

5 Years Self-Consumption Residential Solar + Storage Case Study Results For Zero Carbon Smart Home and NEM-Equivalent Savings

John Borland, eStat & J.O.B. Technologies, Aiea, Hawaii

INTRODUCTION:

As more and more utilities adopt programs that limit excess residential rooftop solar-PV export back to the grid with very low export rates, peak demand charges or time-of-use (TOU) rates, the payback or return on investment (ROI) times are increasing from 6-7 years to >12 years. Hawaii customer grid supply plus (CGS+) export rate is \$0.10/kWh and California NEM-3 plans \$0.06/kWh plus monthly charges based on solar-PV size making rooftop solar unattractive and out of reach for affordable housing and renters. Self-consumption programs restrict export back to grid and results in PV-curtailment based on battery sizing. PV-curtailment is OK and still result in 3.1 year payback provided the home energy ecosystem is balanced to maximize Renewable Clean Energy efficiency.

METHODS:

We report results for 5 years residential solar + storage on Oahu, Hawaii under the customer self-consumption (CSS) program that restricts export of excess solar-PV generation back to the grid resulting in PV-curtailment. This case study will show how using energy conservation lifestyle behavioral changes with optimized residential demand response to maintain Quality of Life, NEMs export to the grid is not required. Smart home total energy ecosystem monitoring, control and balancing is required.

RESULTS:

Pre-solar years 2012-2016, the 4 year average home monthly electric bill from Hawaii Electric was \$396.21 and 1250kWh. Post-solar years 2017-2020, the 4 year average home monthly electric bill from Hawaiian Electric was \$34.22 and 114kWh a savings of 91.3%. Most sunny and partly cloudy days the hybrid inverter was in the Island Nano-Grid (off-grid) mode of operation for resiliency and Zero Carbon home. This required 100% home electrification, energy efficient home appliances and optimized residential demand response (DR) techniques including: 1) water heater-DR, 2) space cooling/heating-DR, 3) pool pump-DR, 4) behavioral-DR without disrupting Quality of Life. Total home energy ecosystem monitor, control and balance was achieved using smart IoT devices and eStat Controller including local weather information for predictive weather forecasting.

SUMMARY:

Using Smart IoT devices with eStat Controller, we achieved total home energy ecosystem balancing in the self-consumption solar program from Hawaiian Electric which restricts excess PV energy export to the grid. Self-consumption provides the path to resilience and true Zero Carbon (100% Renewable Clean Energy Home) and 100% home Electrification today with 3.1 years payback.

