Passive House Monitoring Systems

By Carsten Steenberg
CEO PowerWise Systems

Thanks for the support

At this 9th. PH conference:

- Michael Hindle mentioned at the opening speech how important monitoring is!
- More than 10 of the presenters are PowerWise client! .

Agenda:

- Background information
- Why monitor Passive House type buildings
- Monitoring Systems available
- The InView Passive Solution
- Energy Monitoring
- Live dashboards
- Monitoring of heat pump technology
- Future Monitoring & Control features
- Q&A

Background information

- The eMonitor -circuit level monitoring.
- The beginning –Peter Schneider/VEIC came with the idea in late 2010.
- Started with eMonitor & the WEL
- Today PowerWise have monitoring systems in more than 60% of certified Passive House buildings in US & Canada.

Why monitor Passive House buildings

You heard it before –*"you can't manage what you don't measure"*

- Feedback for architect, builder, homeowner
- Evaluate and optimized building systems
- Verify performance vs. design
  - Air quality
  - Home comfort
  - Temperature
  - Low energy use appliances, lighting, HVAC
  - HVAC
- Answer the questions –demystifying the technology use in passive houses

Monitoring Systems available

- Many systems can monitor total power or several circuits
- Few systems can ad temperature & RH sensors
- Very few, if any have a dedicated system that tying it all together in an online dashboard.

TED

onset HOBO Data Loggers

power wise

eGauge Systems MEASURE EVERY MOMENT

CAMPBELL SCIENTIFIC, INC.

Continental Control Systems LLC

Web Energy Logger

The InView Passive Solution

- Energy management, including renewables
- HVAC performance
  - ERV/HRV energy savings and recovery efficiency
  - ASHP Heat pumps
  - Home comfort conditions
  - Air quality through the year - CO2, VOC, RH
- Water and gas
  - Domestic hot water, solar thermal, HPWS heat pumps
  - Water use, storage, rainfall
- Broad or targeted projects

The InView Passive Solution
- Designed to Answer following questions:

- How much energy is each circuit using?
- How much energy is required to heat and cool the house?
- How uniform is the temperature throughout the house?
- How much energy is saved through the ERV/HRV system and what is the recovery efficiency of the ERV/HRV?
- How much energy does the ventilation system require to run?
- How much energy does the hot water system require? What percent is provided by solar?
- How is the air quality of the house throughout the year (indicated by CO2/VOC ppm)?
- What is the relative humidity level in the home?

Passive House Monitoring

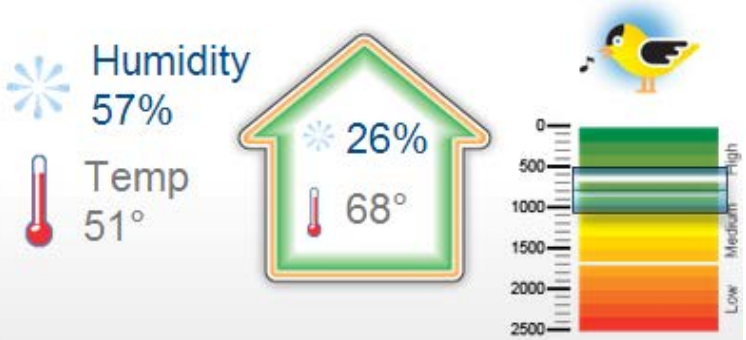
Welcome, James | Settings | Log Out

inView Passive™

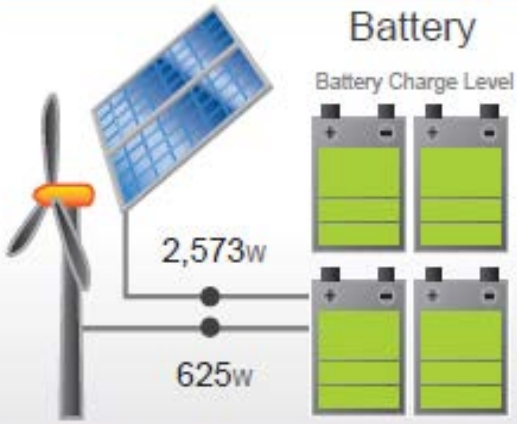
Passive House Dashboard

November 19, 4:16pm
High today 39°, Clear

Tomorrow
39°, Clear

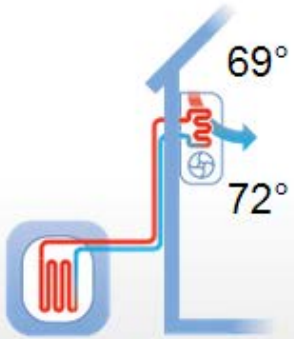


Building Environment Details



Battery Details >>

ERV Details



Mini-split Details

HPWH Details

My Location

eMonitor™ Login

Export My Data

Weather By wunderground.com®

InView™ Dashboard

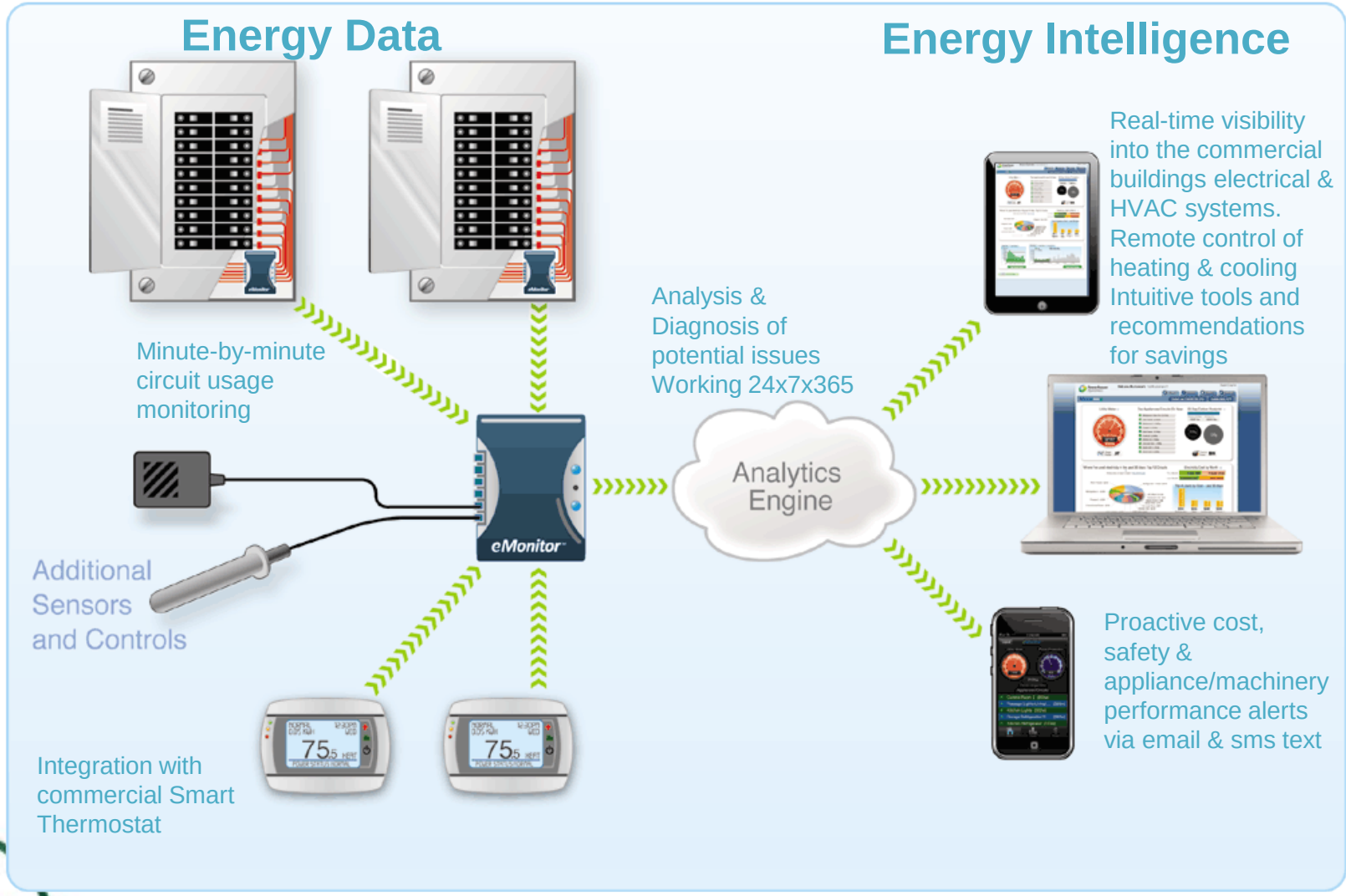
Circuit Level Energy Monitoring

Circuit Level Energy Monitoring

The Most Powerful and Versatile Circuit level Monitoring Available
Solutions for residential (single phase) & commercial (3Phase) buildings
More than 3500 units installed since 2010

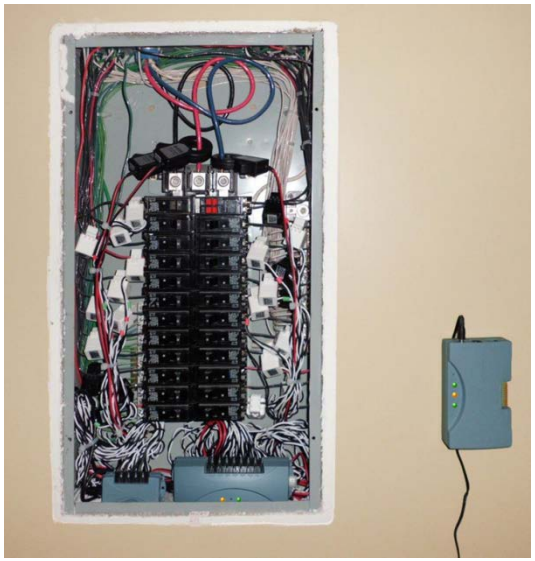
- Monitors ALL energy costs and all energy production
- Controls HVAC via Thermostats - the largest cost
- Proactively alerts – safety, cost & appliance performance
- Pinpoints major cost contributors with granular information
- Recommends targeted actions to save money
- **Delivers Cost Savings + Peace-of-Mind**

Circuit Level Energy Monitoring Overview



Simple, Clean, Cost-Effective Installation

Wireless communication - no wires outside the service panel



Eliminates issues with **outdoor panels**

Eliminates issues with **recessed** or **exposed panels**

eMonitor c-Series/eMonitor4 configuration examples

The eMonitor unit alone is an eMonitor 15c or eMonitor4-14

Channel count can be upgrades in **10 circuit increments** to 45 or 44 circuits with same base unit.

