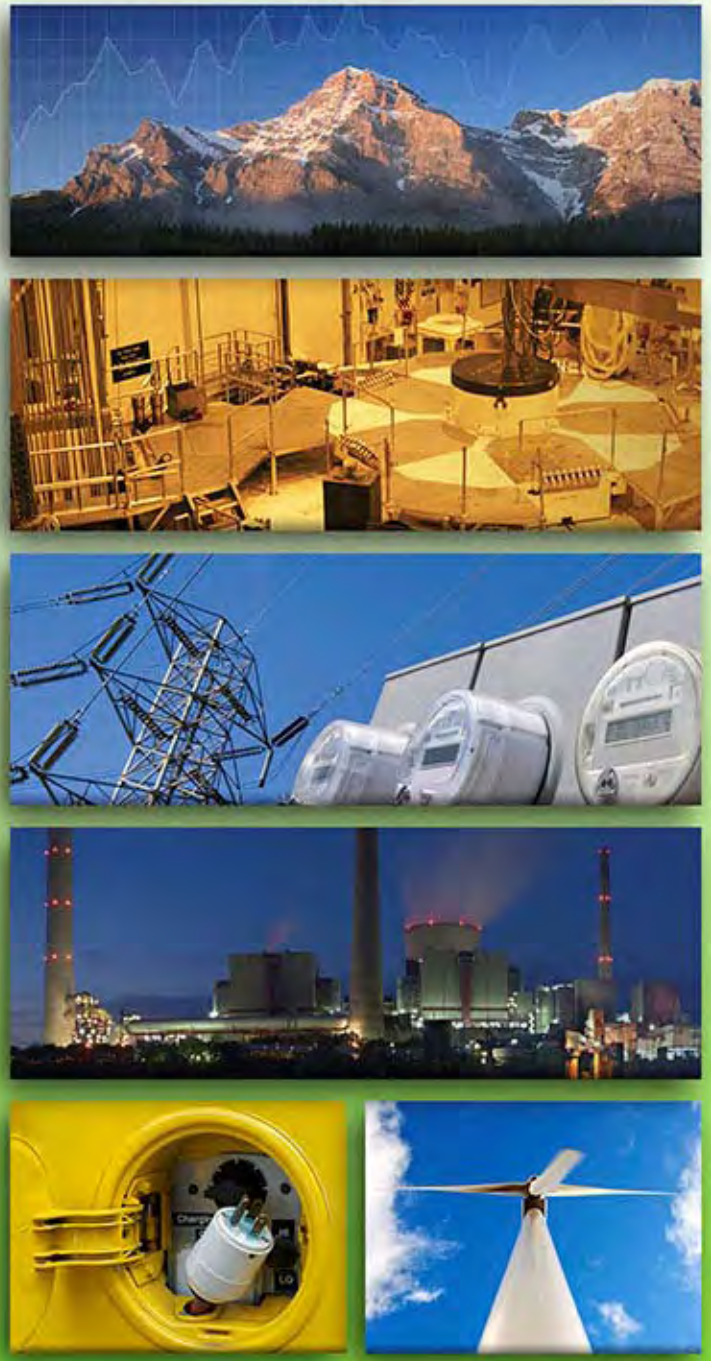

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Emerging Technologies in Energy Efficiency

Omar Siddiqui
Program Manager

Utility Energy Forum
Tahoe City, California

May 7, 2010

EPRI End-Use Energy Efficiency Program

Advancing EE & DR as Reliable Resources

Infuse technology pipeline for EE/DR programs through testing & demonstration

Lead efficiency development in electronics and “infotainment” technology

Advance technology to enable automated, ubiquitous DR

Provide analytical frameworks on EE/DR

- Potential magnitude
- Environmental impact (CO_2)
- Valuation/economic impact
- Measurement & verification
- Feedback and behavior effects

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EPRI RD&D is helping accelerate emerging smart and efficient technologies into utility energy efficiency programs

Clear performance metrics

Performance validation
(testing, field demos, pilots)

- Energy savings
- Durability, reliability, compatibility
- Cost, ROI
- Customer satisfaction

Deemed savings

- Region/segment-specific
- Persistence/lifetime

Risk Mitigation

Regulatory Approval

Utility EE Programs

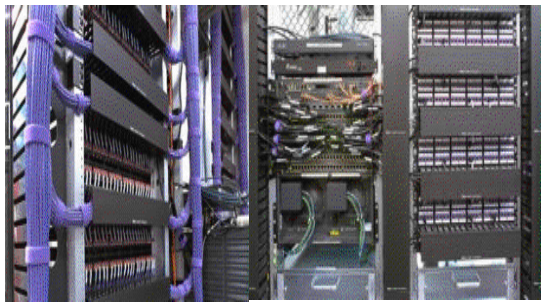
EPRI RD&D

Emerging Technology

EPRI liaising with DOE and numerous industry groups to advance energy-efficient technologies

