

# Issues Related To Structuring Off-Grid Solar & Renewables

## Residential Island Nano-Grid & Nano-Grid Cluster Solar + Storage

1) Residential Grid-Tie → **Switchable On/Off-Grid** for Resilience & Safety requires Storage Sizing for 100% Overnight Energy Needs

- a) Oahu Case Study since March 2017: **On/Off-Grid Rooftop-Solar + Storage (Battery & Thermal)**
- b) Molokai Low Income Section-8 Rental House/Apartments/Condo Aug 2023: **Non-rooftop Portable-Solar + Storage**

2) Off-Grid Molokai Native Hawaiian Homesteads using Fossil Fuel → Clean Energy with Solar + Storage

- a) **Aug 2023 Rooftop-Solar + Storage (Battery & Thermal) Nano-Grid Cluster**
- b) **Sep 2023 Non-Rooftop Solar (Canopy Ground Mount) + Storage Nano-Grid Cluster**



John Borland  
J.O.B. Technologies  
8-23-23





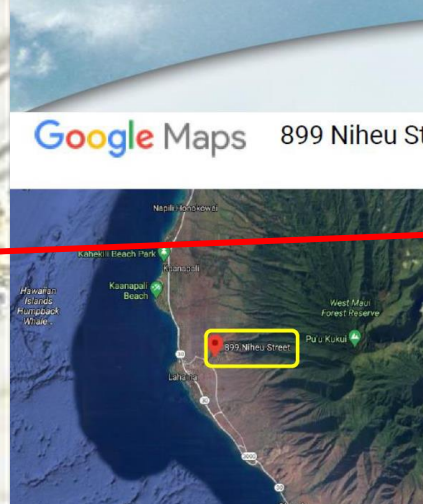
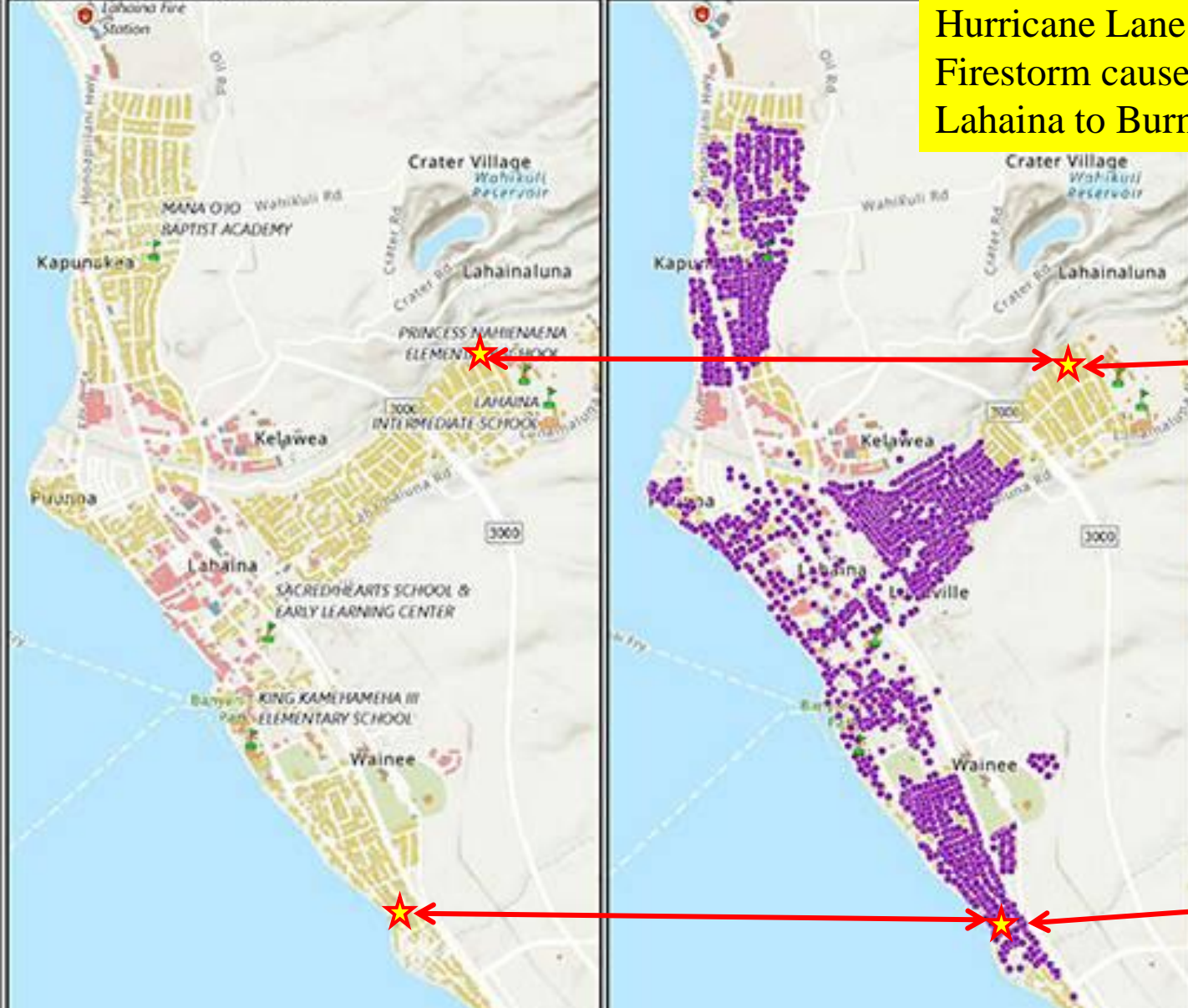
# Summary of Geospatial Damage Assessments near Lahaina, Hawaii

Hawaii Wildfires - DR-4724-HI



Hurricane Dora Aug 8, 2023  
Firestorm caused >1,700 homes in Lahaina Burned and >115 Loss of Life with 1,000 still missing!  
Puerto Rico had 2,975 deaths.

