

California Energy Commission PON 14-307:
Demonstrating Clean Energy Solutions That Support
California's Industries, the Environment, and the Electrical Grid

Photo Voltaic Storage Networks



PVS Networks

Integrated PhotoVoltaic Storage Modules & Energy Storage Systems
for the Software Optimized Energy Network
at College of San Mateo Campus



College of San Mateo

West Parking Lot Canopy Site



System Size for RN767A:
400 kW DC PV & 200 kW / 400 kWh ESS

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RN767A Data

Baseline Facility Load RN767A

FIGURE 1: Average daily load profile; separated by day of the week

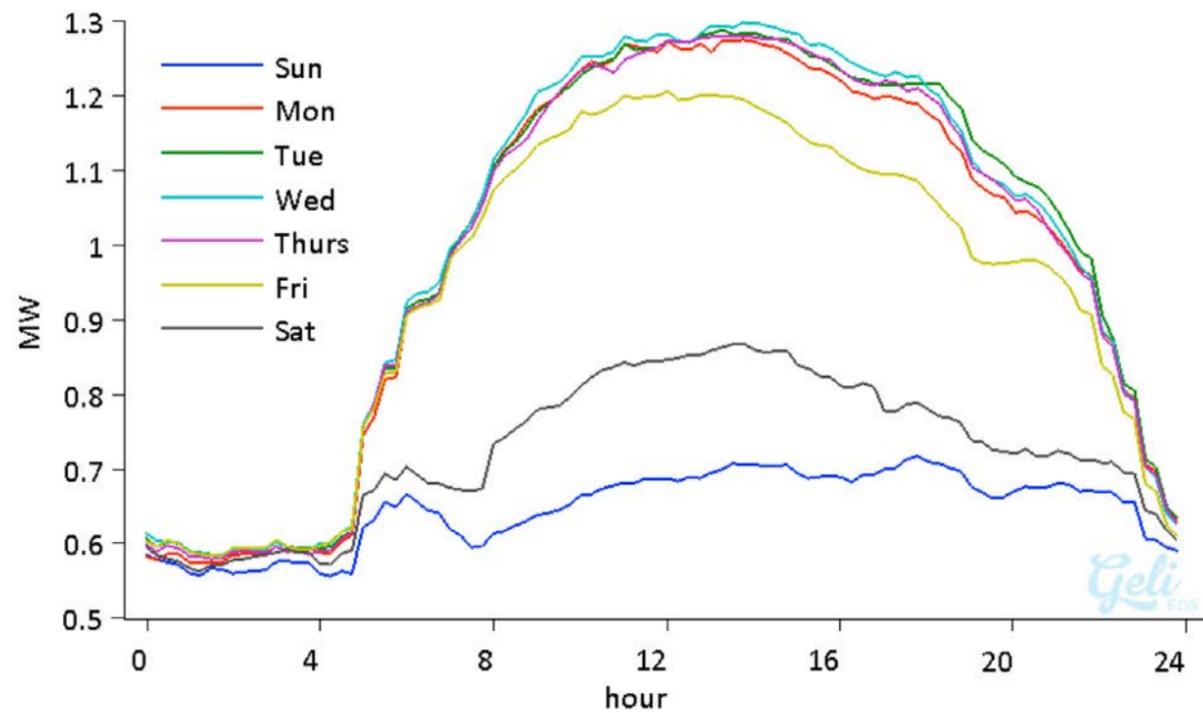
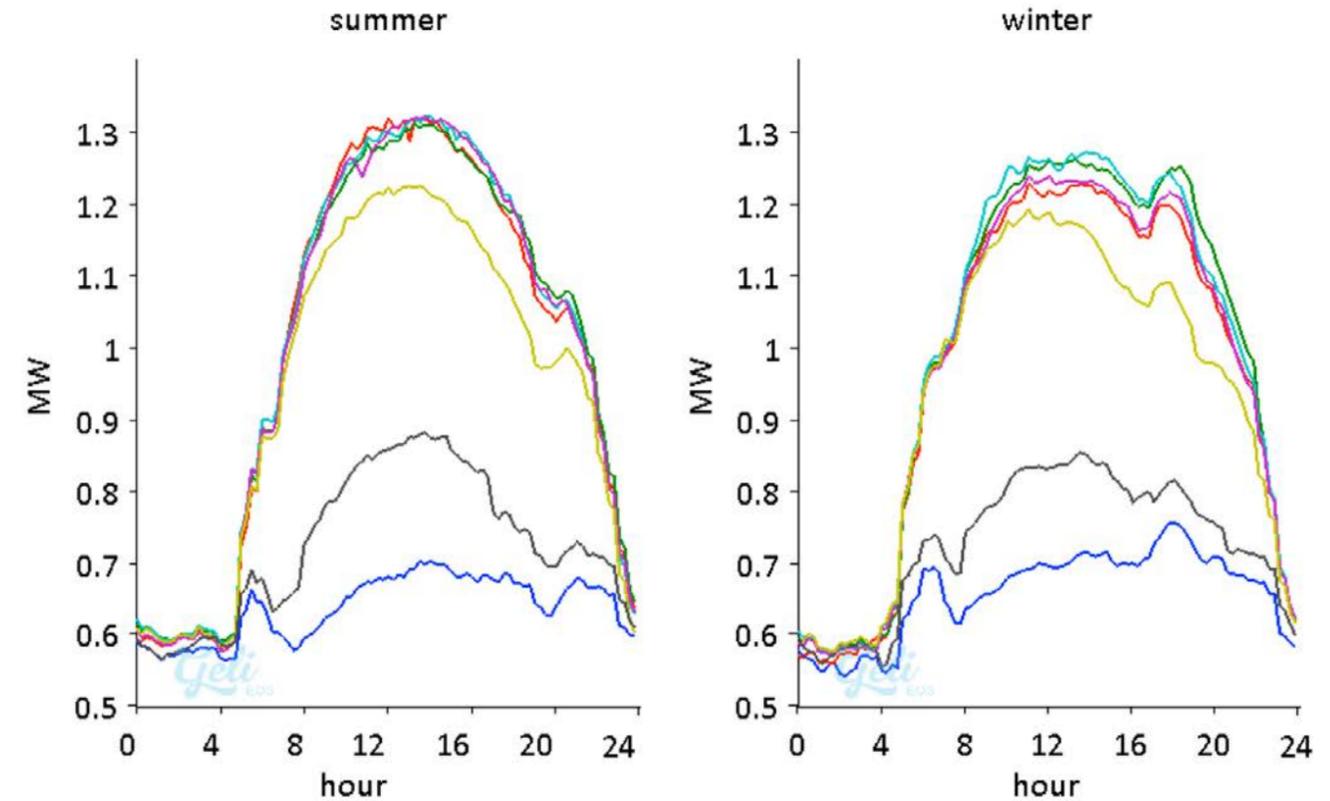


