



Pa'auilo Mauka Kalopa Community Association

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Monthly News & Updates

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April 2021 Newsletter



Old Off-Grid, New Off-Grid

**By Joe Clarkson,
PMKCA President**

Many of the homes in the Pa'auilo Mauka and Kalopa neighborhoods get their electricity without being connected to the grid. Where I live on Waika'alulu Road, all 27 houses are off-grid and it is estimated that at least 10% of all the homes in the Pa'auilo Mauka – Kalopa areas are not grid-connected. This essay is about the changes in technology over the last few decades and gives an explanation of what is currently being recommended for residential off-grid equipment.

Older Home Power Systems

From the late 1980's to the late 2000's, retail photovoltaic (PV) module prices drifted down slowly from \$7 per Watt (W) of peak output to \$4 per Watt. In the past, the relatively high cost of solar electricity meant that people couldn't afford to purchase a lot of it. My house is a perfect example of the historical trend. It started out in 1986 with very little solar capacity (under 600 W), so everything was geared to minimizing the use of electricity. Thirty years ago, our electrical consumption was about 2 kilowatt-hours (kWh) per day at most, with much of that coming from a gasoline powered generator. PV and generator supplied energy was stored in lead-acid batteries and turned into 120 volts of alternating current (VAC) electricity by a single inverter, which operated continuously.

To avoid using electricity as much as possible, typical off-grid homes never used electricity to generate heat, so cooking, backup hot water and the heat source for the clothes dryer (if any) was usually propane. Sometimes people even ran their "backup" generator with propane. Rarely, the refrigerator was also powered by propane to keep electrical usage down even more.

Our refrigeration and water pumping equipment are 24 volts of direct current (VDC) (most early off-grid homes were either 12 VDC or 24 VDC for battery and PV voltage) and

powered straight from the storage battery. This was originally for efficiency and power demand reasons, but over the years we have kept these appliances operating directly off the battery as a precaution against inverter failure. If the inverters fail, we can still have water and keep our refrigerator and freezer powered up. We would need to run the generator in the evenings two to three hours for light and for other electrical appliances, but it would save us from having to run the generator more often to keep the fridge cool and to pump water.

Times Have Changed for Off-grid Homes

In the last decade the cost of PV has plummeted as China began manufacturing huge numbers of modules. Seven of the world's largest manufacturers are based in China and that country now produces about a third of all the world's PV modules. Retail module prices now range from \$0.50 to \$1.00 per Watt. According to Roland Shackelford, owner of Renewable Energy Services in Honoka'a, whom I interviewed to discuss the latest trends, most new owners of off-grid homes purchase very large PV arrays. Most of these are installed on the roof of the home being served and often roof area is a limiting factor in how much PV is installed. Ground-mounted PV arrays are less common due to the extra cost in building the support structure. For roof-mounted arrays, installation cost can often exceed the cost of the modules themselves.

Modern PV arrays are "oversized" to allow for the production of adequate amounts of electricity even during stretches of cloudy weather. This means that little investment is required for fossil fuel powered backup generation. Some homes have either no backup generator or just a small gas-powered generator for emergencies.

Many new off-grid homes use no propane. Most of the hot water is produced by solar water heaters, with backup hot water from an electrically powered heat-pump water heater. The kitchen range and clothes dryer are electric. Off-grid electricity consumption is now more likely to resemble that of conventional grid-tied homes than the dramatically lower consumption in off-grid homes from earlier years. Average residential electricity consumption for a grid-tied home on Hawai'i Island is about 17 kWh per day. Many new off-grid homes exceed that level of consumption.

Almost all new off-grid homes have 48 VDC batteries, according to Shackelford. Shackelford also noted that new battery installations by his company are now 99% lithium-ion. Lithium-ion batteries are still more expensive than lead-acid batteries, but they require almost no attention from the home owner. Lead-acid batteries must be rigorously maintained and properly charged to ensure their expected lifespan. Lithium-ion batteries are much more forgiving of deep discharge and prolonged periods of low state-of-charge, situations which will greatly reduce lead-acid battery life.

Since modern off-grid homes have little generator backup and since everything in the home runs on either 120 or 240 VAC electricity, the inverter system must be very reliable. Inverters, which convert the DC electricity supplied by the PV modules and the battery to regular AC electricity, are often installed in multiple, parallel units. That way, if one of the inverter units fails, the rest of the units continue to supply the house.

The very latest in off-grid living is to incorporate electric vehicle charging into the home system. Electric cars are efficient, but it still takes a lot of energy to move an electric vehicle (EV) around the ups and downs of the Big Island. EV electric usage is typically one kWh for every 3-4 miles driven, which means that a 50-mile round trip commute could consume about as much electricity per day as the home itself (charging the car at work will greatly reduce home charging requirements). Incorporating an electric car will obviously require a much larger PV array, but if charging is timed appropriately, the battery and inverter system can remain much the same.

Costs and Benefits

PV modules are about the only part of an off-grid system that have had really significant declines in cost in recent years. Lithium-ion batteries continue to see modest declines in cost, but demand for EV batteries is continuing to grow and, in my opinion, competition for battery cells will prevent dramatic declines, at least in the near future. Inverters and installation labor costs are stable.

Mid-range costs for an off-grid system are about \$8,000 per KW installed (based on the PV array capacity). About 25% of this cost is for the PV array, 35% is for the battery, with the remaining 40% for the inverter system, charge controllers and ancillary wiring and equipment. This year, there is a 26% federal tax credit and a maximum \$5,000 state tax credit available to help offset the cost of a solar installation.

HELCO average residential electricity bills on Hawai'i Island are about \$150 per month or \$1,800 per year. While this is far above the national average, it would still take many years of saving on utility bills to pay for an off-grid system, even after factoring in tax credits. While going off-grid will not cost a lot more than being grid connected, it won't save a lot of money either over the long term. In a way, this is a great improvement from the early days of off-grid systems, where the cost per kWh could easily be 3-4 times greater than that from the HELCO grid.

The principal benefit of using an off-grid electric system is that it allows one to use electric appliances in locations where the grid is absent. It is also likely to be more reliable than grid electric supply. Considering that land costs in areas without connection to utility power are lower, it may be that the savings on land purchase costs can exceed the cost of an off-grid electric system, in which case going off-grid can be a real money saver. As someone who has been in the same off-grid house for the last 35 years, I wouldn't connect even if the grid came right to my door.



Next PMKCA Meeting

Thursday, April 8, 2021, 7PM PMKCA Board of Directors Meeting
(Probably by Zoom Videoconference. (Contact a Board member for details.)

We continue to work at the Board and committee level on behalf of our communities. If you have any interests or concerns, we encourage you to email any Board member and to attend the April 8 Board meeting.

THANK YOU, 2021 MEMBERS!

Many of you responded to our plea to renew your annual membership in PMKCA by sending in your \$20 dues (for 2021) by Paypal or by check. Mahalo!

If you haven't had the opportunity to join or renew for 2021, we encourage you to do so. Your dues support our communities by funding projects and making contributions to other local groups that serve our communities. Your dues are our primary source of these necessary funds.

RENEW YOUR ANNUAL MEMBERSHIP IN PMKCA! ***(It's easy to do - and easy to forget!)***

You can find payment options, including an easy PayPal link, on our website, www.PMKCA.org. Under "Home", click on "Membership/Dues".

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