Solutions sold as eMonitor-15c, 25c & 45c or eMonitor4 14, 24 & 44

The Gateway architecture in place to support PowerWise **Temp and RH sensors , flow meters and Zigbee & Z-Wave** ra

15 or 14 circuits

+10 circuits

+10 circuits

+10 circuits

U-Snap module supports Z-Wave and Zigbee radios

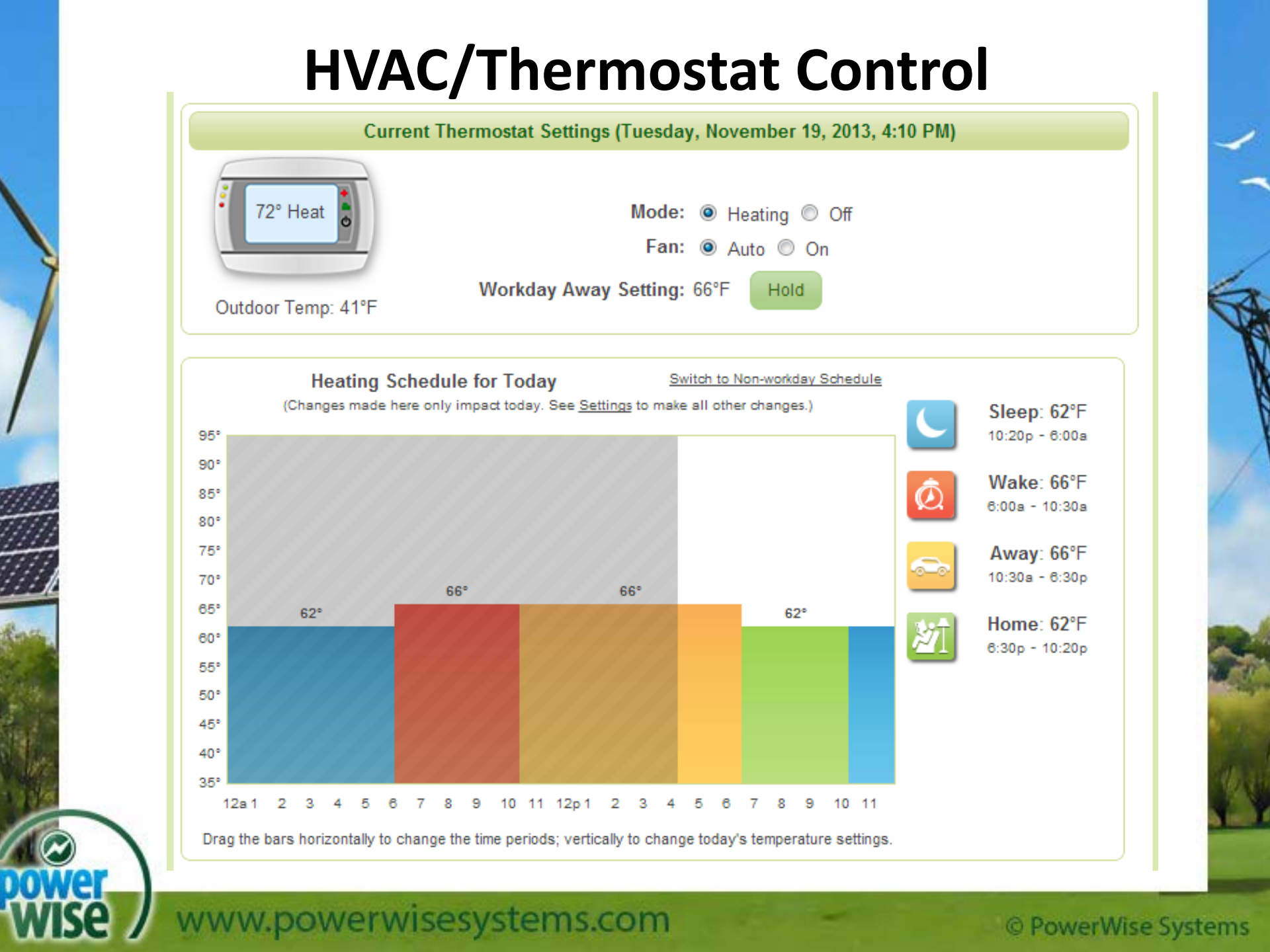
3 analog + 3 digital wired ports

eMonitor c-Series Base Unit

Expansion Pod (xPod)

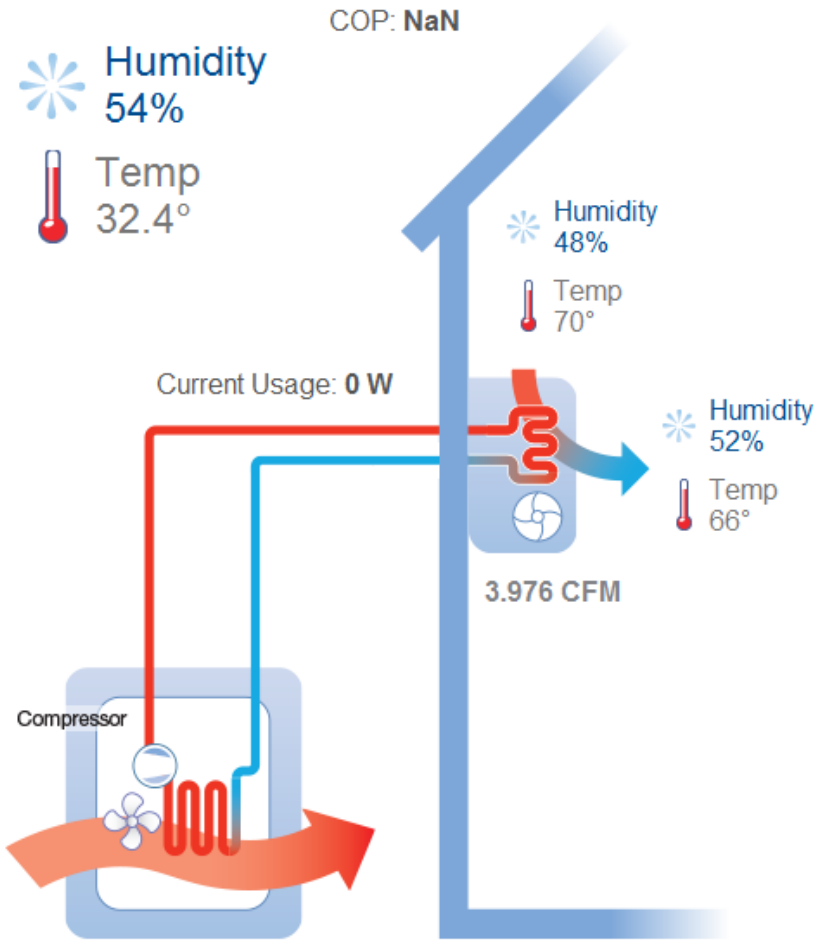
Gateway

HVAC/Thermostat Control



In & outdoor environment Monitoring
Temperature, Relative Humidity, CO_2 & VOC levels