FIGURE 2: seasonal daily load profile



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FIGURE 3: Heat map of daily demand. Each row of pixels represents the demand for a single day, with high demand mapped to hotter colors (red hues) and low demand mapped to cooler colors (blue hues).

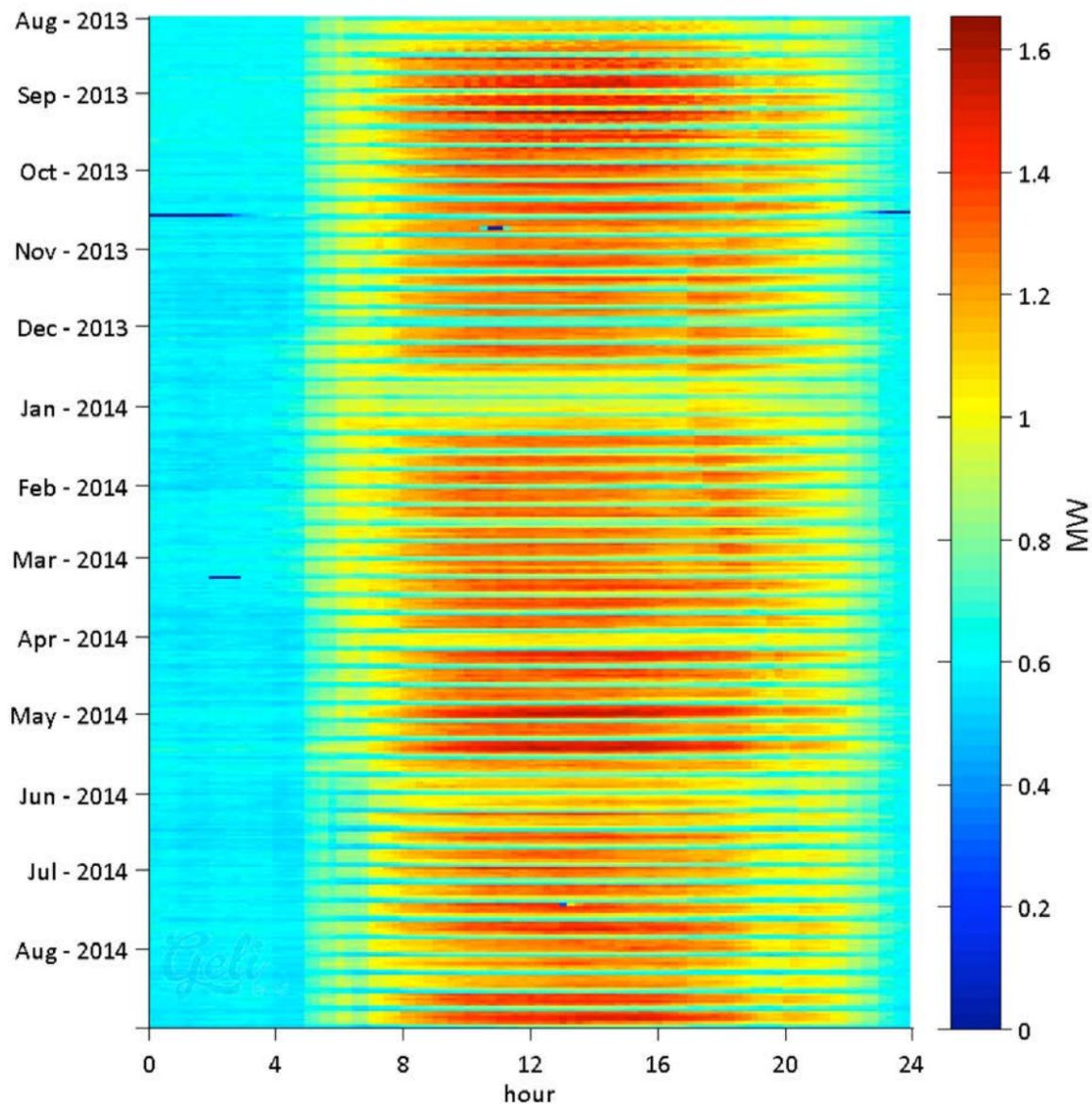
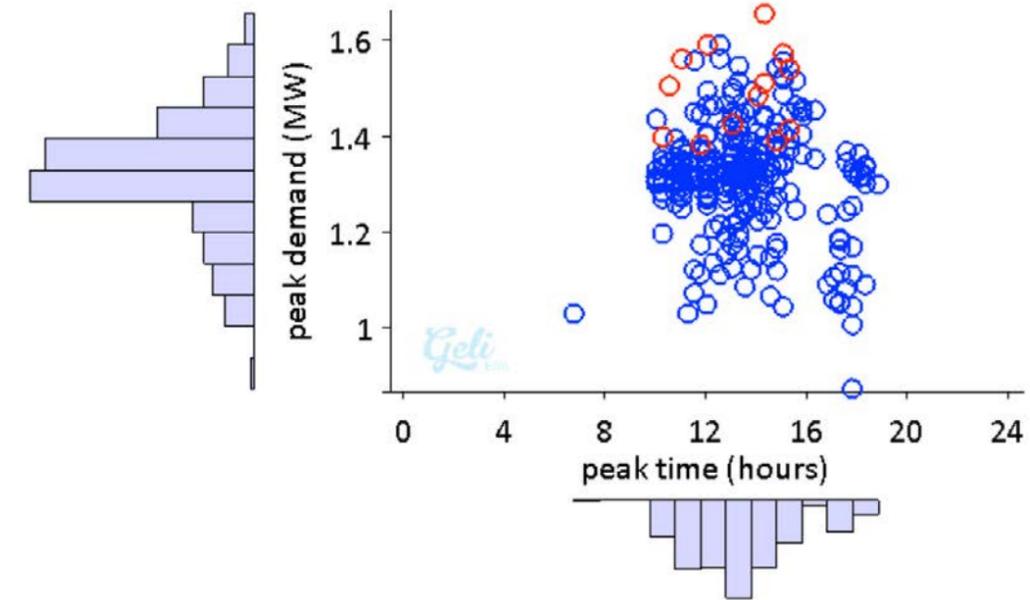


FIGURE 4
Scatter plot of daily maximum power demand versus the time-of-day at which it occurred. Maximum demand for each month is highlighted in red.



