Area: 10

A CASE STUDY FOR ACHIEVING 100% RESIDENTIAL HAWAII HOME ENERGY NEEDS WITH RENEWABLES BY OPTIMIZING ROOFTOP SOLAR PV AND HOT WATER WITH ELECTRICAL AND THERMAL (HOT&COLD) BATTERY STORAGE INTEGRATION

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With the end of net energy metering (NEM) and export/selling of excess rooftop solar PV energy back to the utility Grid for residential Hawaii, future growth in the residential solar market will no longer drive the solar industry to higher solar cell efficiency because this results in excess PV generation dumping of up to 30% based on NREL's System Advisor Model for Honolulu. For customer self-supply in a post-NEM world, lower price packaging of smaller solar-PV systems integrated with battery storage (electrical & thermal) and optimized energy usage of key household appliances will drive the next wave of residential solar deployment by minimizing excess PV energy dumping and reducing HECO Grid-Buy electricity to achieve 0.0kWh/day. We will report field data starting from the June 1, 2016 installation of the rooftop solar systems + battery storage and steps we took to achieve the reduction in the daily Grid-Buy electricity going from ~47kWh/day for April 2016 to 2.6kWh/day for April 2017 with 12 days at 0.0kWh/day Grid-Buy after solar installation and energy usage optimization as shown in Fig.1 below. After the 1st month we only realized 50% reduction in HECO Grid-Buy so PV+battery did not provide enough reduction in Grid-Buy so better monitoring of daily energy usage was needed to identify areas to further reduce Grid-Buy. Three different energy monitoring systems (Tabuchi, Laplace and Hawaii's Blue Planet Foundation Bidgely) were used for real-time and off-line energy usage analysis to improve the PV system hardware, software and reduce Grid-Buy. Air Conditioner was the #1 energy consumer at ~40.5kWh/day, #2 was the Hot Water Heater at ~13.5kWh/day, #3 was Washer/Dryer at ~12.0kWh/day, #4 was refrigerator/freezer at 7.2kWh/day, #5 was pool pump at 6.5kWh/day, #6 was X-mas lights at 2.9kWh/day and #7 was the night lights at 1kWh/day. Rainy day 3/1 Grid-Buy was 7kWh/day while sunny day 3/23 Grid-Buy was 0.0kWh/day. This was achieved using 7kWh solar-PV + 10kWh Li-ion Electrical Storage battery + 2 solar thermal panels for 120 gallons of water >160°F as Hot Thermal Storage battery + PV generated Air Conditioner for <67°F room temperature as Cold Thermal Storage battery.

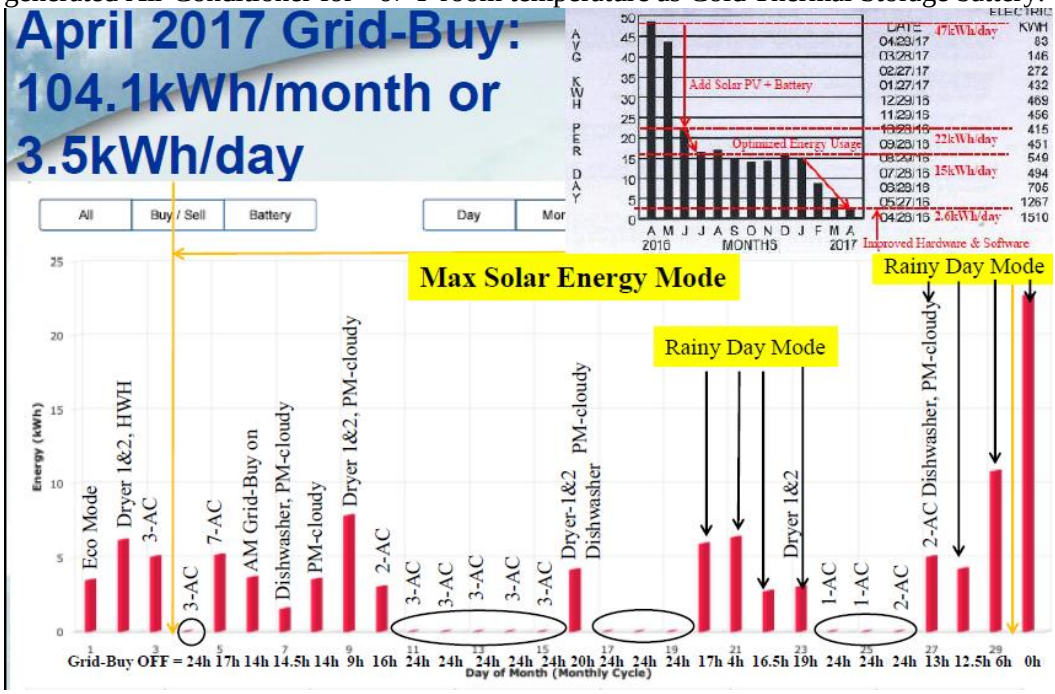

Fig.1: Grid-Buy electricity usage for April 2017. Top right insert for April 2016 to 2017.