

ZNE Retrofit Home

M&E of EE, DR, Storage, HEMs & PV

California Solar Initiative (CSI)
RD&D Solicitation 5 (Small Grant)



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California Solar Initiative (CSI)

In 2006 the California Public Utilities Commission (CPUC) established a budget for the California Solar Initiative (CSI) Research, Development, Demonstration and Deployment Program (RD&D)



Goal:

- Install 3,000 megawatts of distributed solar by 2016
- Move the market from the current retail solar price to the retail price of electricity
- Develop new business models



Background & Benefits

- **Background: 1980's Home in Santee Retrofitted to be Source ZNE**
 - CSI RD&D 2 Project (Low-Cost Solar Retrofit PV)
 - Efficiency, DR, Storage, HEMs, and PV
- **Continue Monitoring & Evaluating Retrofit**
 - Monitor savings – compare with simulations / predictions
 - Rooftop solar – Load profiles
 - Intelligent storage – Smart charging & discharging
 - Energy “cost” of storage
 - Load benefits
 - Demand Response
 - All GE DR-appliances
 - Nucleus controller
 - DR vs Storage
 - Home Energy Management System
 - Impacts
 - Comparisons and integration with other systems
- **Project Results: Develop and Demonstrate Practical ZNE Retrofits**
- **Large Potential Market: 99% of Homes are Existing (1%/yr new)**

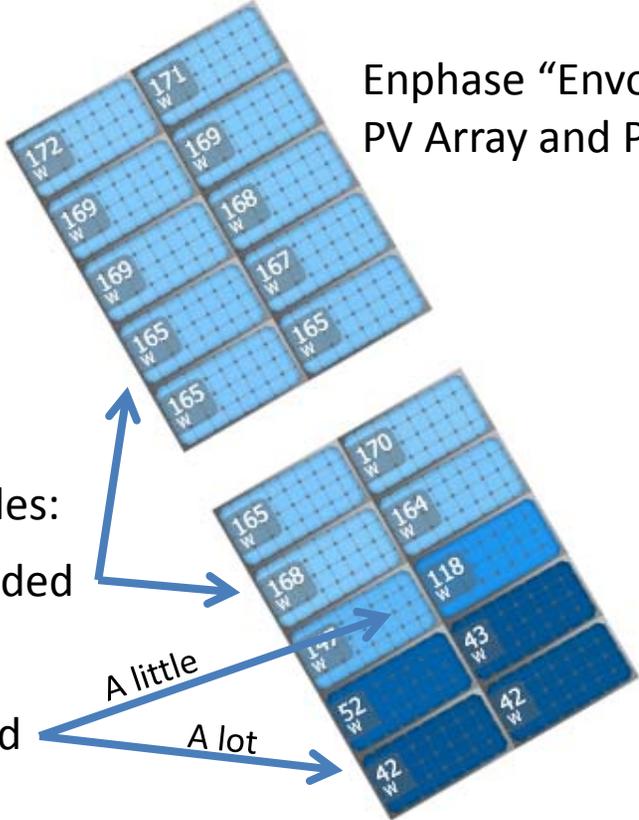
PV System: GE Plug & Play AC-PV System

Micro-inverter Integrated into Panel



Micro-inverter

Wire-Harness Connector



Modules:
Unshaded

Shaded

A little

A lot

AC System: Reduced Output due to Shading is limited to Shaded Modules, *Not Entire String*; Could be important in Retrofit Market



GE Demand-Response (DR) Appliances

Retrofit: EE, DR, Storage, HEMs & PV

Sunverge SIS: Intelligent Battery Storage

Efficiency Upgrades:

- Attic Insulation
- Radiant Barrier
- Windows & Sliding Glass Door
- Furnace & AC Replaced
- Ceiling Fans
- HPWH
- LED Lighting
- On-Demand Hot Water System