EPRI field demonstrations of six categories of "hyper-efficient" technologies to fundamentally change energy usage in U.S. buildings and homes

Variable-Refrigerant-Flow Air Conditioning



Efficient Data Centers

LED Street & Area Lighting

Heat-Pump Water Heaters

Ductless, Residential Heat-Pumps and Air-Conditioners

Hyper-Efficient Appliances

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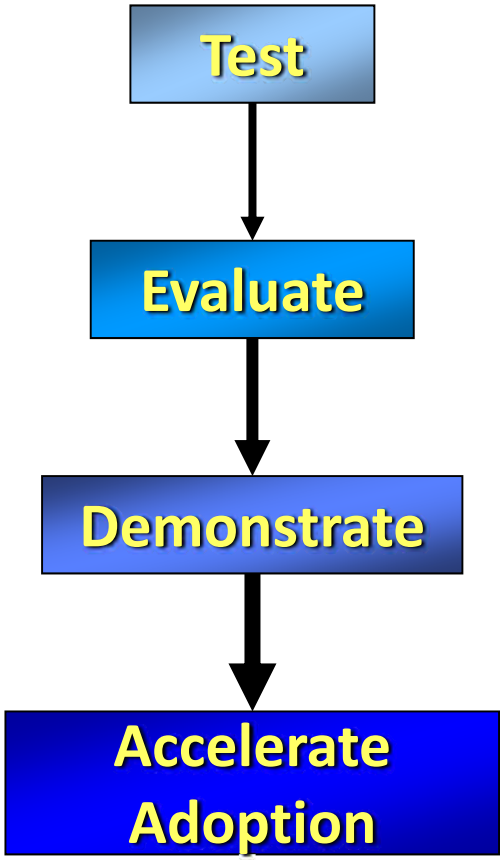
Demo is answering fundamental questions to accelerate adoption of efficient technologies into programs



How do these technologies perform?

What level of energy savings?

What about diversity factors?

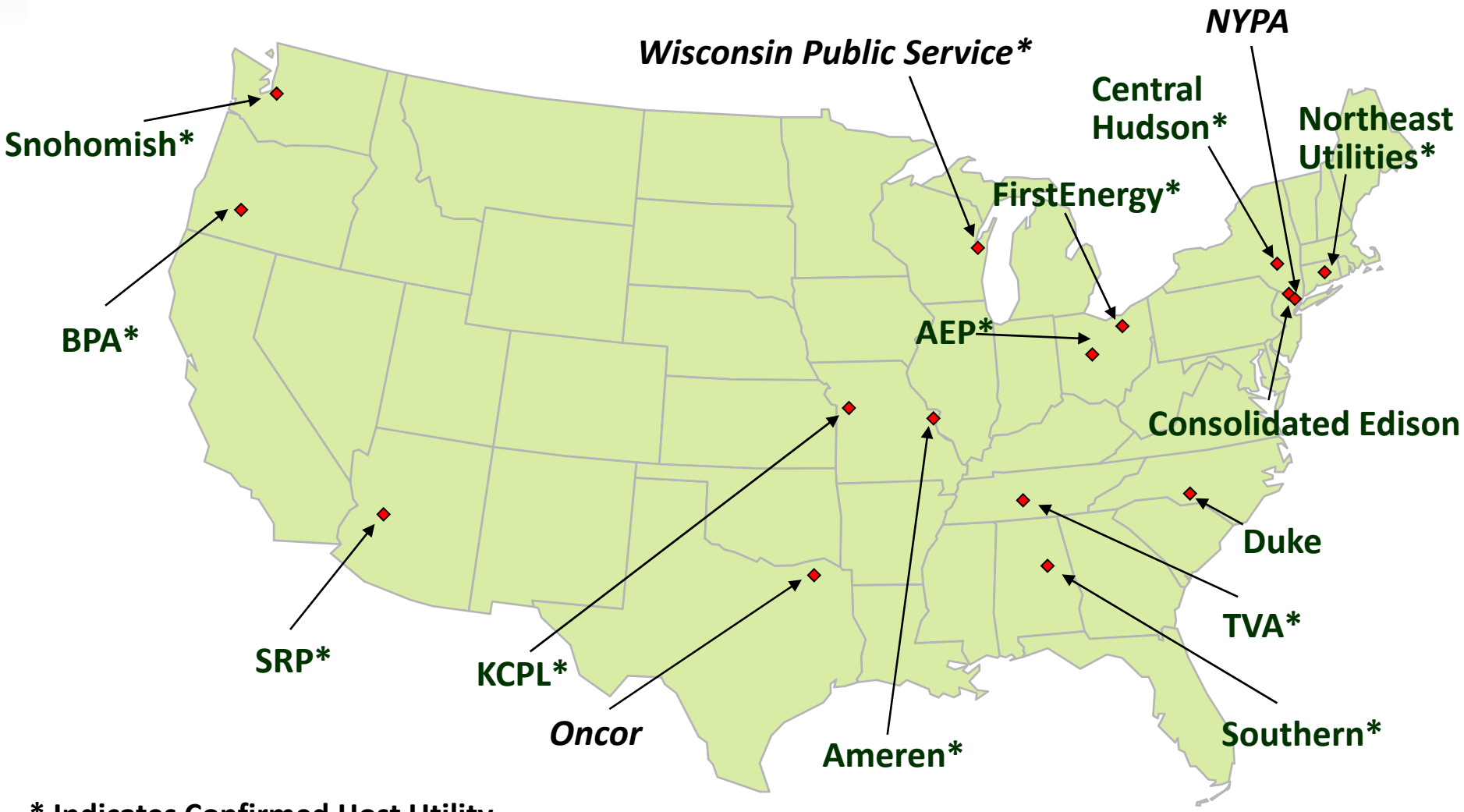
- manufacturer, climate, electric rates, building design and construction, etc.