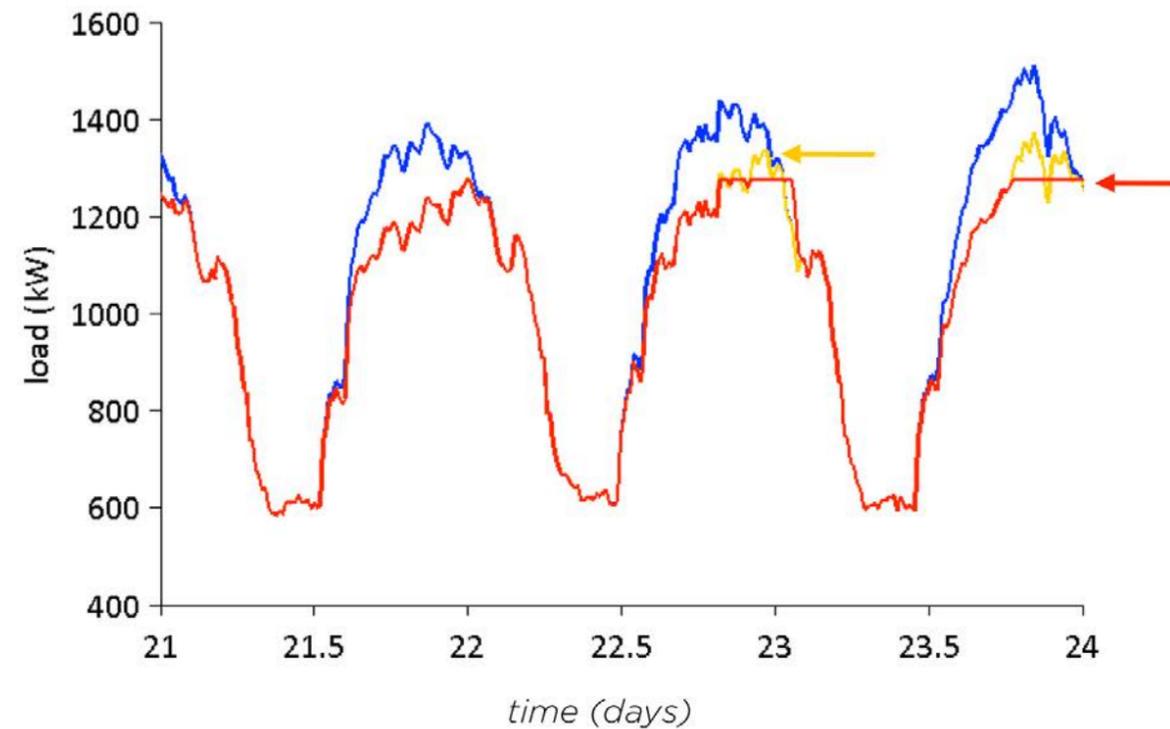
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Example of Solar + Storage Demand Reduction

Solar + Storage Demand Reduction

FIGURE 5:

Example 3-day load profile given 200 kW DC PV and 100 kW / 200 kWh ESS

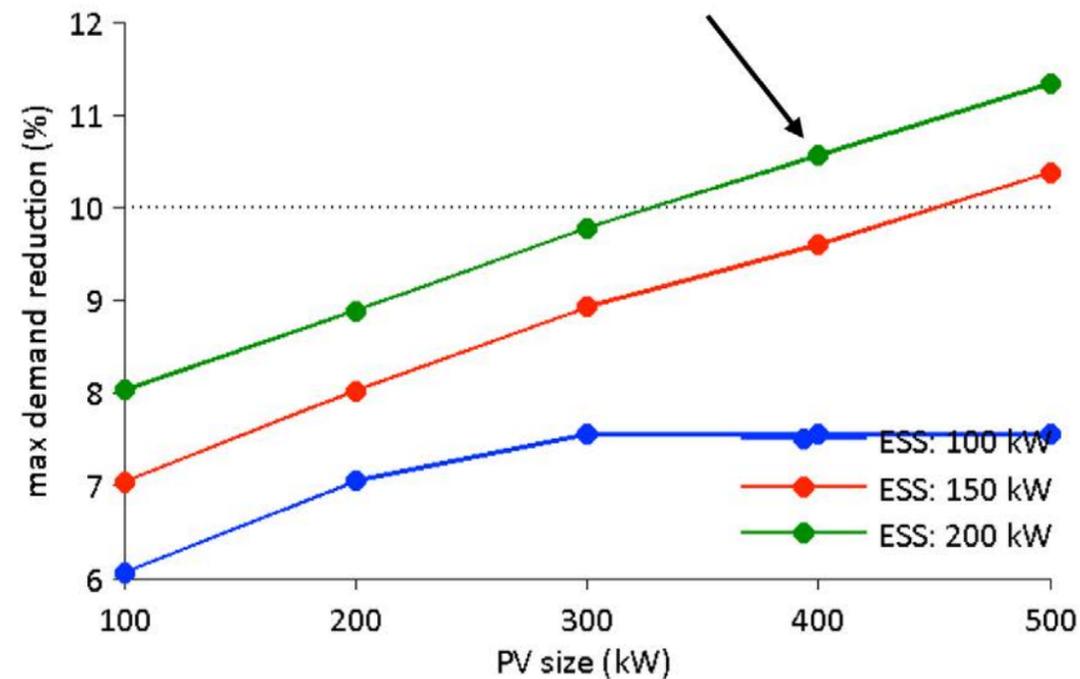


Baseline load is depicted in blue, modified load with solar in gold, and solar + energy storage in red. Solar reduces daily peak demand (gold arrow). Energy storage strategically discharges the energy storage system to further reduce peak demand (red arrow).

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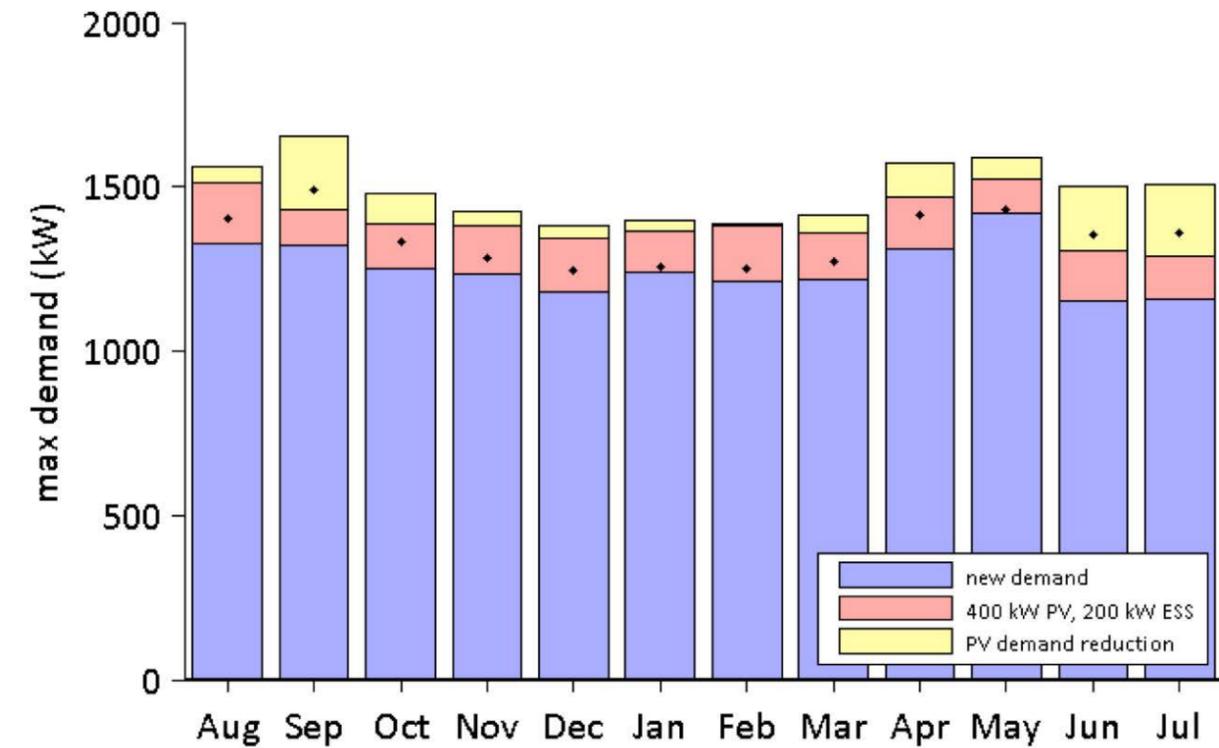
RN767A 400 kW DC PV & 200 kW / 400 kWh ESS