Hurricane Lane Aug 18-19, 2018  
Firestorm caused 7 homes in Lahaina to Burn



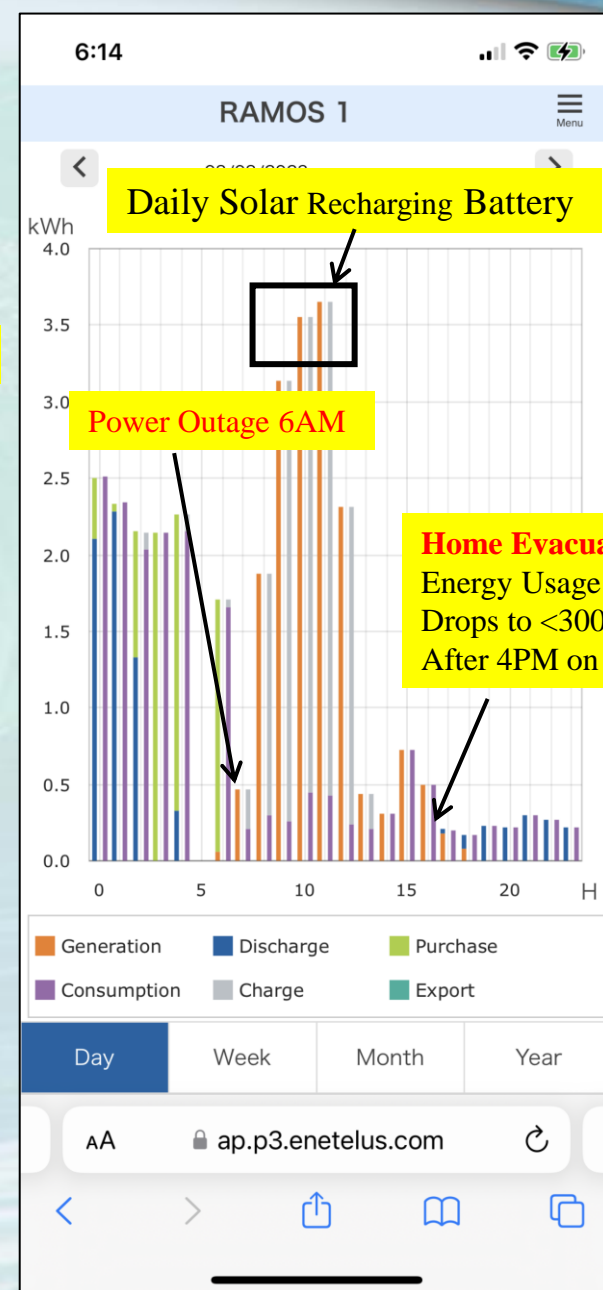
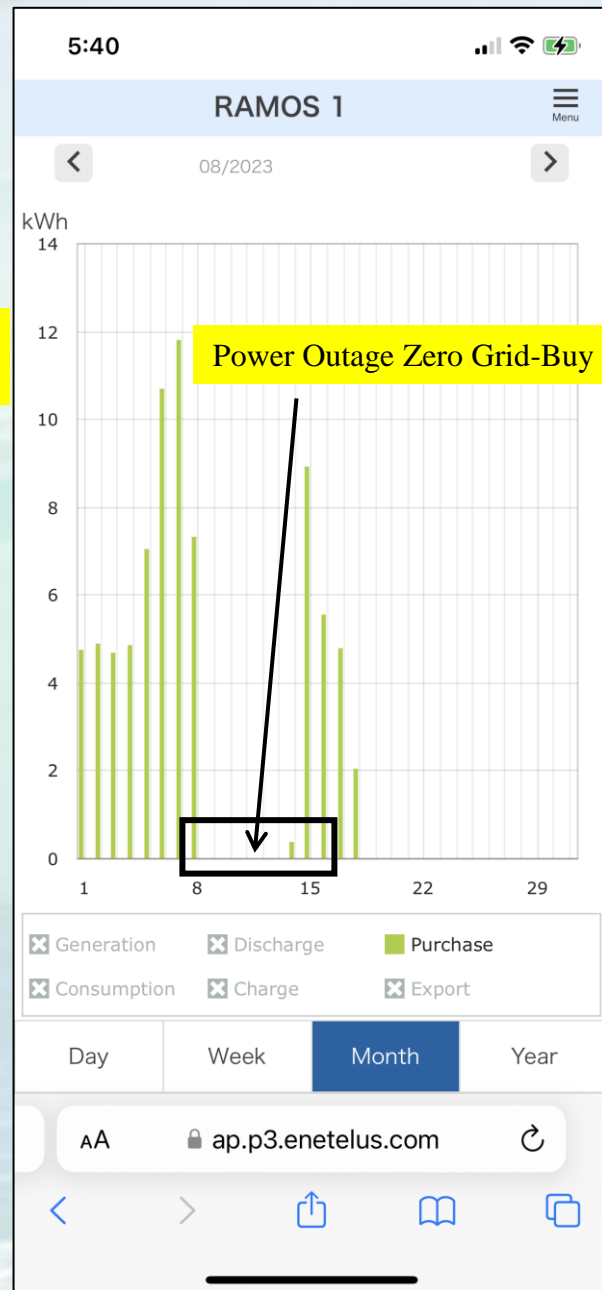
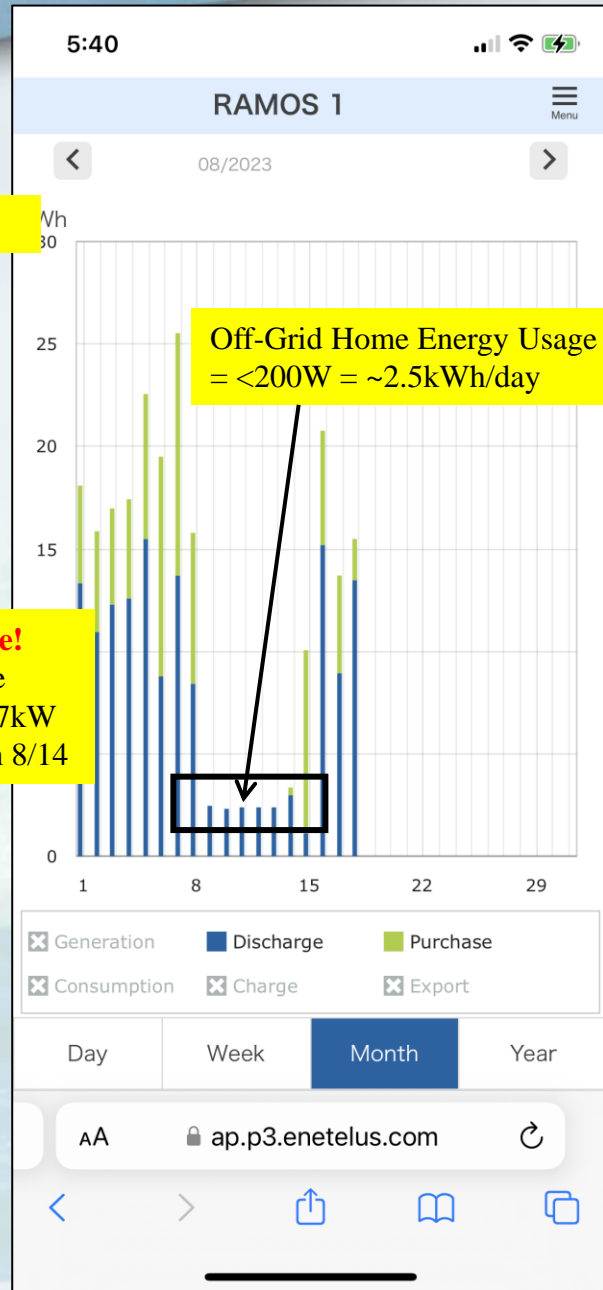
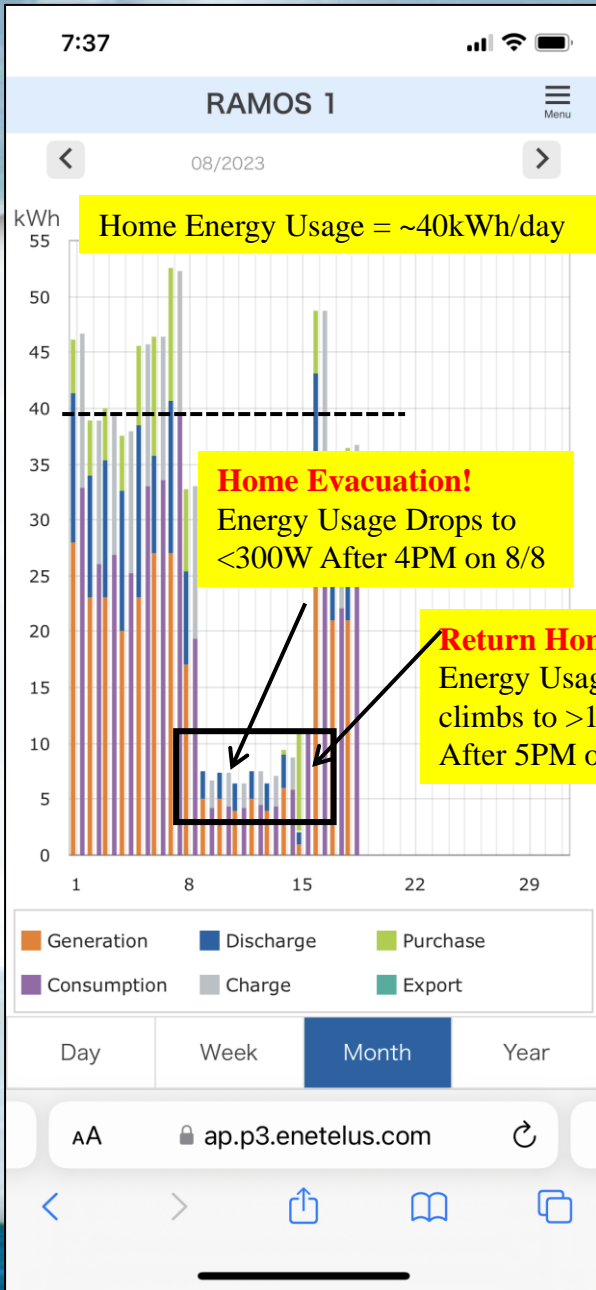
899 N Niheu Pl

Ramos 1&2: 67.3kWh/\$675 → 21.2kWh/\$195  
PV=7.8 + 7.8kW = 15.6kW x 5.Shours = 85kWh/day (57.2kWh/67%)  
4-Battery=29.4kWh/day (1-cycle discharge) (23.9kWh/98%)  
Hot Water= Solar-Thermal Size 3-panels 240 gal (12-6AM high usage >20kWh) 59% overnight usage!

Norton Home 3-Tabuchi

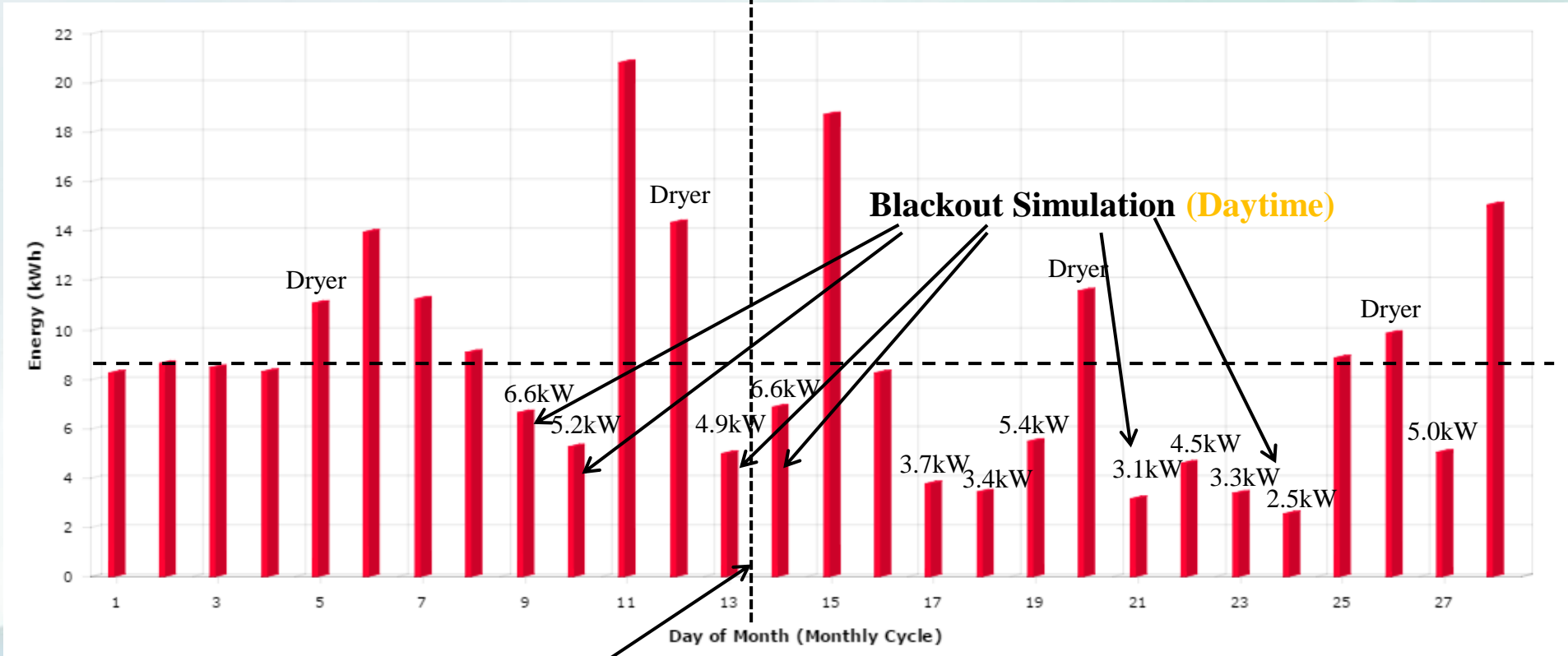
**Be Proactive To Next Centralized Grid Failure with Island Nano-Grid**