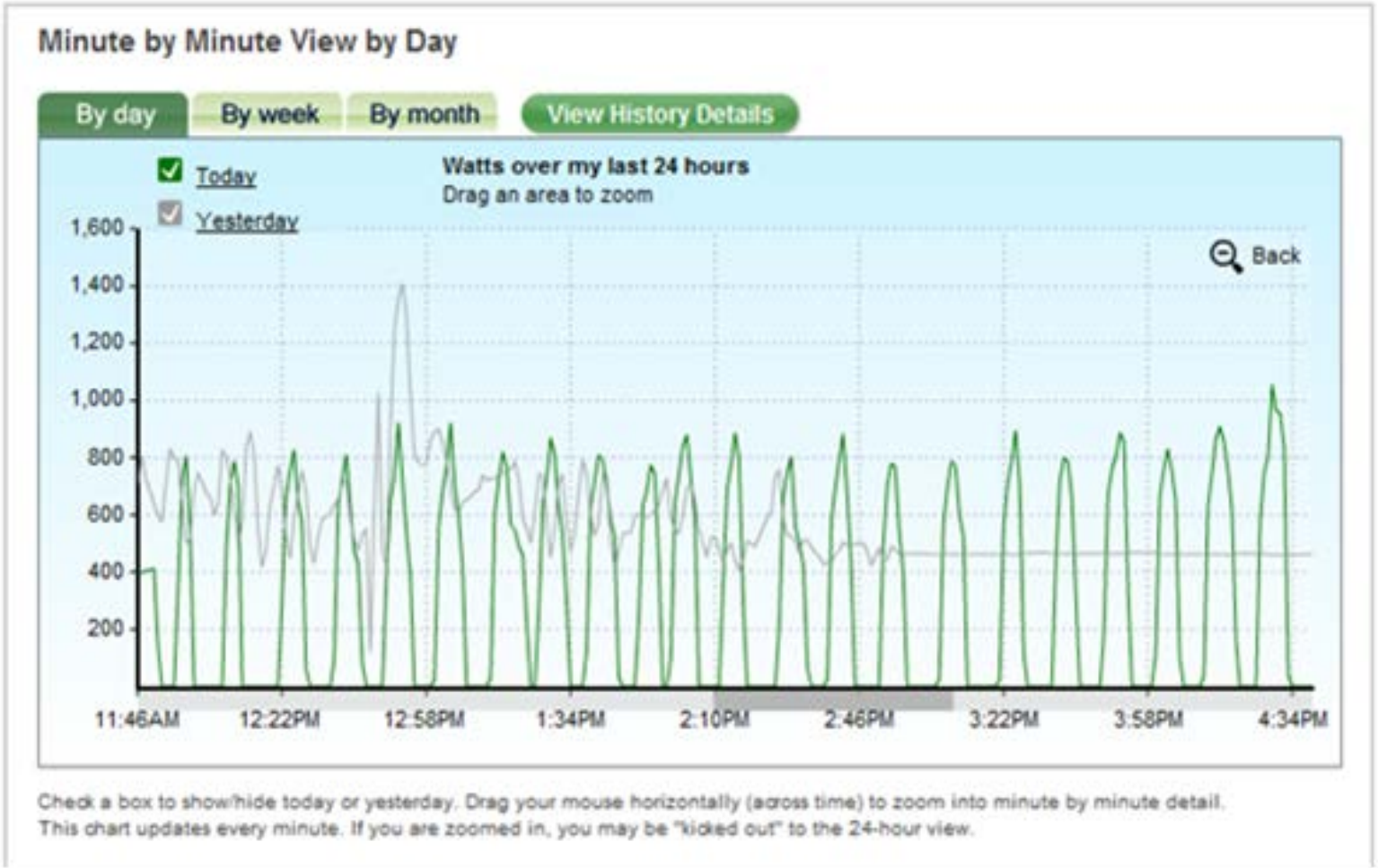
Mini-split Monitoring



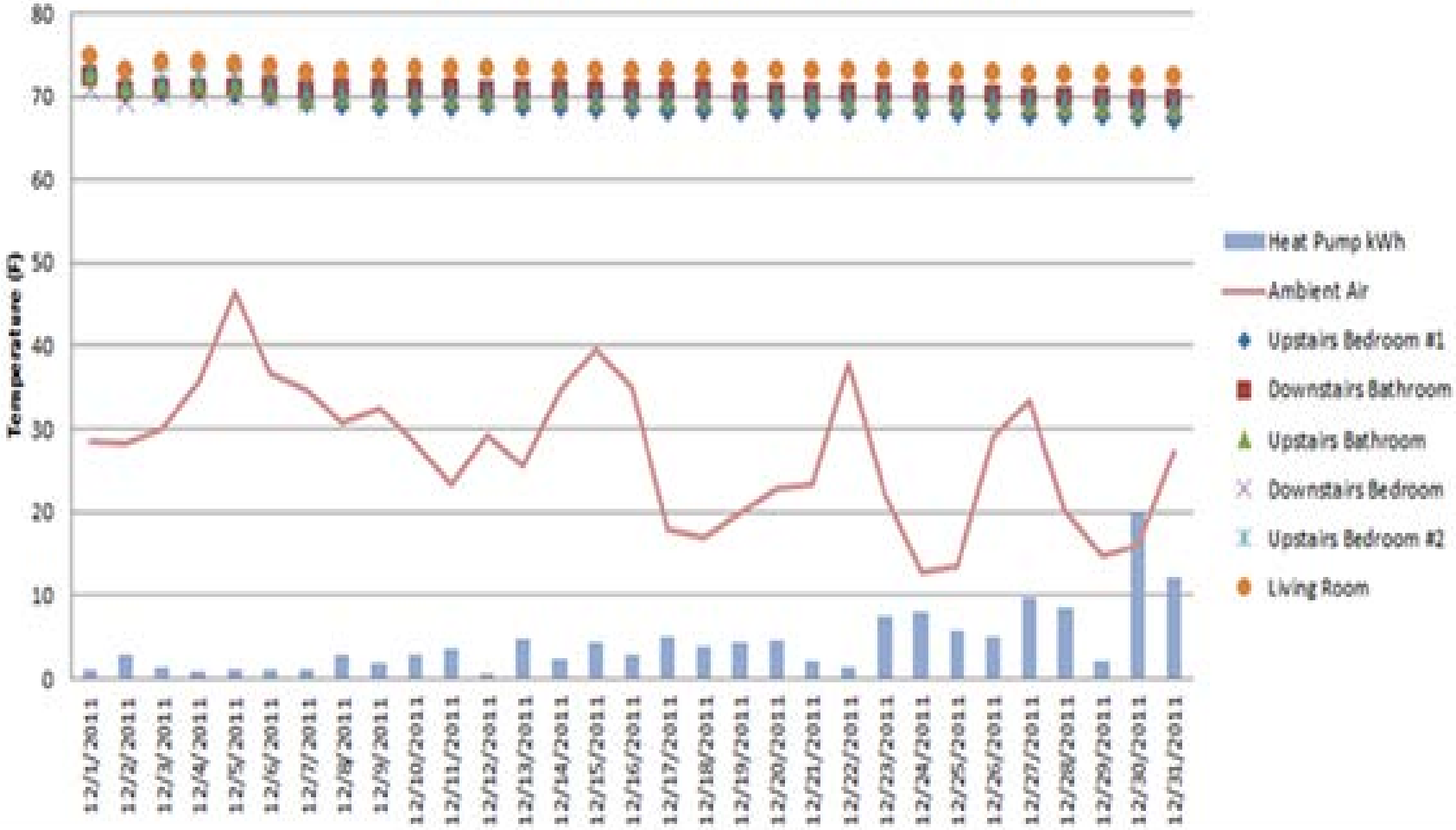
Day | Week | Month

Data	Min	Max	Avg
Relative Humidity Inside Supply	18	60	55
Relative Humidity Inside Return	40	55	51
Temperature Inside Supply	66	108	71
Temperature Inside Return	70	81	74
Analog Mini-Split	3.972	4.144	3.982

Mini split Heat Pumps – Short Cycling



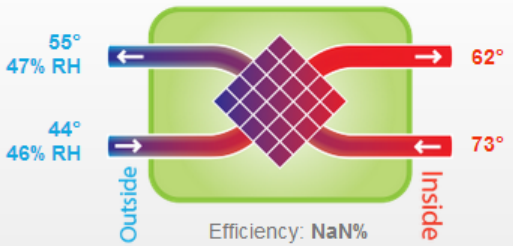
Temperature Variation with Point Source Heating & Heat Pump Energy Usage (135kWh)



ERV & HRV Monitoring

Home | Bldg Environment | SHW Details | Gnd Source Details | ERV Details

Current Usage: **261 W**



Efficiency: **NaN%**

Day | Week | Month

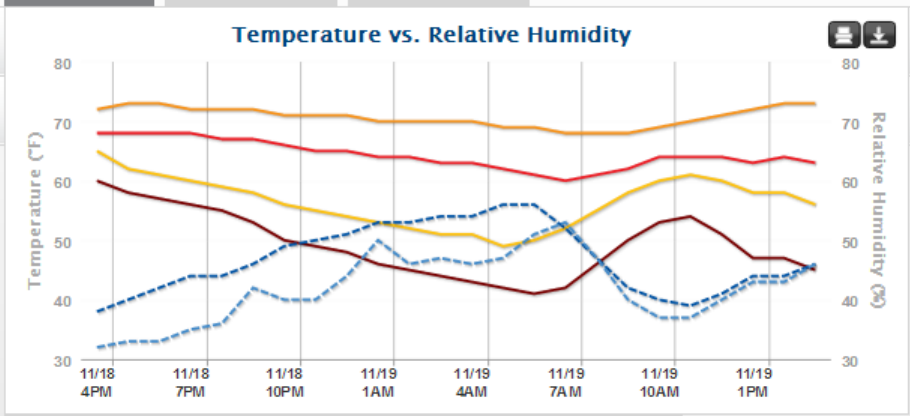
Data	Min	Max	Avg
ERV Exterior Fresh Air Temperature	39	70	53
ERV Interior Supply Air Temperature	59	69	65
ERV Interior Exhaust Air Temperature	68	73	70
ERV Exterior Exhaust Temperature	48	69	59
ERV Exterior Exhaust Air Relative Humidity	36	74	48
ERV Exterior Fresh Air Relative Humidity	28	99	47

