

# Grid-Interactive Electric Water Heater

Amy Bryan  
Director of Residential Marketing  
Jackson EMC

Michelle Simmons, Oglethorpe Power Co.

Tristan de Frondeville, SkyCentrics

Bill Hosken, AO Smith

---

# Field Pilot – Grid Interactive H20



# Consumer Electronics Association

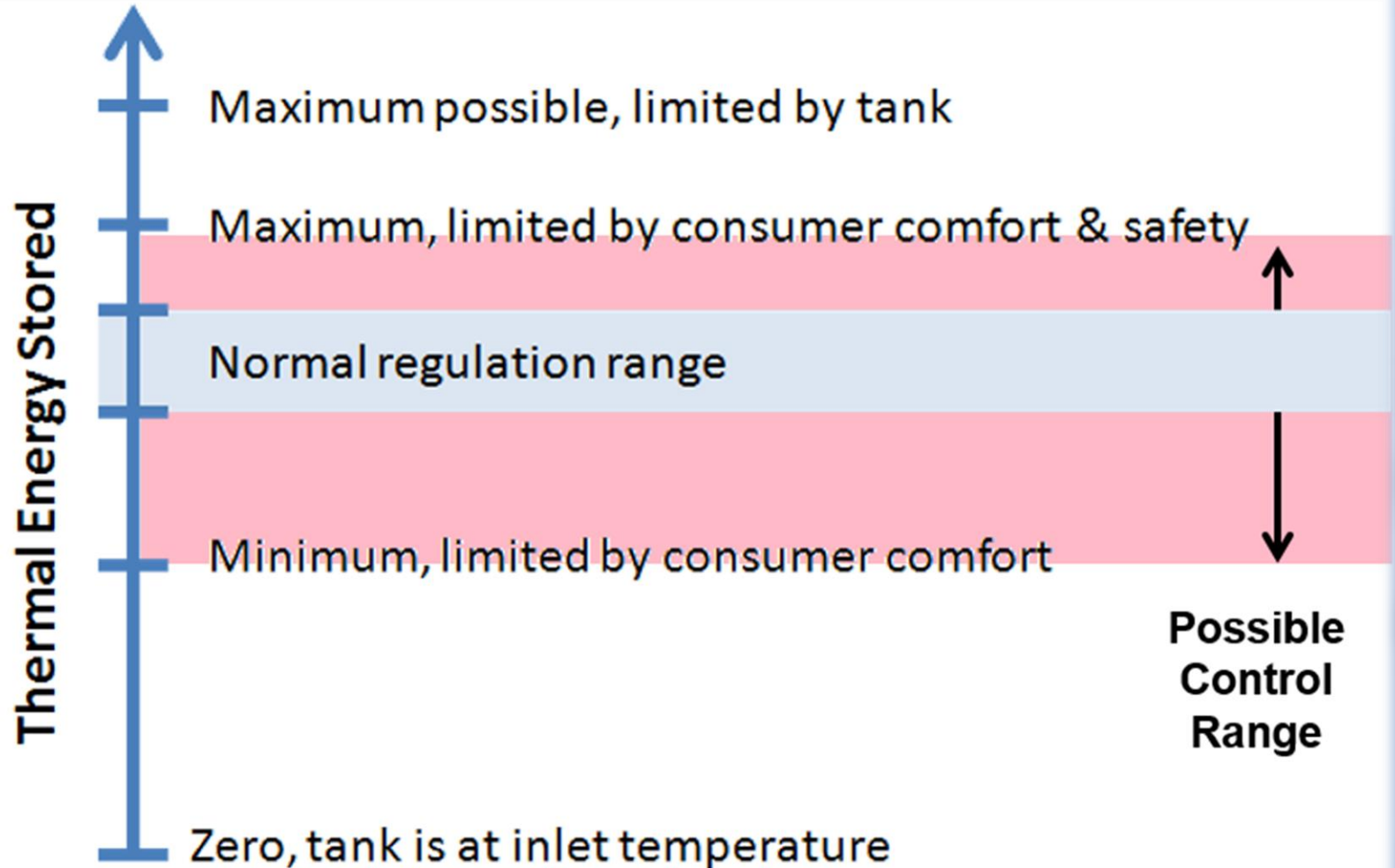
- What is the CEA – 2045 Standard?



# Why has DR ready been slow to arrive?

- Upfront cost **practical for mainstream retail**  
(Future grid connectivity is uncertain, and no interest from the consumer)
- Communication technologies-
  - Diverse – different needs and capabilities in different regions
  - Evolving – shorter expected service life than the appliances
- Diverse demand response **use cases**  
(Modules provide an opportunity for housing “logic”)