# Feb 2017 Grid-Buy Results

## 241.4kWh/month or 8.62kWh/day

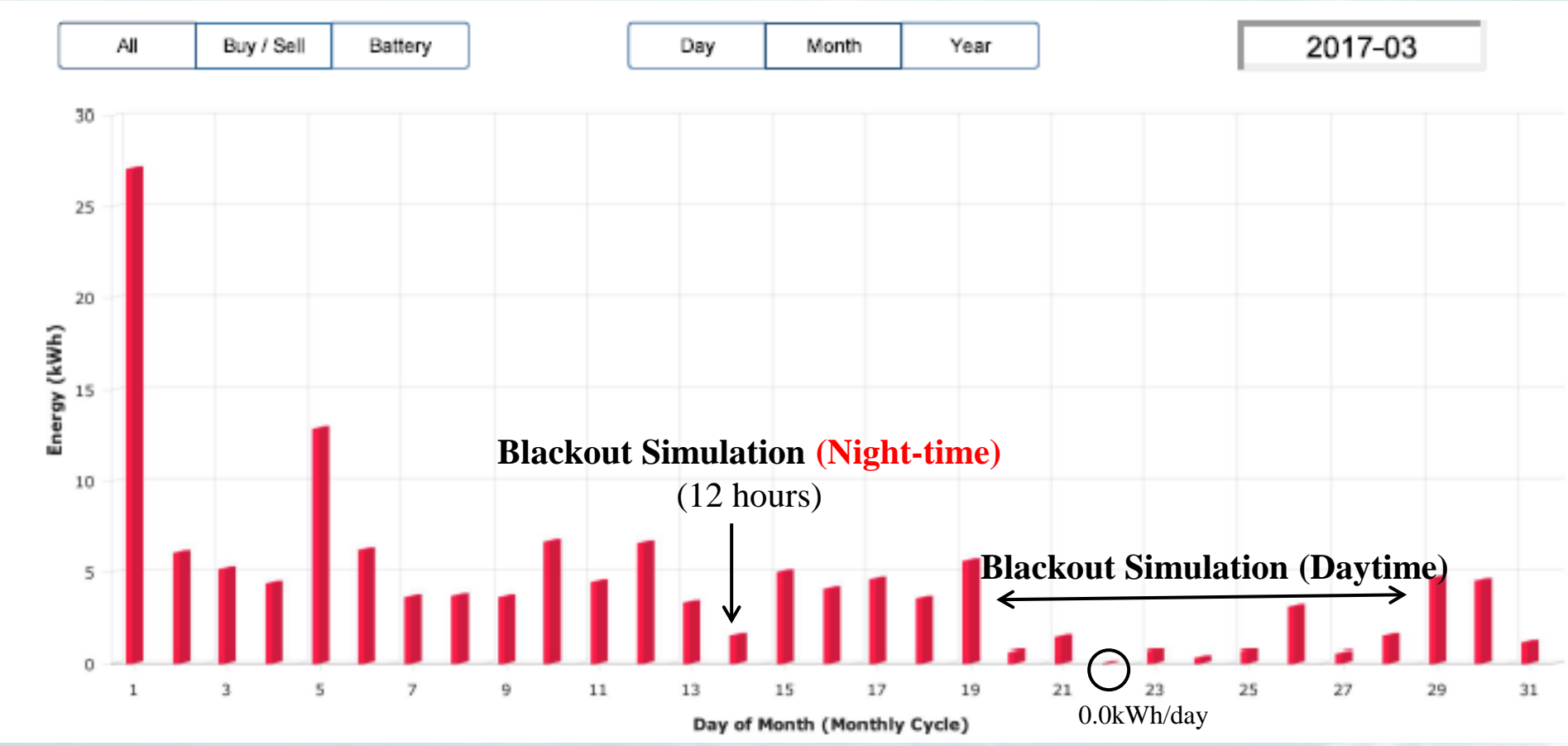


New Tabuchi Software 2/14 reduces Grid-Buy by ~5.2kWh/day! (~8.5kW → ~3.3kW)  
 Blackout mode Grid-Buy by 2.5kWh/day (4.9kW → 2.5kW)  
 But now battery charging very Noisy but smooth in Blackout simulation mode!

Tabuchi Electric new software with 50W → 20W → 0W minimum grid-buy still results in grid-buy of 110W/h or 2.5-3.7kWh/day so I must manually disconnect grid-tie!

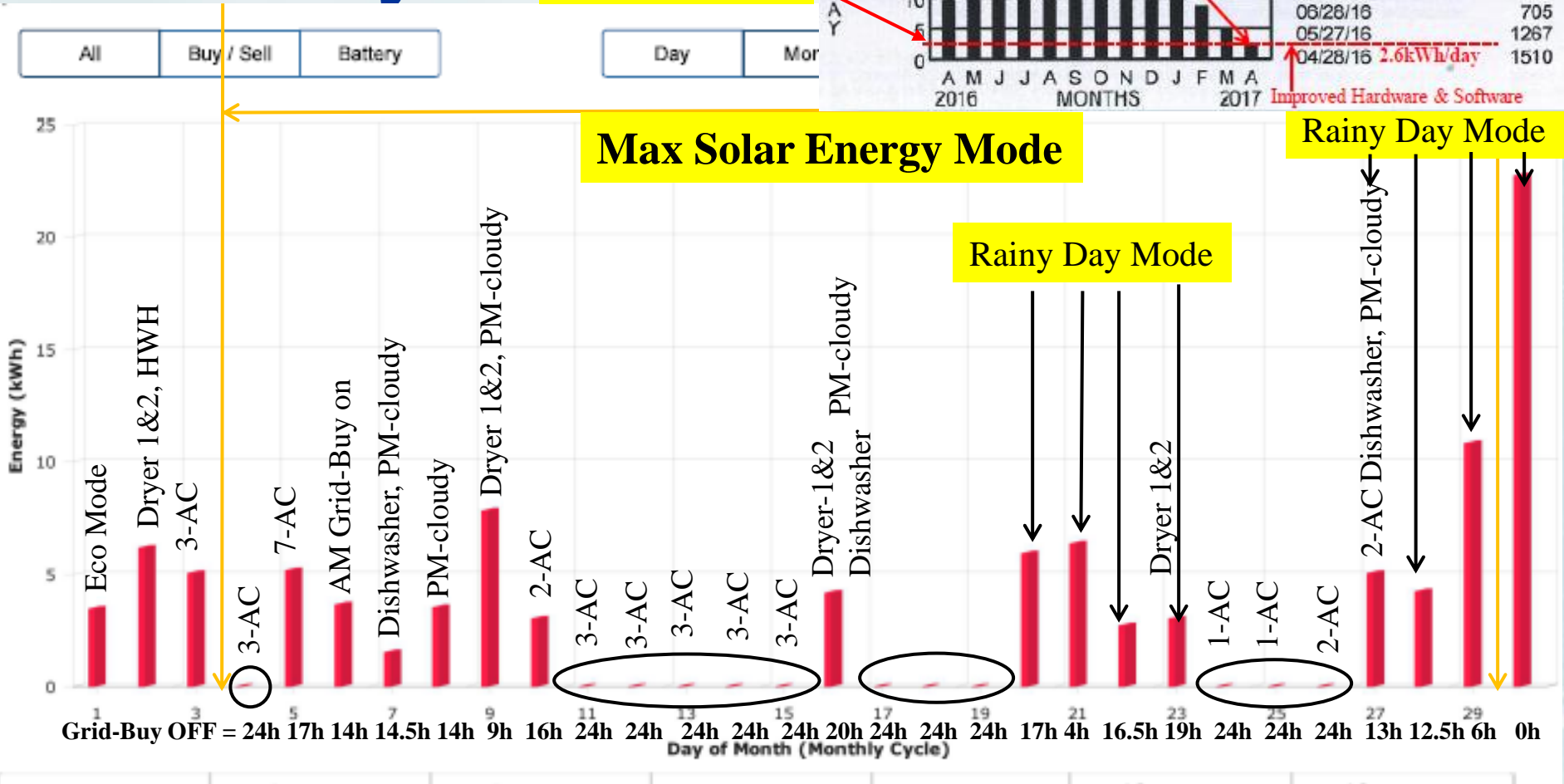
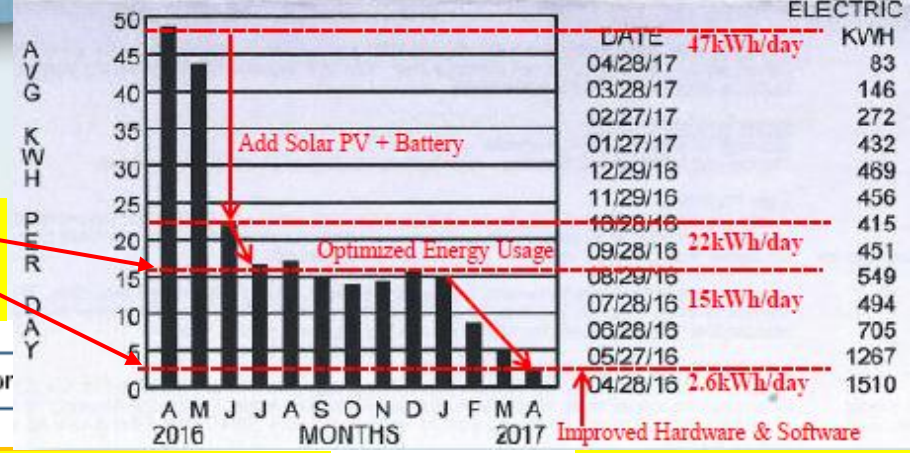
# March 2017 Grid-Buy Results