View and Download Data

Day | Week | Month

Temperature

Relative Humidity

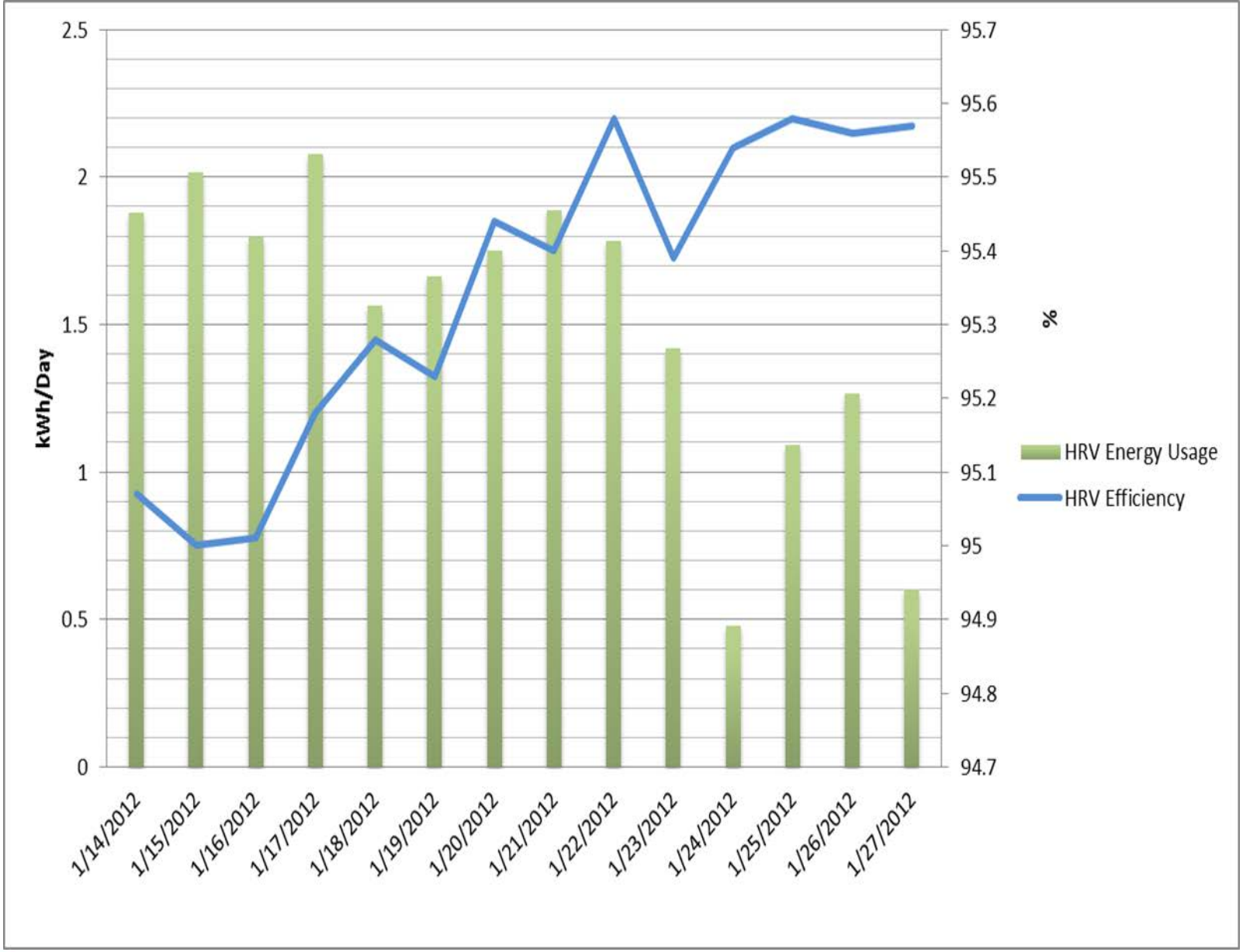


Temperature

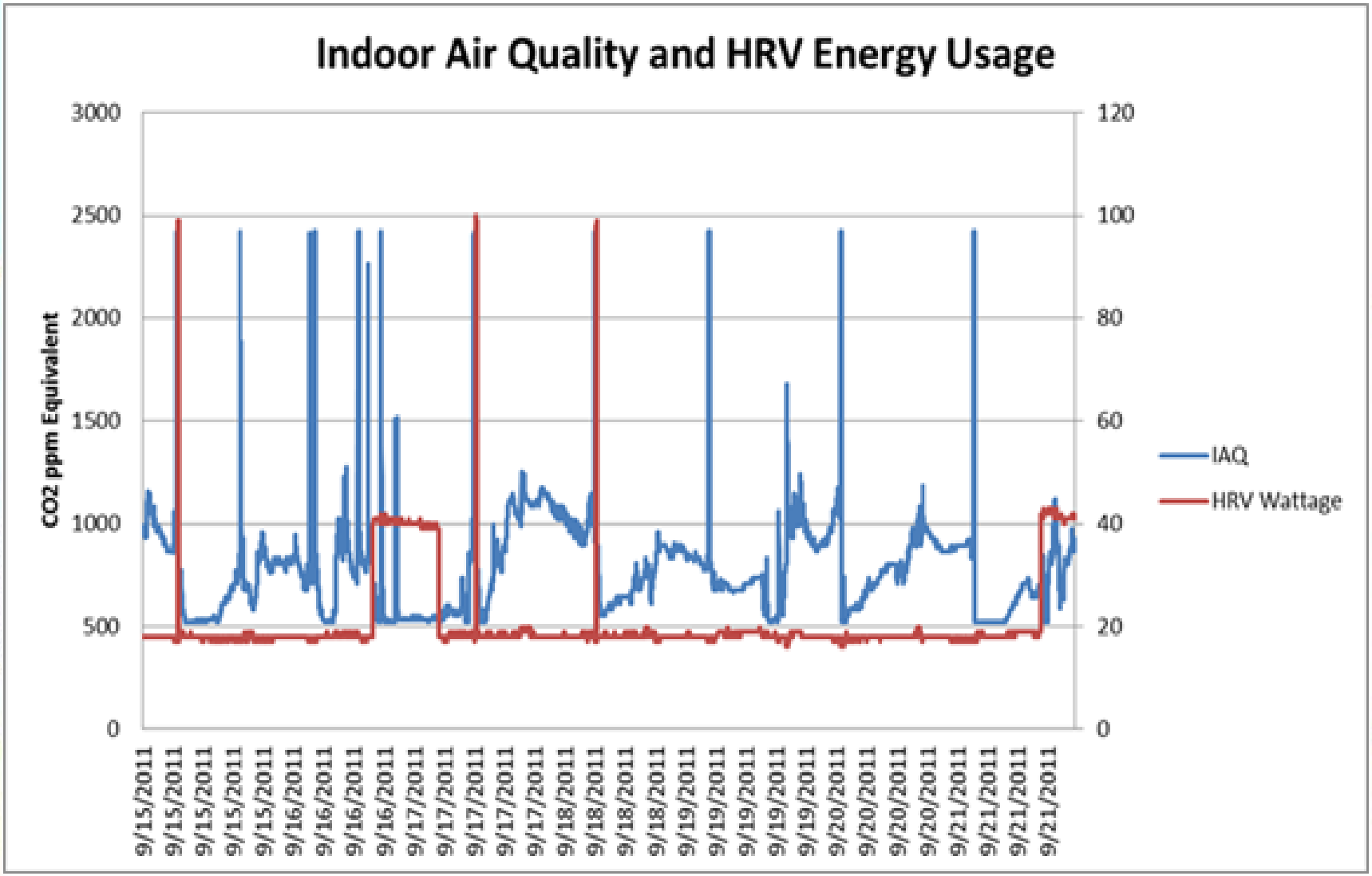
Relative Humidity

ERV Exterio (°F) | ERV Interio (°F) | ERV Interio (°F)