Are they compatible with building designs and various codes and standards?

Are there differences in quality and other effects compared to traditional technologies?

What are the technical and market obstacles and how do they impede adoption?

Committed Collaborators



* Indicates Confirmed Host Utility

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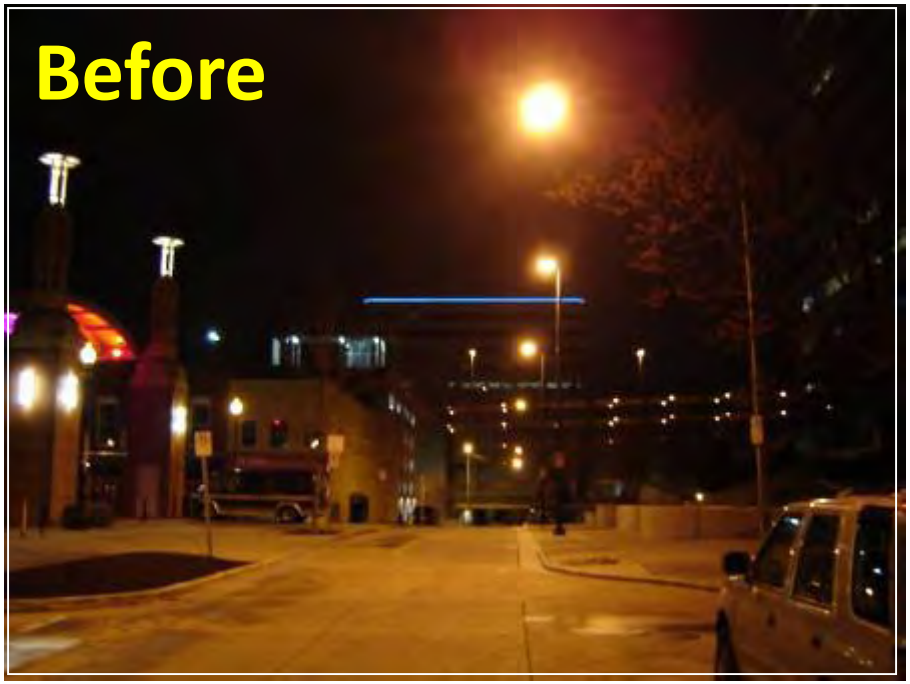
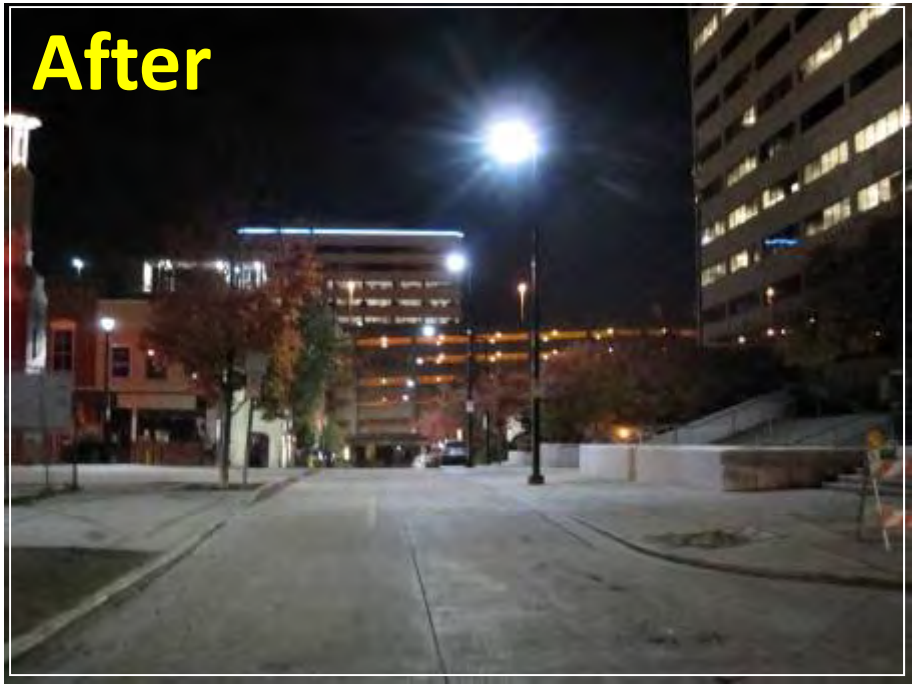
LED Street & Area Lights Installation