## 136.4kWh/month or 4.4kWh/day



# April 2017 Grid-Buy: 104.1kWh/month or 3.5kWh/day

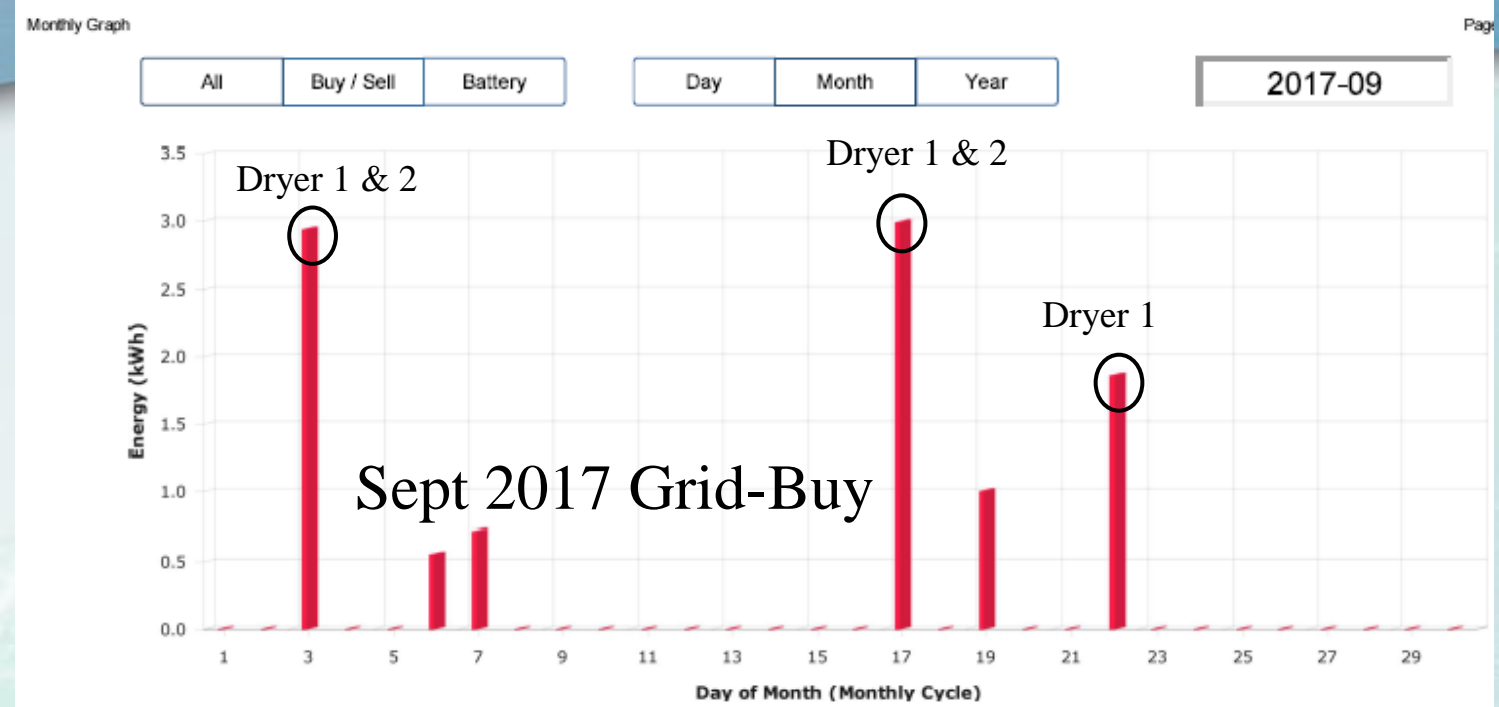
Battery Backup  
Grid-Tie Backup



5/6 Straight Days Off-Grid, Need Grid 240V for Dryer Operation



# Solar Phase 3: Dual Battery 20kWh



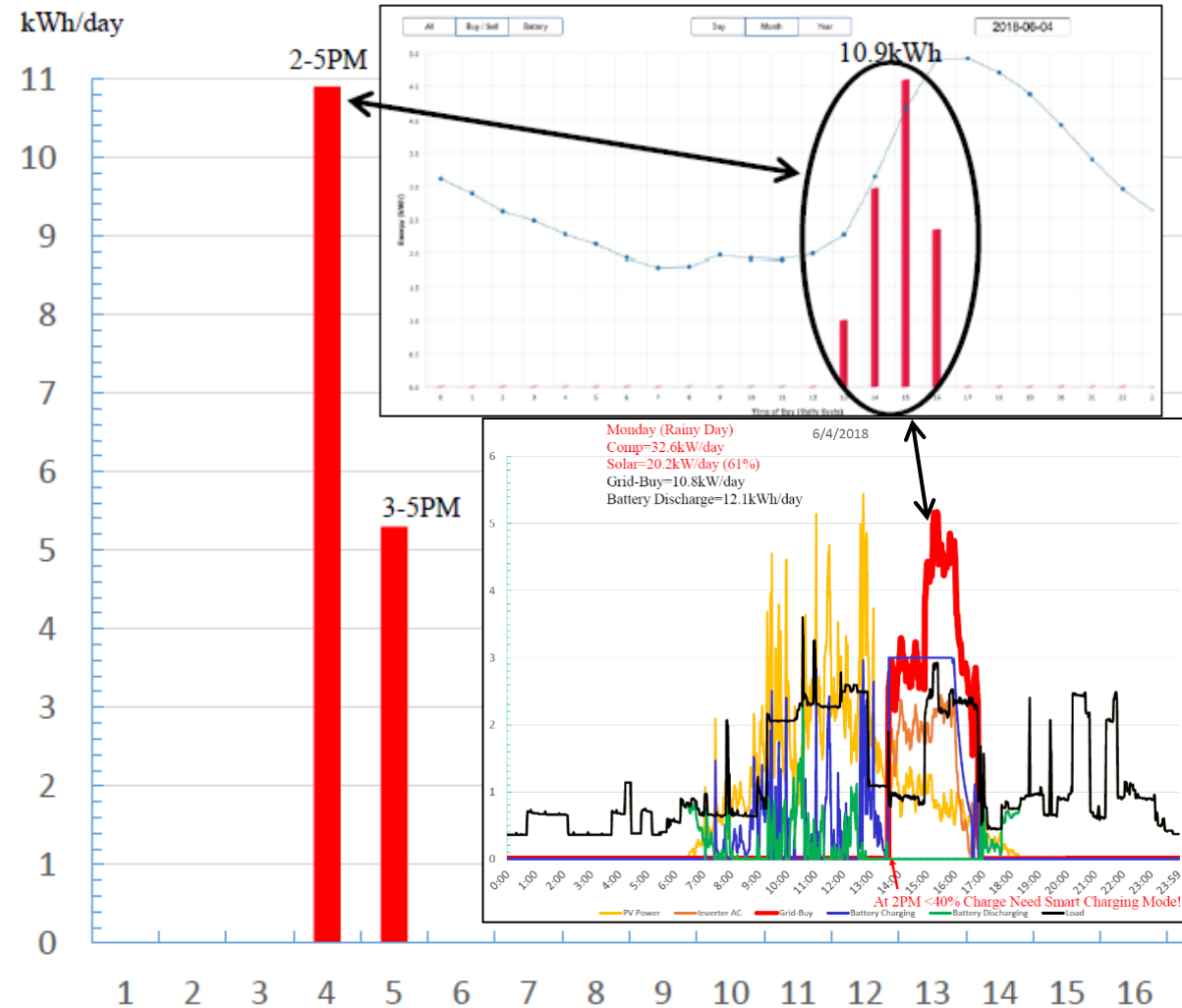
**24 Days Off-Grid!**

If 240V not needed then +3 Days

**Dec 2017 added transformer for 240V and Complete/100% Home Back-up (Off-Grid mode of operation): Clothes Dryer, Stove/Oven, Pool Pump and Hot Water Heater**

