Grid-Interactive Loads: Pursuing Market Acceptance through Codes and Standards

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STEFFES
CUSTOMER FOCUSED. SOLUTION DRIVEN. FIELD PROVEN.

ISO 9001 2008

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Steffes Corporation

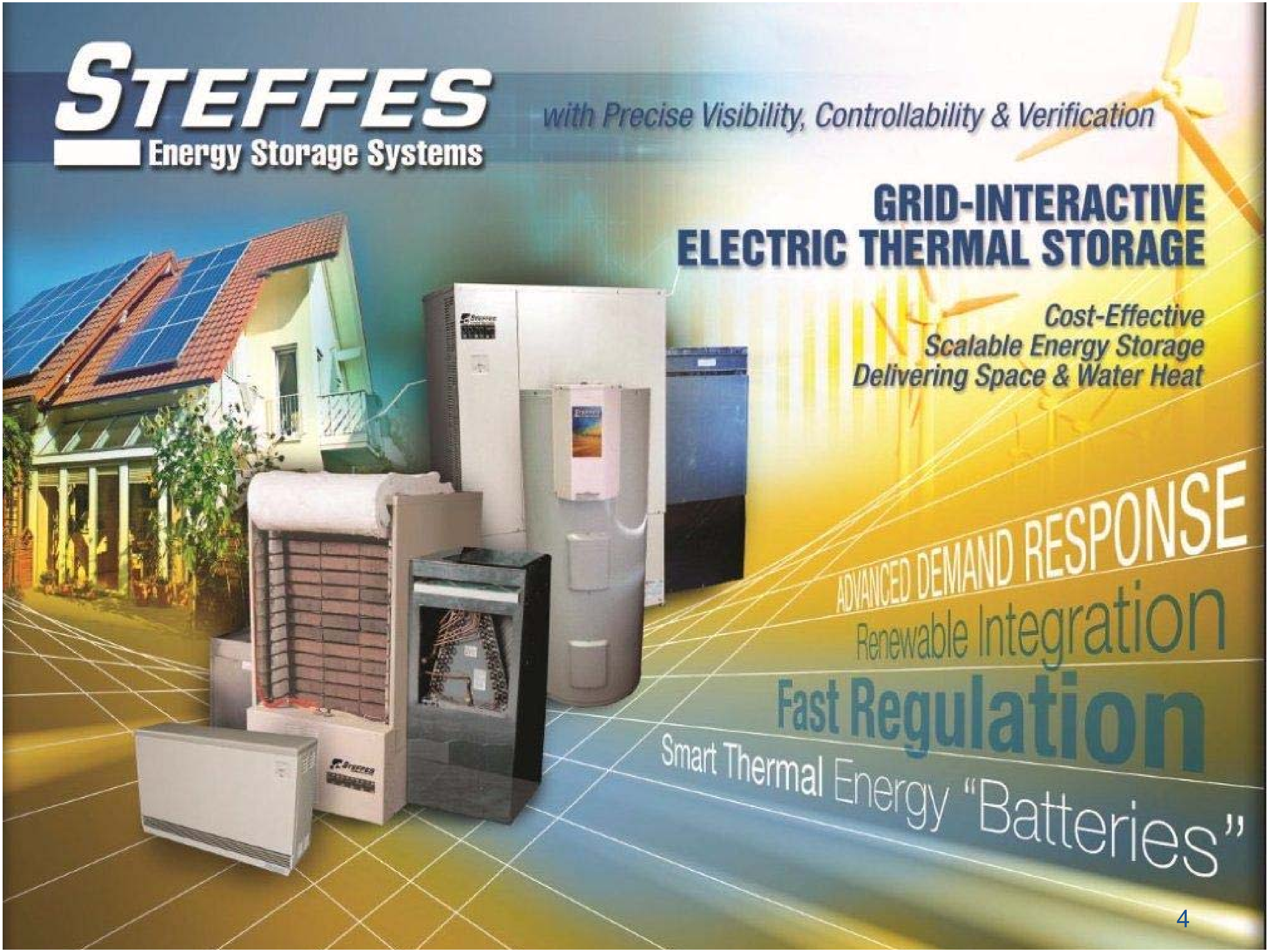
Leader In Cost Effective Electric Storage

- ***Load Management***
- ***Fast Regulation***
- ***LMP Optimization***
- ***Renewable Integration***

Work with over 200 Electric Utilities, many for over 20 years

Steffes Corporation

- Manufacturer of Innovative Products and Services for the Energy, Utility and Construction Industries
- Over 40 Years in Business
- 200,000 sq feet of Manufacturing Space
- 300+ Employees
- Sales Territory - North America


STEFFES
Energy Storage Systems
with Precise Visibility, Controllability & Verification
GRID-INTERACTIVE
ELECTRIC THERMAL STORAGE
Cost-Effective
Scalable Energy Storage
Delivering Space & Water Heat
ADVANCED DEMAND RESPONSE
Renewable Integration
Fast Regulation
Smart Thermal Energy "Batteries"

Grid-interactive Electric Thermal Storage (GETS)

Dynamically couples consumer usage to real-time grid needs

Space Heating

Water Heating

Hydro Plus Water Heater

HYDRO Plus

with

Dynamic Dispatch™

Cost-Effective

Distributed yet <u>GRID SCALE</u>

Energy Storage

Set Precise Charge Rate (0-100% wattage)

↓

Set the Target Charge Level (temperature)

↓

Report Individual Unit Current State of Charge

↓

Report Power and Energy Metering for Verification

Why is GETS important?

- Saves consumers money
- Helps Integrate Large Quantities of Renewables
- Helps Utilities Manage Load Shape
- Reduces Emissions of Greenhouse Gases
- It's low-cost Energy Storage "Thermal Battery"
- Aggregated Water Heaters are Distributed Energy Resources yet GRID SCALE flexible load
- Think of 50 Million Electric water heaters as a Terawatt-hour, 200 Gigawatt, "Battery"

WIN-WIN-WIN

Consumer, Utility, Environment

Demonstrations and Deployments

- Last 30 years: Deployed 100,000 passively controlled ETS units in all areas of USA and Canada
- Last 10 years: Demonstrated 1,000 actively controlled GETS units in over 25 projects in all regions
- Last 1 year: Deployed hundreds of actively controlled GETS units

Building Codes

Grid-interactive Electric Thermal Storage (GETS) products recognized in the 2015 International Green Construction Code.

- **Worked to allow Grid-interactive water heaters in Building Codes Since 2007**
- **2015 IGCC has recognize GETS as an approved option**
- **Three current submittals into IECC for the 2016 code cycle for flexible thermal energy storage devices**

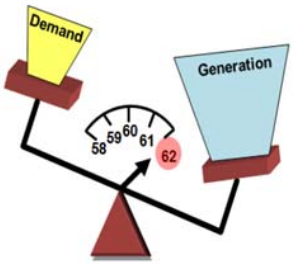
ASHRAE

Codes & Handbook Updates
for
Grid interactive
Space and Water Heaters

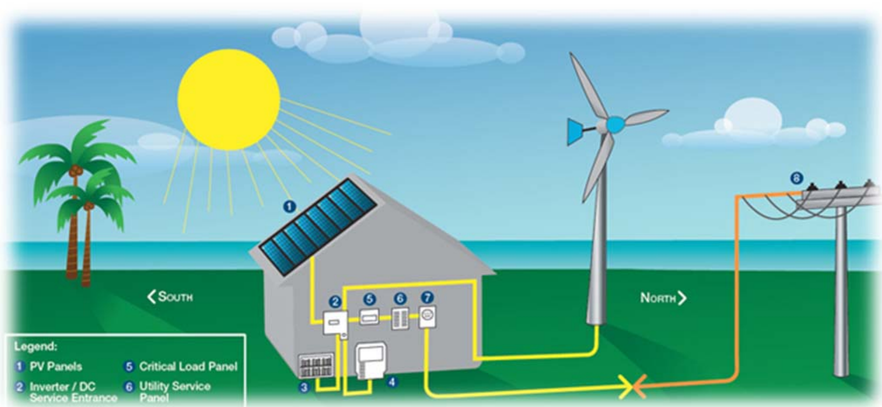
- Member of TC 6.9 (Energy Storage) for 25 years
- Chapter 51 rework in ASHRAE 2016 Handbook
- Recognition in in 189.1, 90.1 and 90.2
- More ongoing code work in progress

How does GETS bring value?