# Full Range of Management

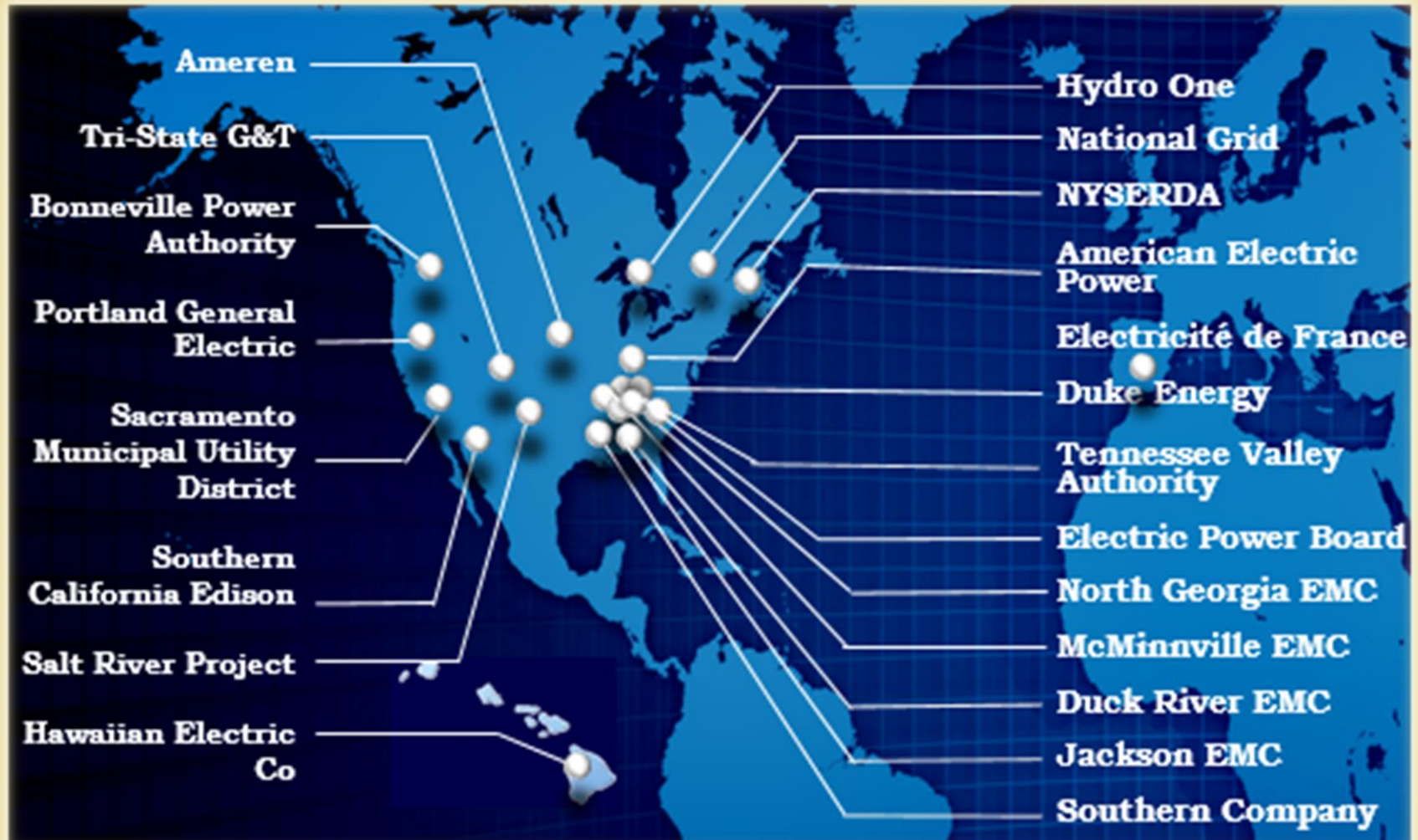


# EPRI CEA – 2045 Field Demonstration

## Standard Modular Interface for Demand Response

- Field evaluation of the standard
- Products that support the standard
- Operated in active DR programs
  - Evaluate capabilities-
    - All kinds of DR systems and programs
    - Technology evolution without impacting consumer products
    - Single communication module for all end devices
    - Potential of no electrician or utility service call to add device into program

# EPRI CEA – 2045 Field Demonstration





# Goal

- Provide-
  - Cost effective way for residential products to be made smart grid ready, off-the-shelf
  - Modular interface flexibility in the selection of communication technologies
  - Ease of DR program participation, self-install, no truck roll
- Accommodate rapid technology evolution to avoid appliance obsolescence related to changing communication technologies