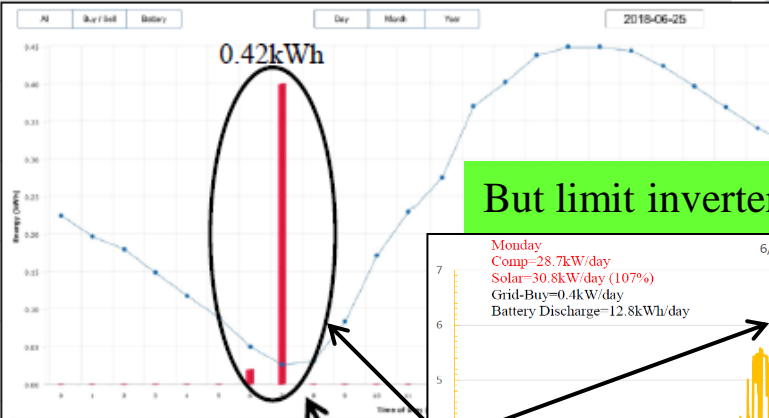
# June 2018 Grid-Buy

Grid-Buy on Rainy/Cloudy Days to charge multi-storage batteries/devices

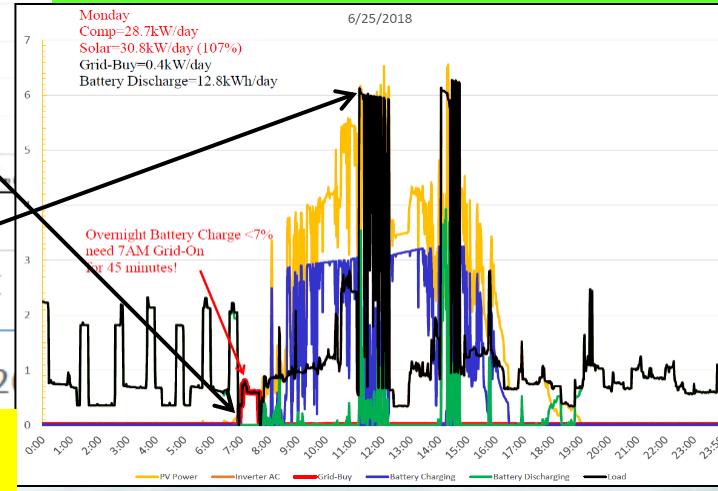


27 Days **Zero Grid-Buy** (714 hours)  
 3 Days **Grid-Buy** (6 hours)  
 16.4kWh/month  
 \$16/month minimum

**Grid-Tie Home: Digitized Smart Switchable On/Off Grid Mode of Operation for 100% Clean Energy from the Sun!**



**But limit inverter power to <6.4kW!**



**Dec 2017 added transformer for 240V and Complete/100% Home Back-up (Off-Grid mode of operation): Clothes Dryer, Stove/Oven, Pool Pump and Hot Water Heater.**

June 2018 = 99.1% Off-Grid (6 hours Grid-Tie=16.4kWh/month)  
 July 2018 = 100% Off-Grid (0 hours Grid-Tie=0kWh/month)  
 Aug 2018 = 1<sup>st</sup> 17 days Off-Grid before **Hurricane Lane** forced On-Grid (99kWh/month)



# Solar Plus Multi-Storage Restores Power to Families in Puerto Rico

May 1, 2018

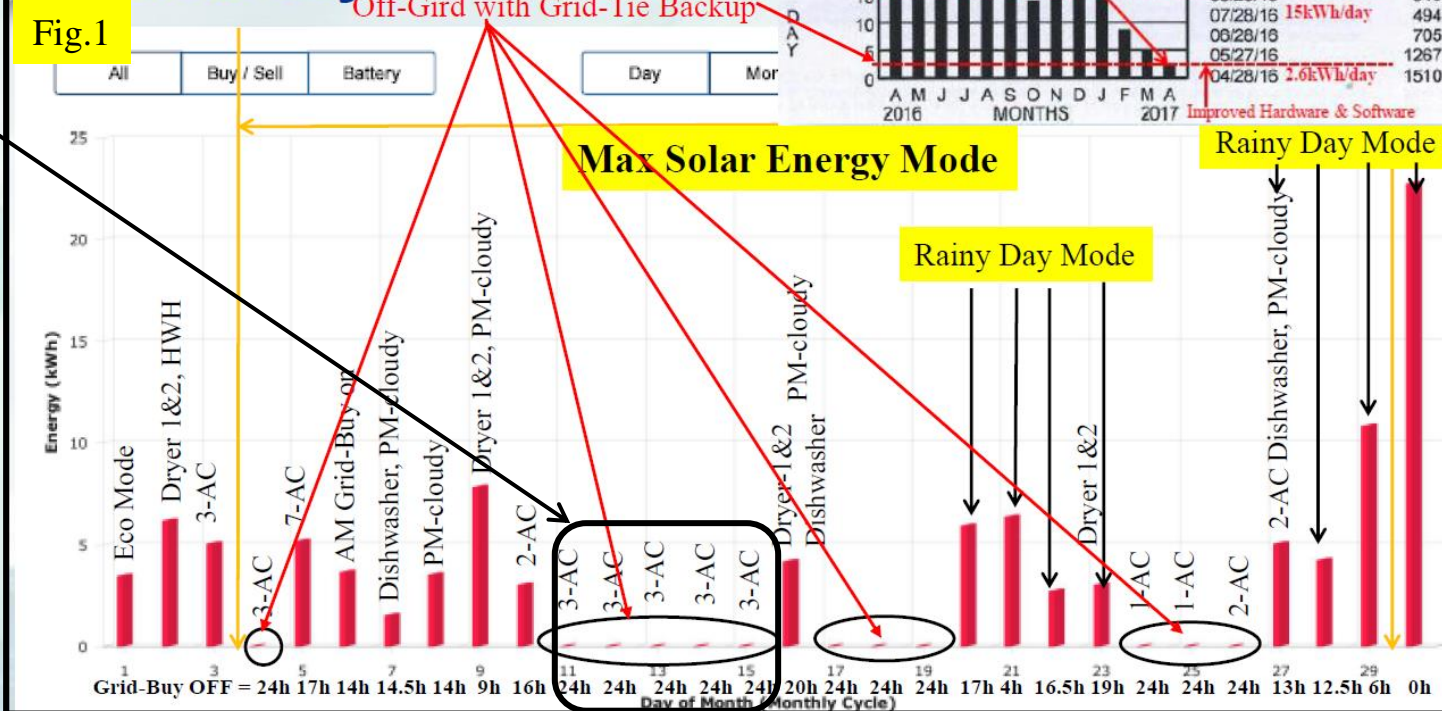


John Borland and Takahiro Tanaka

Based on my **Off-Grid Proof-of-Concept** results using **Island Nano-Grid** since **April 2017** — as shown in **Fig.1**—, Tabuchi donated 10 off-grid systems in **Oct 2017 to Puerto Rico**. Tabuchi has installed 200+ of their systems throughout Puerto Rico with **30 percent initially installed for off-grid operation** until grid-tied power could be restored. **Fig.2** shows an isolated remote family home installing the Solar + Multi-Storage system for off-grid operation. This is one of the donated off-grid systems that went to a family in remote *Maricao, Puerto Rico*, whose house has been **without power for 20 years since hurricane George struck in 1998**. The electric power was never restored to their area, according to Tabuchi. **Fig.3** is a photo of Edison Rivera standing in his living room with the light on for the first time powered by non-fossil fuel consuming generator since 1998.