- Provide fast regulation to stabilize the grid



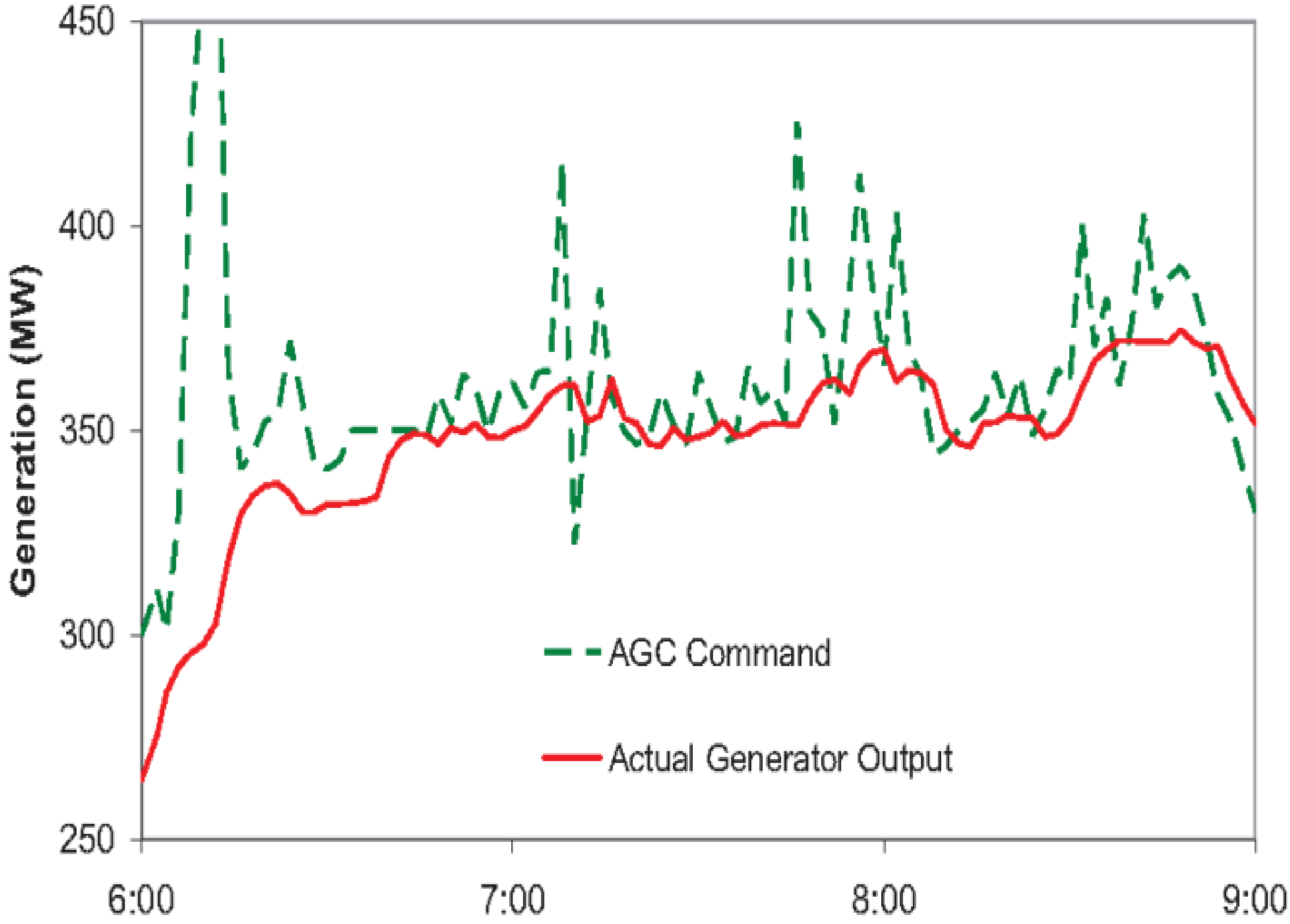
- Integrate much higher percentages of renewable electricity



Fast Regulation – Speed Matters…

A fossil power plant following a fast regulation command signal --

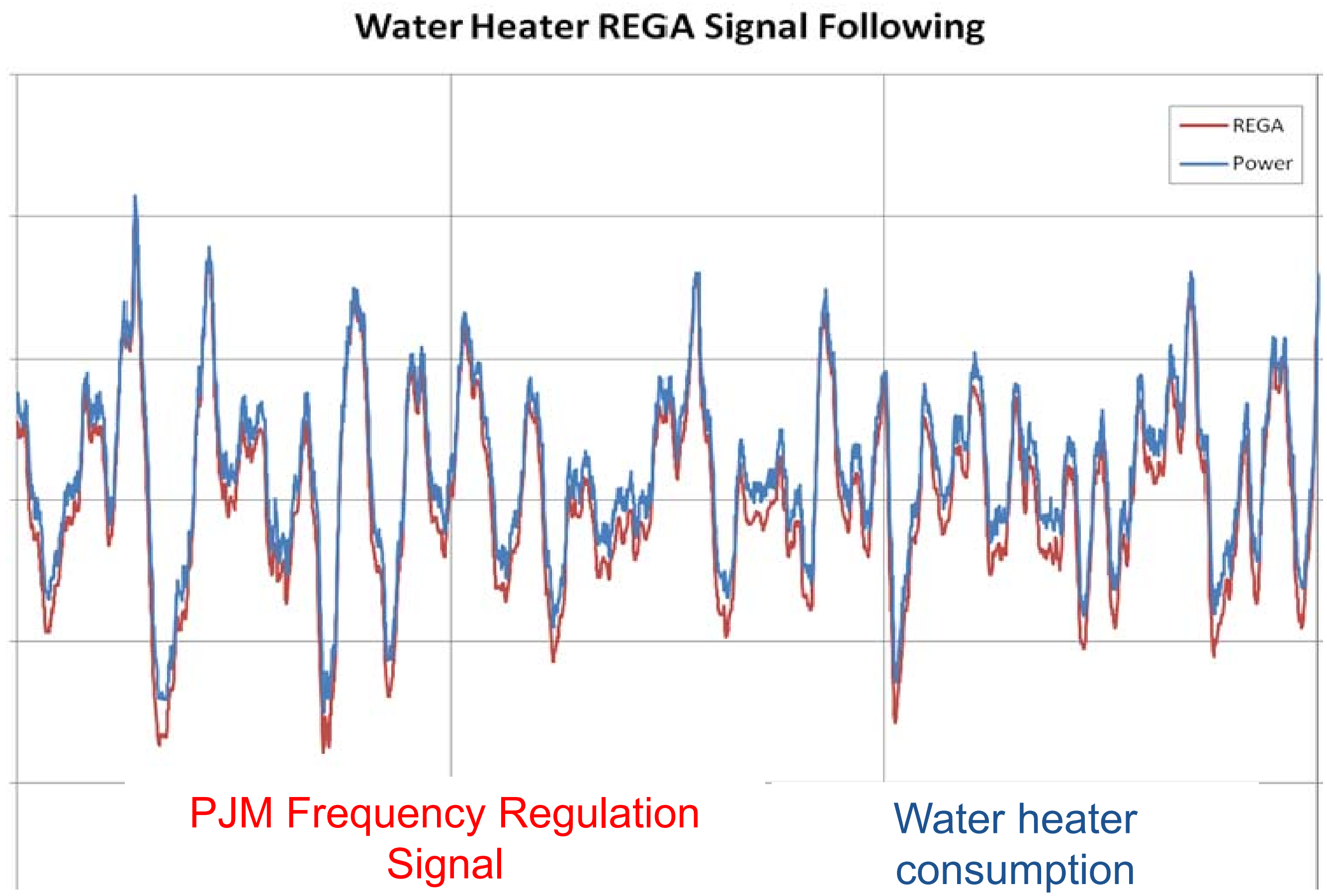
It cannot keep up!!