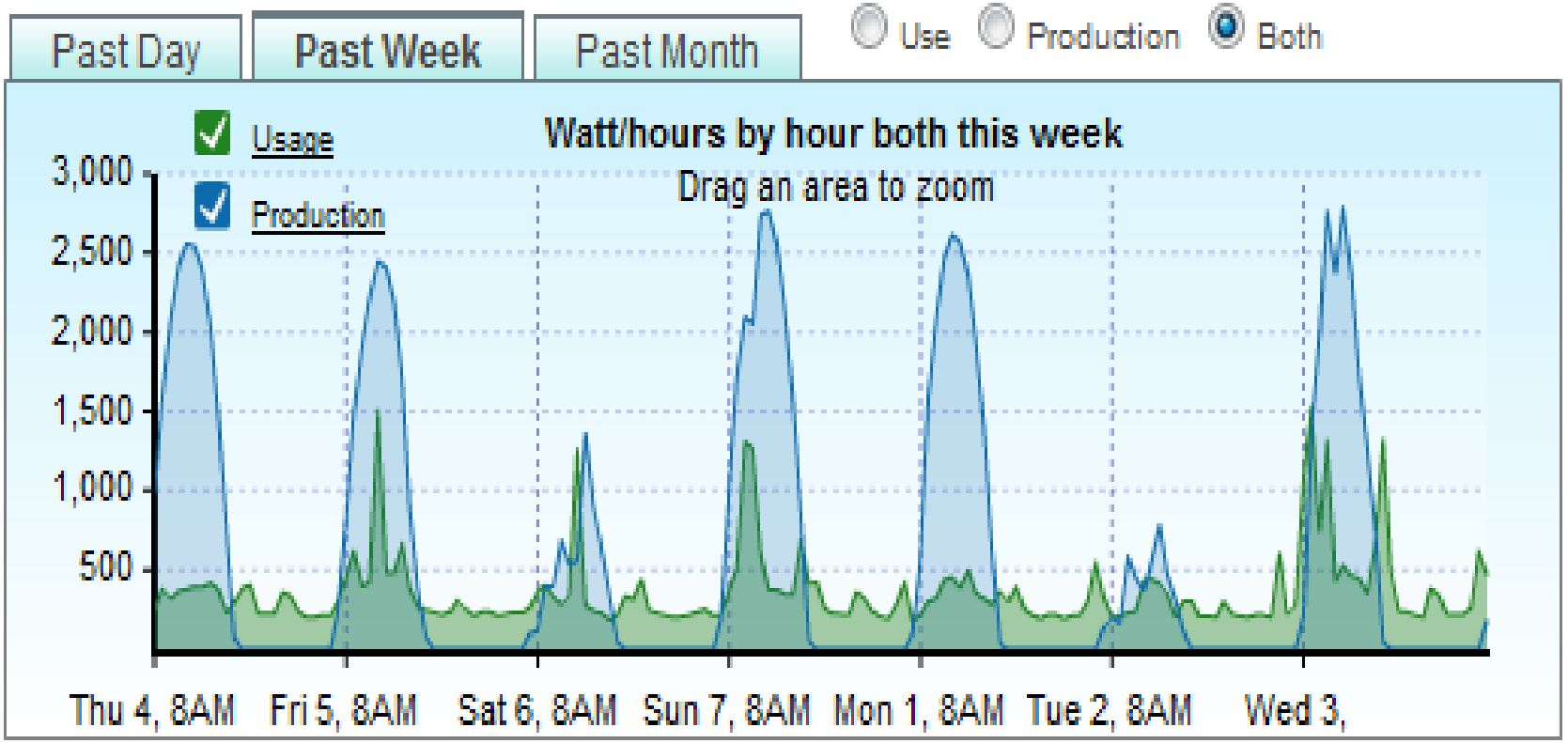
ERV Exterio (°F) | ERV Exterio (%) | ERV Exterio (%)



Indoor Air Quality and HRV Energy Usage

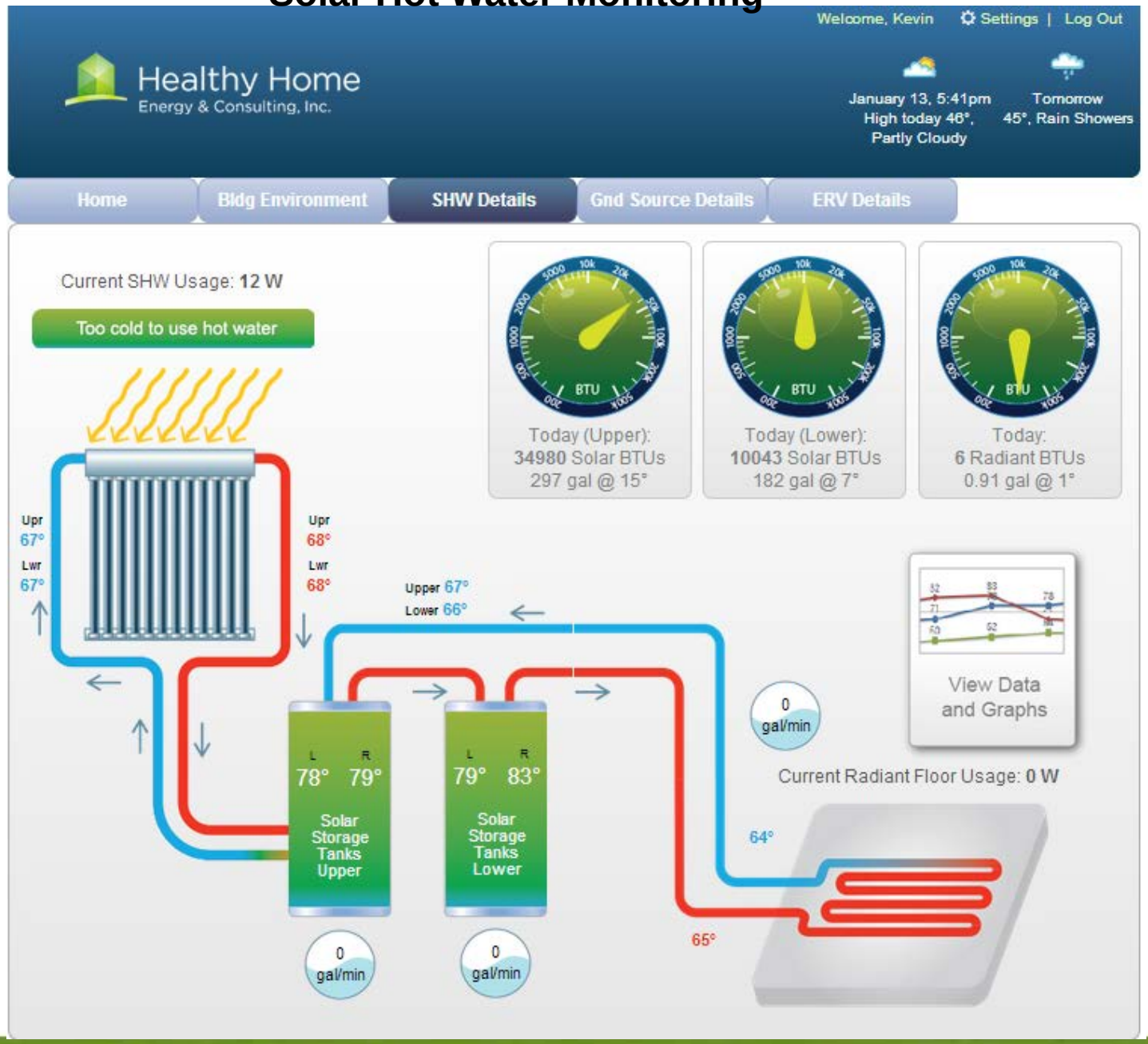


Electricity Use and Renewable Power



Solar Hot Water Monitoring

Solar Hot Water Monitoring



Solar Hot Water Monitoring

Welcome, Kevin | Settings | Log Out

Healthy Home
Energy & Consulting, Inc.

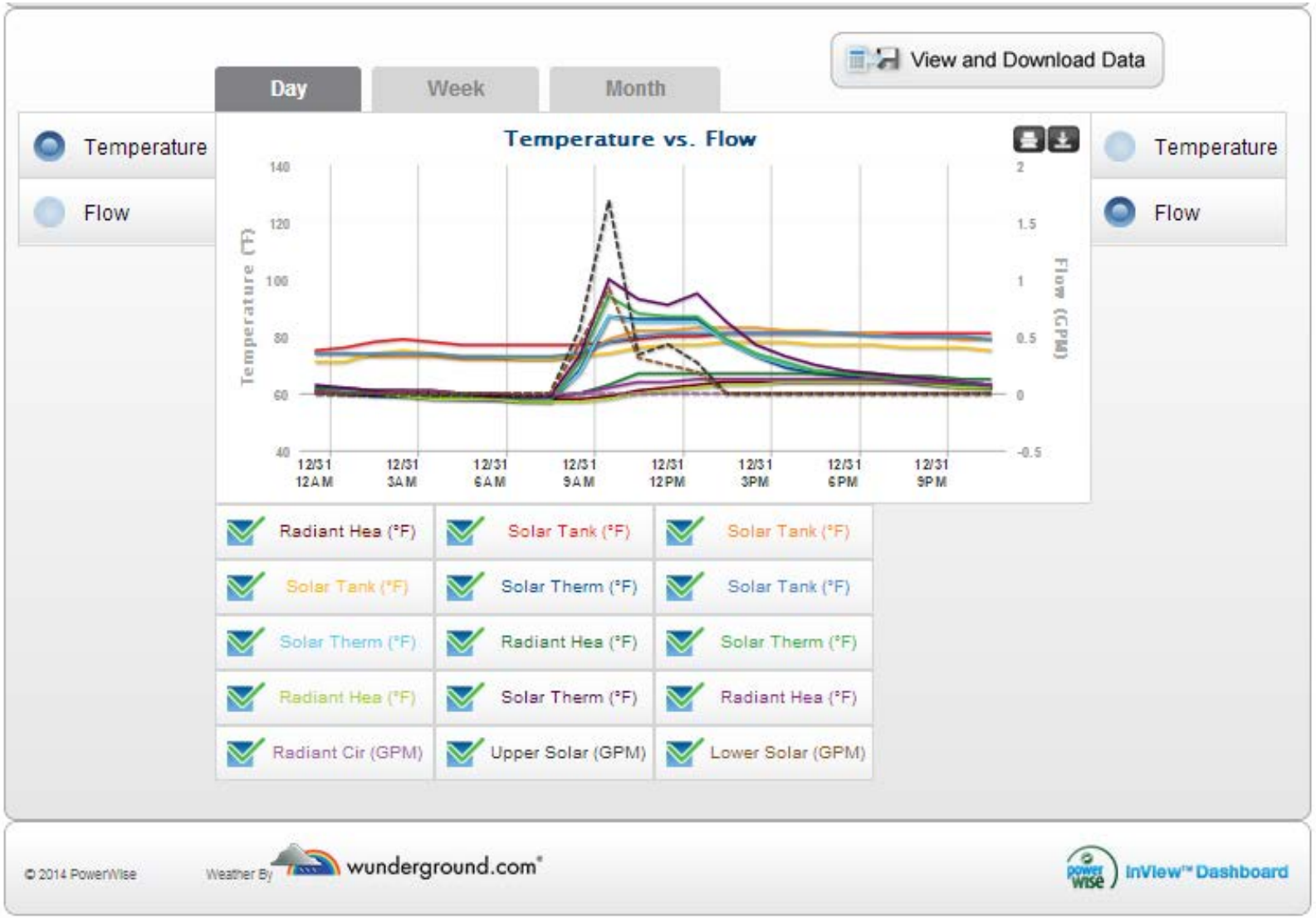
January 13, 5:43pm
High today 46°,
Partly Cloudy