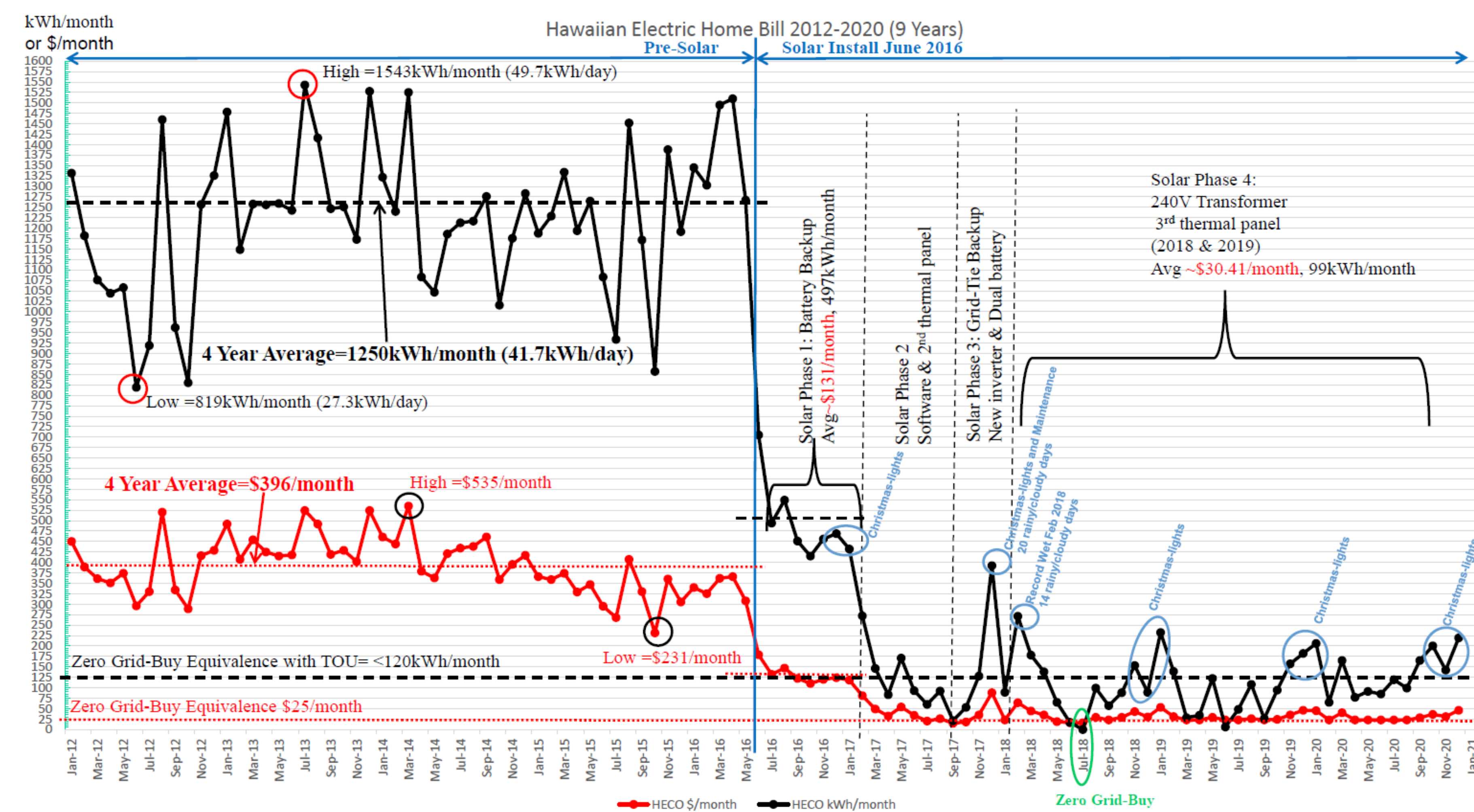


Fig.1: Home monthly HECO electricity usage and bill from Jan 2012 to Dec 2020.