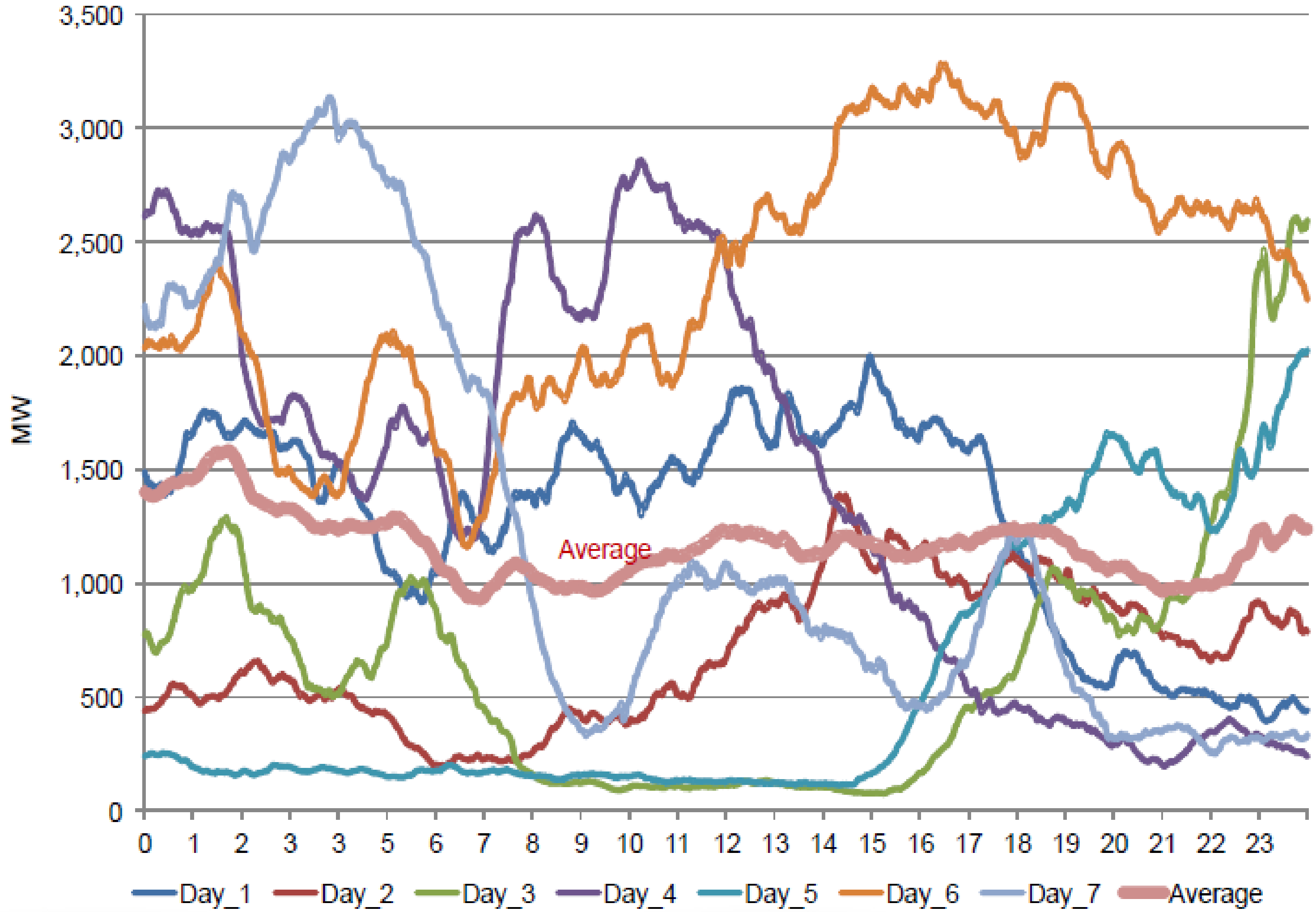
Fast Regulation – Speed Matters…

A very fast grid-interactive water heater

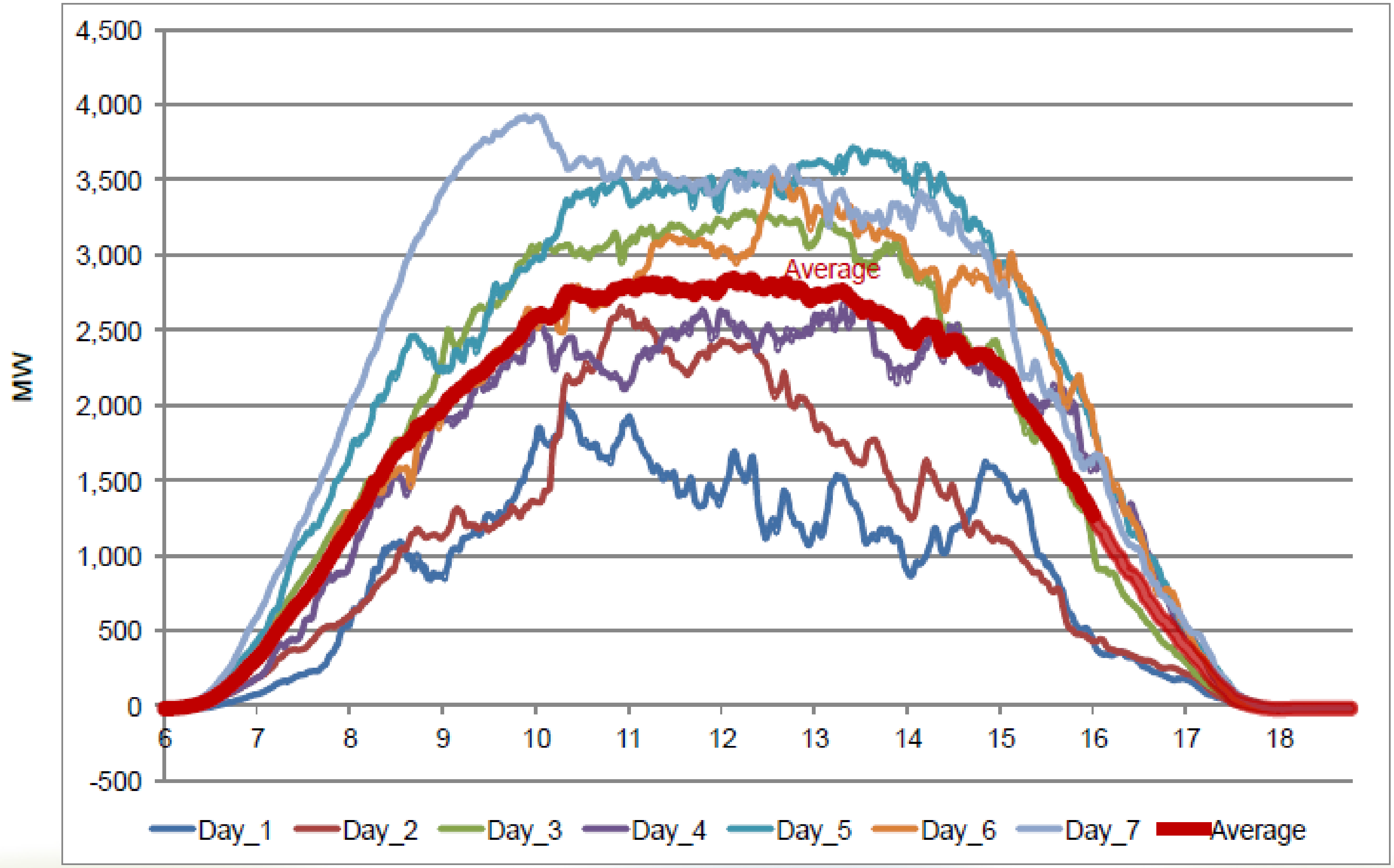
Not only can the water heater keep up – it does so <u>very</u> accurately



