each year if the electricity comes from the utility company.



Chu Residence, Hilo, 2.88 kW

Getting Ready

To get the most value out of a solar electric system, we encourage our customers to first explore the benefits that may be available from investments in energy-conserving appliances. The new generation of compact fluorescent lamps, washing machines, and refrigeration technologies can offer dramatic reductions in energy consumption. If you have a second refrigerator or freezer in the garage, consider if it is really necessary. Or if it is an old model, consider replacing it with a newer, high-efficiency model. Our customers who do not have access to utility power are generally required to use gas appliances for cooking and clothes drying. Our utility-connected customers may choose to use electricity for these purposes, but should be aware that the operating costs for these appliances are high and will likely increase. We encourage all of our residential customers to use solar thermal systems for heating domestic water. The state and federal tax credits that apply to solar electric systems also apply to solar thermal systems. Further, Hawai'i homeowners connected to the utility grid can often receive a generous rebate from the utility when they install a solar hot water system (\$1,000 for HELCO customers). By reducing the total amount of electricity used in your home, a smaller solar electric system will provide power for a larger fraction of your needs.

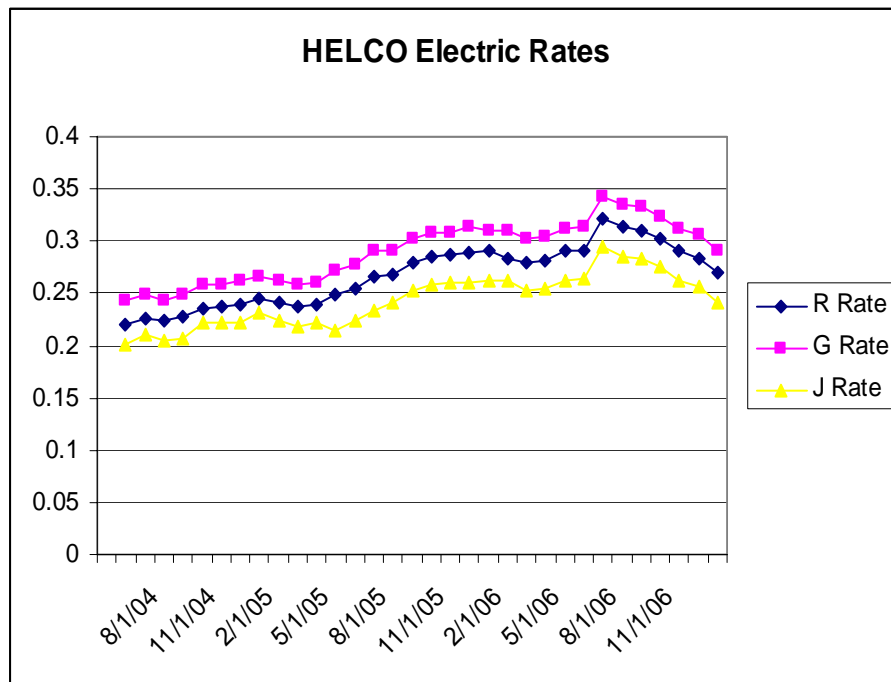
Making Solar Affordable

On the Big Island, a homeowner purchases HELCO electricity for about \$0.32 per kilowatt hour(kWh). The kWh is the fundamental bundle of electricity and you can use it in an astounding number of ways, from making toast to running big screen TVs. What we pay for electricity on the Big Island is about twice as expensive compared to California and four times as expensive as the cheapest electricity on the Mainland.

A solar electric system is sized by looking at the average energy consumption at the site. This information is conveniently provided by the utility company on your monthly bill, telling you how much power has been used that month and in prior months. (We would also want to know of any future changes in your energy consumption like the addition of a new spa.) Given how much energy you have used and your solar resource, we can determine the size solar system required to meet your needs. We don't usually want to design systems that will produce more than the average **yearly** consumption. This is because of the first of our incentives to install solar electric called **Net Energy Metering (NEM)**.

NEM is a program mandated by the state (by an act of the legislature and the governor's signature) that requires the state's island electric utility companies to allow us to be independent power generators and mate our electricity production with the whole utility grid. If we can generate electricity with electrical characteristics that is as good (or better) than the quality provided by the utility itself, we may add our solar electric production into the grid. Our solar-generated electricity will push into our home (or business) electrical system and be used for our needs first. If our needs exceed the production of our solar generation system, then the additional electricity will flow into our building from the utility grid. We end up purchasing less energy than we

would have without the system. If our system produces more electricity than we need at the site, that surplus flows back into the utility grid, making our meter spin backwards, and generating a credit for us to be used later that night, for instance. Net Metering means that the credit you earn from pushing your excess electricity into the utility grid is priced at the same rate as what the utility charges you. You will essentially be credited at the full retail price for any excess power you generate and you have up to one year to use this credit. This means that you can generate surplus power while you are away on vacation or during a particularly sunny month to be used later in the year when your needs are greater or there is less sun and more rainy weather. Net Metering means that every kWh you generate is worth the full retail value, regardless of whether you have a need for the power at that moment or not. The value of this will change as the price of power changes. The graph below shows the recent history of electrical costs for the residential (R rate), small business (G), and larger commercial (J) rates.