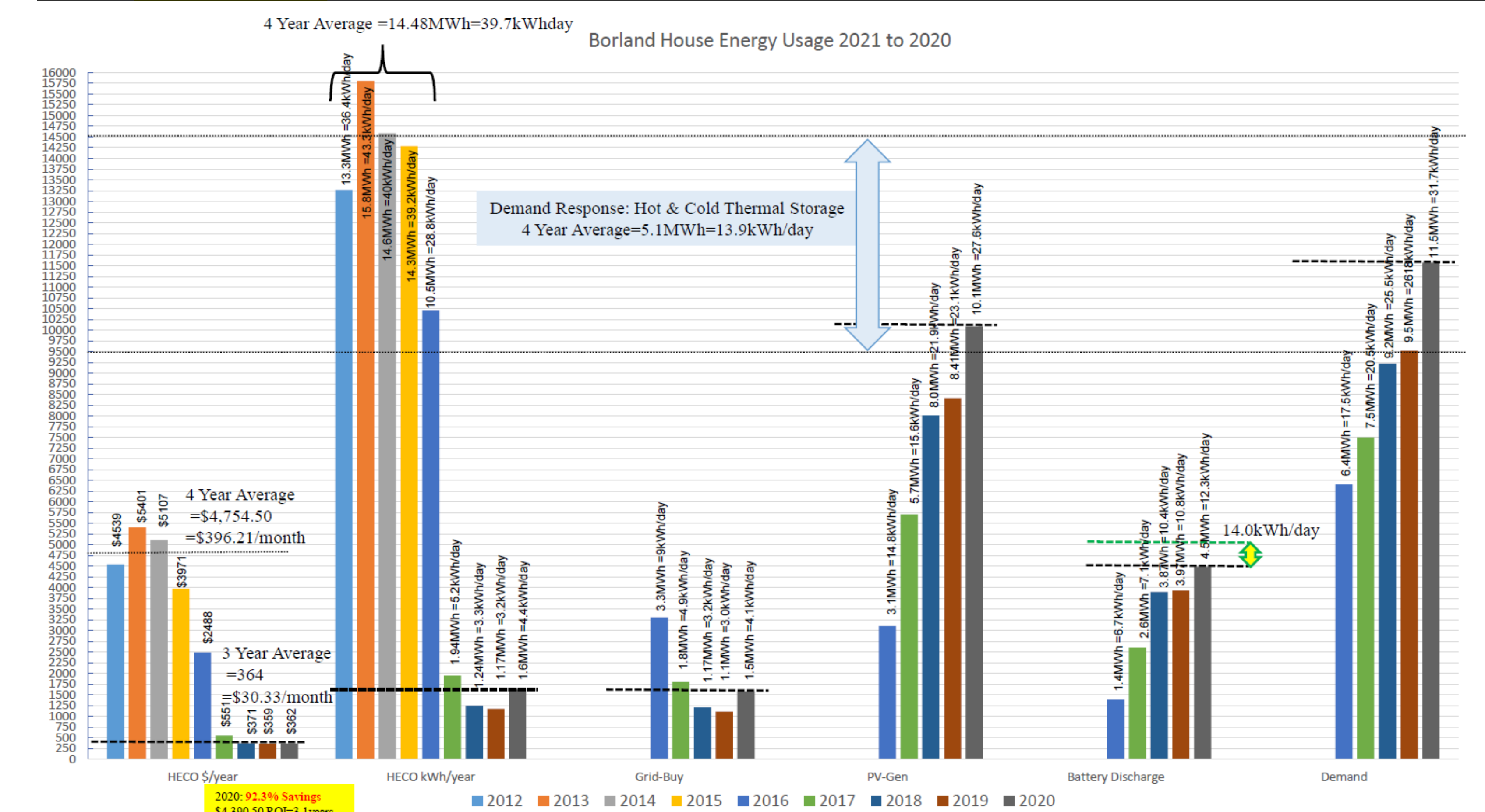
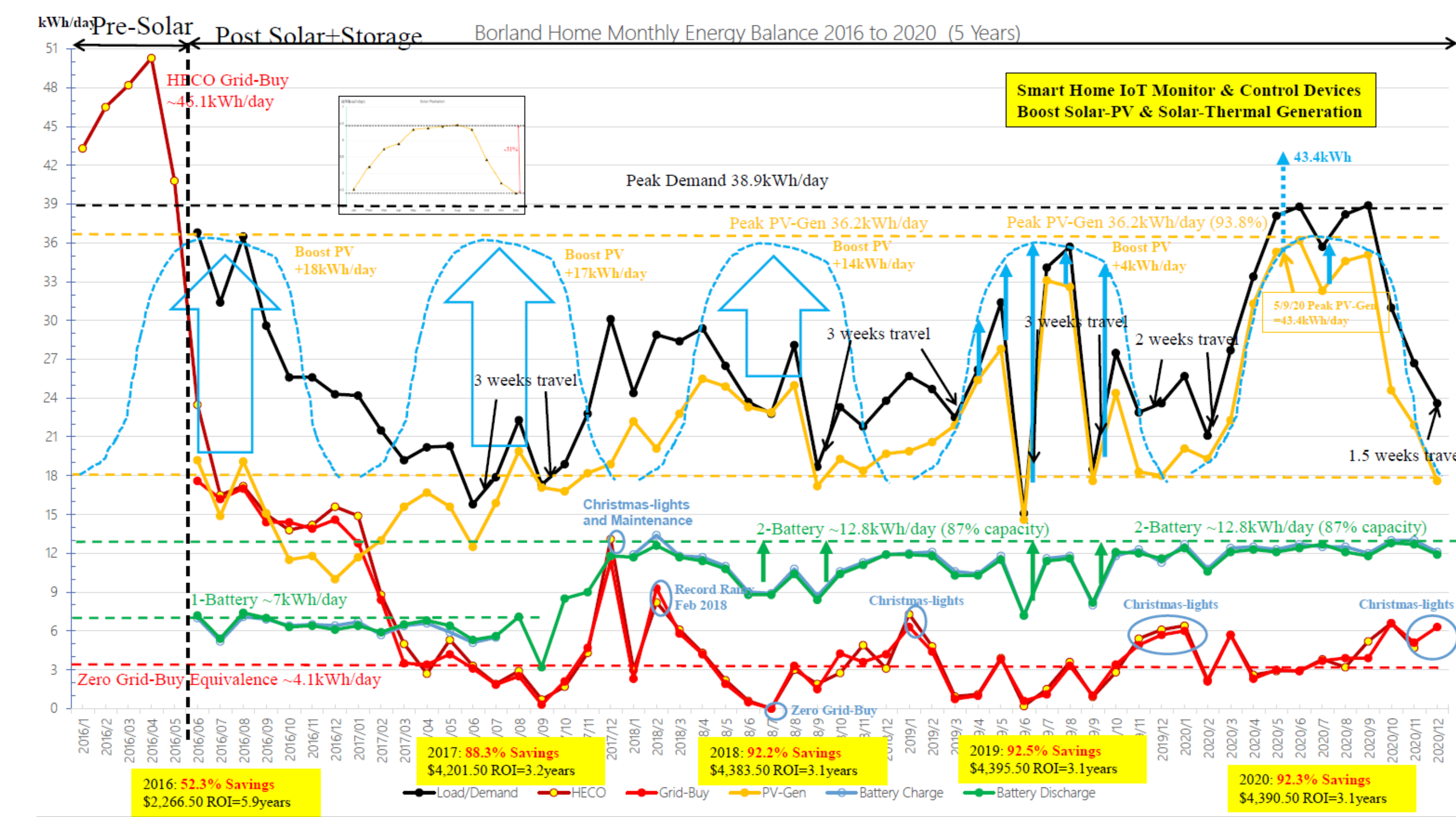


Fig.2. List of smart plugs with energy monitoring used throughout the house.