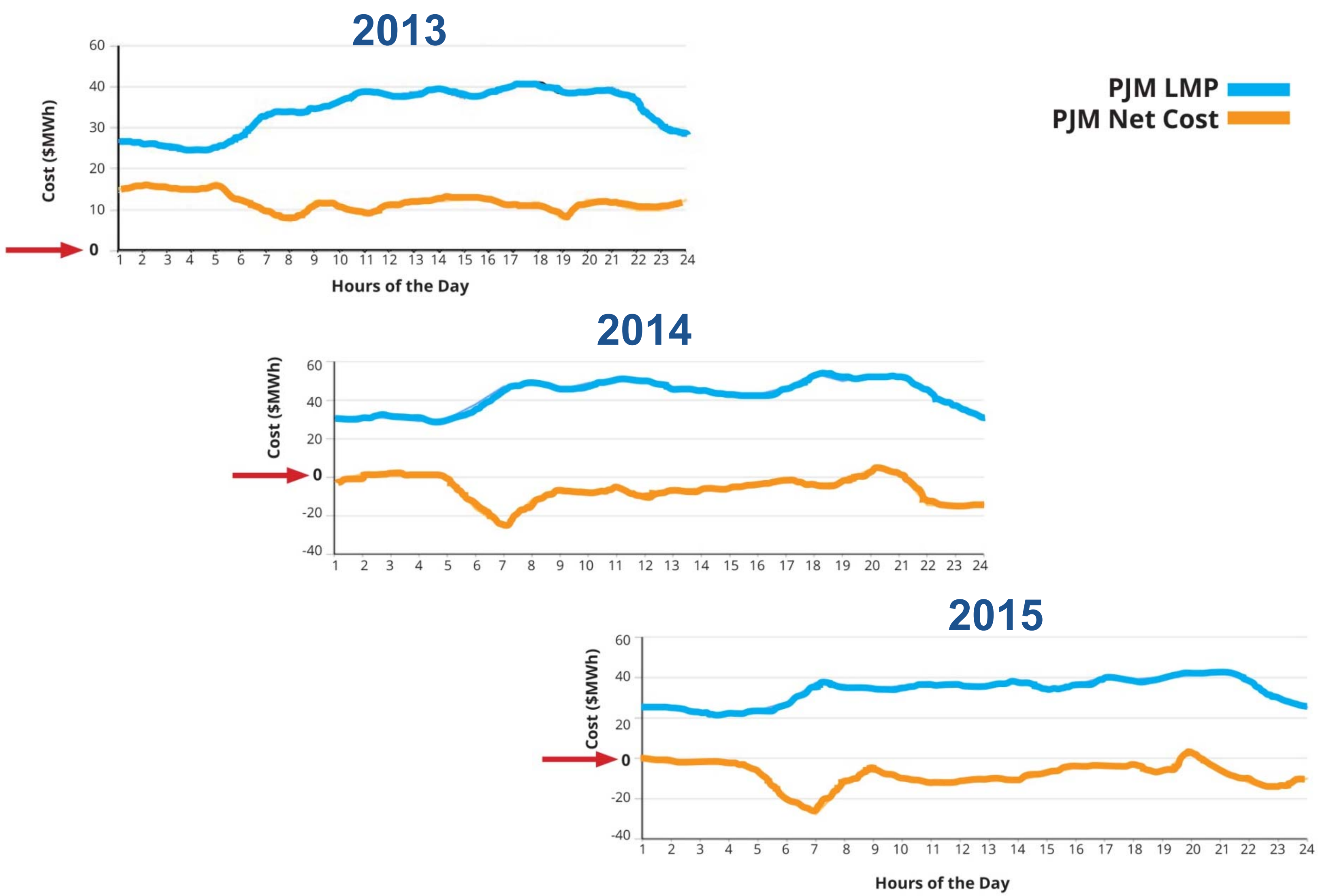
Typical Wind - Daily



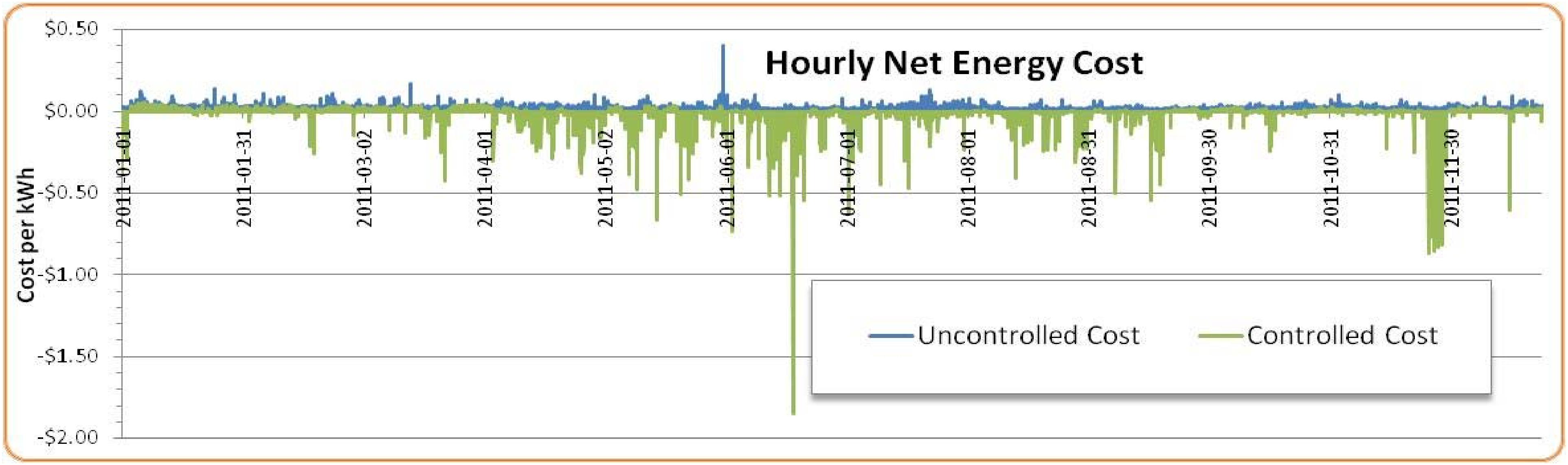
Typical Solar – Daily

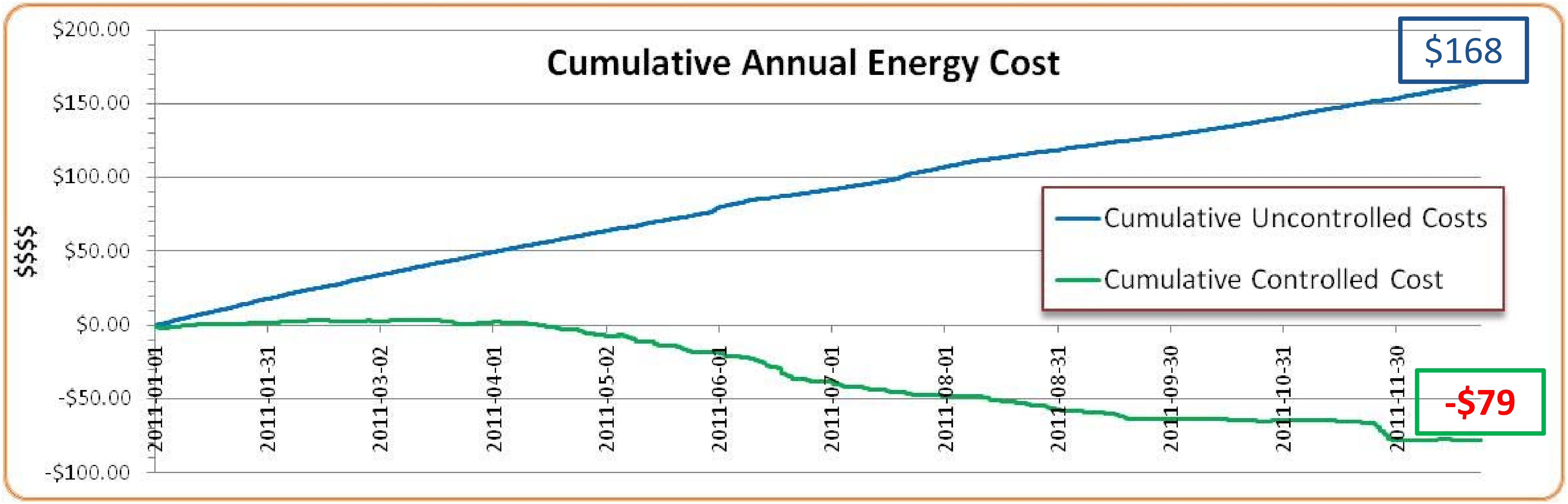


PJM LMP & Regulation Averages

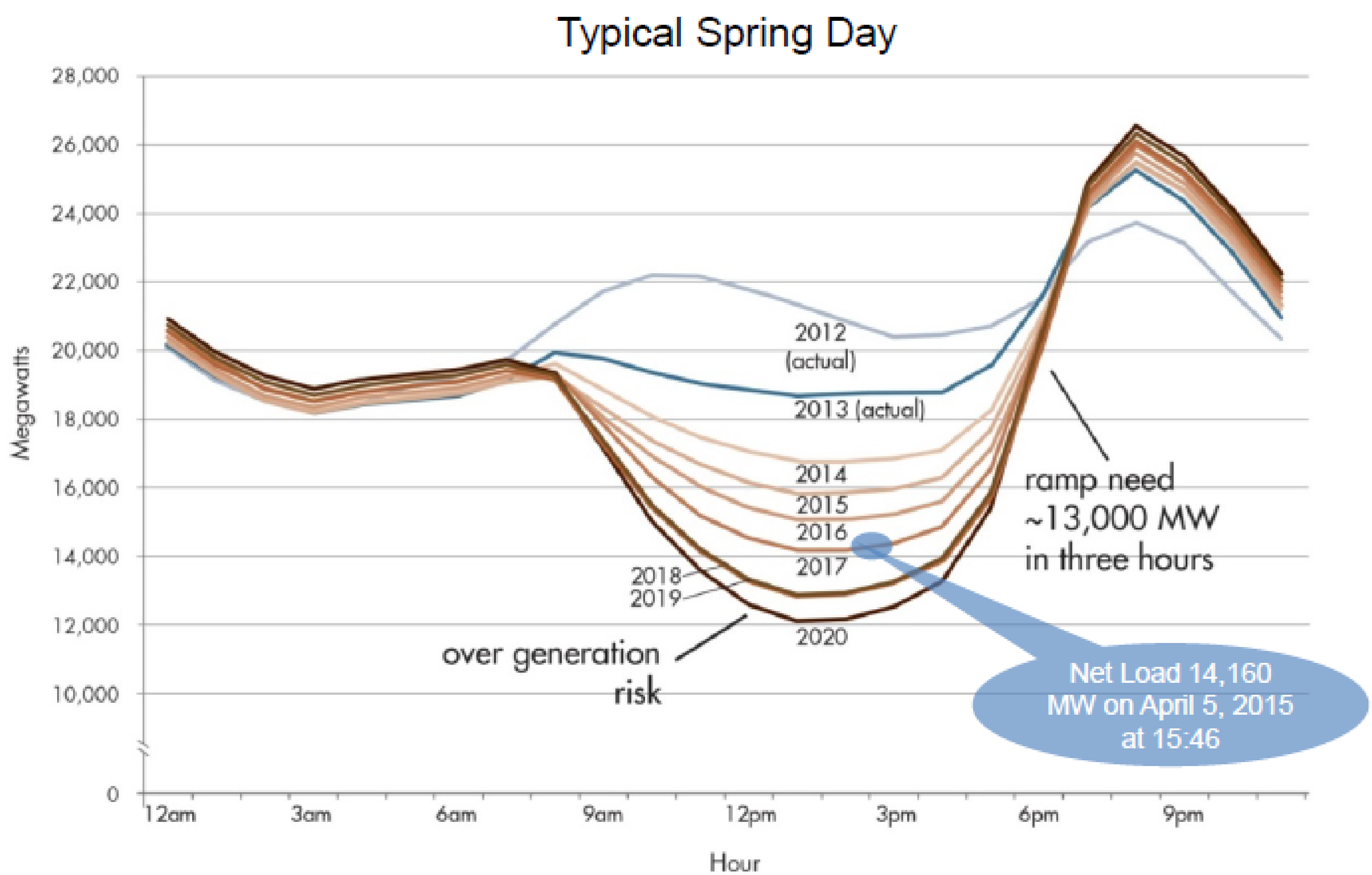