**April 2017 Grid-Buy:**  
**104.1kWh/month or**  
**3.5kWh/day**

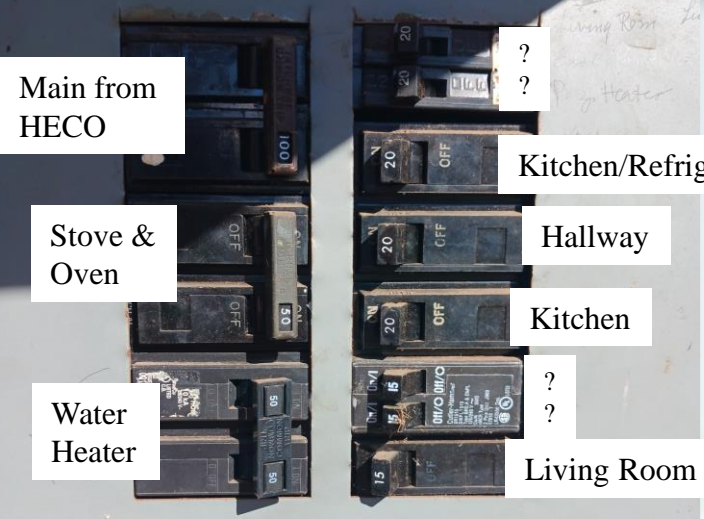
April 2017 = 720 hours (30 Days)  
 Off-Grid = 480.5 hours (20 Days)  
 On-Grid = 239.5 hours (10 Days)



Off-Grid Solar + Storage Improved Rivera Family **Quality of Life!**

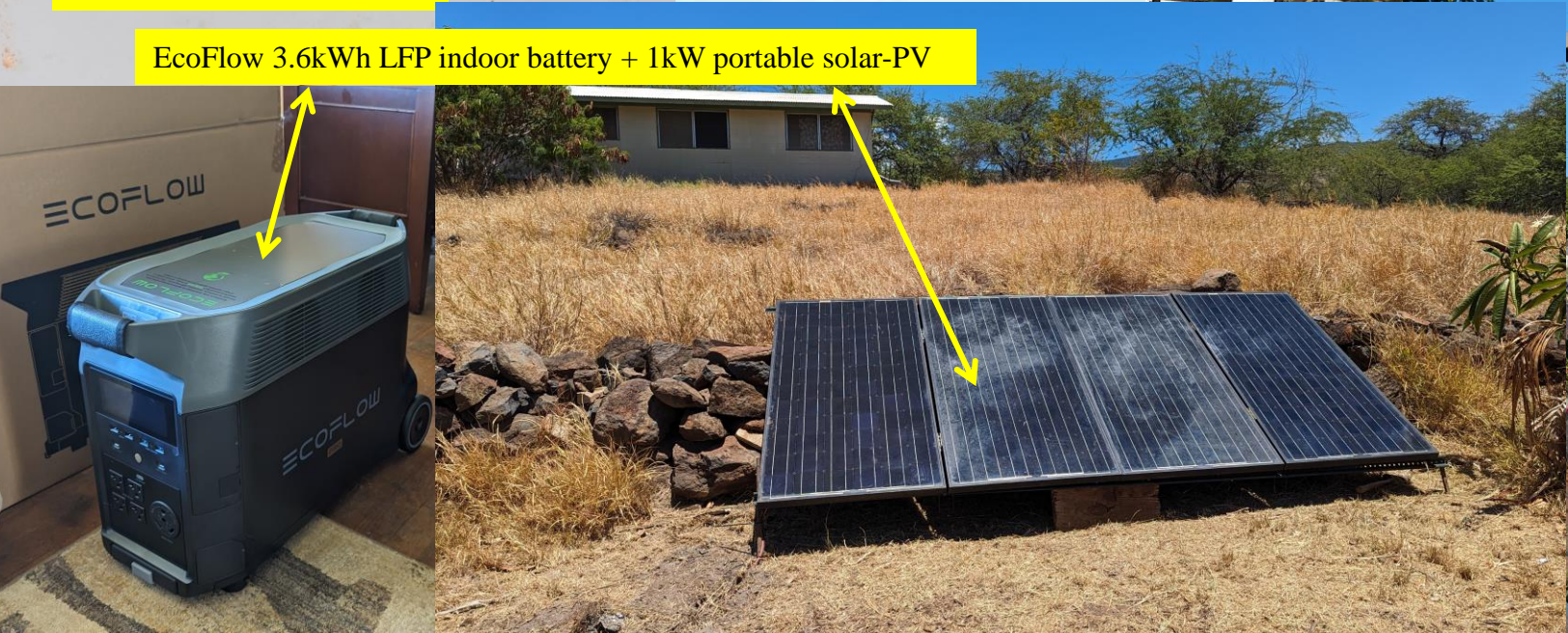


# Native Hawaiian Low Income Section-8 Rental Home Aug 2023



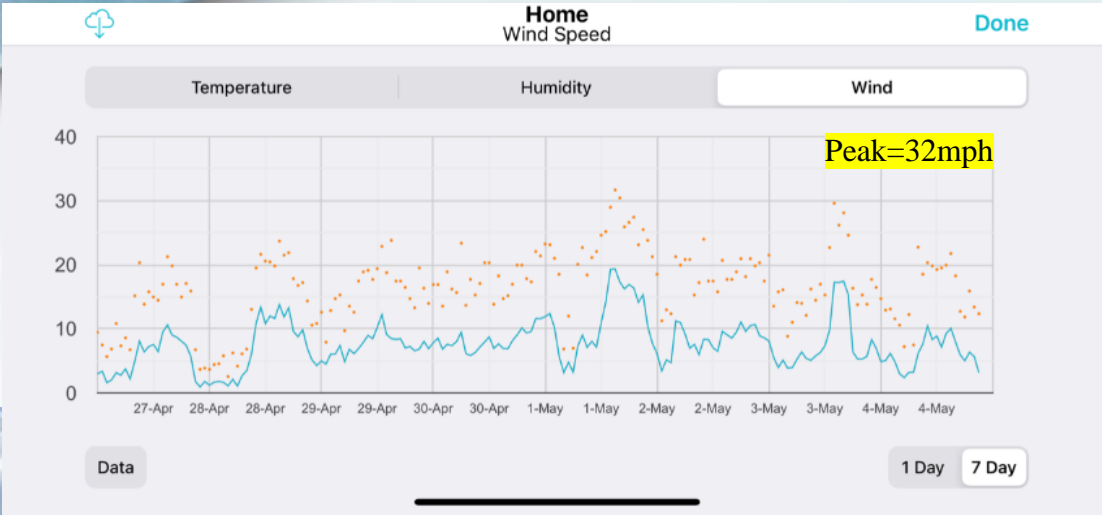
Energy Usage  
 240V Water Heater = 4.5kW  
 240V Stove/Oven = <3.5kW

EcoFlow 3.6kWh LFP indoor battery + 1kW portable solar-PV

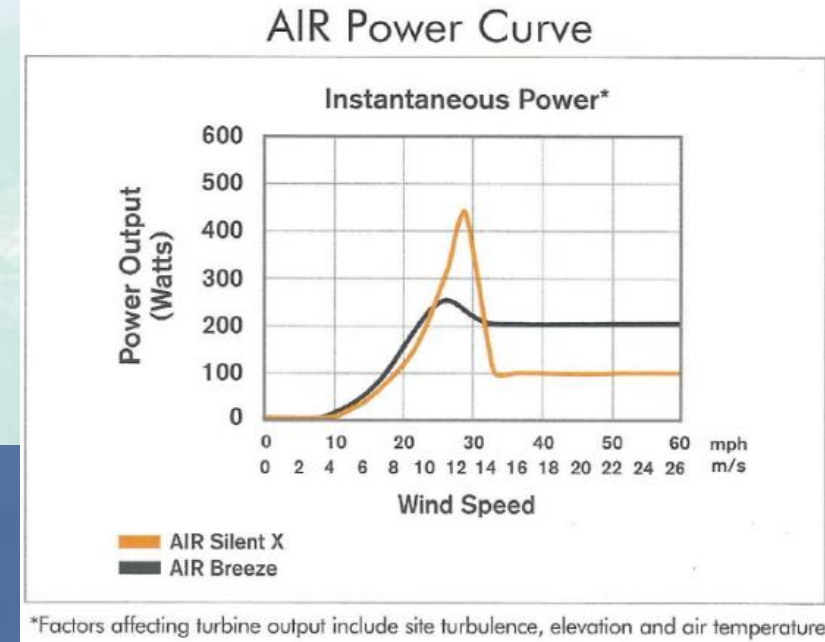




# Borland's Resilient Island Nano-Grid Solar + Wind + Storage (Battery & Thermal)



Dec 14, 2022



Wind Generator

7.1kW Solar-PV

3-Solar Thermal Panels

3-Blade Propellor (400W)

5-Blade Lantern (<200W)



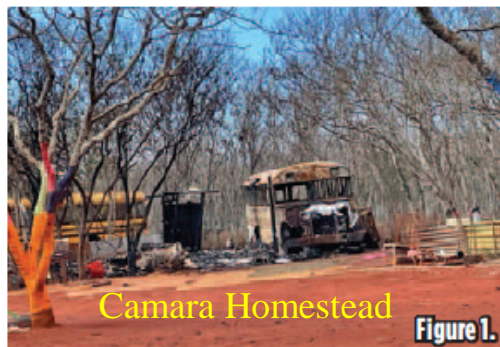
Replace Off-Grid Fossil Fuel use with 100% Clean Renewable Energy using Solar + Battery



## IEEE ELECTRON DEVICE SOCIETY BRINGS ENERGY EQUITY TO NATIVE HAWAIIAN HOMESTEADERS ON MOLOKAI LIVING WITHOUT ACCESS TO GRID ELECTRICITY

By John Borland, IEEE

The IEEE Electron Device Society (EDS) recently approved funding a humanitarian project to bring Energy Equity to Native Hawaiian Homesteaders on Molokai living without access to electricity from the Grid. The \$25K grant will be used as part of the 6-month phase-1 pilot project administered by IEEE Smart Village (ISV). Three homestead sites with 2 to 5 multi-generational family dwellings have been selected. John Nelson President of ISV and John Borland chair of the IEEE Hawaii EDS chapter traveled to Molokai on Dec 15th and



Camara Homestead Figure 1.

met with each Homestead family representative to discuss the project.