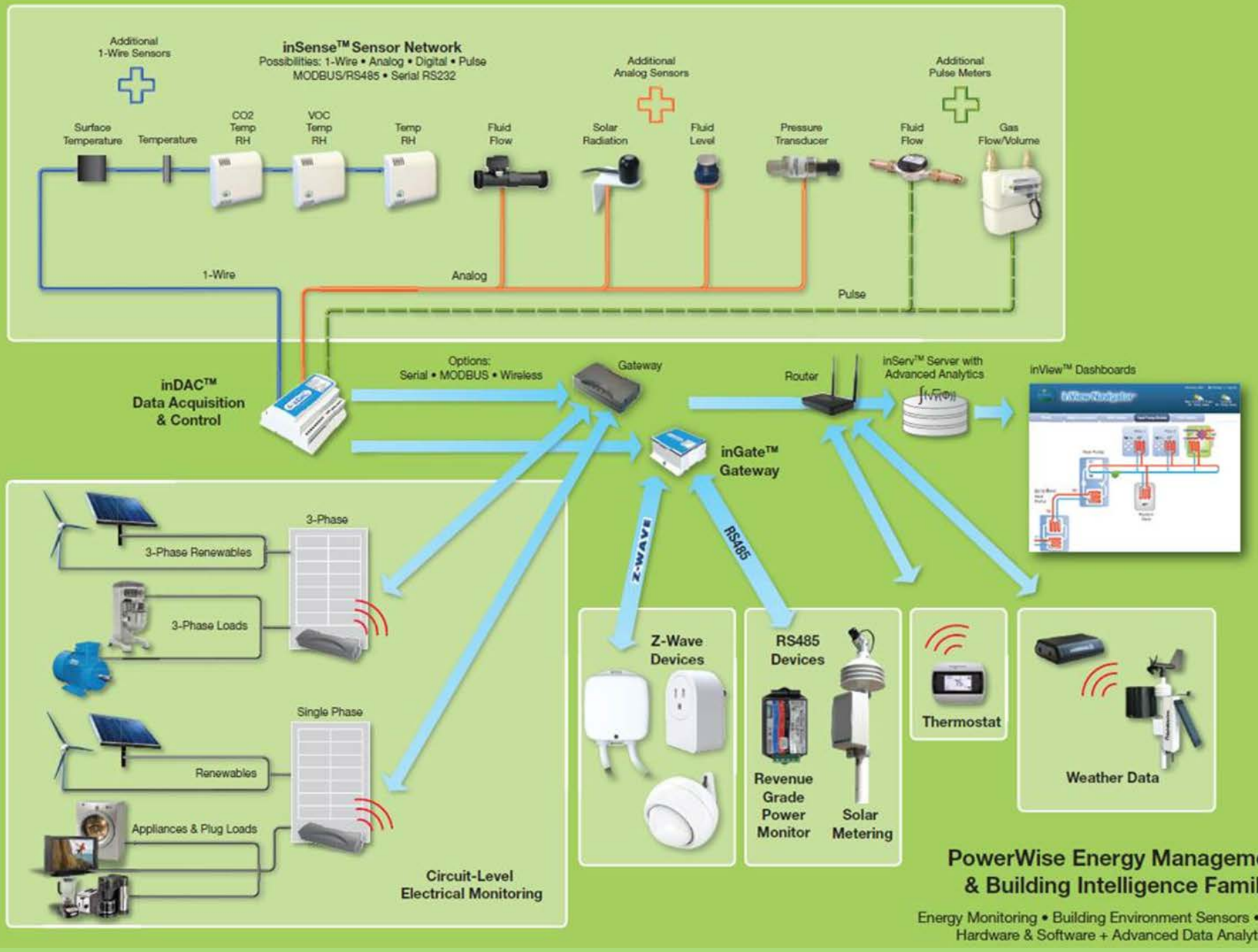
Tomorrow
45°, Rain Showers

Home | Bldg Environment | SHW Details | Gnd Source Details | ERV Details

Data	Min	Max	Avg
Radiant Heat Supply Loop Temperature	56	65	59
Solar Tank - Lower Right Temperature	64	84	70
Solar Tank - Upper Right Temperature	60	80	66
Solar Tank - Lower Left Temperature	65	80	69
Solar Thermal Return to Panels - Lower System Temperature	56	94	65
Solar Tank - Upper Left Temperature	60	80	65
Solar Thermal Return to Panels - Upper System Temperature	56	89	64
Radiant Heat Return - Upper Tanks Temperature	56	67	60
Solar Thermal Feed from Panels - Lower System Temperature	56	103	66
Radiant Heat Return Loop Temperature	56	64	59
Solar Thermal Feed from Panels - Upper System Temperature	57	105	66
Radiant Heat Return - Lower Tanks Temperature	57	66	59
Radiant Circulators Flow	0	0.54	0
Upper Solar Thermal Pump Flow	0	2.25	0.15
Lower Solar Thermal Pump Flow	0	1.13	0.1

Solar Hot Water Monitoring




Additional
1-Wire Sensors
inSense™ Sensor Network
Possibilities: 1-Wire • Analog • Digital • Pulse
MODBUS/RS485 • Serial RS232
Additional
Analog Sensors
Additional
Pulse Meters
Surface
Temperature
Temperature
CO2
Temp
RH
VOC
Temp
RH
Temp
RH
Fluid
Flow
Solar
Radiation
Fluid
Level
Pressure
Transducer
Fluid
Flow
Gas
Flow/Volume
1-Wire
Analog
Pulse
inDAC™
Data Acquisition
& Control
Options:
Serial • MODBUS • Wireless
Gateway
Router
inServ™ Server with
Advanced Analytics
inView™ Dashboards
inGate™
Gateway
Z-WAVE
RS485
3-Phase
3-Phase Renewables
3-Phase Loads
Single Phase
Renewables
Appliances & Plug Loads
Circuit-Level
Electrical Monitoring
Z-Wave
Devices
RS485
Devices
Revenue
Grade
Power
Monitor
Solar
Metering
Thermostat
Weather Data
PowerWise Energy Management
& Building Intelligence Family
Energy Monitoring • Building Environment Sensors • Weather
Hardware & Software + Advanced Data Analytics

Environment Monitoring Hardware

- **PowerWise Building environment Metering -Temp, RH, CO2 & VOC**
- **inDAQ Senor Controller**
  - 1-Wire support of 15 Temp + 5 RH/Temp or Multi Sensors
  - 4 x Pulse Input Counters, 4 Analog & 4Digital Inputs
  - RS485 Modbus input/output RS232 Serial input/output
  - Optional Wire-less connect to Gateway
- **Environment Sensors**
  - All sensors 1-Wire (normally using existing CAT 3or4 phone/Ether
  - Compact & easily wall mountable
  - Measure Temperature, Relative Humidity, Volatile Organic Compounds (VOC) & CO_2
  - Wireless version planned for Q4 2014

RH & Temp

CO_2,RH & Temp

VOC, RH & Temp

Temp

Environment Monitoring Hardware

- **PowerWise Water ,Gas & other liquid flow Metering**
  - Support of many pipe diameters from 2”-1/2”