TVA Hosted Location, Knoxville, TN





310 W (each),
High Pressure Sodium (HPS)

94 Watt (each),
Light Emitting Diode (LED)

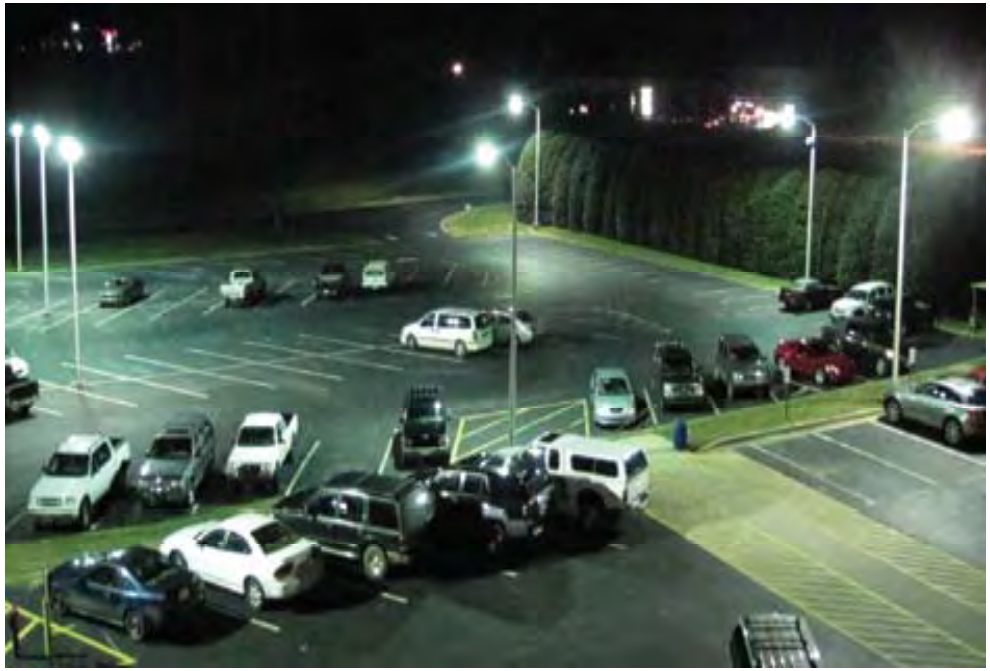
TVA project: Wall Ave., Knoxville, TN

LED Street & Area Lights Installation

Southern Company (Georgia Power – Cornelia, GA)

Replacement of metal halides with LEDs at parking lot in Cornelia, Georgia has yielded 50% energy savings and improved light quality

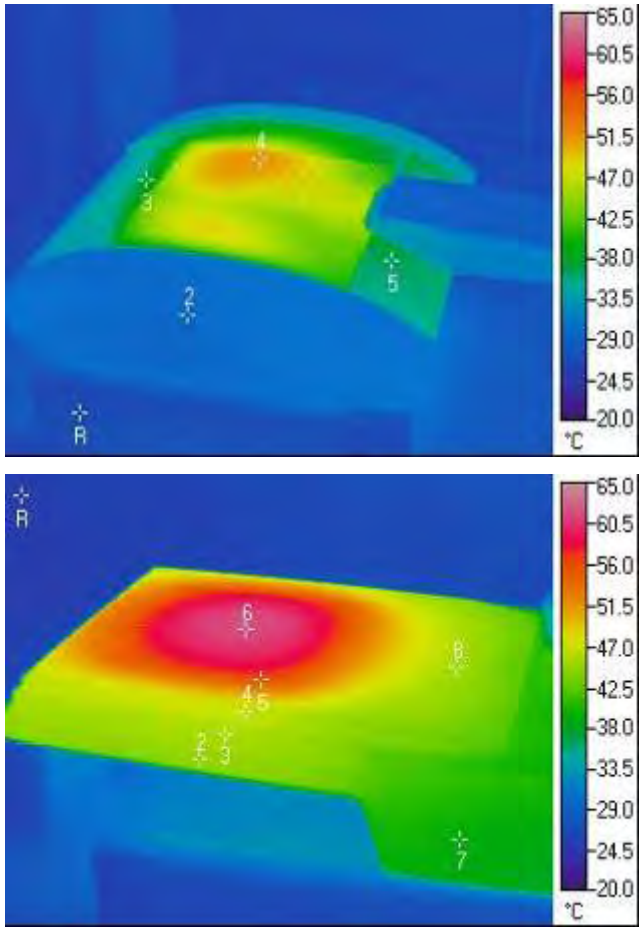
Before (Metal Halide)