Everyday life on Molokai involves using 5 gallon

propane tanks for heating hot water and cooking but one family was using wood and charcoal for cooking. Gasoline is \$6.35/gallon and they use 5 gallon gasoline containers to fill and power several electric generators. We noted the various gasoline nozzles in use to reduce spilling and the toxic odor when handling. One Homestead site had a propane tank gas leak fire that destroyed their bus-home (see Figure 1).

Another homestead family uses ice boxes requiring ice for refrigeration, gasoline generator for electricity, propane for cooking on their livestock and agriculture farm (see Figure 2).

They try to live off the land but end up polluting the air. Total monthly costs for fuel and ice for each family varies from \$400-\$800/month depending on fossil fuel usage. Replacing dirty fuel usage (propane and gasoline) with 100% clean energy from the Sun (light & heat) will not only create a healthier environment but also reduce Energy Burden for Energy Equity and improve Quality of Life, never having to take a cold shower.

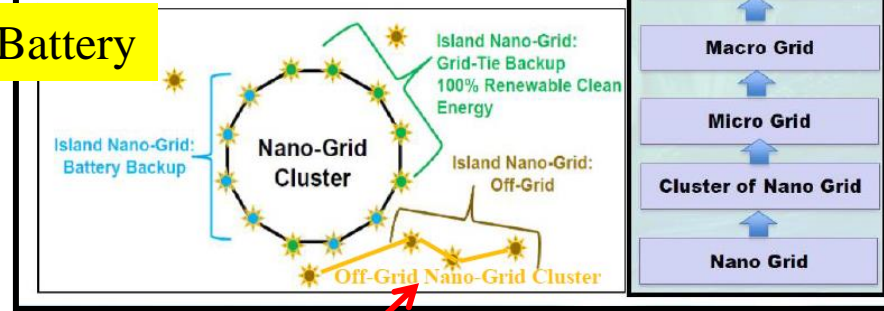
We will install Island Nano-Grid and Nano-Grid Clusters using Solar + Wind + Storage (battery and thermal hot water) systems



Figure 2.

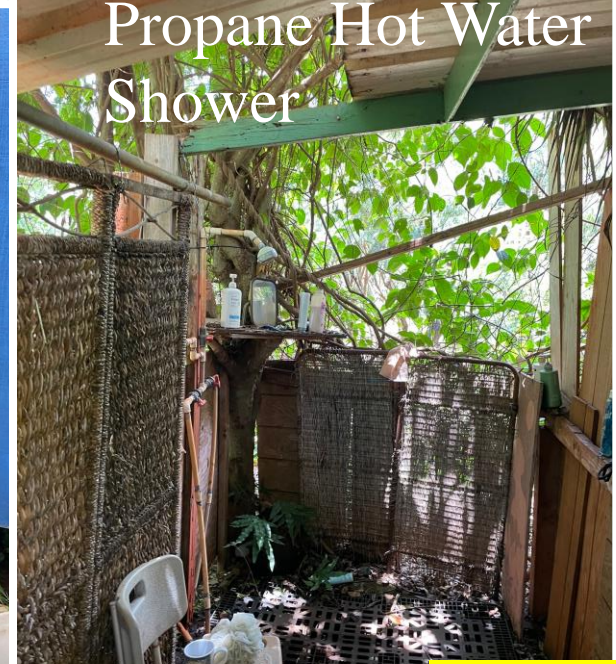
with energy sharing between each family dwelling. Energy efficient household appliances will also be installed including heat pump hot water, heat pump washer/dryer, Energy Star refrigerator/freezer, LED lighting and other energy saving household appliances (microwave oven, toaster oven, etc.).

Each homesteader will have access to internet connection for smart home energy digitization to monitor, control and balance energy usage to maximize savings. After phase-1 completion, phase-2 would be a 2-3year project to expand



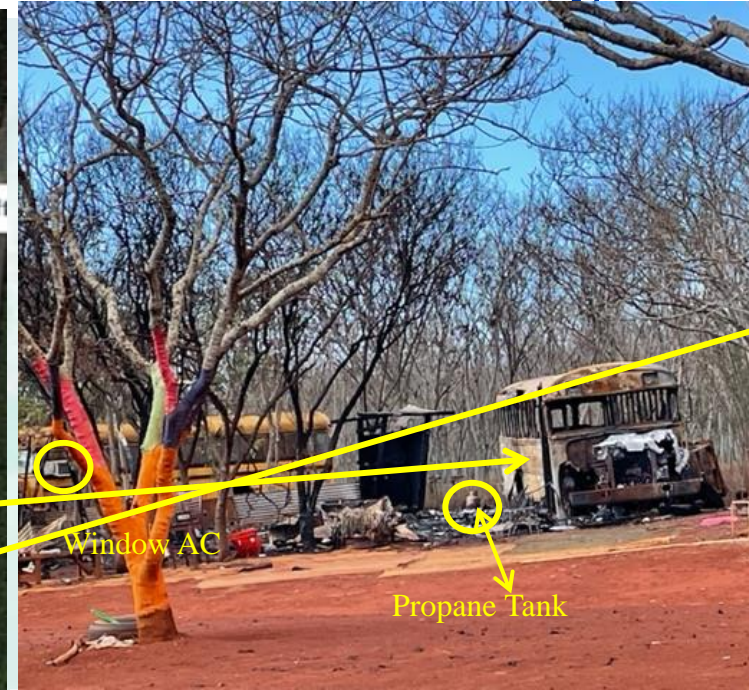
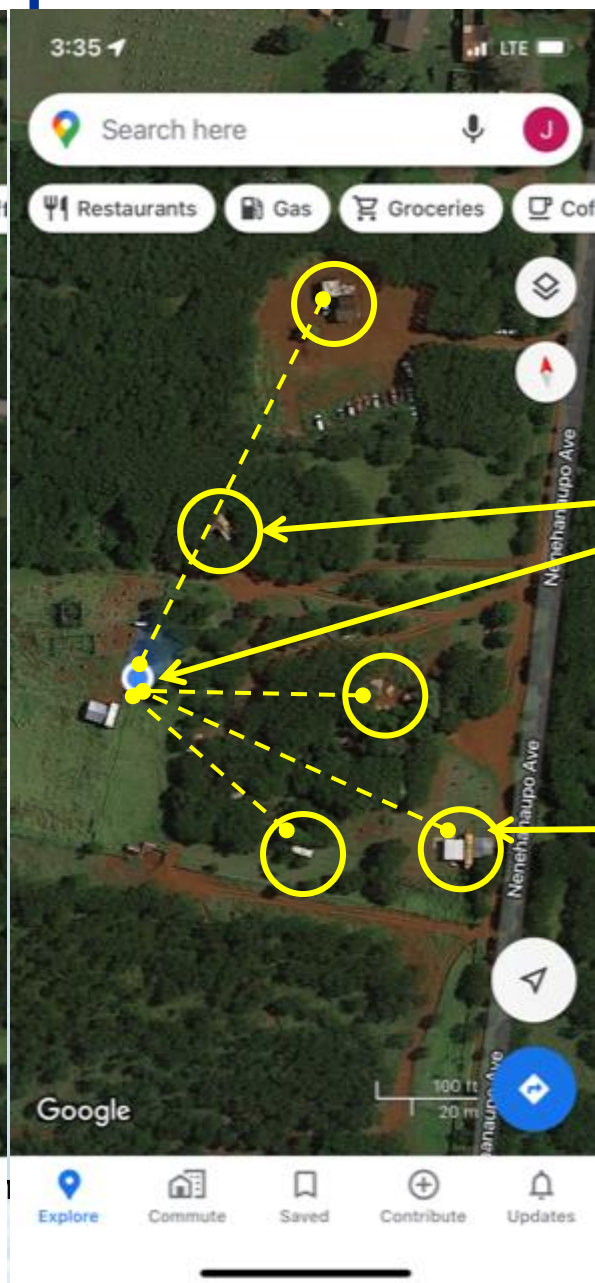
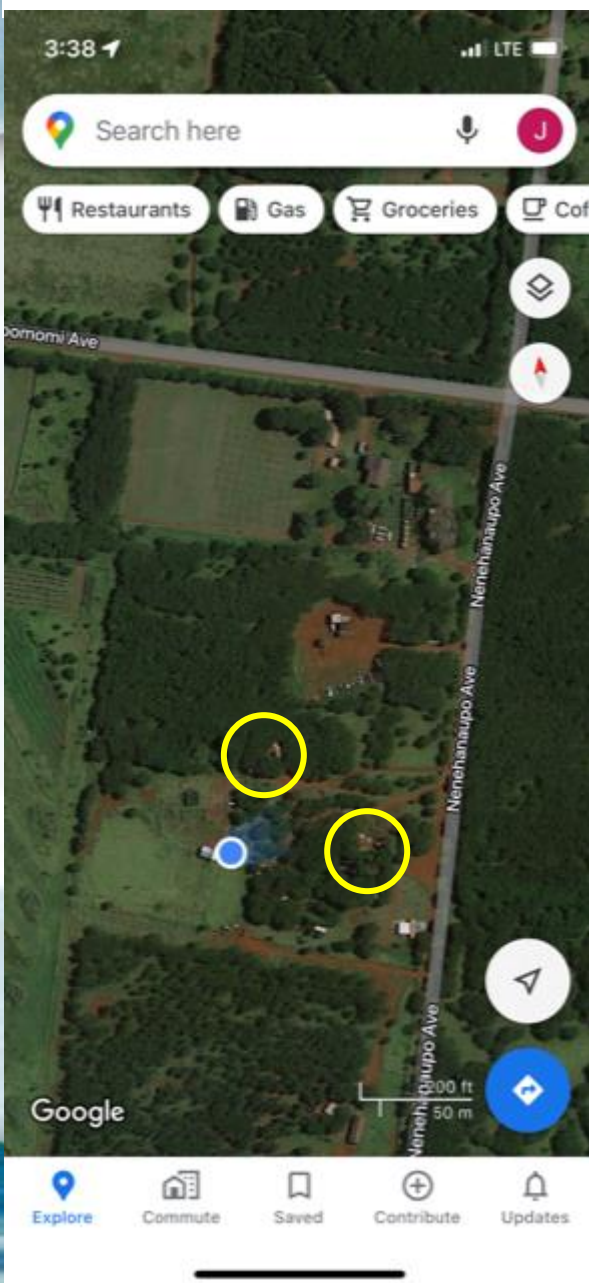