Detailed Weather Monitoring

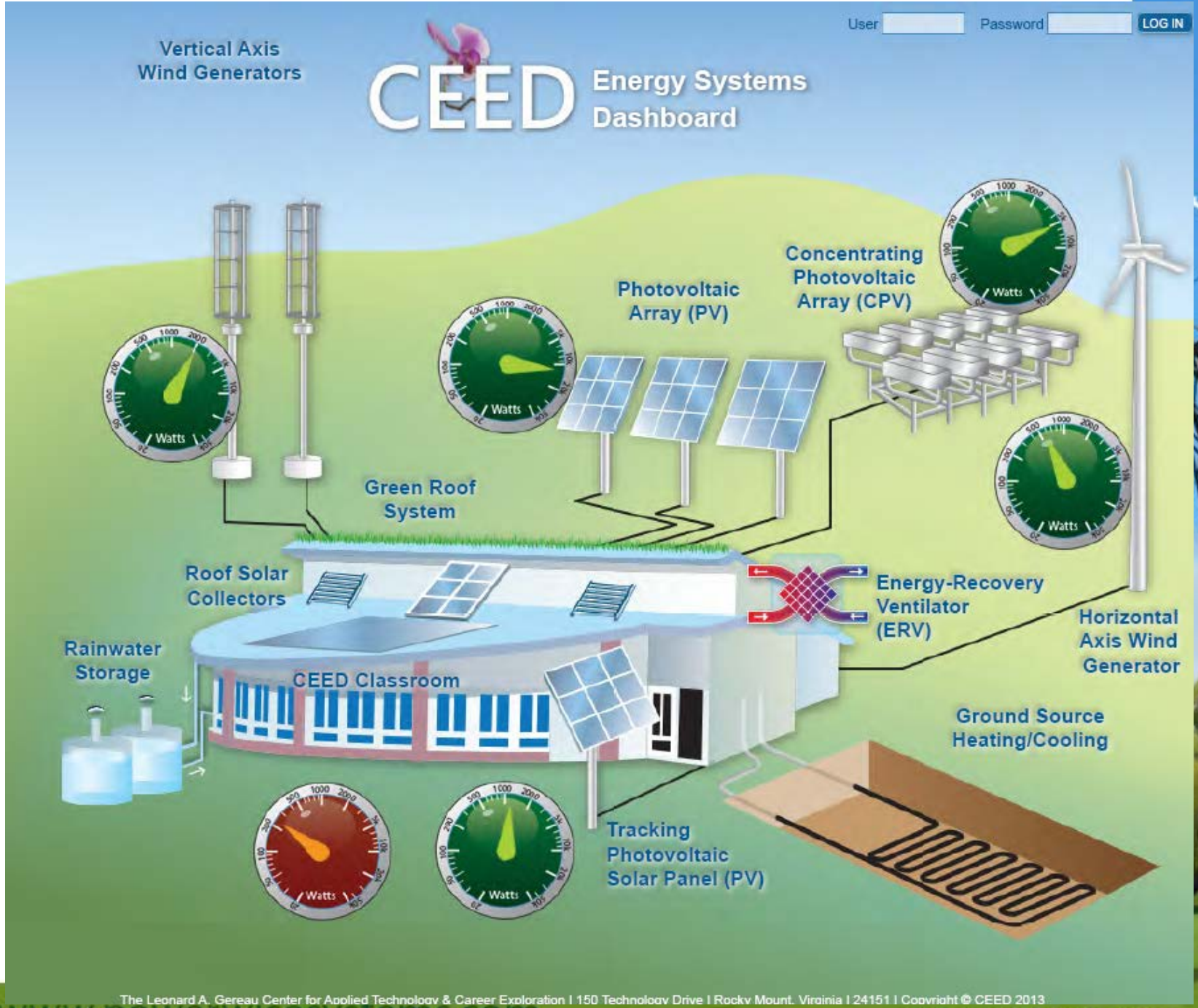
- **PowerWise Local Weather data- Via professional grade weather stations**
  - Wireless sensor assembly, Wind speed & direction, RH, Temp, Rainfall, Barometric pressure.
  - Accurate real-time weather data from a professional grade weather station by RainWise - the preferred station by Weather Underground and the Weather Channel
  - If no weather station is supplied PowerWise can supply weather data from Weather Underground.

RainWise® Inc.

WEATHER UNDERGROUND

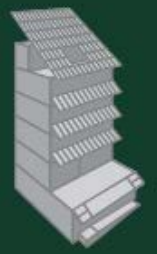
The Weather Channel
weather.com

Custom Dashboard Portal design



Custom Dashboard Portal design

Building



2A | 2B | 3A | 3B | 4A | 4B

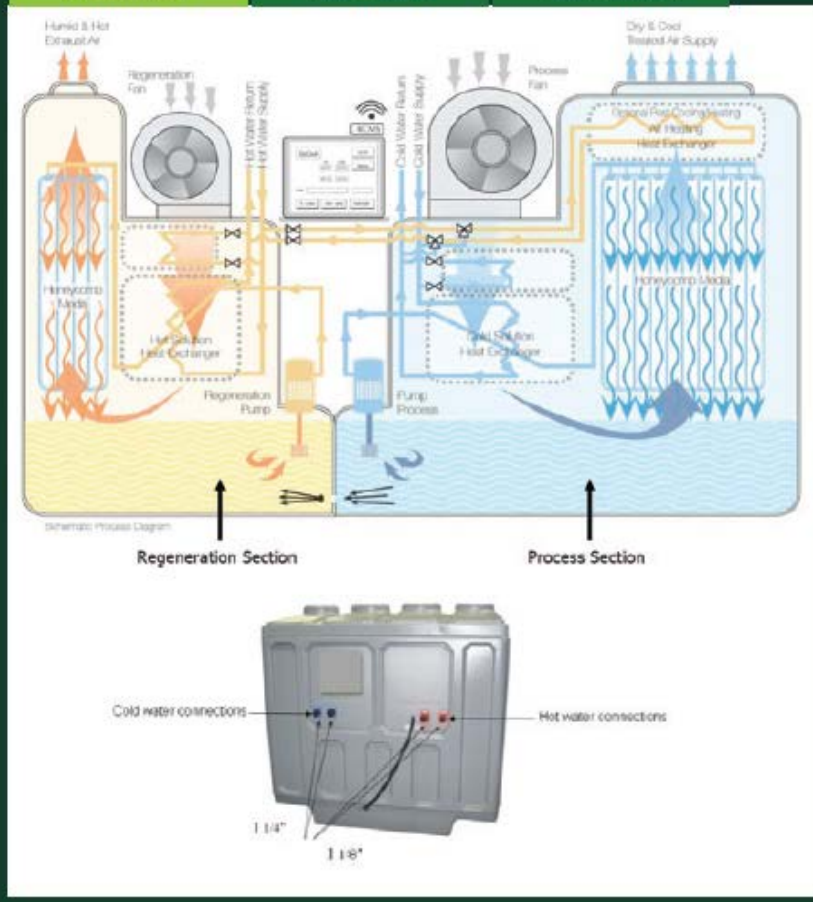
Solar PV Production | **Advantix** Ventilation/Geo Tube/Liquid Desiccant Unit | Solar Hot Water Thermal | Geothermal HVAC/ Indoor Air Quality | Grey/Storm Water Reuse

Advantix

View History

Geotube CFM	248CFM
Geotube Temp in	87° F
Geotube Temp out	54° F
Advantix Processing Chamber – Supply to Risers: Temp/CFM/RH	64° F/14 CFM/ 87% RH
Advantix Regen Chamber Exhaust Air into chamber: Temp/CFM/RH & Out to discharge Temp/RH	64° F/14 CFMM/ 87% RH
Advantix Cold Water Usage in & Out: Gal/Temp	64° IN/ 73°F OUT
Advantix Hot Water Usage In & Out: Gal/Temp	98° IN/ 122°F OUT
Air Pressure Sensors readings in both Supply Risers	18.6 PSI Riser 1 19.4 PSI Riser 2

Advantix 1 | Advantix 2 | Advantix 3

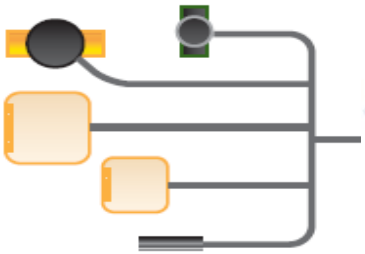


Future Monitoring & Control features

- Alert functions for all parameters
  - Temperature deviation
  - RH, CO2, VOC levels
- Deeper integration with ERV/HRV systems
- Add additional control features
  - ASHP Mini-Split
  - Lighting
  - Outlets
  - Blinds

Monitoring & Control possibilities beyond electricity

Near future announcements

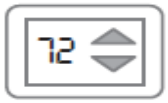


inSense™
Sensor Network
1-Wire • Analog
Pulse • Digital
RS485 Modbus
RS232 Serial

inDAC™
Data Acquisition
& Control

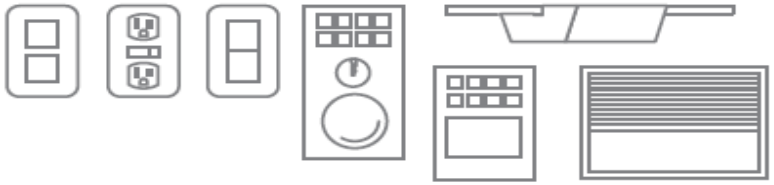
PowerWise
inServe™ Server with
Advanced Analytics