# Jackson EMC's Participation

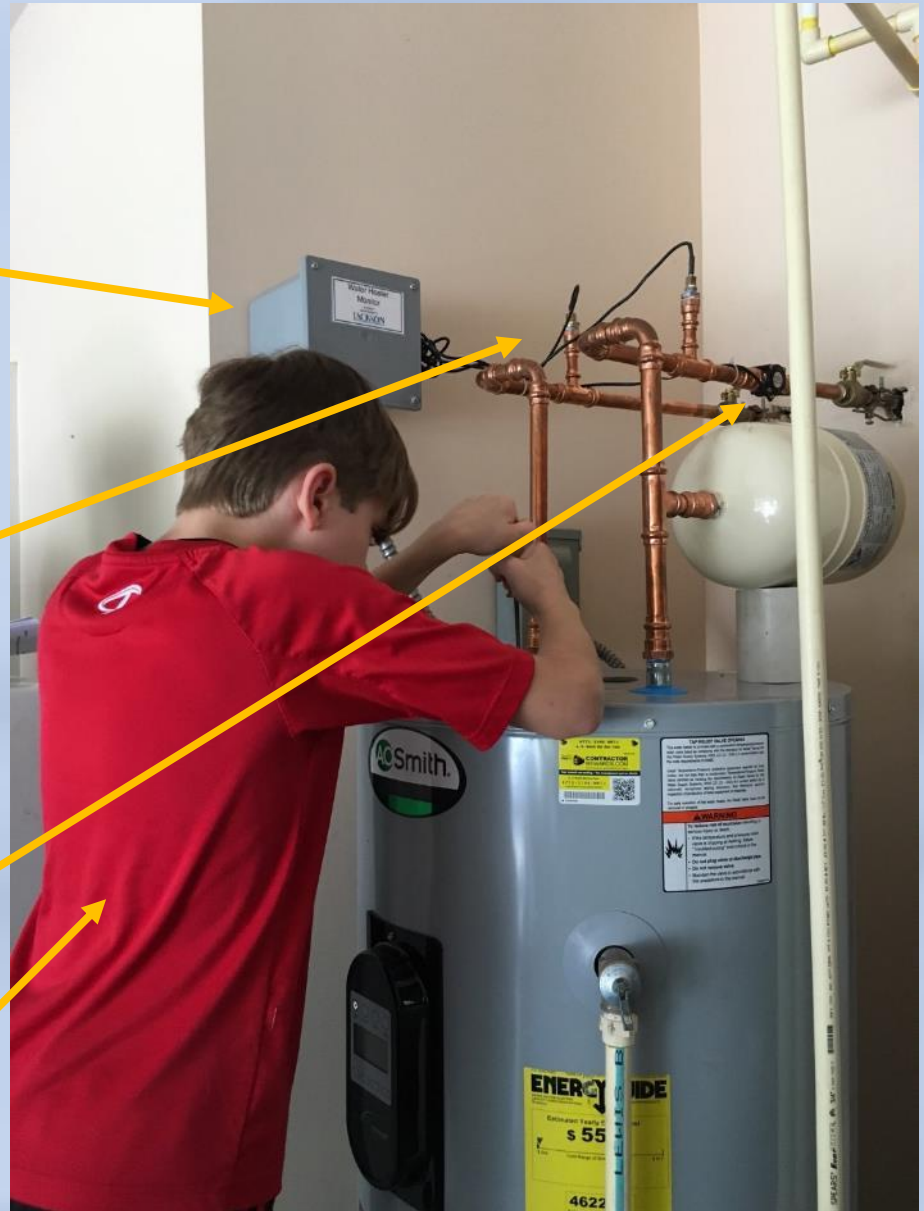
- 10 Grid-enabled electric water heaters
- Water heater monitor
  - Water flow
  - Inlet and Outlet temperature
  - Current and Voltage Measurement
- SkyCentrics CEA-2045 load management device
- EPRI CEA-2045 interface monitor
- Term of research one year after installation

# Research Benefits

- Demonstrate use of CEA-2045 load control protocol
- Measure load control impact
- Verify consumer comfort
- Investigate direction of future water heating load control
- Maintain residential water heating revenue
- Evaluate cutting edge demand response technology
- Collaborate and share results with 20 utilities nationwide

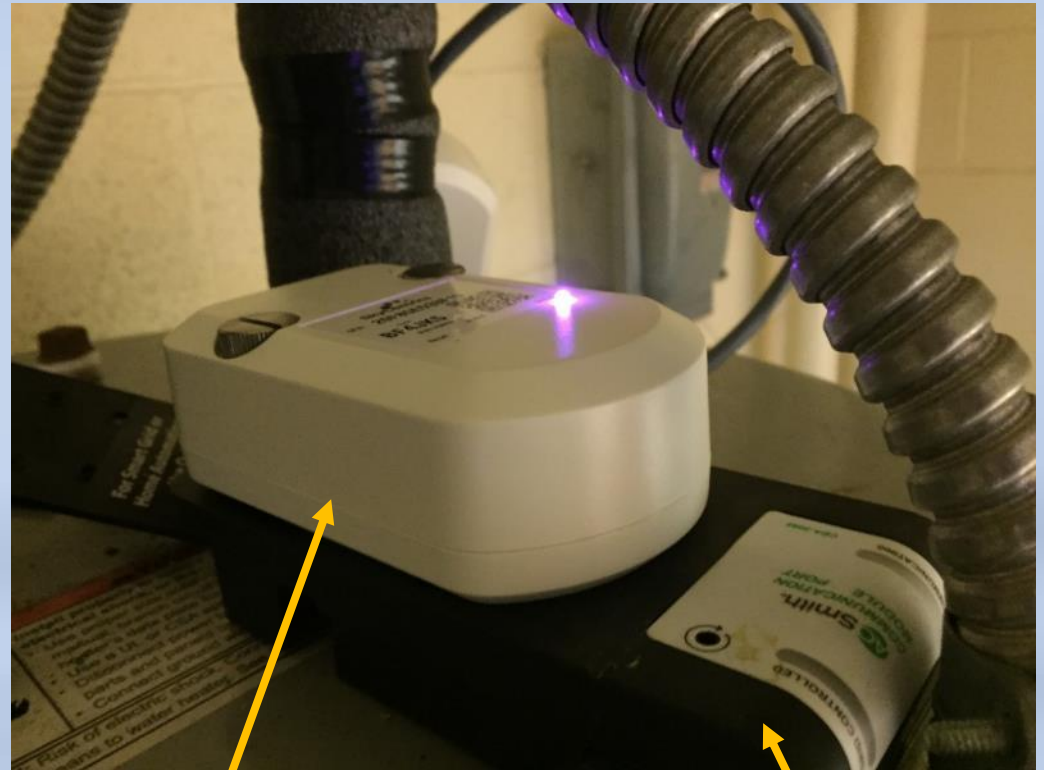
# Pilot - Employee Installation

- Monitor in supply line measuring current and voltage
- Temperature Sensors
- Water flow Sensor
- Customer Load Control Install



# Load Control Installation

- Plug & play
- Wi-Fi setup
- Account setup
- About the same level of difficulty as internet installation



SkyCentrics CTA-2045  
AC (USNAP) module

AO Smith CTA-2045  
Port Adaptor

# Water Heater Control

SkyCentrics Control Port: x  
 Secure | https://my.skycentrics.com

Jonathan Weaver

Jackson EMC | Devices | Properties | DASH | DR Admin | DR Scheduler

Devices Tree

- Jonathan Weaver's
  - Customer Devices
    - First Half
      - WH1
        - waterheater
        - Water heater
        - Hicks House
        - Debbie's
      - Second Half
        - Water Heater
        - Water heater
        - QUEEN
        - waterheater
      - Mitsubishi
      - okamoto2
      - okamoto