FIGURE 8: weakest monthly max demand reduction



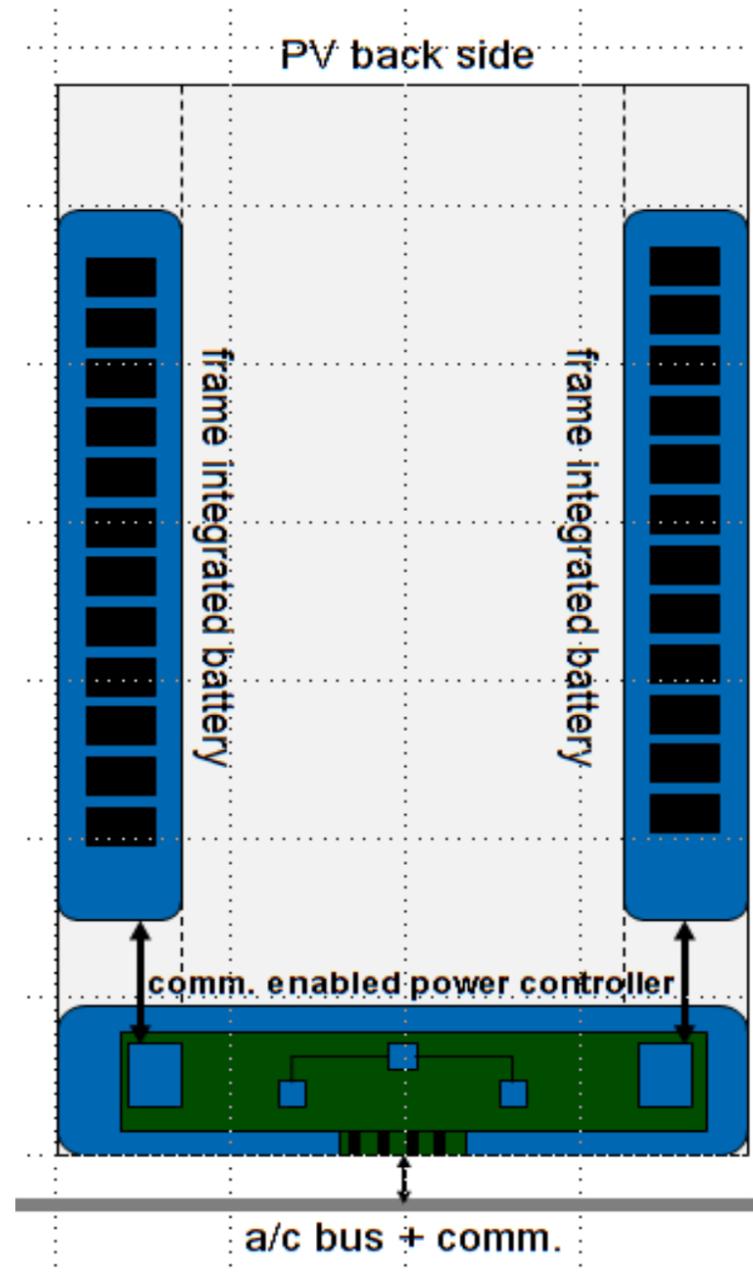
A 400 kW DC solar system paired with a 200 kW / 400 kWh energy storage system is sufficient to reduce max demand by at least 10% in all 12 months.

FIGURE 9: Max monthly demand (90% of baseline is marked by a black dot)