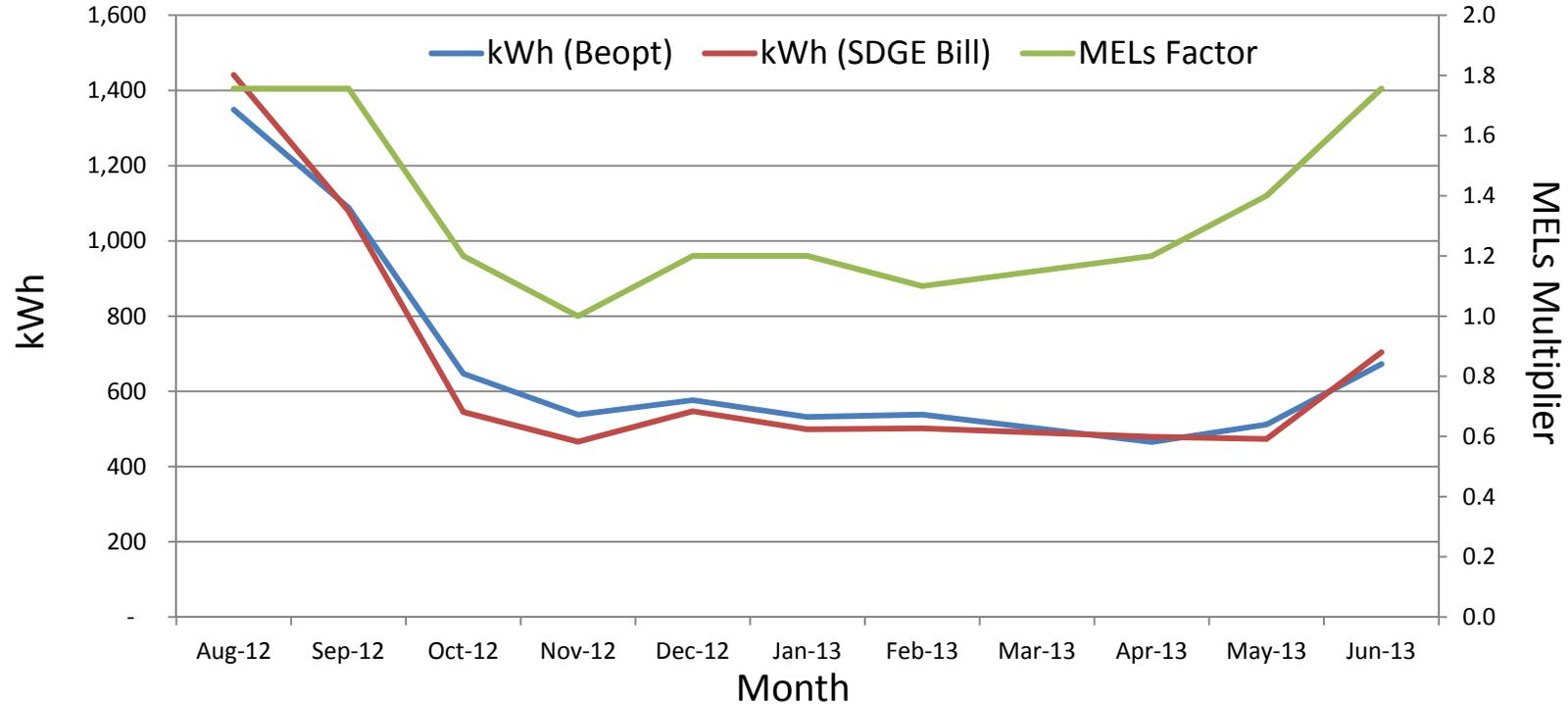
Home Energy Management System (HEMs):