After (LED)

Lab testing has revealed manufacturing defects in some LED Fixtures

Thermal Imaging Profiles Reveal Potential Overheating Problems



Root Cause Determination of Transistor Damage

Air Pocket in Potting Material Led to Overheating and Failure of LED Ballast

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Installations: VRF* Air Conditioners

Southern Company – Mobile, Alabama

Before

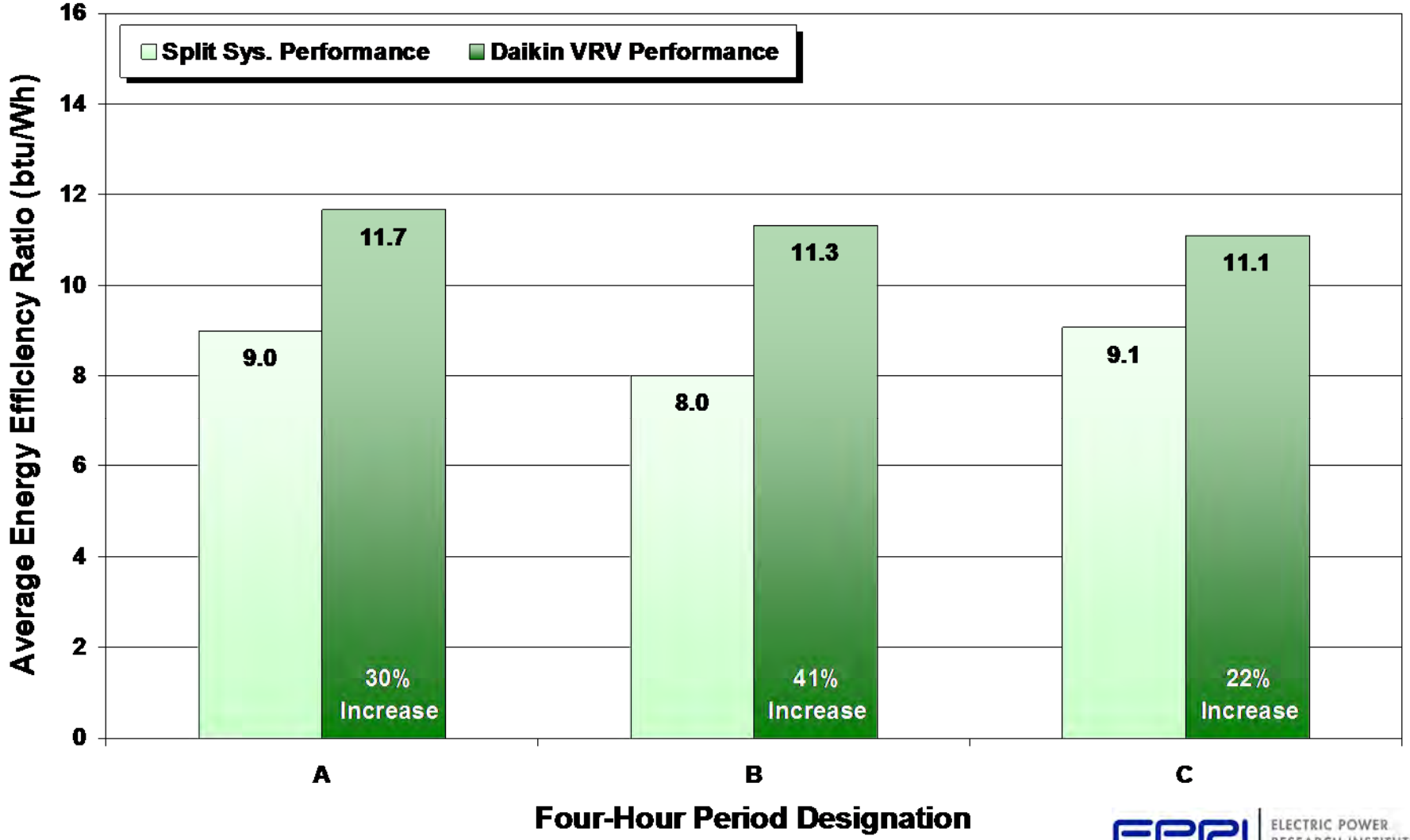
After

- Monitoring performance and measuring savings (40% savings potential)
- 31% reduction in February 2010 energy use (heating mode)
- Two Southeast sites plus two in Pacific NW providing valuable mix of cooling and heating field data in two diverse climate regions
- EPRI established expertise in VRF performance measurement & verification

