

# Emerging Technologies

October 16, 2014  
Oregon Utility Roundtable

Jennifer Williamson  
Employee of VanderHouwen, on assignment at BPA

# Agenda

- Two Focus Areas
  - Compressor technologies
  - Smart, connected devices
- DSM meets T&D
- E3TNW.org

# HEAT PUMPS

# Variable Capacity Heat Pumps

## Ductless Heat Pumps



## Residential Variable Capacity Heat Pump



## Advanced Rooftop Unit



## VRF Systems



## CO2 Heat Pump Water Heater

# Heat Pump Technology

Japan  
Experience

Next  
Generation  
HP

Refrigerants

Load Based  
testing

Power Quality  
Assessments  
of HVAC

# Next Generation Heat Pump

## *An EPRI Technology Innovation Breakthrough Project*

### Primary Ongoing Tasks

- Specifications Development
- Technical Development
- Market Development



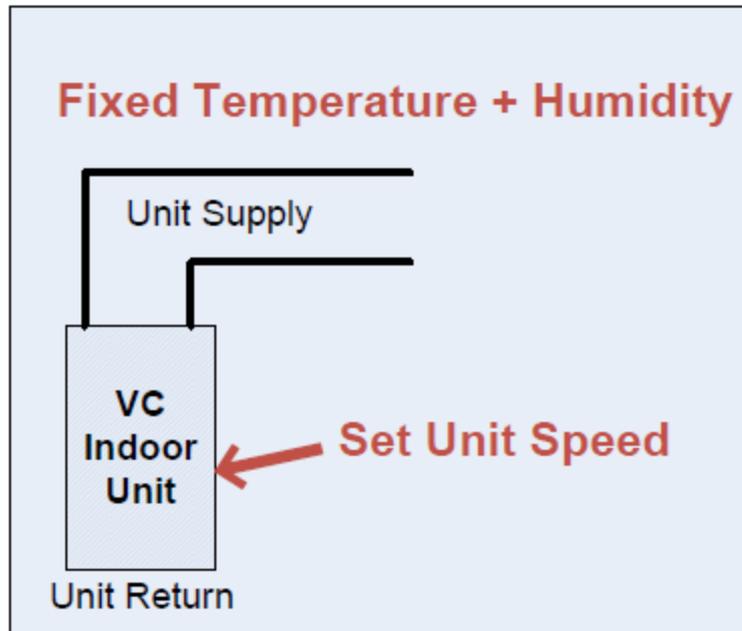
# Products Jack Callahan is Watching, Based on Japan Tour with 4 Mfrs

1. Sanden Eco Cute CO2 residential split-system HPWH
2. Residential forced air inverter heat pump (Daikin/Goodman)
3. Commercial/Industrial Eco Cute (air-to-air, and water-to-water)
4. Mitsubishi Hyper Heat (100% Capacity 5 degrees F)
5. Packaged Ammonia/CO2 Supermarket Refrigeration
6. Hybrid VRF / water loop fan coil
7. CO2 refrigerant grocery display case
8. Residential DHW / DHP combo unit
9. Ammonia Heat Pump for commercial applications