Putting it all together in PJM…

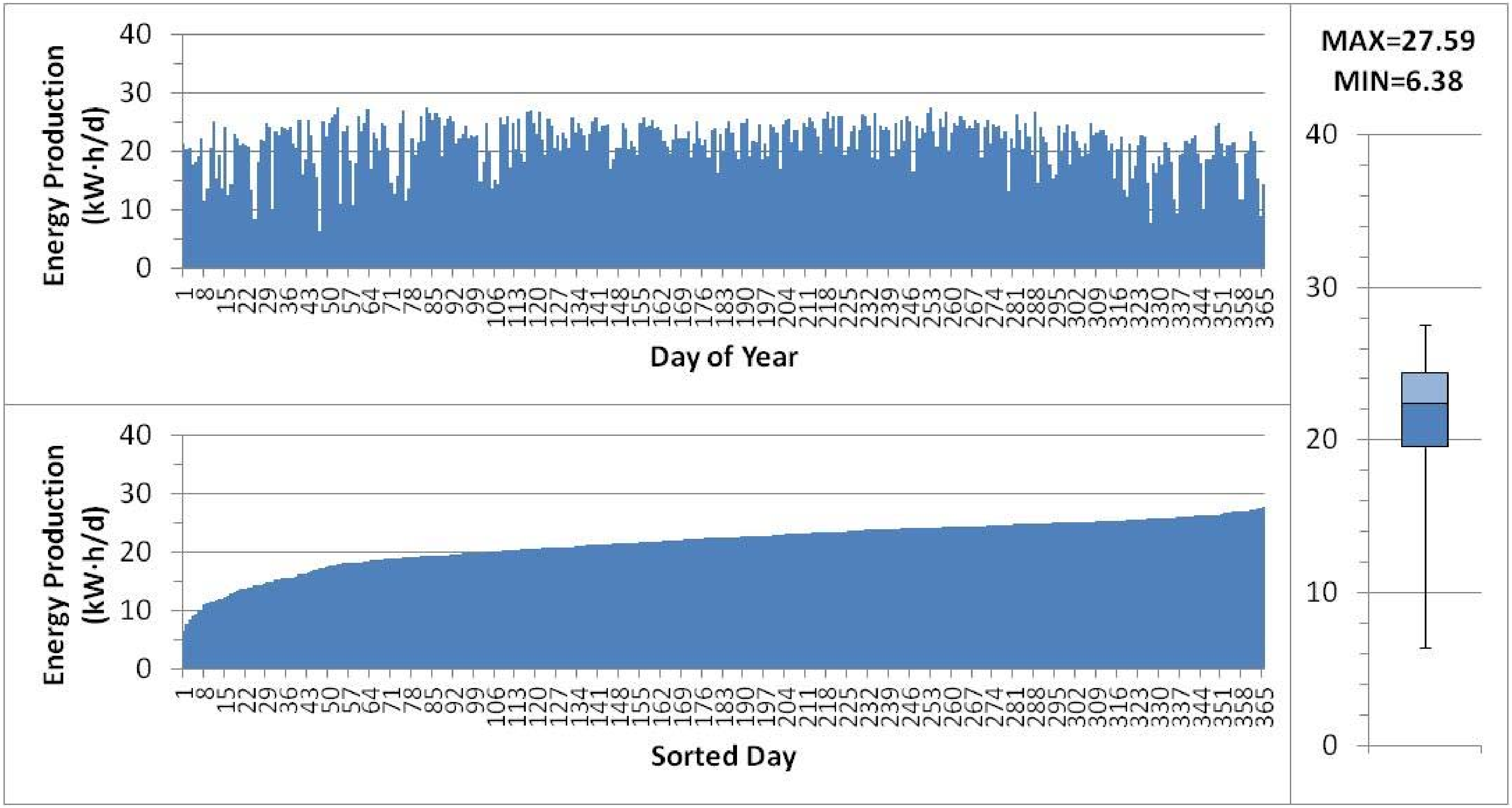




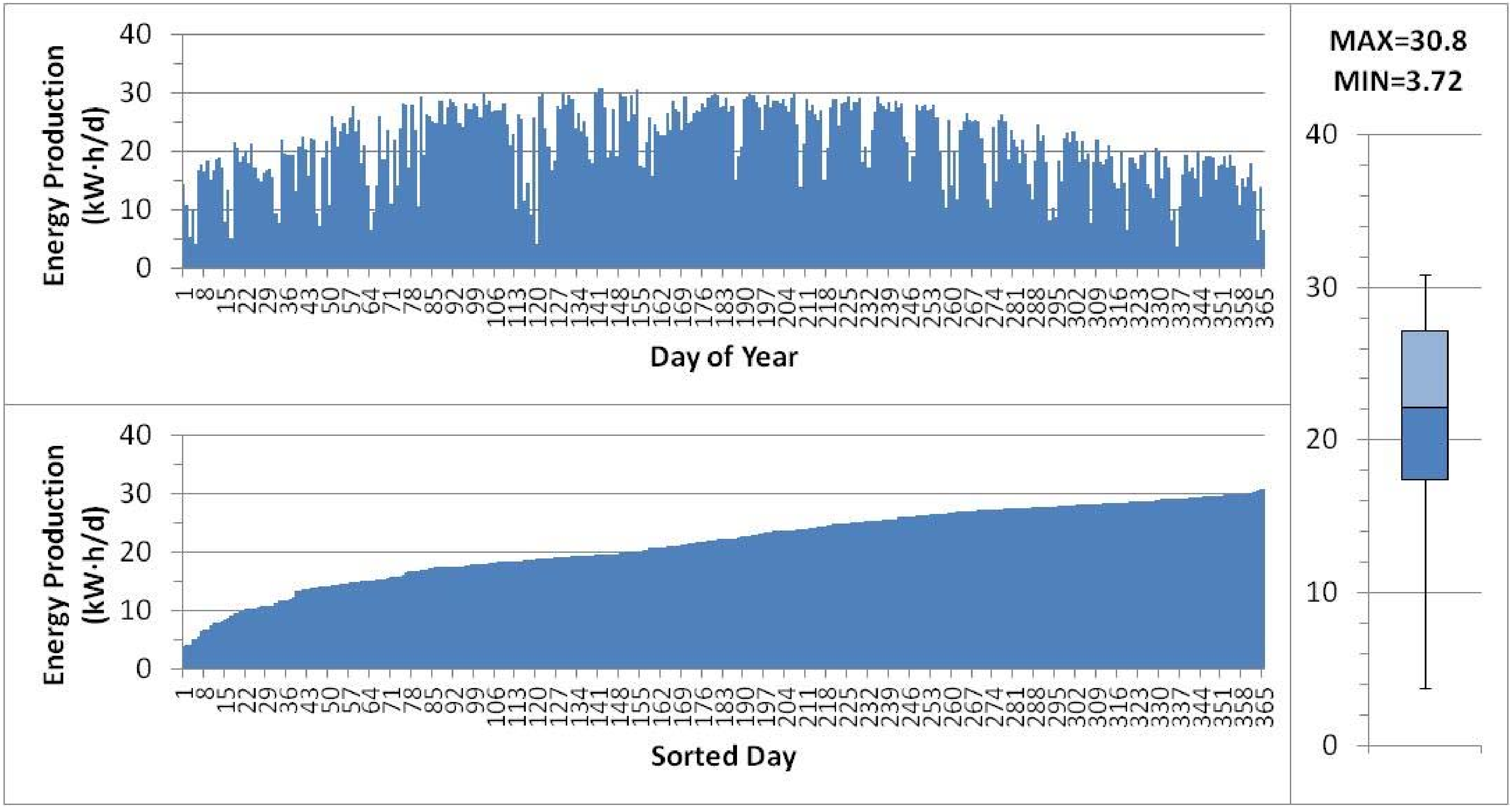
Solar Over Generation



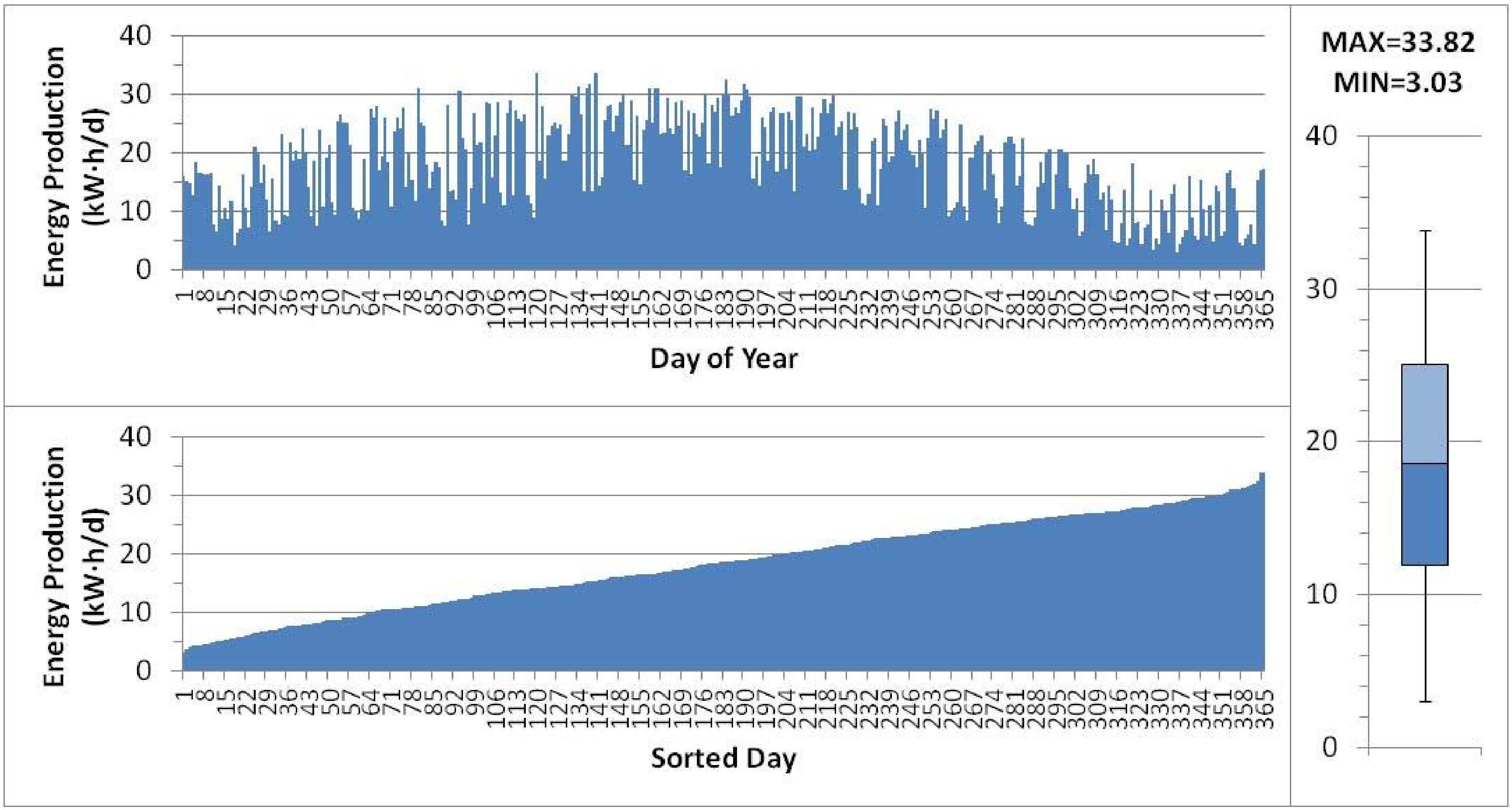
Daily Energy Production from a 5-kW Photovoltaic (PV) Array - Honolulu, HI