- GE Nucleus (DR Controller)
- Sunverge

**Sunverge in
ZNE Home**

ZNE Baseline Energy Use

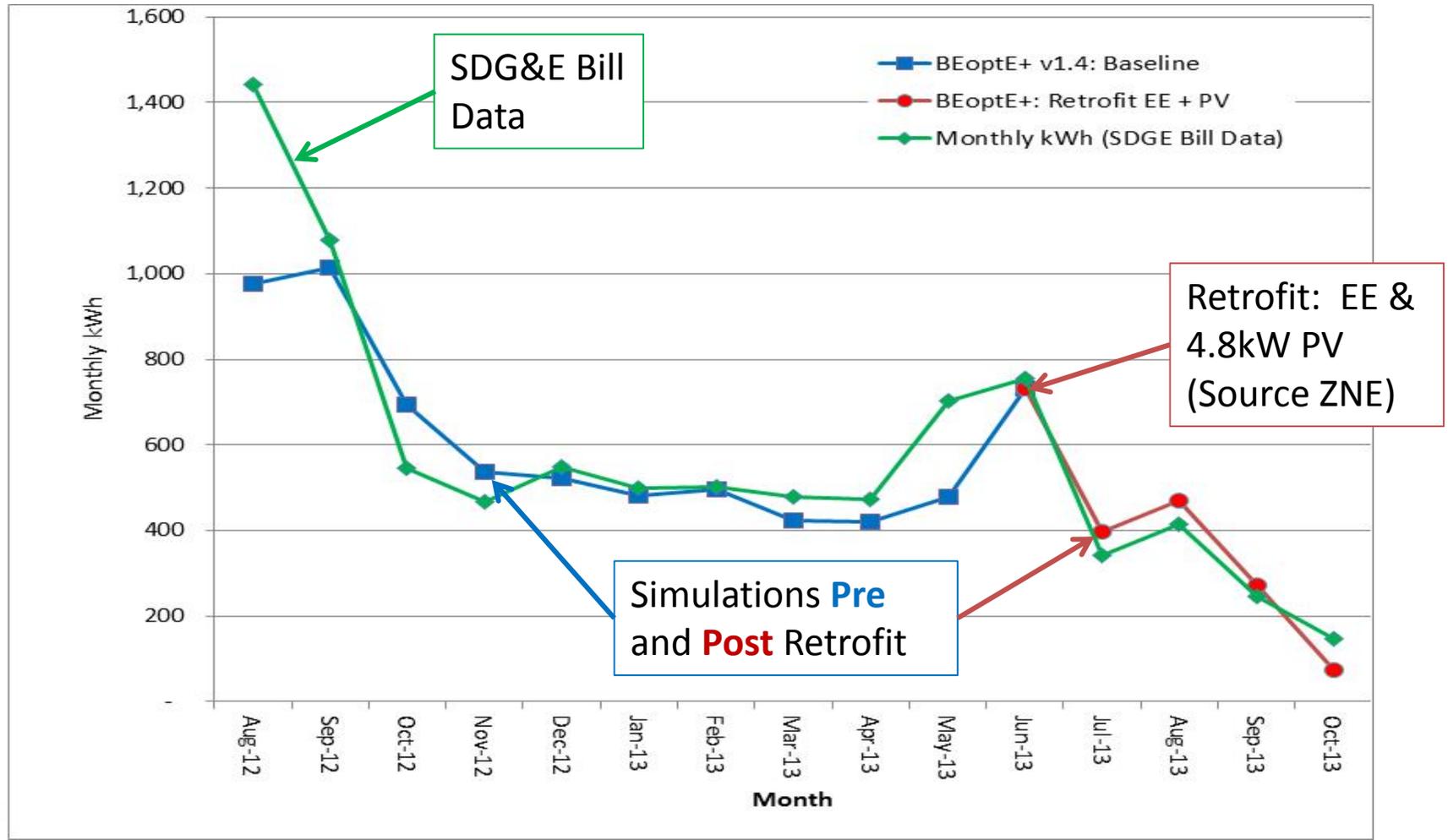