Mitsubishi Mini-splits

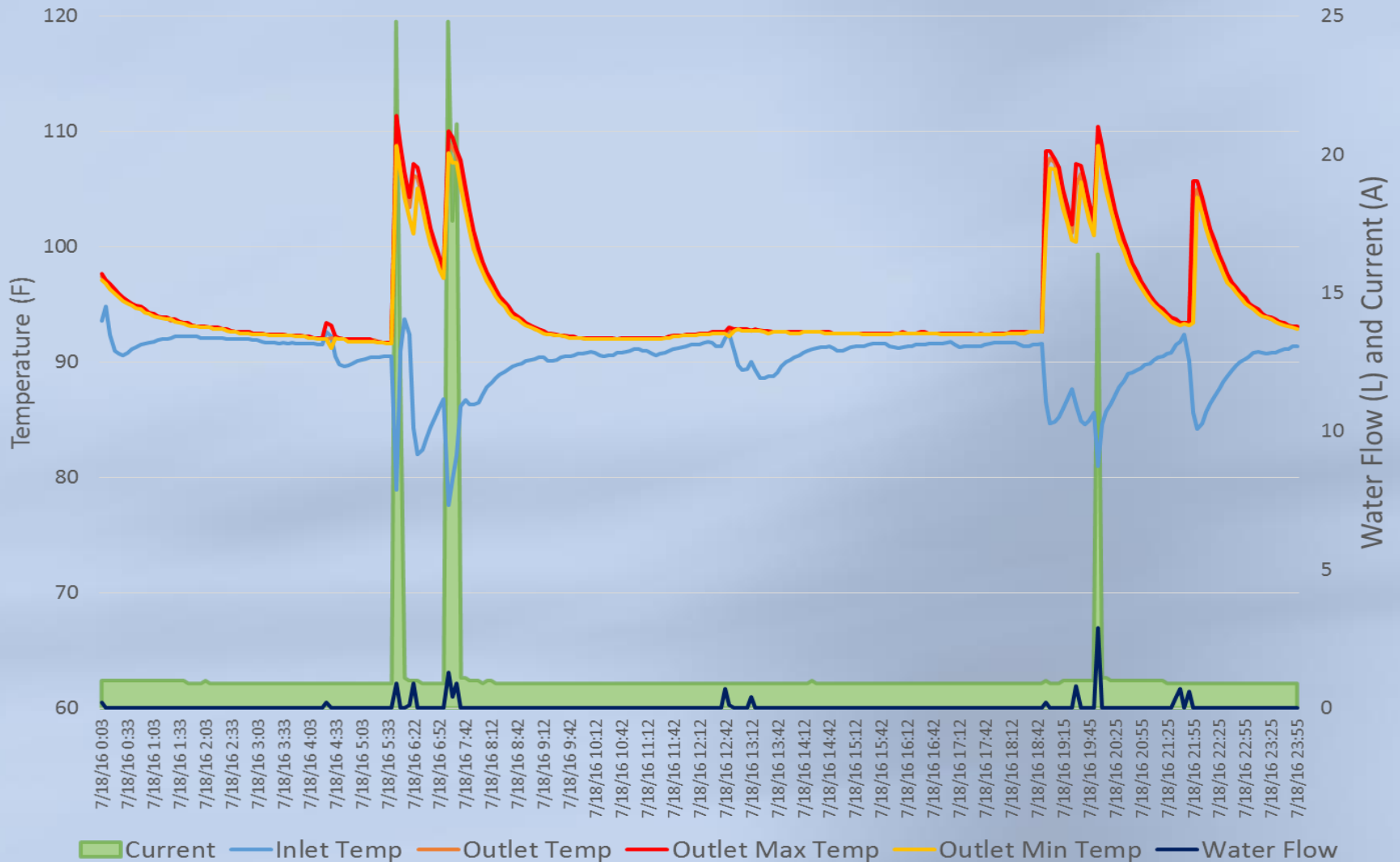
Name	Group	Set Point #1	Set Point #2	Temp	Offset	Power (W)	Event	Override	Commodity	Op. State	Utility	Last Heartbeat
Master controller	Apply											
okamoto2	Customer Devices	---	---	---	---	---	---	No	---	Comm Lost	Show Info	10/27/2016 13:33:11
okamoto	Customer Devices	---	---	---	---	---	---	No	---	Comm Lost	Show Info	10/27/2016 13:33:10
Mitsubishi	Customer Devices	---	---	---	---	---	---	No	---	Comm Lost	Show Info	02/06/2017 03:19:20

AO Smith - Electric Resistance Water Heaters

Name	Group	Power (W)	Capacity	Event	Override	Commodity	Op. State	Utility	Last Heartbeat
Master controller	Apply								
waterheater	Second Half	0	75	----	No	Show Info	Idle Normal	Show Info	02/08/2017 11:11:02
Debbie's	First Half	0	225	----	No	Show Info	Idle Normal	Show Info	02/08/2017 11:11:01
QUEEN	Second Half	0	600	----	No	Show Info	Idle Normal	Show Info	02/08/2017 11:11:02
Water Heater	Second Half	0	525	----	No	Show Info	Idle Normal	Show Info	02/08/2017 11:11:03
Water heater	First Half	0	450	----	No	Show Info	Idle Normal	Show Info	02/08/2017 11:11:02
Hicks House	First Half	0	900	----	No	Show Info	Idle Normal	Show Info	02/08/2017 11:11:02
Water heater	Second Half	0	750	----	No	Show Info	Idle Normal	Show Info	02/08/2017 11:11:02
waterheater	First Half	0	675	----	No	Show Info	Idle Normal	Show Info	02/08/2017 11:11:02
WH1	First Half	4500	150	----	No	Show Info	Running Normal	Show Info	02/08/2017 11:10:53