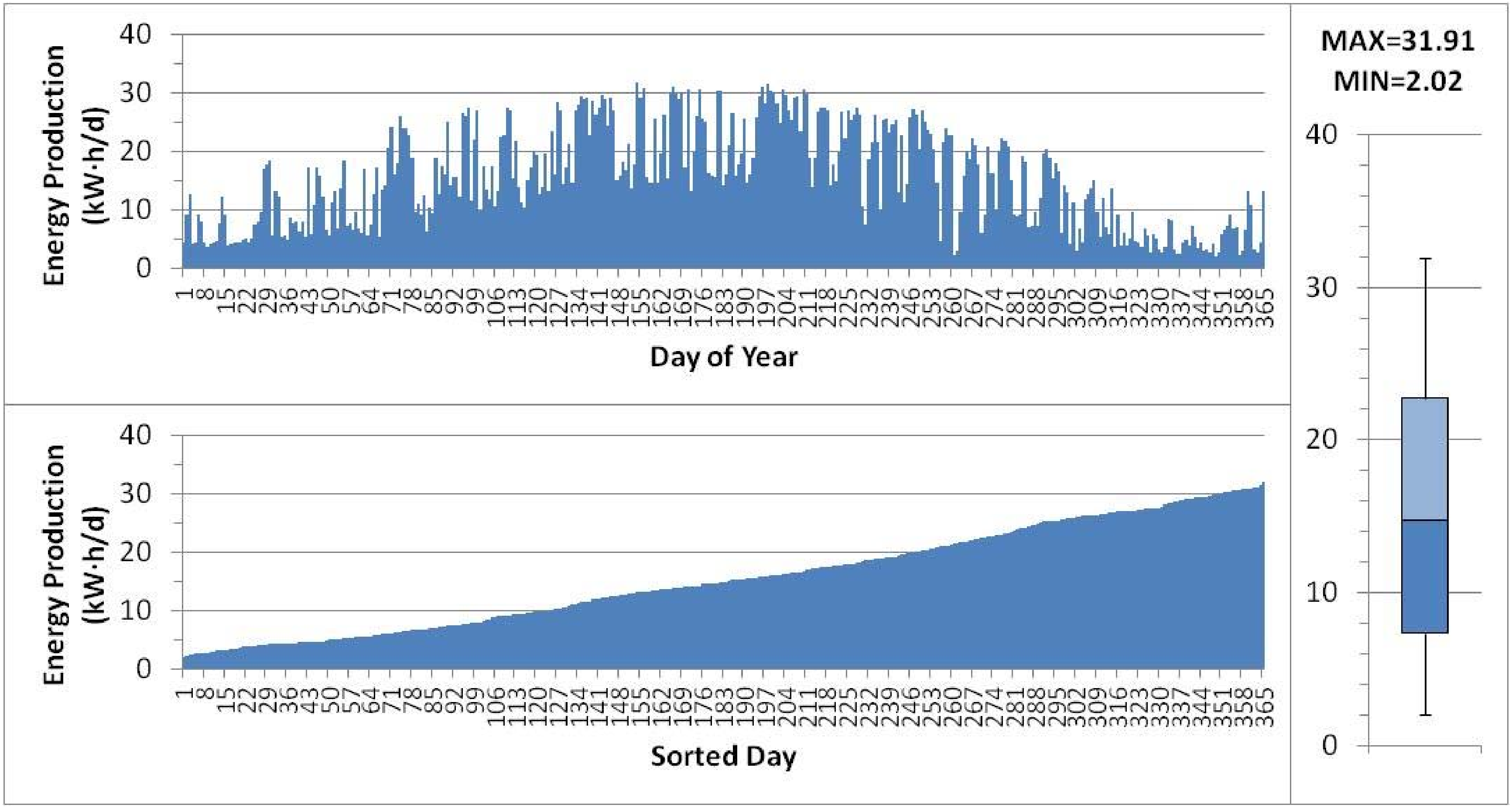
Daily Energy Production from a 5-kW Photovoltaic (PV) Array - Los Angeles, CA



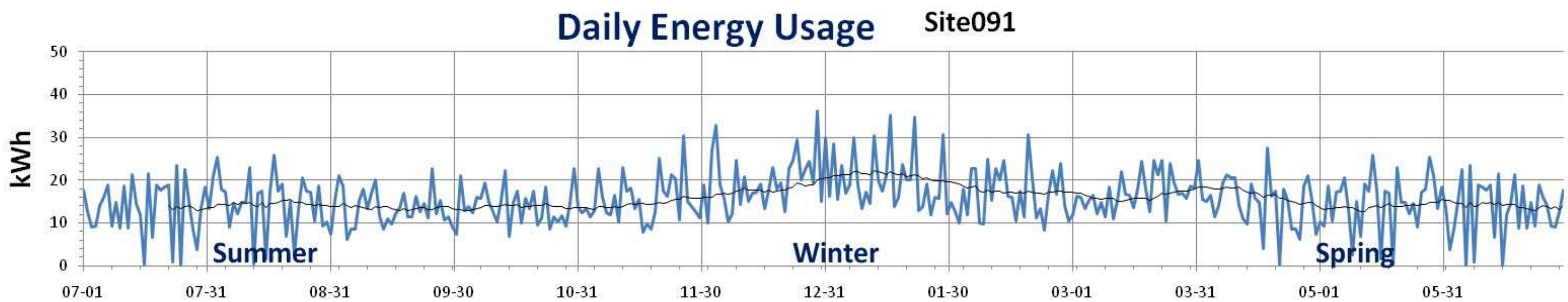
Daily Energy Production from a 5-kW Photovoltaic (PV) Array - Minneapolis, MN