*VRF – Variable Refrigerant Flow

2009 Lab Test Results: VRF 20 – 40% more Efficient than Conventional Split System AC

Variable Refrigerant Flow AC Testing Results: Daikin VRV



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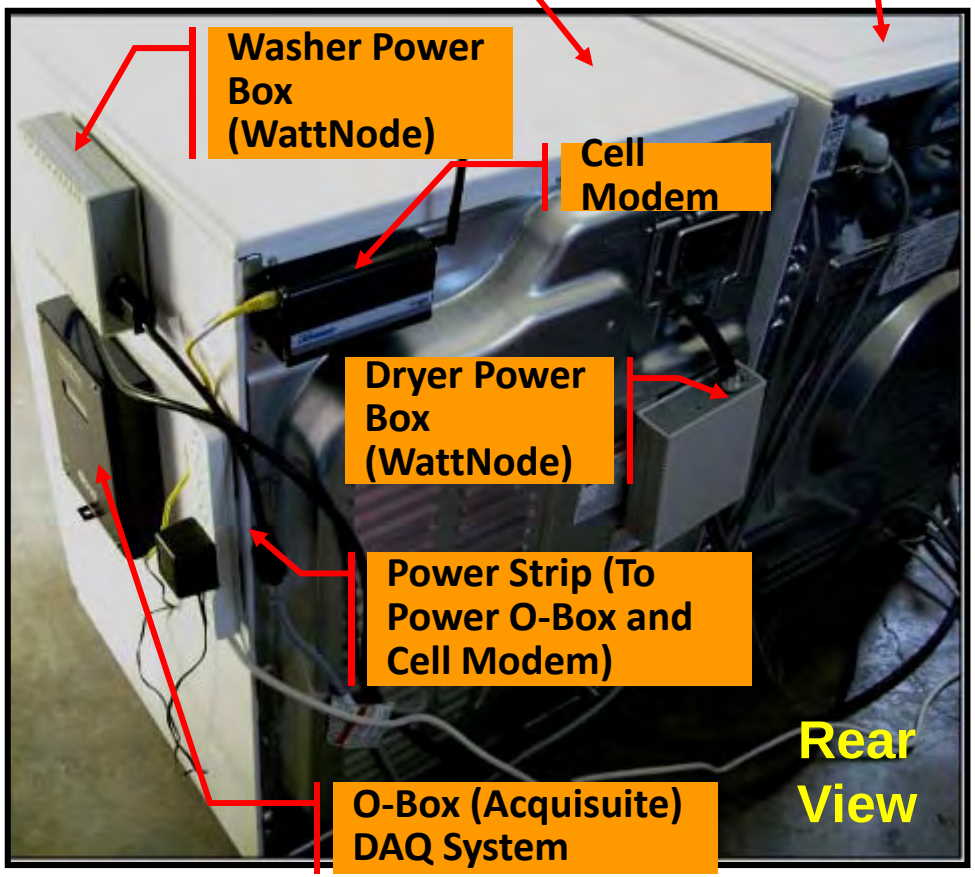
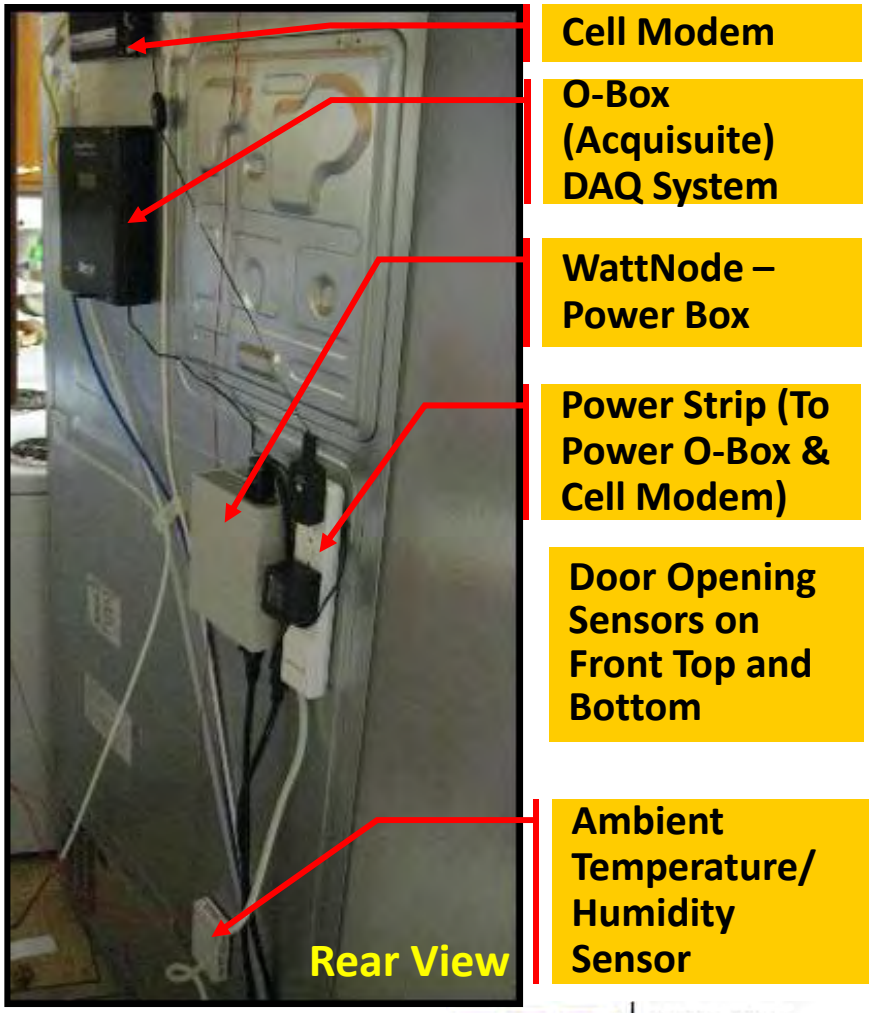
Demonstrating innovative high-efficiency refrigerators, washers, and dryers