# Water Heater Monitoring Data







# Control Scheduling

SkyCentrics Control Port: X | <https://my.skycentrics.com> | Secure | Jonathan Weaver

**SkyCentrics** | Devices | Properties | DASH | DR Admin | **DR Scheduler**

Jackson EMC | today | **December 2016** | month | week | day

Devices Tree

Search by:  MAC  Name

Jonathan Weaver's

- Customer Devices
  - First Half
    - WH1
    - waterheater
    - Water heater
    - Hicks House
    - Debbie's
  - Second Half
    - Water Heater
    - Water heater
    - QUEEN
    - waterheater
  - Mitsubishi
  - okamoto2
  - okamoto

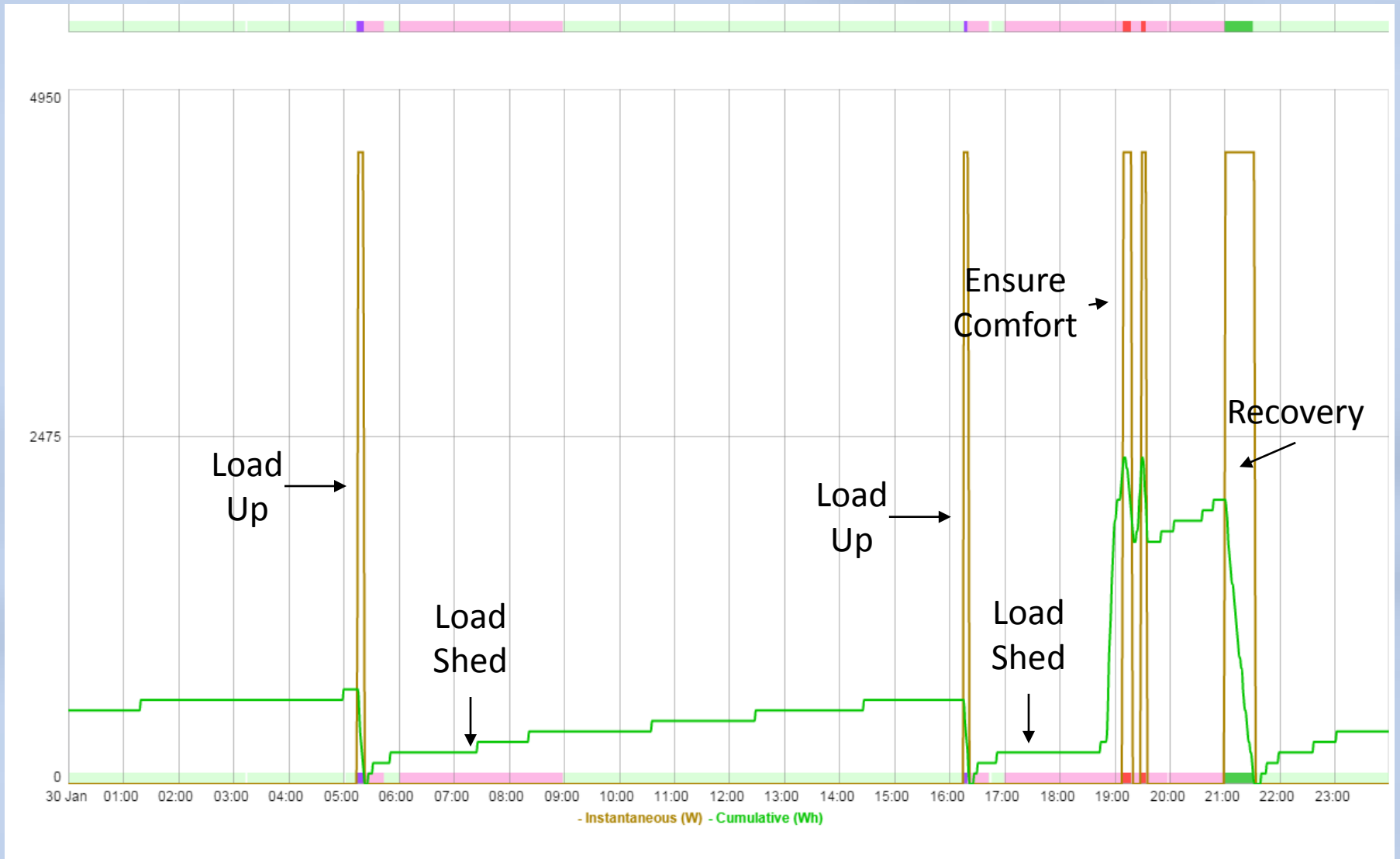
Save Tree

Saved Graphs

Saved Trees

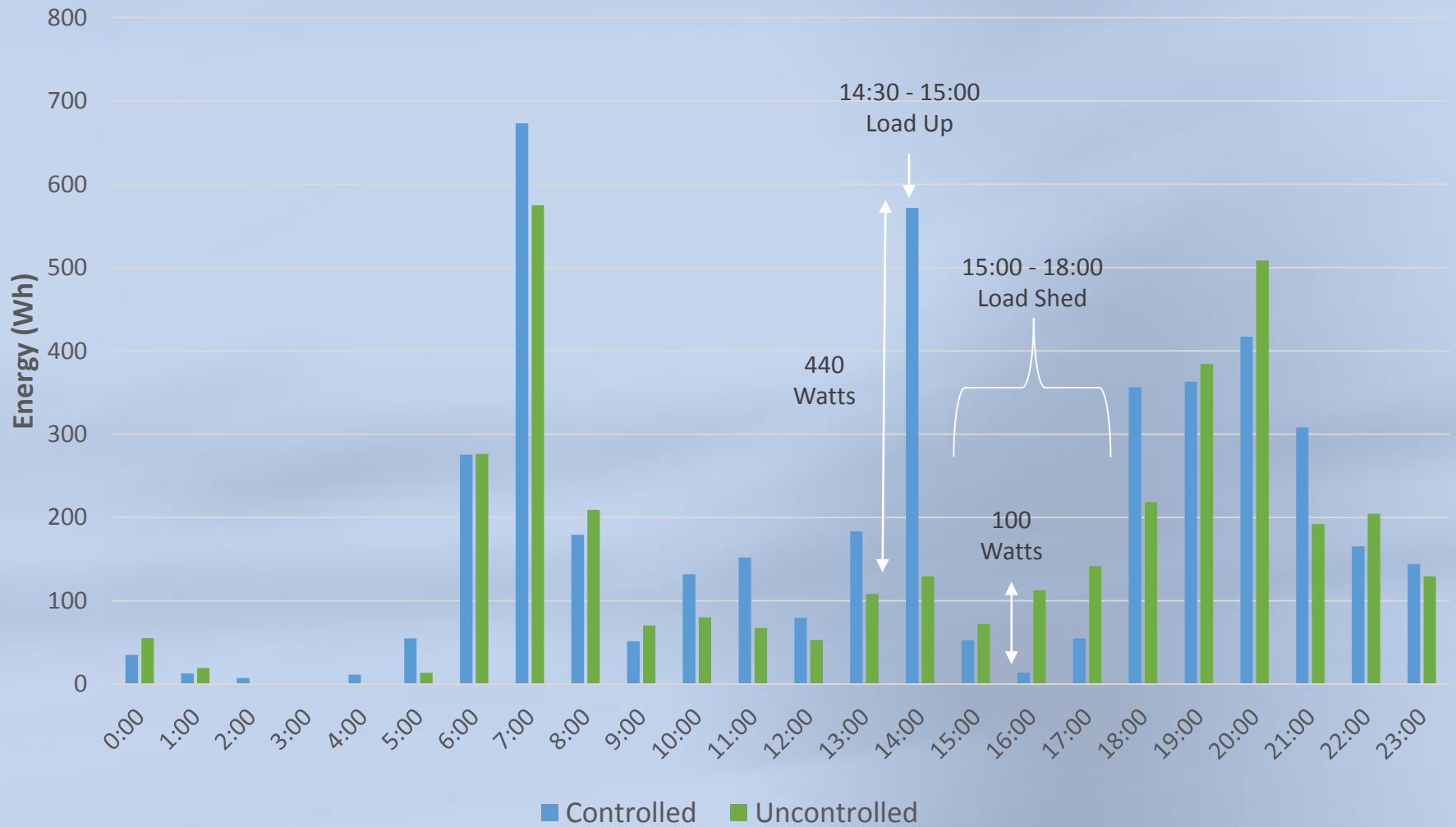