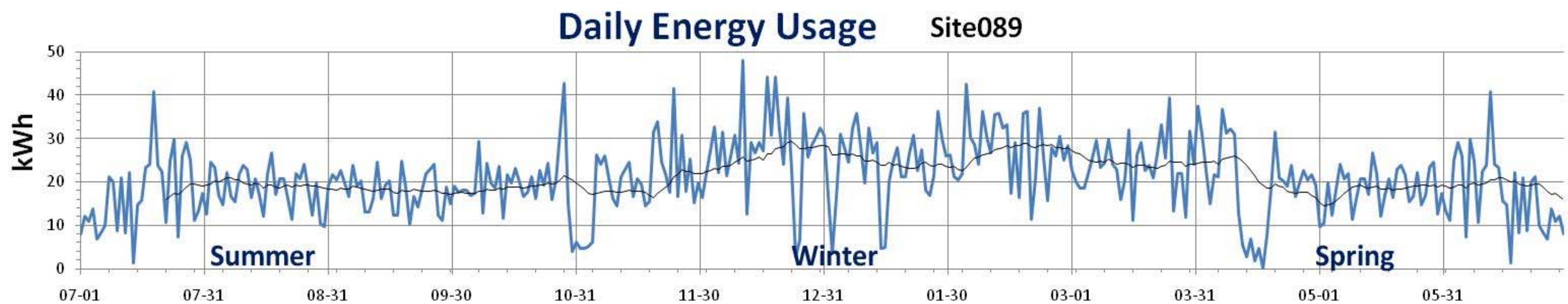


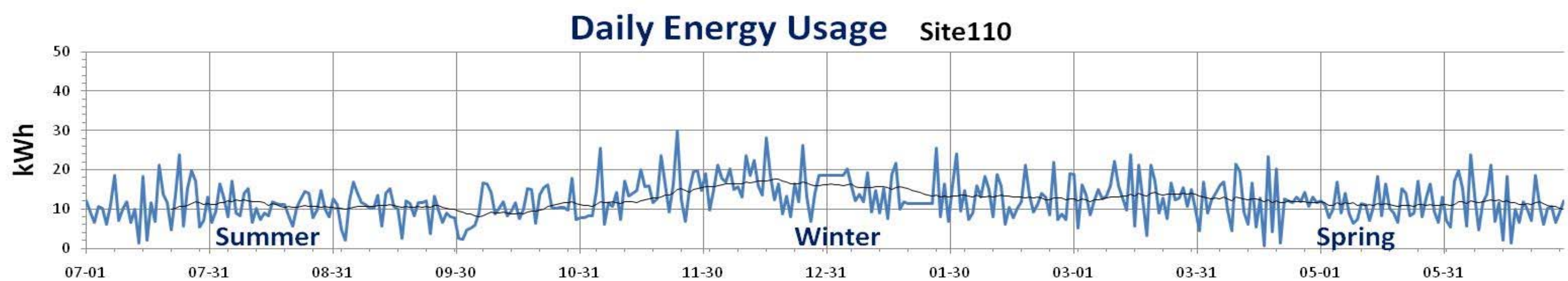
Daily Energy Production from a 5-kW Photovoltaic (PV) Array – Portland, OR



Individual Water Heaters Daily usage Variability over the Year



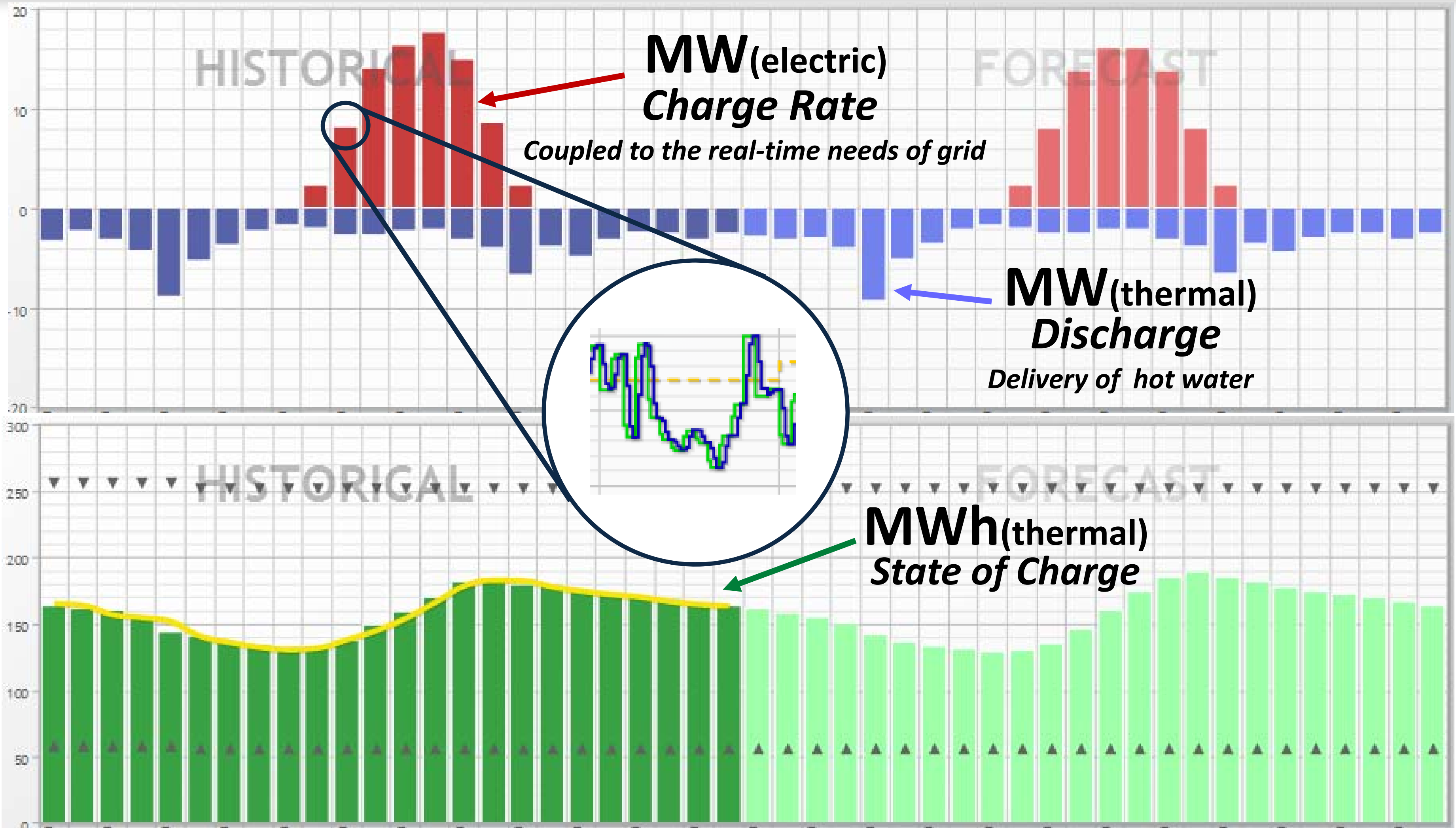




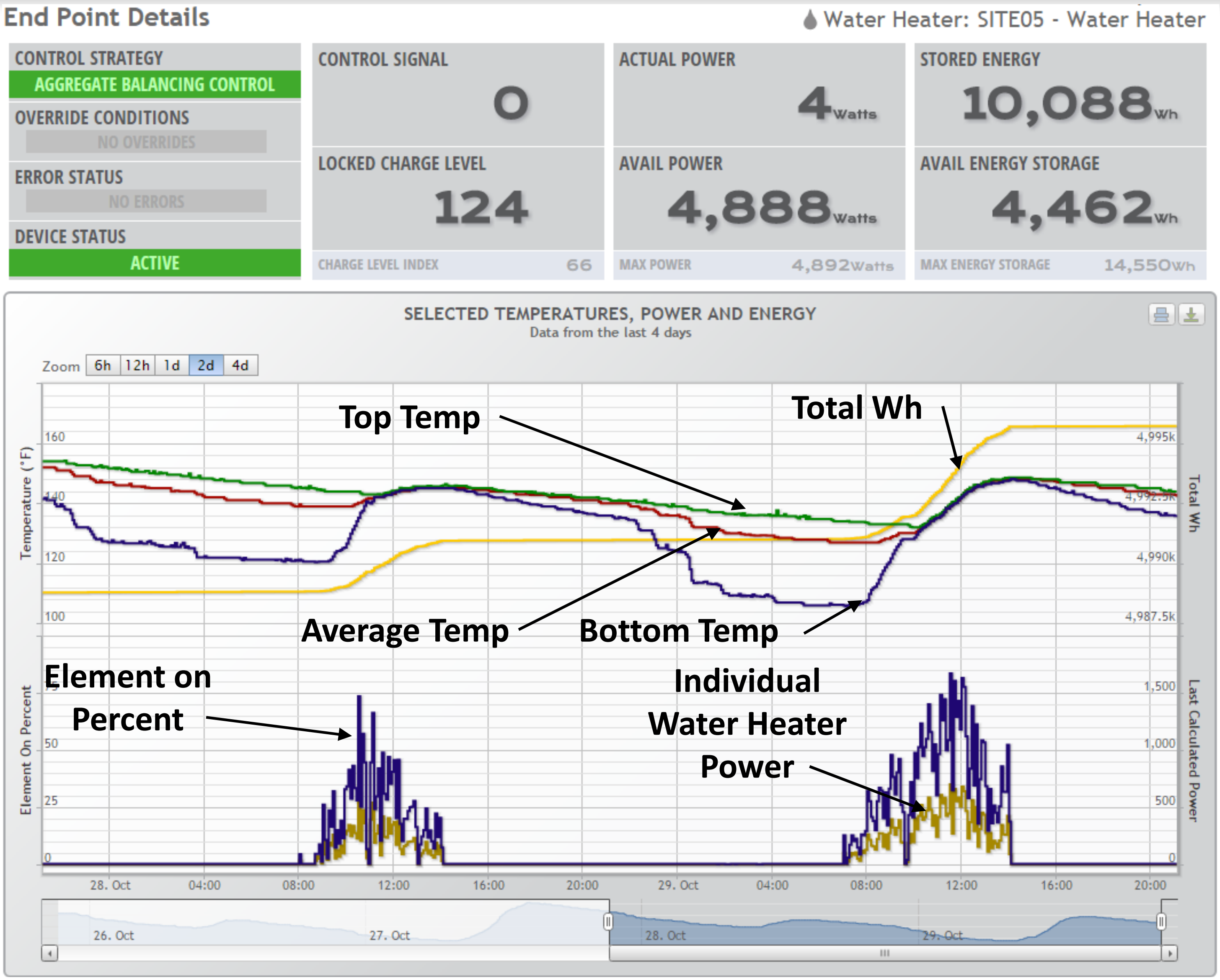
Note: There is greater average daily usage during winter months