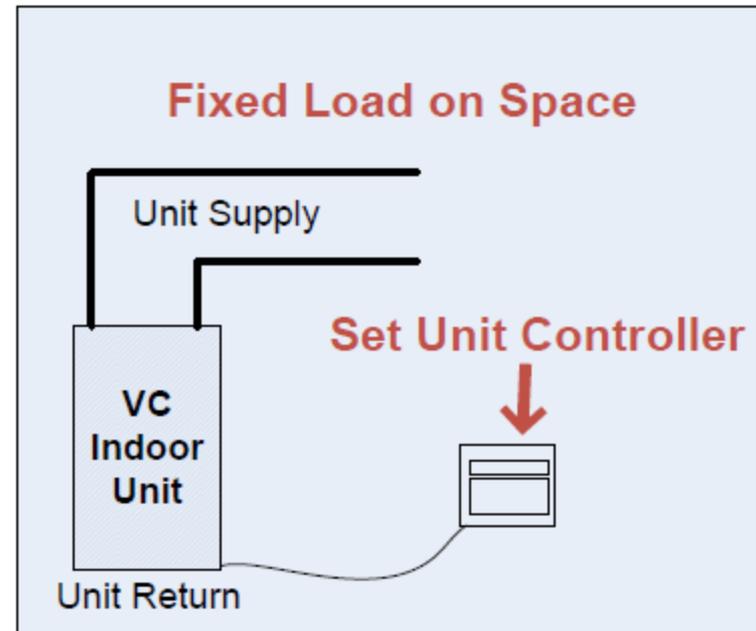
# Steady-State vs. Load Based Evaluations

## Steady-state Testing



**\*Unit Operation is Fixed/Set**

## Load-Based Testing



**\*Dynamic Unit Operation**

# Natural Refrigerants

- EPA Proposed Rulemaking in Aug 2014 would ban common refrigerants soon
- EPRI is working to make sure replacement refrigerants are chosen for energy efficiency AND GWP

## What is a refrigerant?

Refrigerants are everywhere...



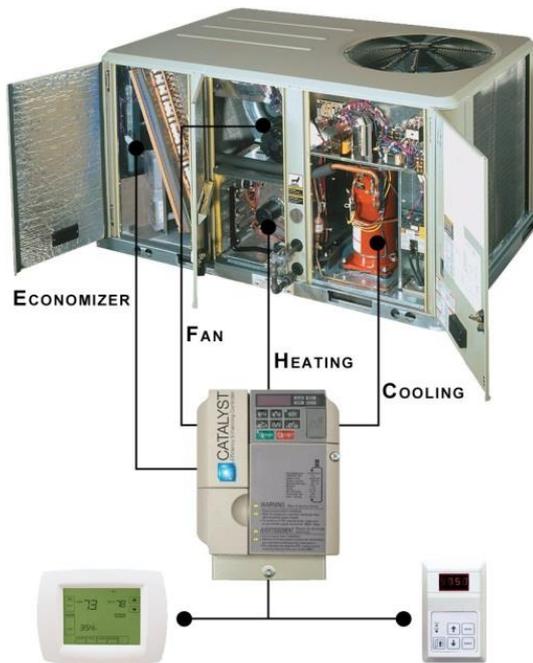
EPRI | ELECTRIC POWER RESEARCH INSTITUTE

## Why Should Utilities Be Interested?

- Legislation pushing new technology
  - Changes are coming – starting in refrigeration, moving elsewhere
  - Only a few options will save energy, reduce demand
- Helping customers understand their choices
  - Some national supermarket chains are already looking into low- or zero-GWP technologies
- Environmental concerns
  - Atmospheric impact in some applications doubled by refrigerant leaks

# Energy Management: *Smart Connected Devices*

- Low cost, high resolution, real-time, large scale performance data.
- Feedback used by manufacturers and providers for performance improvements.