Sun	Mon	Tue	Wed	Thu	Fri	Sat
27	28	29	30	1	2	3
4	5	6	7	8	9	10
	5:15a 20161205LUM 6a 20161205LSM 4:15p 20161205LUA 5p 20161205LSA	5:15a 20161206LUM 6a 20161206LSM 4:15p 20161206LUA 5p 20161206LSA	5:15a 20161207LUM 6a 20161207LSM 4:15p 20161207LUA 5p 20161207LSA	5:15a 20161207LUM 6a 20161207LSM 4:15p 20161207LUA 5p 20161207LSA	5:15a 20161207LUM 6a 20161207LSM 4:15p 20161207LUA 5p 20161207LSA	
11	12	13	14	15	16	17
18	19	20	21	22	23	24
			5:15a LUM 6a LSM 4:15p LUA 5p LSA	5:15a LUM 6a LSM 4:15p LUA 5p LSA	5:15a LUM 6a LSM 4:15p LUA 5p LSA	
25	26	27	28	29	30	31
1	2	3	4	5	6	7
		5:15a MLU 6a MLS 4:15p ALU 5p ALS	5:15a MLU 6a MLS 4:15p ALU 5p ALS	5:15a MLU 6a MLS 4:15p ALU 5p ALS	5:15a MLU 6a MLS 4:15p ALU 5p ALS	