Simulations vs Actual - Calibrations



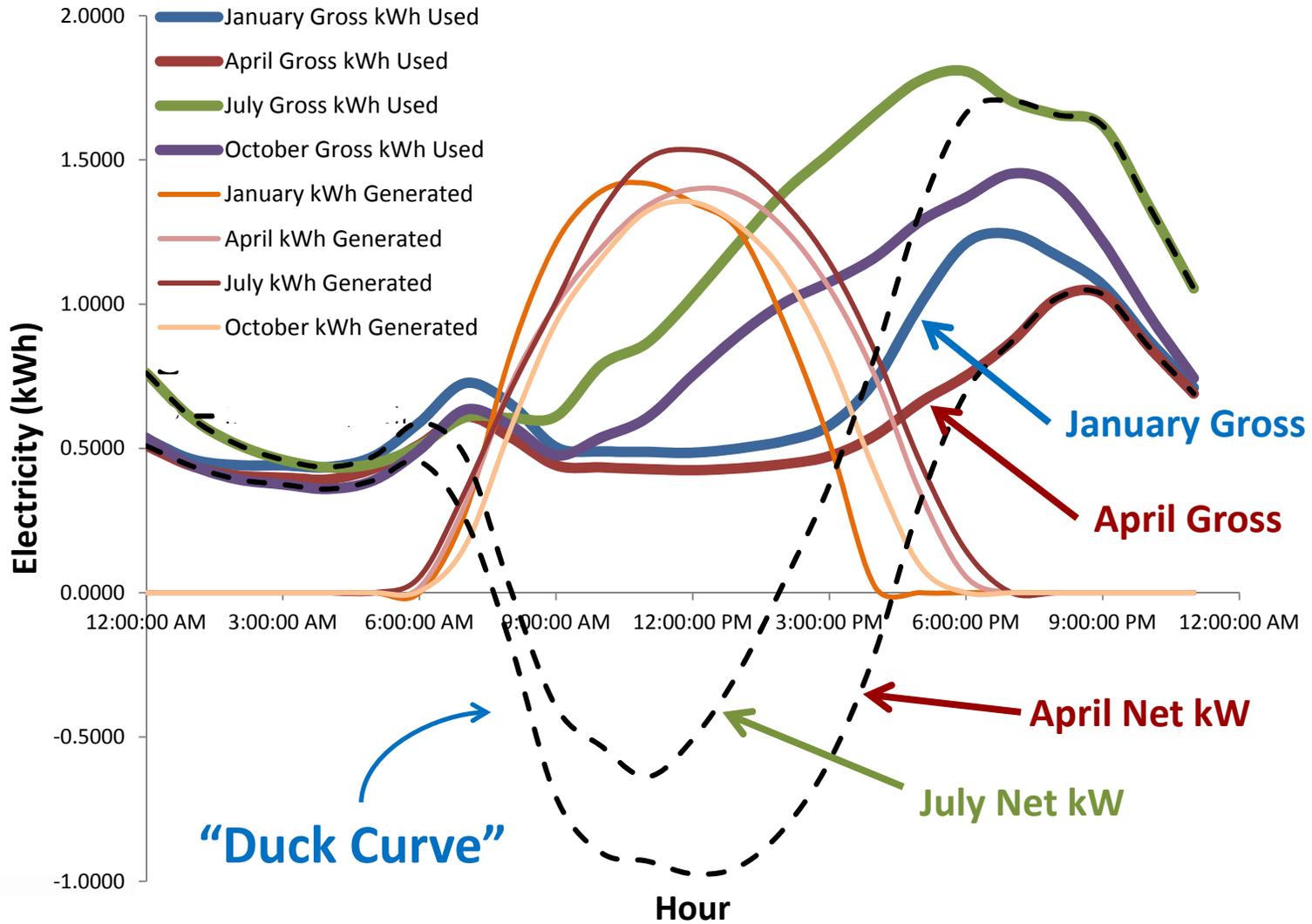
*Calibrating Simulation: Match TStat Set-points & MELs
to Occupant-Reported Values*