May 14, 2023 IEEE Region 6 Leadership Visit Molokai Native Hawaiian Homesteaders Living Without Access To Grid Electricity: **Multi-Generational Homestead Family With 4 Dwellings Pay \$2,100/month For Gasoline, Propane & Ice Cubes!**





# Camara Homestead Visit 8-27-22: 20+ Years 5 Families, 1 Bus-Home Caught Fire Burnt Gas Propane Bottle for Hot Water & Cooking, Gasoline Generator



Molokai resident Kala'e Tangonan shows off her mother's living area located on homestead land near the Molokai Airport.

5.5kW Inverter + 19.6kWh Li-ion Batteries



Aug 5, 2023 Molokai Camara Homestead Visit to Commission Refurbished **Tabuchi** 5.5kW Inverter with 19.6kWh **Panasonic** Li-ion Batteries & 6.9kW Solar panels donated from **Kumukit**



Energy Star LG Refrigerator/Freezer (90W)



5.5kW Inverter + 19.6kWh Li-ion Batteries



**POWER SHARING FEATURE**

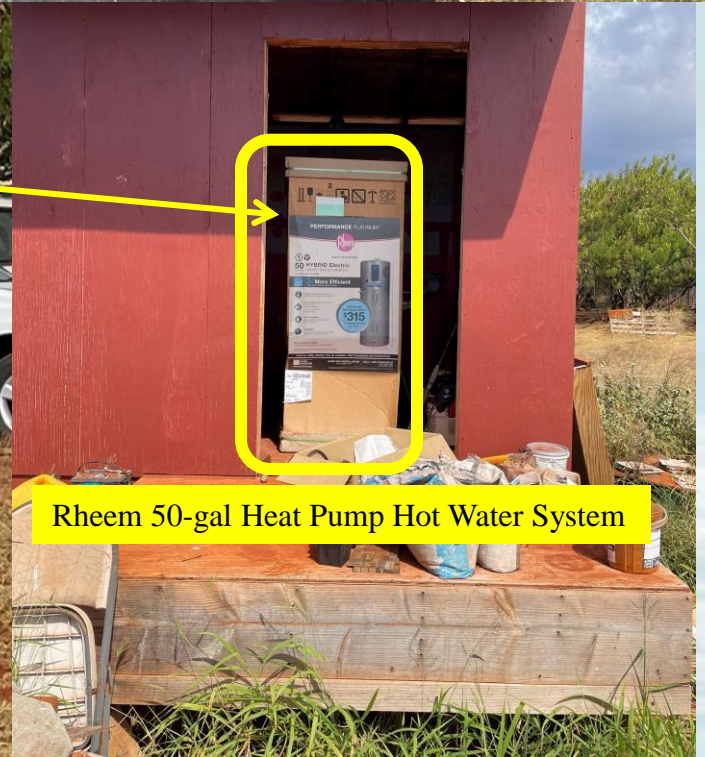
When operating only 1 burner:  
The maximum power of the one burner is 1800W.

When operating both burners at the same time, total power of the two burners will not exceed 1800W, so if one burner increase power, another may decrease power or stop.

Left and right mutual control:  
two burners in power gear work at the same time.

The complex block contains text and a diagram of an induction cooktop. The diagram shows two burners, one on the left and one on the right, with a small flame icon above each. Below the diagram, it states that the left and right burners have mutual control and work at the same time in power gear.

Induction Heating Dual-Cooktop (1.8kW)

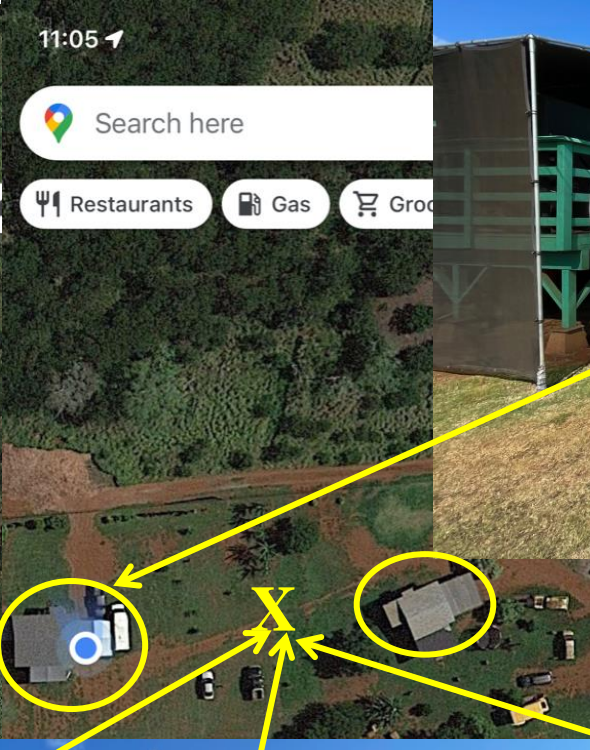
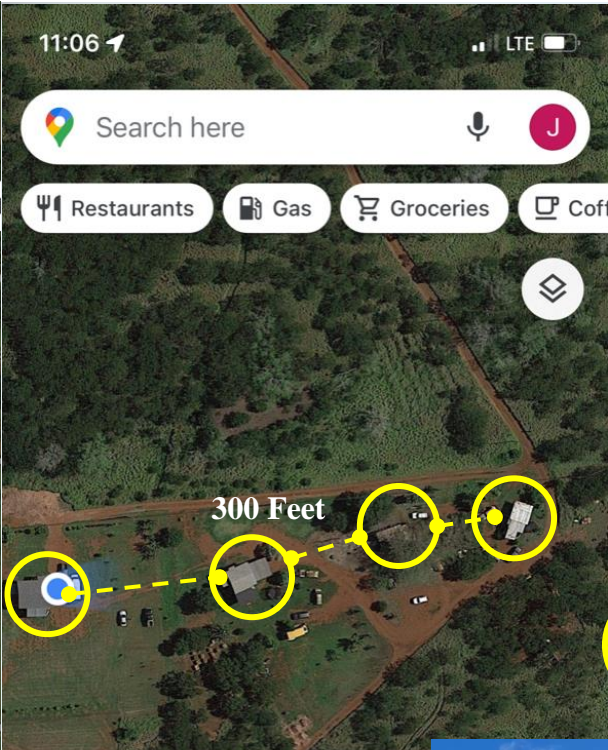
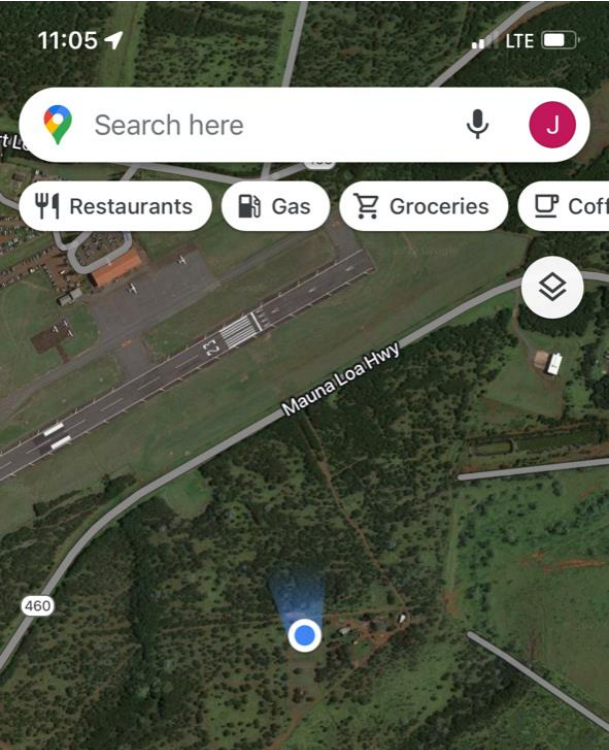


Rheem 50-gal Heat Pump Hot Water System



# Poepoe Homestead Visit 12-15-22

4 Family Compound (\$500/month each = \$2000)  
Gasoline Generators  
Satellite TV  
No WiFi only Cell phone



Off-Grid Canopy Ground Mount



Off-Grid Canopy Ground Mount