# Control and Customer Comfort



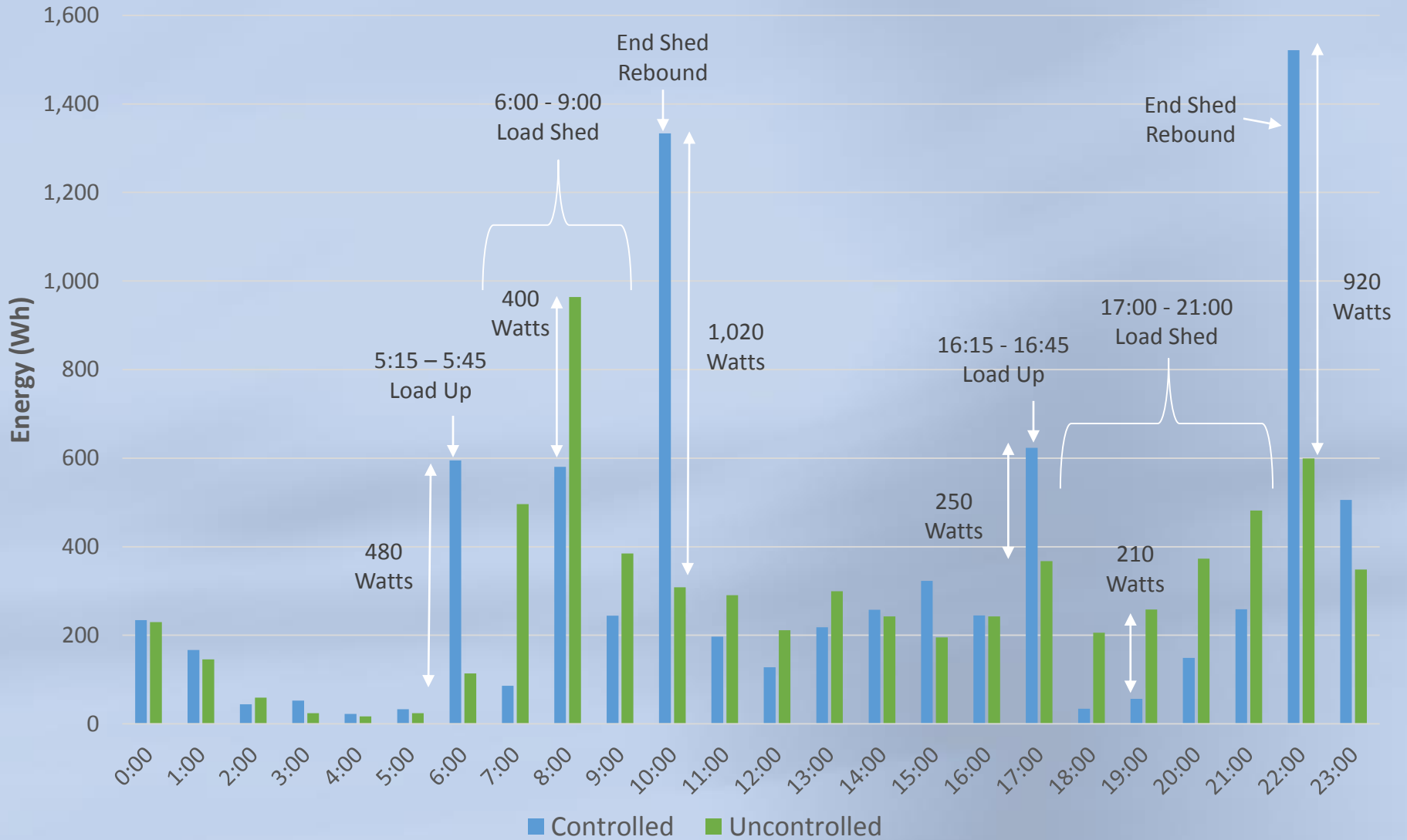
# Water Heater Control

September 2016



# Water Heater Control

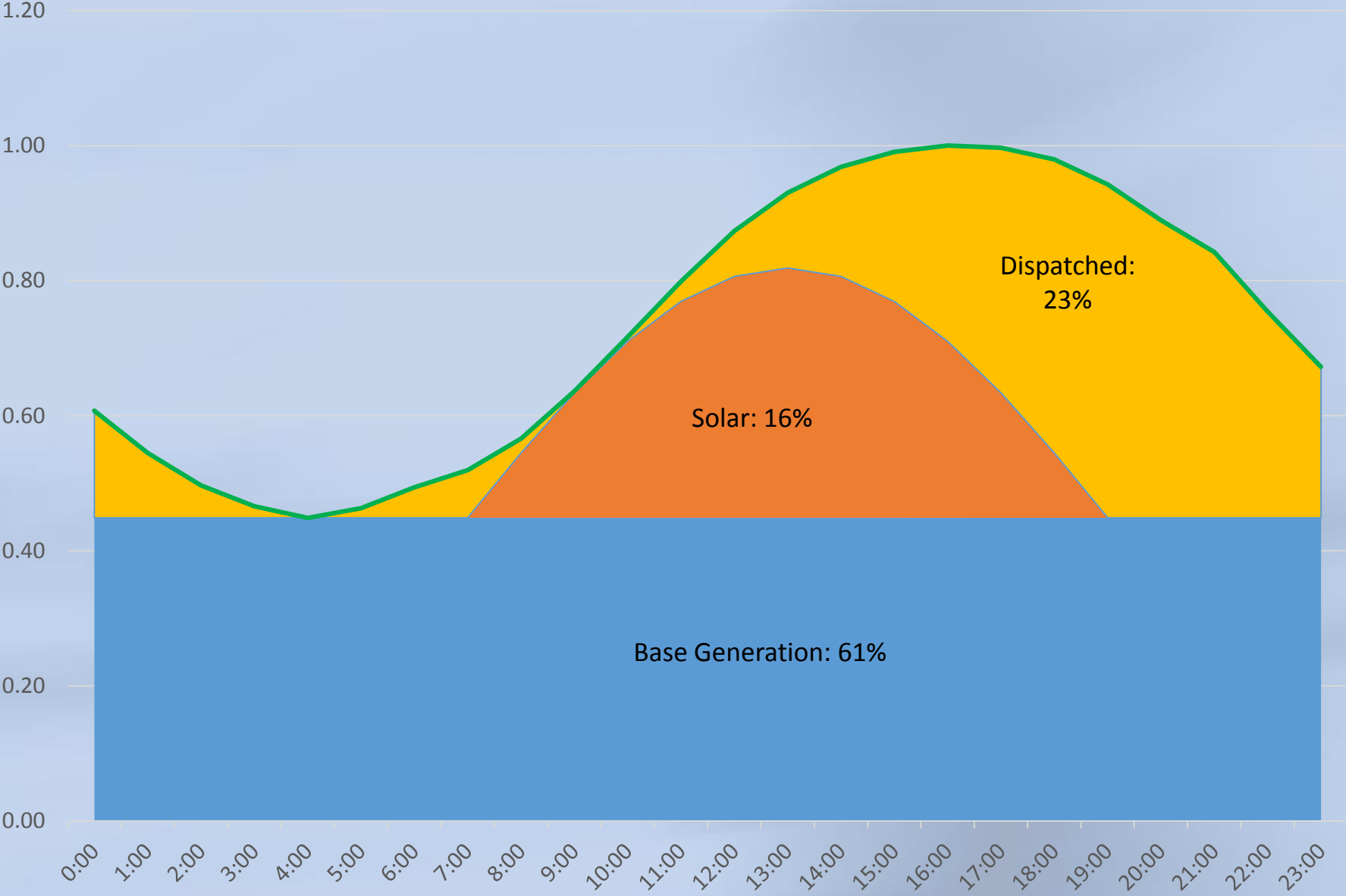
December 2016



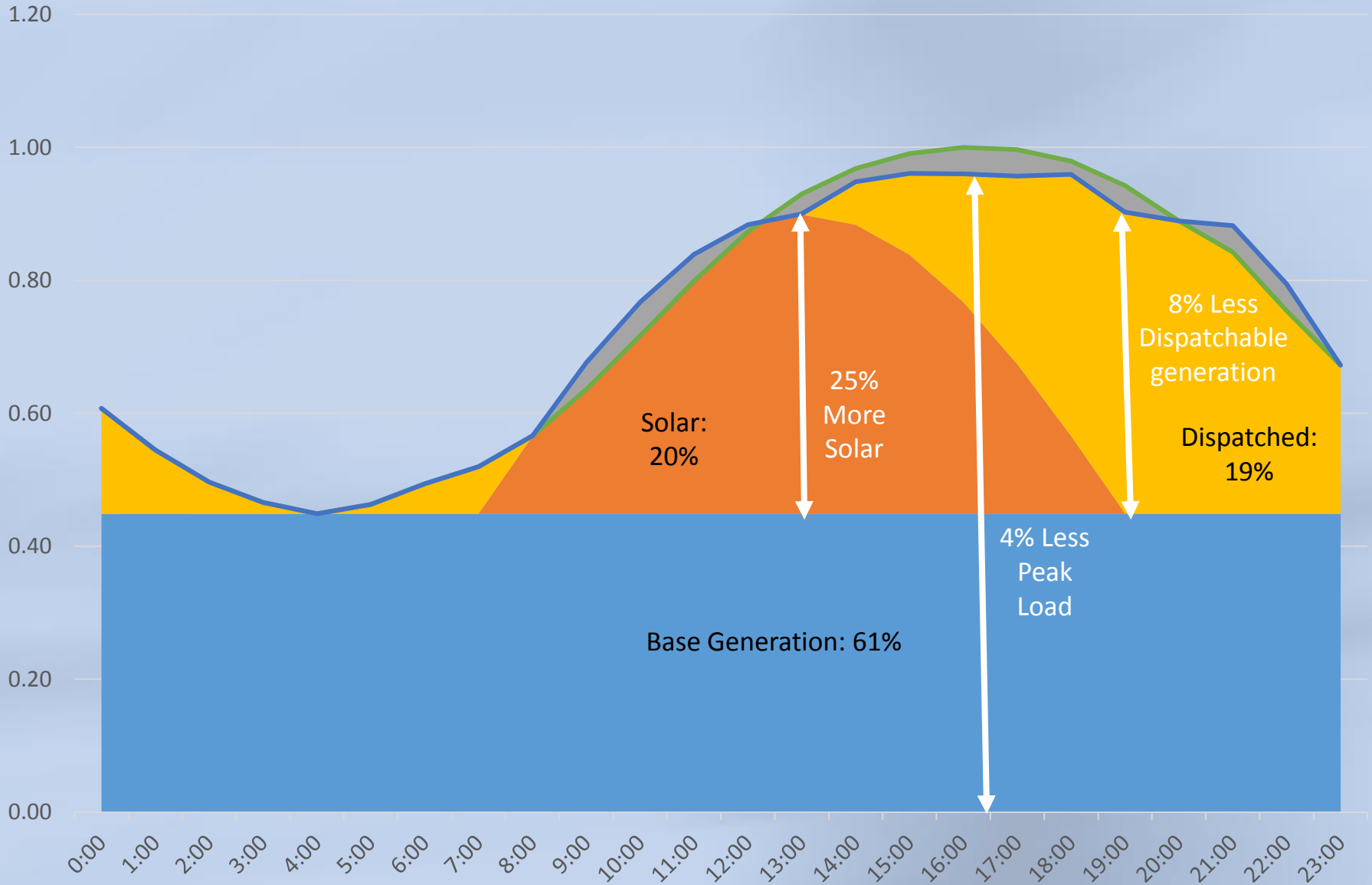
# Possibilities

- At 380 kWh per month, water heating is just under 30% of residential electric load
- Grid control of water heaters could
  - Shape the load to accommodate more renewable generation
  - Be utilized to respond to variations in renewable output
  - Reduce peak generation needs

# No Grid Controlled Water Heaters



# All Grid Controlled Water Heaters





Questions?