



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



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 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 2-3-year project to expand

Energy Burden	HI No Solar	HI NEM	HI CGS+	HI CSS	HI Battery Only	HI Battery +	HI Community	HI Community
Family Energy Usage	No Solar	NEM	CGS+	CSS	Battery Only	Battery +	Community	Community
Low Usage = 325kWh/month	/(Savings)	/(Savings)	/(Savings)	/(Savings)	/(Savings)	Portable-Solar	Solar/Battery	Solar/Battery
High Usage = 1250kWh/month					TOU= (-26-33% Savings)	/(Savings)	/(10% Savings)	/(25% Savings)
Affluent Low Usage (Molokai)	2.4%/(0%)	0.3%/(87%)	0.3%/(87%)	0.3%/(87%)	1.3%/(43%)	1-0.3%/(55-87%)	2.10%	1.80%
Affluent High Usage (Oahu)	6.6%/(0%)	0.3%/(95%)	0.3%/(95%)	0.3%/(95%)	3.3%/(49%)	2.7-0.3%/(58-95%)	5.90%	4.90%
LMI Low Usage (Molokai)	9.9%/(0%)	1.3%/(87%)	1.3%/(87%)	1.3%/(87%)	5.6%/(43%)	4.3-1.3%/(55-87%)	8.90%	7.40%
LMI High Usage (Oahu)	27.5%/(0%)	1.3%/(95%)	1.3%/(95%)	1.3%/(95%)	13.9%/(49%)	11.5-1.3%/(58-95%)	24.70%	20.60%

Table 1. Energy burden analysis for Molokai and Oahu

Energy Equity to the remaining 126+ Native Hawaiian Homesteaders living without grid access.

Molokai is an island of ~7,500 residents relying on tourism and government subsidies. Reducing the need for each homestead family to generate ~\$500/month (\$6,000/year) reduces the need for Molokai to generate cash inflow of \$774K/year! Residential Island Nano-Grid systems getting 100% energy from the Sun will create a source of cash inflow for Molokai from Passive Renewable Energy rather than from tourism and government subsidies.

A long time resident of Molokai says, "a dollar saved is a dollar earned" on Molokai. This project is "bringing electricity, a better quality of life, hot water, refrigeration and saving them money, you are reducing air pollution and stemming the outflow of money from Molokai to the oil companies."

To bring Energy Equity to all on Molokai including the remaining ~1,250 households with grid access but no access to rooftop solar including renters and low to moderate income (LMI) households, another future IEEE humanitarian project will look at "Battery Only

or Battery + Portable/Mobile-Solar" systems as reported by Borland in his IEEE-PVSC June 2022 paper. Energy Burden reduction by 43-87% by lowering the schedule R rate 57¢/kWh (Aug 2022) to daytime Time-of-Use (TOU) rate which is ~31% lower on Molokai compared to >40% lower on Oahu (see Table 1 energy burden analysis for Molokai and Oahu).

But the new federal Inflation Reduction Act (IRA) falls short to reverse Energy Divide by not providing direct cash rebates/incentives to LMI households. Solar Builder reported that 4 in 10 Americans do not pay any taxes and 7 in 10 do not have enough tax liability to receive full income tax credit benefits.

Running the same numbers as above, there are ~1250 renters/LMI households without

residential solar, saving \$100/month (\$1,200/year) reduces the need for Molokai to generate cash inflow of \$1.5M/year. Combined with the Homesteaders that totals ~\$2.27M less in needed tourism and government subsidies creating a new industry from **Passive Renewable Energy**.

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