Integrated PhotoVoltaic Storage Module

250Watt PV, 250Wh Energy Storage, MicroPowerConverter

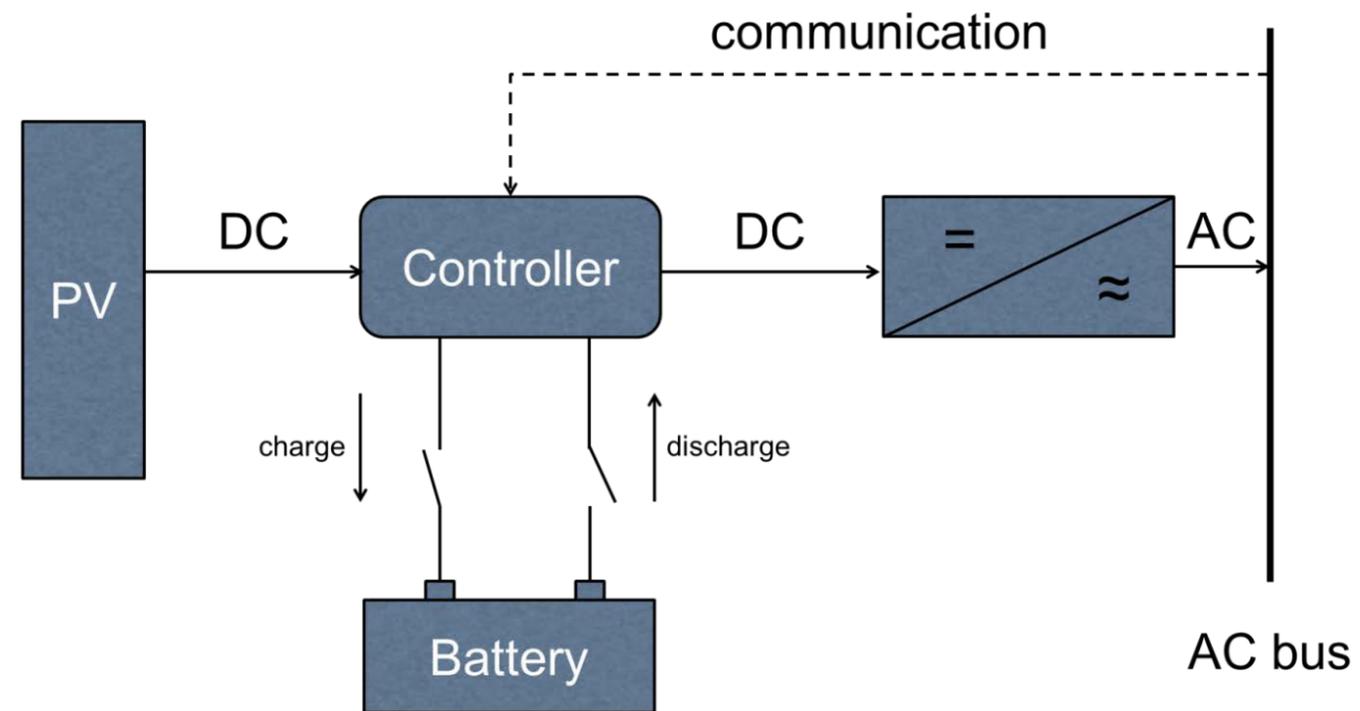
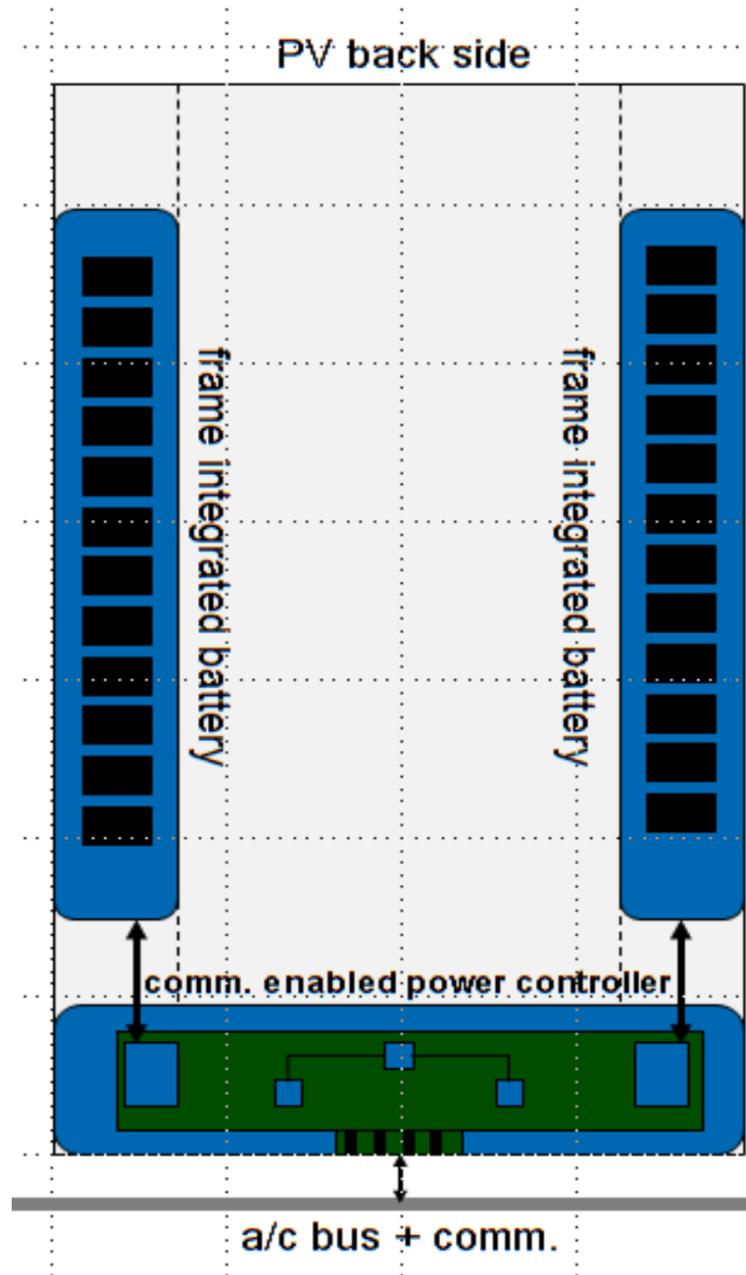