inSense™
Wireless Sensors
& Controls



Wide Range
of Smart Wireless
Thermostats

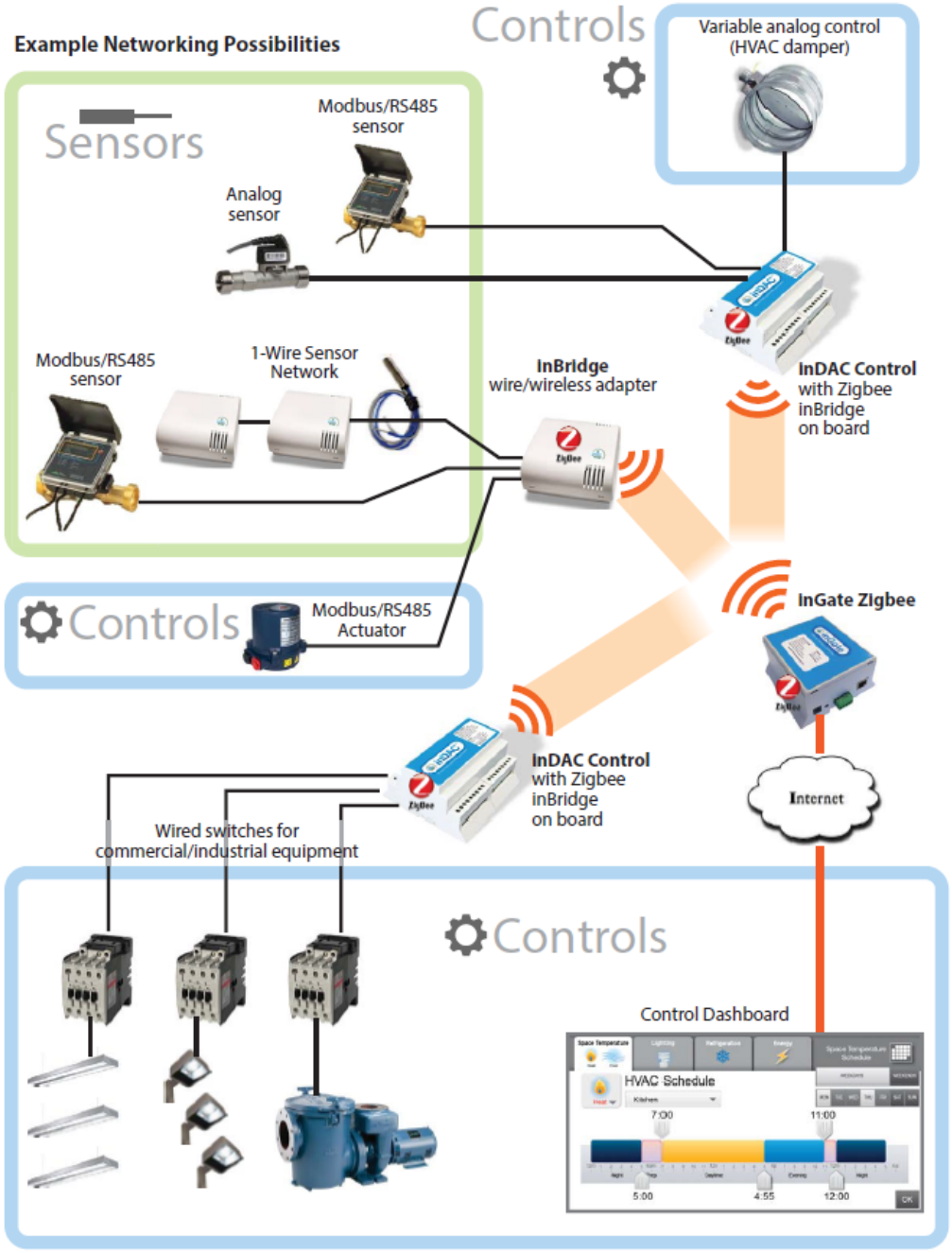
inControl™ Wireless Smart Devices



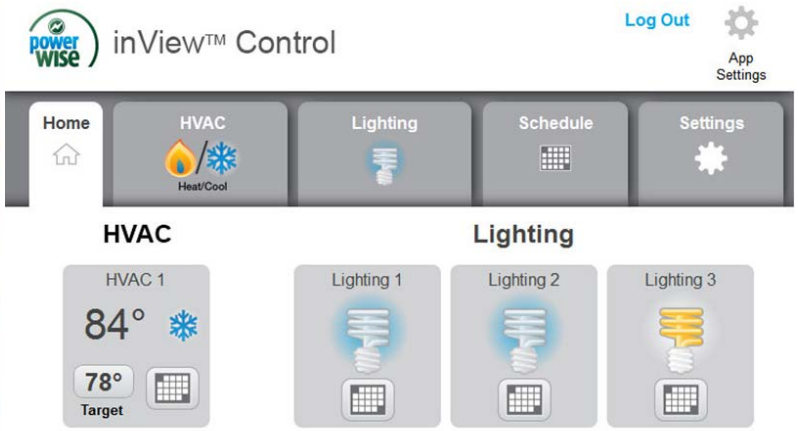
Lighting & Fan Switches, Smart Outlets, Lighting
Dimmers, Door Locks, Garage Door Openers,
Motion Sensors, Shade Controls

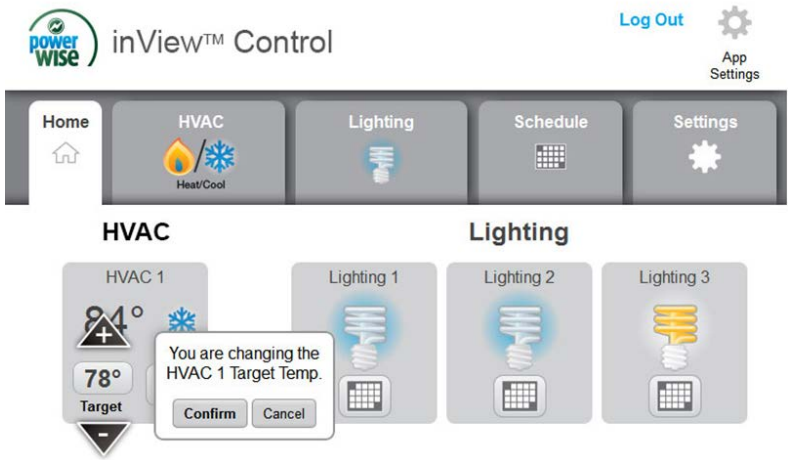
Mini-Split HVAC control (coming soon)

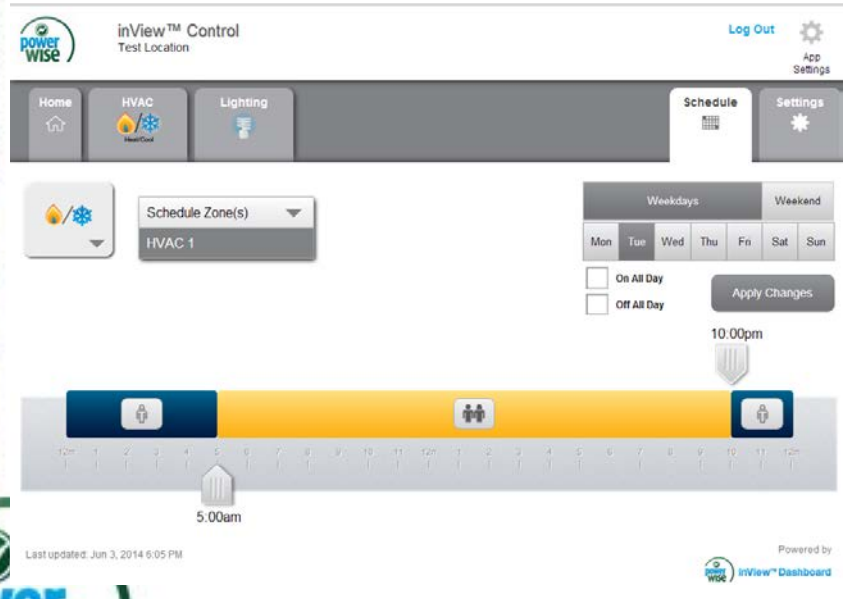
Example Networking Possibilities

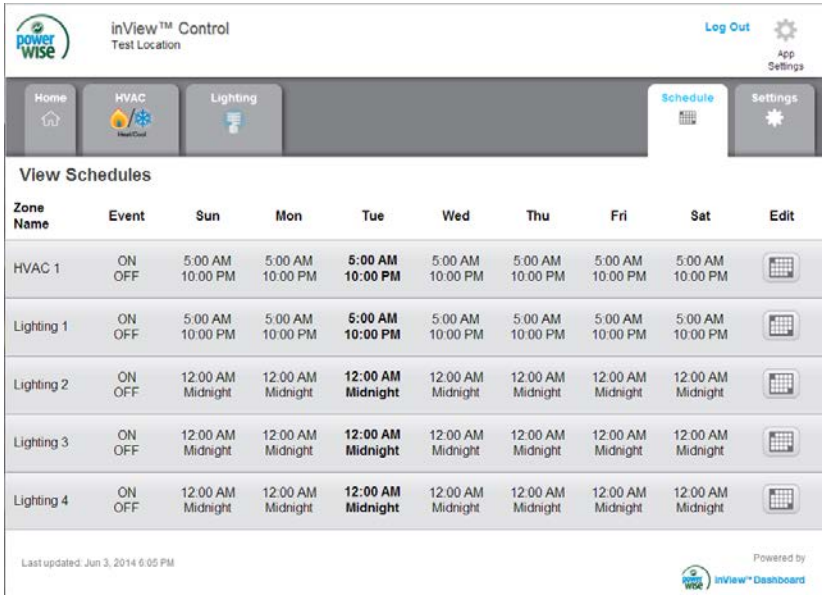


Monitoring & Control possibilities beyond electricity
Near future announcements









Thank you

For additional information please contact
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