Robust Instrumentation





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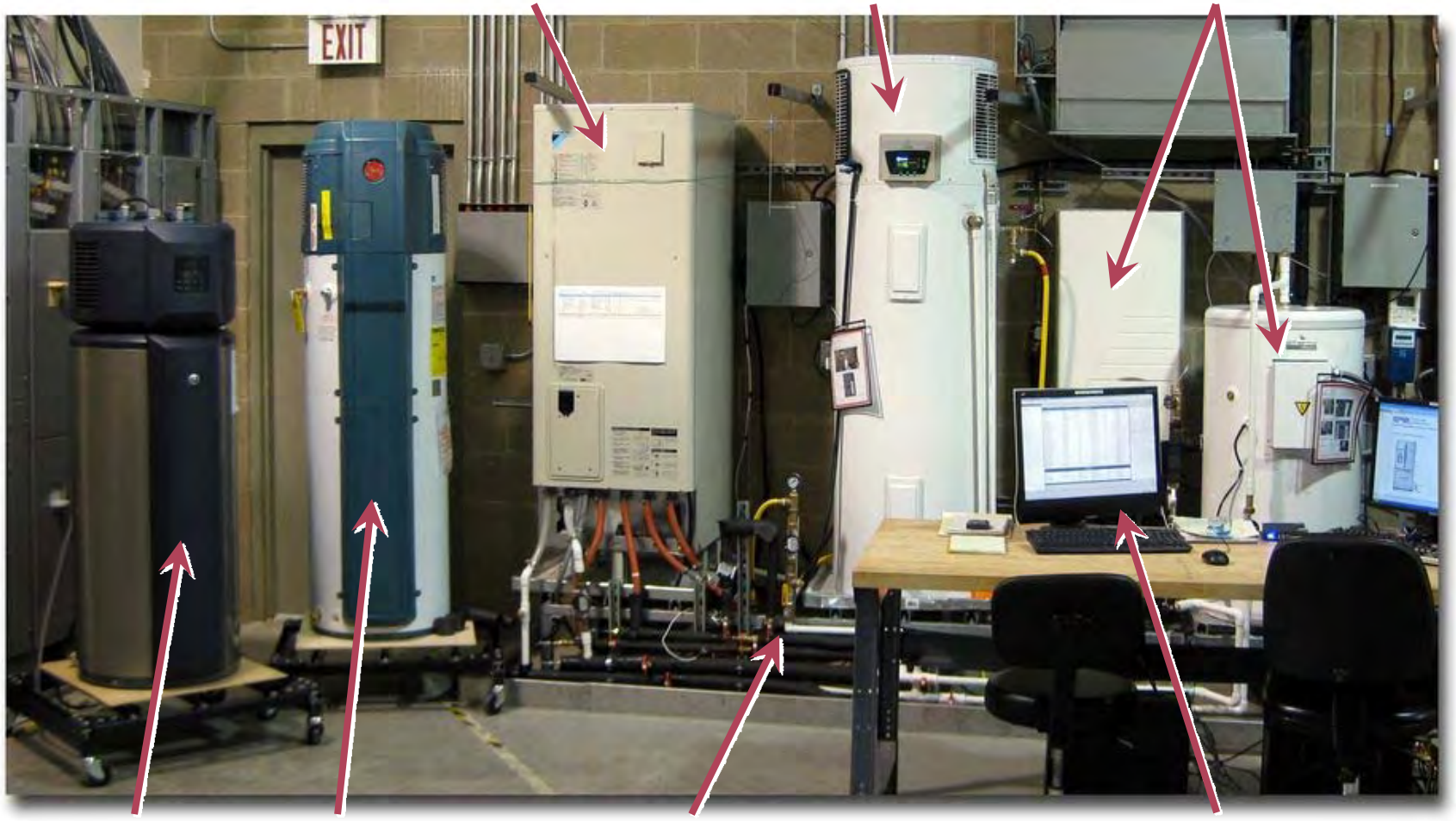
Heat Pump Water Heater – Family Portrait