Dynamic Dispatch - Aggregate Group

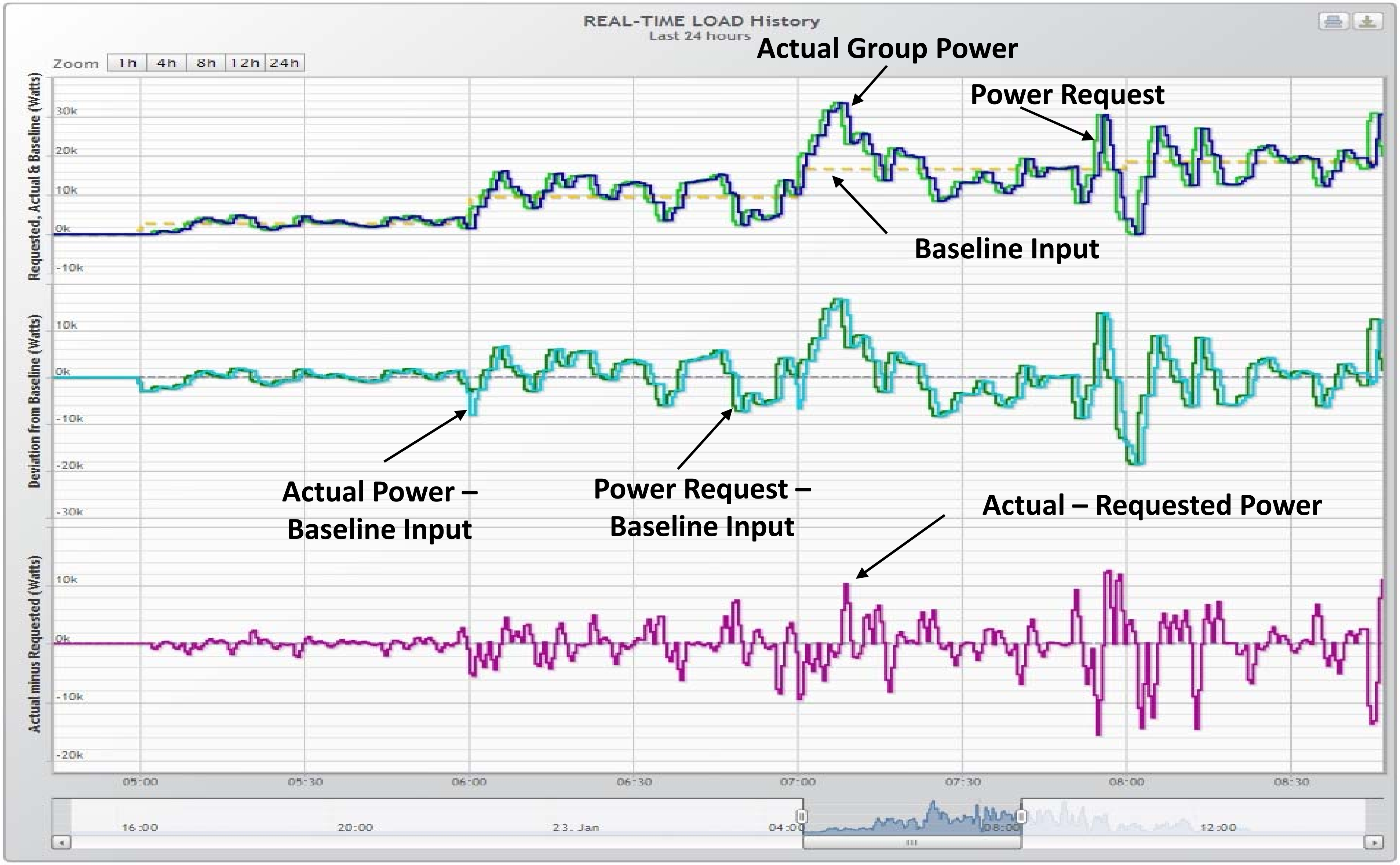
System View (actual case study data and display)



Individual GETS Water Heater



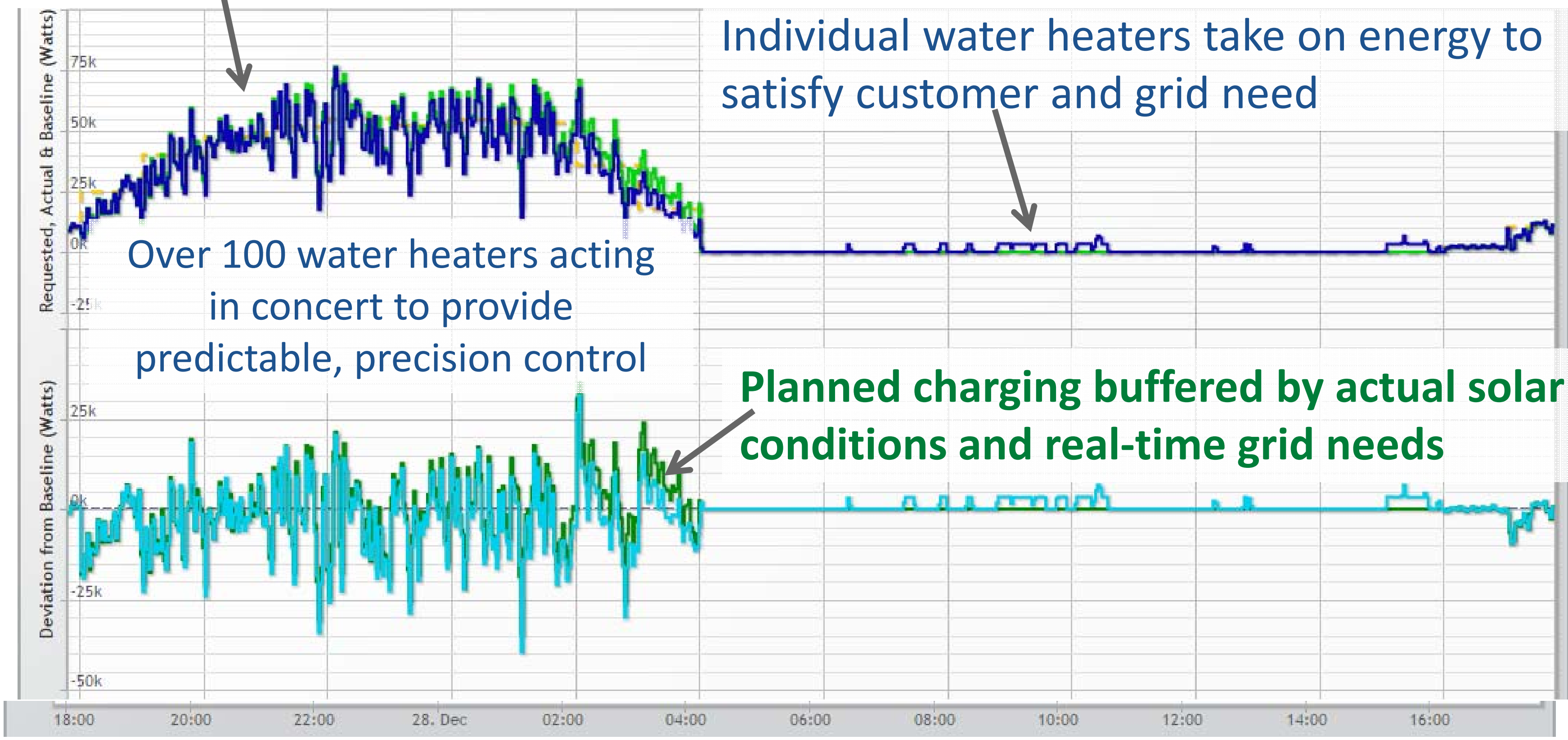
Community Storage 5.4MW—42MW-h



Community Storage 2MW– 4MW-h

Power Request (Green) – Ramps UP or DOWN based on need

Measured Power (Dark Blue) – Confirms high-accuracy following in real-time

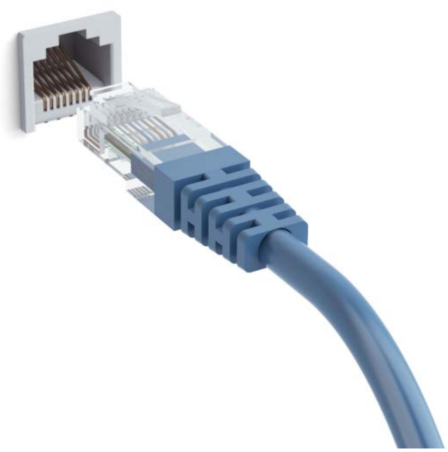


Communication Standards

- Focused on Standards and Interoperability since the founding meeting of the NIST Smart Grid Interoperability Panel (SGIP) in November of 2009
- George Arnold spoke of the interesting chicken or egg comparison to new industries and standard
- Must me room for new innovations

Current Communication Standards

- OpenADR
- TCP/IP Ethernet & WIFI
- DNP3
- BACnet



Future Communication Standards

- MultiSpeak
- IEC 1850
- ANSI C12
- SEP 1.x and 2.0
- OASIS EMIX
- CEA 2045
- Satellite or FM Radio
- Zigbee
- Z-wave
- 6LoWPAN
- LORA
- ???????

Grid-interactive ETS (GETS)

Provides “Double Green” benefits:

Economic

<u>**And**</u>

Environmental

Questions?

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"Commitment to Innovation"