NEM agreements with Hawaii utilities are currently limited to solar systems that produce 50 kilowatts or less. NEM agreements are only necessary when energy flows out of your facility into the electrical grid on a regular basis. For instance, If you have a 200-kilowatt demand for electricity all day long, you can install a 100 kilowatt system and the meter would never spin backwards (it would simply spin more slowly forward). You wouldn't need a NEM agreement since the value of the power you'd produce would be at the full retail rate simply because you will be buying fewer kWh from the utility company. (Please note that you would still need to enter into an interconnect agreement with the utility to allow you to interface with their power grid, even if you do not produce excess power for credit.)

The second set of incentives to reduce the cost of a solar electric system are the state and federal tax credits. Tax credits are used instead of payment for tax liabilities. The credits can be rolled forward to subsequent years until exhausted if you can't use them all the first year. The state has decided that it is a good thing to install solar systems

(solar electric or solar hot water, except for swimming pools), and they offer a tax credit equal to 35% of the installed cost of the system with the following limitations:

- Residential: 35% or a maximum of \$5,000, whichever is less
- Commercial: 35% with a maximum of \$500,000
- Multi-family residential: 35% or \$350, whichever is less, for each unit

According to the State Department of Taxation, home-based businesses may have a difficult time claiming commercial credits. Consult with your tax advisor to be sure you will be able to claim these tax credits.

The Federal government also offers tax credits for solar systems. These are:

- Residential: 30% of the cost of the system or \$2,000, whichever is less
- Commercial: 30% with no limit

Another incentive for commercial installations is the accelerated depreciation schedule for the equipment. This allows businesses to deduct a percentage of the system cost over six years as a business expense, thus reducing the company's tax burden each year. Usually, a business will expense purchases based on the expected life of the equipment. Because solar equipment is extremely long-lived (solar modules have 25 year warranties), it is often advantageous for a business to expense the investment over a shorter period rather than 25 years. Some businesses may even be able to expense 100% of the system cost in the first year.

From the above, it is apparent that the current incentives for homeowners are considerably less than those for businesses. We believe that customers should be able to earn tax credits for additional solar modules installed in future years. One option is to design the initial installation so as to allow for future expansion. This will allow additional tax credits to be earned in later years, as well as allowing state and federal legislators the opportunity to develop new, more encouraging incentives to install these systems. *Again, ProVision recommends consulting with your tax professional about your ability to claim these tax credits.*



Big Island Toyota, Hil, 64.5 kW

Applying the sum of the commercial incentives (35% state, 30% federal, and accelerated depreciation for both state and federal) can essentially recover the cost of the system in six years or less *without including the value of the energy produced by the solar system!* Thus, more business owners are installing systems because they achieve a quick payback, save on power bills, and impress their customers. Depending on the future cost of utility power, residential installations can require eight or more years to break even. These homeowners are placing a high value on the environmental benefits, such as greenhouse gas reductions and local generation of electricity with our abundant solar resource, as well as greater independence.



Island Dodge, Kahului, 52.2 kW

Technical Issues

People often ask us about batteries. Solar electric systems will require battery banks if the customer lives on a remote property without access to the utility grid. Net Metering and the utility grid allow homes and businesses to push energy into the utility grid without the need for batteries. The *utility* essentially acts as a battery, allowing us to store excess energy during the day for use at night. We typically advise customers that with a reliable utility grid, a battery-based system adds cost and reduces system efficiency enough to recommend against them. For example, a maintenance-free battery bank designed to hold \$3 worth of electricity would cost over \$3,000. A gas generator could cost less and deliver more power for a longer period. We can design battery-based systems, but a thorough discussion of the issue is important.

Taking batteries out of the picture allows us to use high voltage equipment. Running the solar array at high voltage will allow for a less costly installation, with smaller

wires and conduit, compared to a low voltage installation. A system will normally consist of several solar modules wired in series. The electric energy generated by these solar modules is not suitable for feeding directly into the utility grid. The electricity needs to be conditioned into utility-grade power with a device called an inverter. The inverter is a complicated electronics assembly that performs this power conditioning function while monitoring the quality of the utility grid and recording the production of the solar electric system. The inverter may make a soft humming sound or may have a small fan to help cool the electronics inside. The inverter is designed to be outdoors and is usually accompanied by one or more safety switches.



50 kW Commercial Inverter



Residential 4 kW Inverter with switches

Last Words

Solar electric applications are a proven technology that can make a profound difference in our lives. PV systems differ from most other energy generation technologies because they have no moving parts (aside from the electrons and perhaps a cooling fan). This means they have no oil to change or bearings to wear out. We don't have to wait for this technology to become ready for prime-time because it's ready now. Although the systems are conceptually simple, there are numerous technical and bureaucratic details to be dealt with. Each system requires engineered drawings to secure an electrical permit, and must be installed by a licensed electrical contractor. We expect our customers to be more than satisfied with our systems. We receive most of our business by referrals from our customers. Please contact us with your questions or comments about this document so that we may better serve others.



Copman Residence, Kamuela, 3.44 kW