EXISTING THERMOSTAT OR BMS CONTROLLER  
Photo courtesy of Catalyst



Photo courtesy of Digital Lumens

# Smart Connected Devices

Uses of AMI  
Data

Thermostats  
and RTU  
Controllers

LEDs and  
Advanced  
Controls

Non-Intrusive  
Load Monitoring

Online access  
to field research  
results

# The Big Picture

Select Date: from: 01/29/2014 15 to: 01/30/2014 15



NZE Home

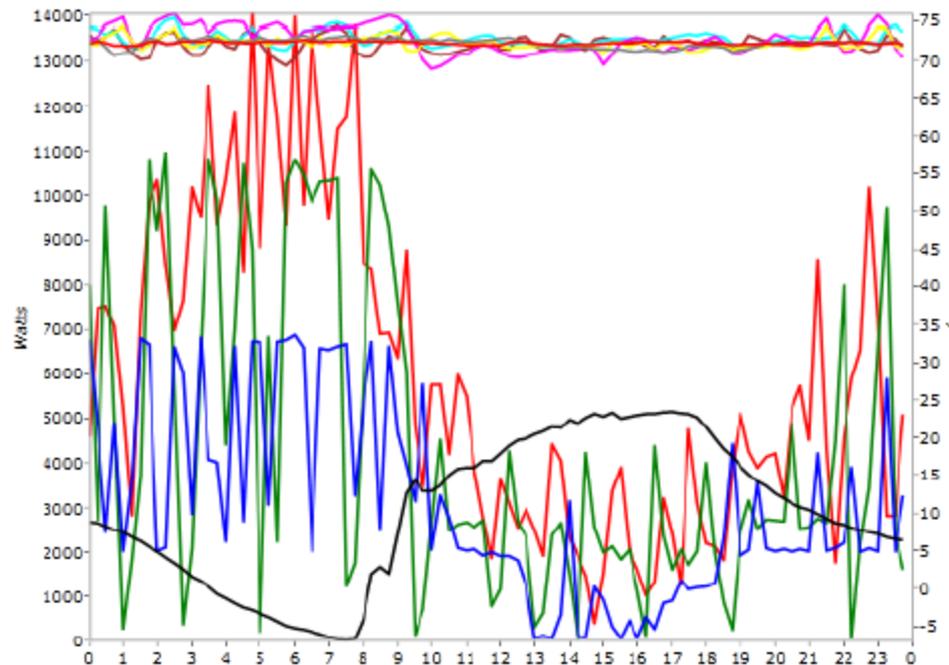
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Full Screen

Summary Home Performance

Detailed Home Performance

- Builder Home - HVAC (Watts)
- Efficient Home - HVAC (Watts)
- NZE Home - HVAC (Watts)
- Builder Home - Temp, Outdoor (F)
- Efficient Home - Temp, Downstairs (F)
- Efficient Home - Temp, Upstairs (F)
- Builder Home - Temp, Downstairs (F)
- Builder Home - Temp, Upstairs (F)
- NZE Home - Temp, Downstairs (F)
- NZE Home - Temp, Upstairs (F)



Energy, Primary (11 items)

- Home
- HVAC
- PV
- Water Heater
- Dryer
- Washer
- Dishwasher
- Refrigerator
- Range
- Outdoor Plugs
- TV

Temperature and Humidity (6 items)

- Temp, Upstairs
- Temp, Downstairs
- Temp, Attic
- RH, Upstairs
- RH, Downstairs
- RH, Attic

Weather (5 items)

- Temp, Outdoor
- RH, Outdoor
- Wind, Outdoor
- Solar Incidence
- Rain

Energy, Secondary (9 items)