Novel Features of Pre-Commercial Product & Solution

1. Frame integrated on-board storage for a PV module
2. Integrated DC \rightarrow DC & DC \rightarrow AC power flow
3. Integrated communication-enabled-controller that manages the aggregated storage and power flows
4. Technology enables
 - a. Maximizing power from the module during the early morning and late evening hours
 - b. Mitigating power output variability due to fluctuations in irradiance
 - c. Capture 'clipped' daytime generation
 - d. Hierarchical storage architecture that enables services such as DCR & DR

Integrated PhotoVoltaic Storage PVS Module

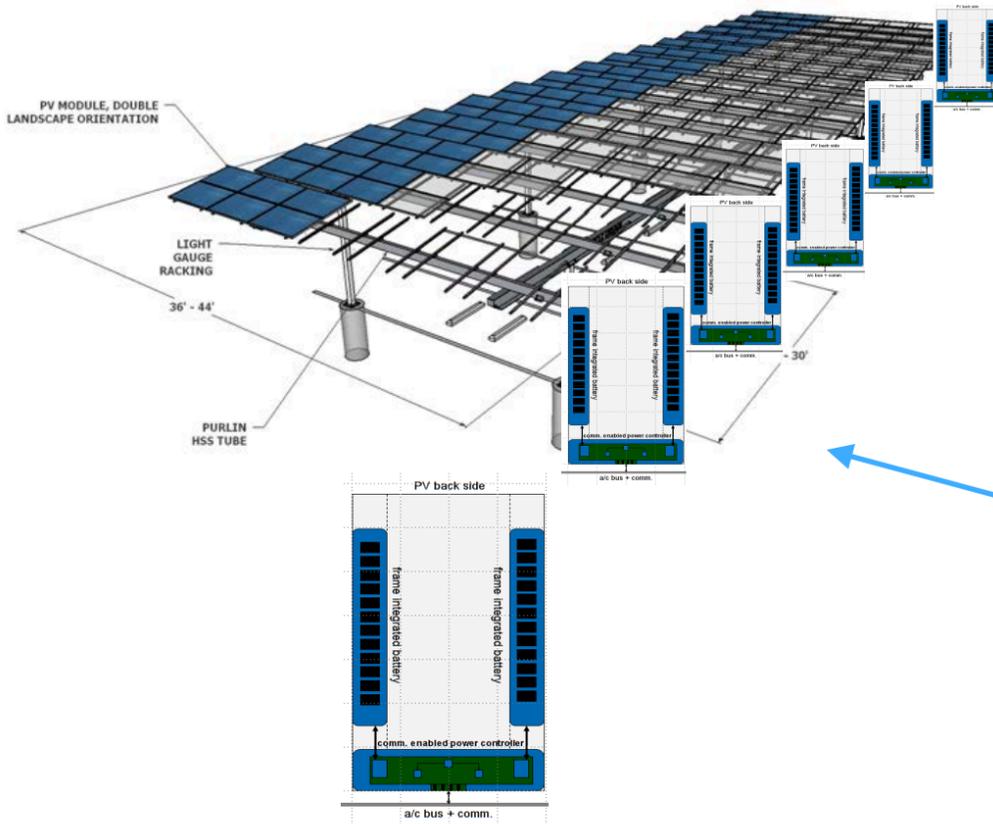
250Watt PV, 250Wh Energy Storage, MicroPowerConverter



College of San Mateo Internet of Energy

Network Optimize & Operate Multiple Energy Assets

200kW/200kWH PVS Network



Increased Generation & Local Stabilization

Network with HVAC, Building Mgmt. & Grid



Demand Charge Reduction
Demand Response
PV Firing Power Quality



200kW Stand-Alone PV & 200kWH Stationary ESS



Provide Campus, Grid, & Market Services

Provide multiple Energy Services

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RN767A 400 kW DC PV & 200 kW / 400 kWh ESS