*Next: Compare ZNE Simulation Results to Actual
using Calibrated Software (BEopt)*

Simulation and Actual Usage - ZNE Baseline and Post-Retrofit

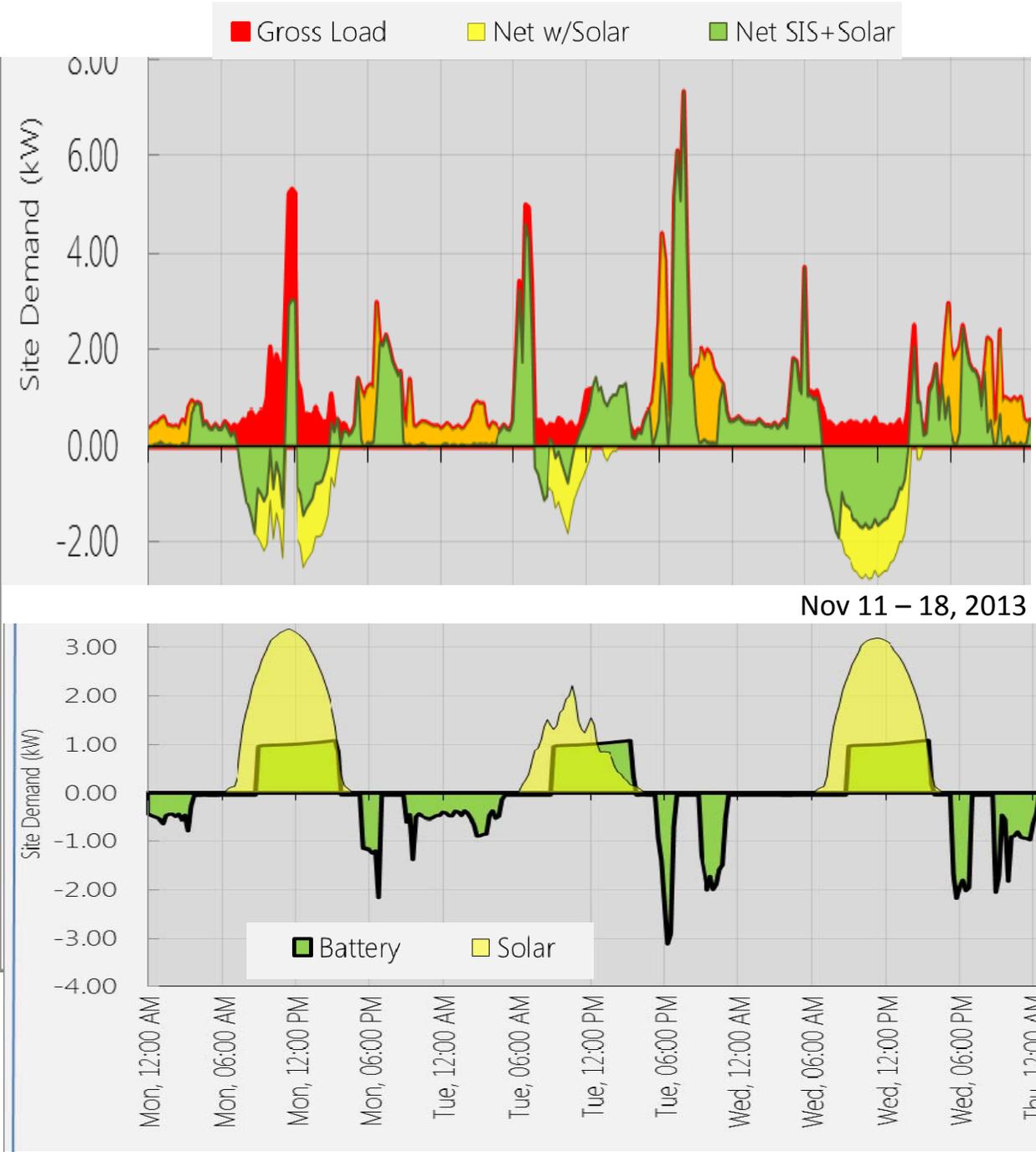


Simulations of Daily Power From Grid By Season: PV on EE Home



Project Deliverables

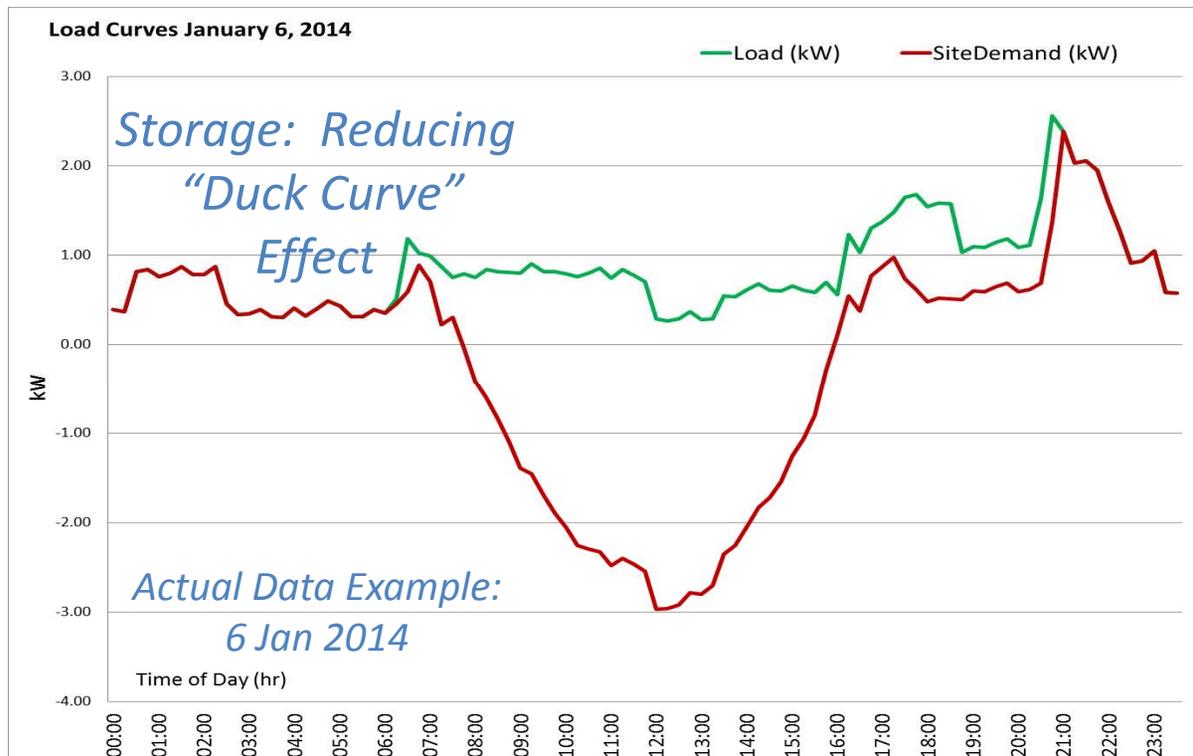
- >1yr Monitored Data from ZNE Retrofit - [EE, DR, HEMs, PV:](#)
- Simulation Calibrations
- Energy Savings
- Peak Reduction
- Optimizing ZNE Interactions with Grid



Data from Previous CSI Project Relating to Current Project

Improving ZNE Home Performance

Example: *Gross* and *Net* Demands



(Sunverge at initial settings – no tuning yet)

Project Next Steps:
Train homeowners:
HEMs, HPWH
Configure & Evaluate
HEMs
DR
Storage
Run Tests, Collect
data, Monitor &
Evaluate Performance
For 12 Months

Residential ZNE Retrofit EE, DR, Storage, HEMs & PVs: Testing, Monitoring & Evaluation

Questions?

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