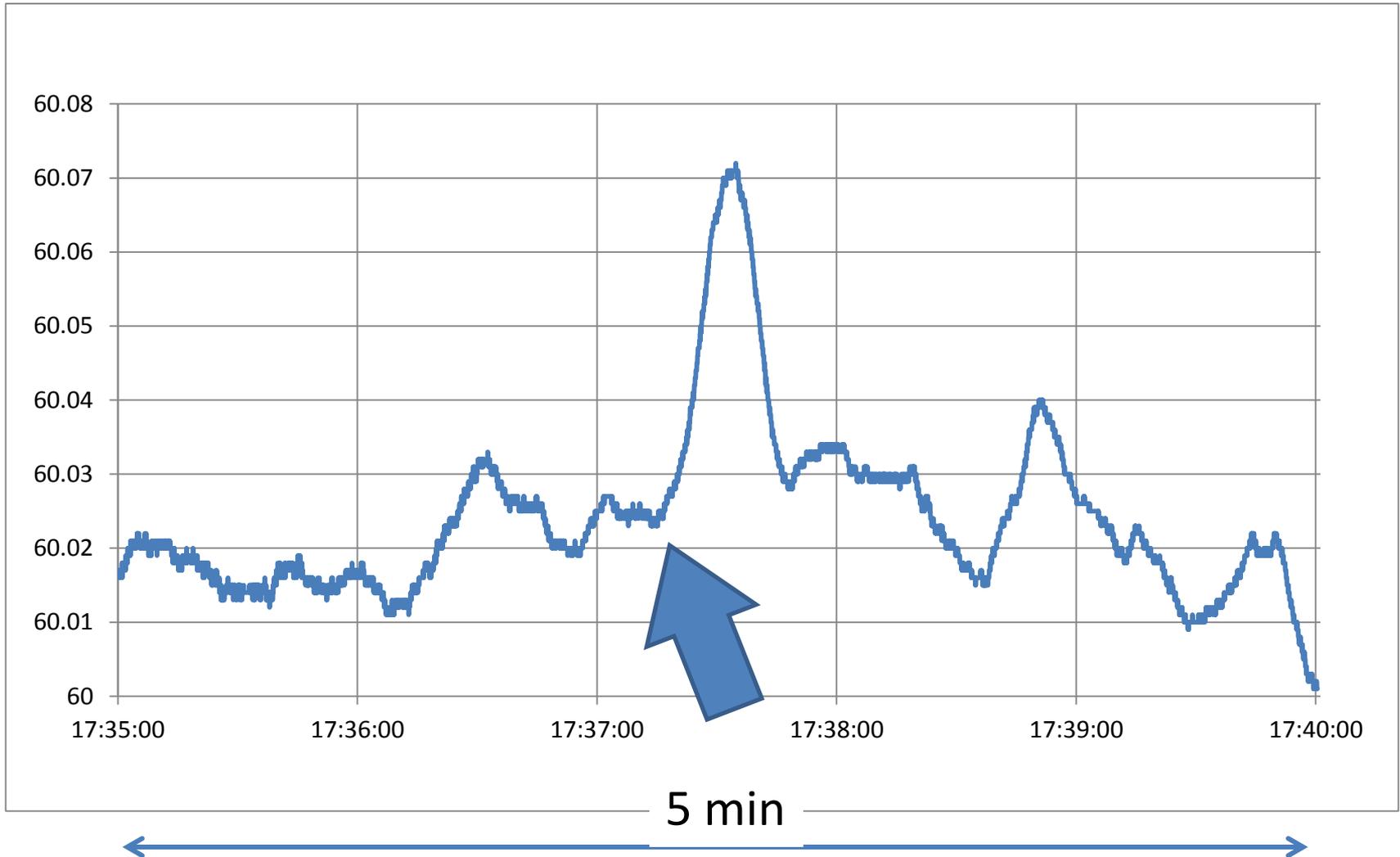
- Bathrooms
- Fresh Air System
- HP Outdoor, Down
- HP Indoor, Down

# Other orgs and other technologies

- Kiosks
- Data Centers
- Home audio devices
- Induction Cooking
- Power factor correction
- Adjustable speed drives
- TVs, Appliances, Streaming Media
- Design of retail buildings
- DC power for data centers and homes
- Dryers
- Aerators
- Engine generator block heaters
- Secondary glazing for commercial
- Drive/Motor/pump or fan packages
- .....

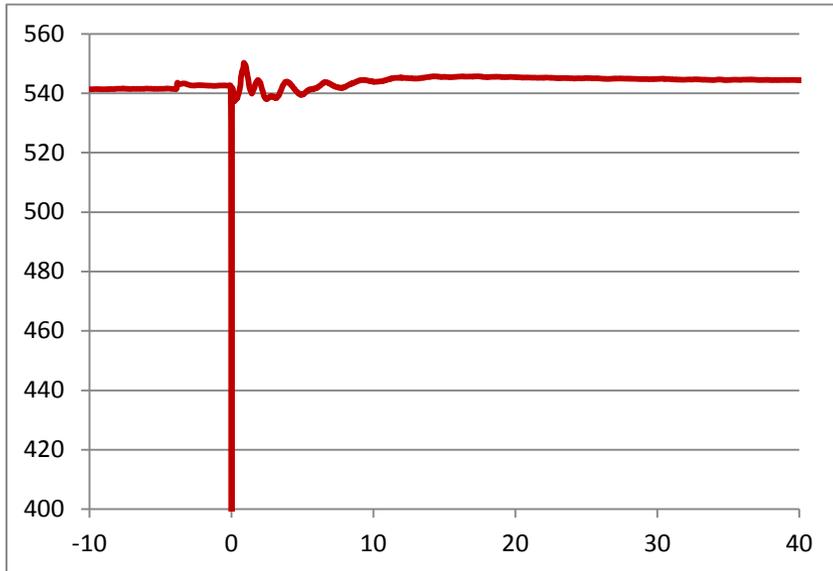
# DEMAND SIDE IMPACTS ON THE GRID (EE'S IMPACT ON EE<sub>s</sub>)

# System Frequency during XLVII Super Bowl

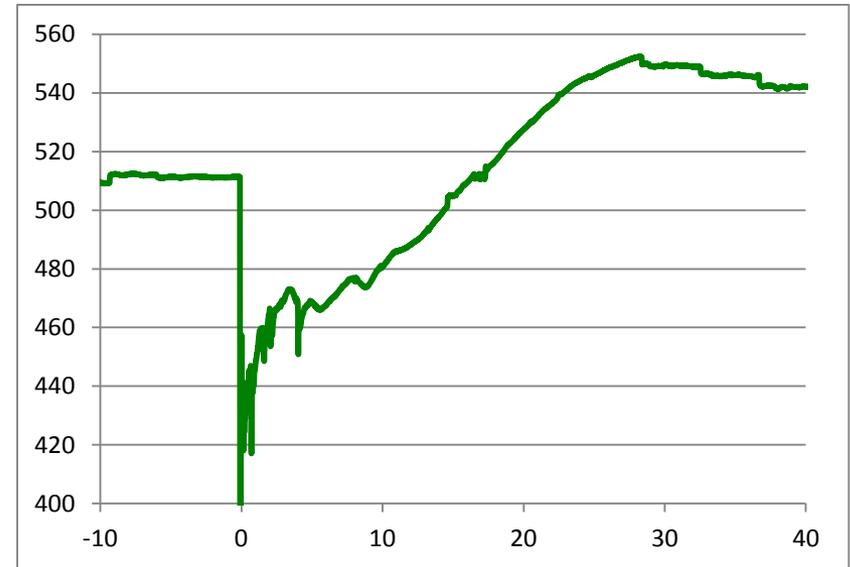


# Changing Nature of Electrical Loads

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Transmission voltage during a fault in an area with mainly resistive loads



Transmission voltage during a fault in an area with high amount of residential air-conditioning load

### Emerging Technologies Showcase (#28): Energy Efficient Block Heaters

Wednesday, October 15, 2014 at 12:00 PM Pacific Time

A BPA Qualified product, energy efficient block heaters for stationary engine generators reduce energy use while still keeping generators ready to operate immediately.

[Click here to register!](#)

### Emerging Technologies Showcase (#27): CEA-2045 Standard for Demand Response

Tuesday, September 23, 2014

ANSI/CEA-2045 is a new standard for a modular communications interface (MCI) that makes appliances smart grid-ready by enabling any product to connect to any type of demand response system.



# E3TNW.org

Jennifer Williamson

Employee of VanderHouwen, on assignment at BPA

Phone 503-230-4536

Email [jcwilliamson@bpa.gov](mailto:jcwilliamson@bpa.gov)

Jack Callahan

BPA

Phone 503-230-4496

Email [jmcallahan@bpa.gov](mailto:jmcallahan@bpa.gov)