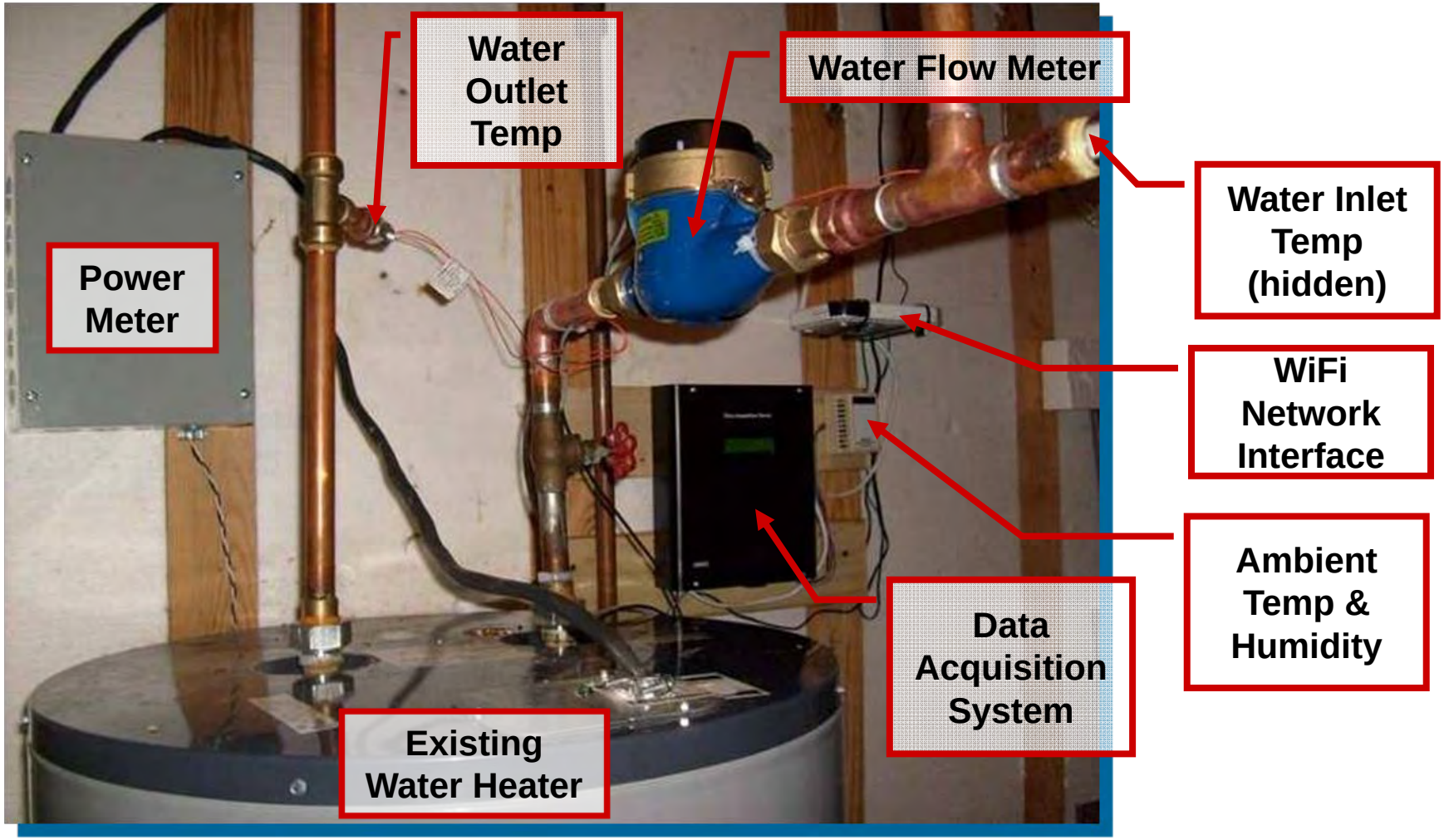
Installations: Heat Pump Water Heater

Southern Company – Birmingham, Alabama

HPWH – Heat Pump Water Heater

- Winter Coefficient of Performance (COP) of ~ 1.5 observed at Birmingham site; over 50% more efficient than current electric resistance water heaters
- Summer COP expected to be significantly higher
- Manufacturers claim annual COP of >2.0; i.e. at least twice as efficient as current electric water heaters
- Shipped 40 units with instrumentation packages to-date

Heat Pump Water Heater (HPWH) Test Instrumentation

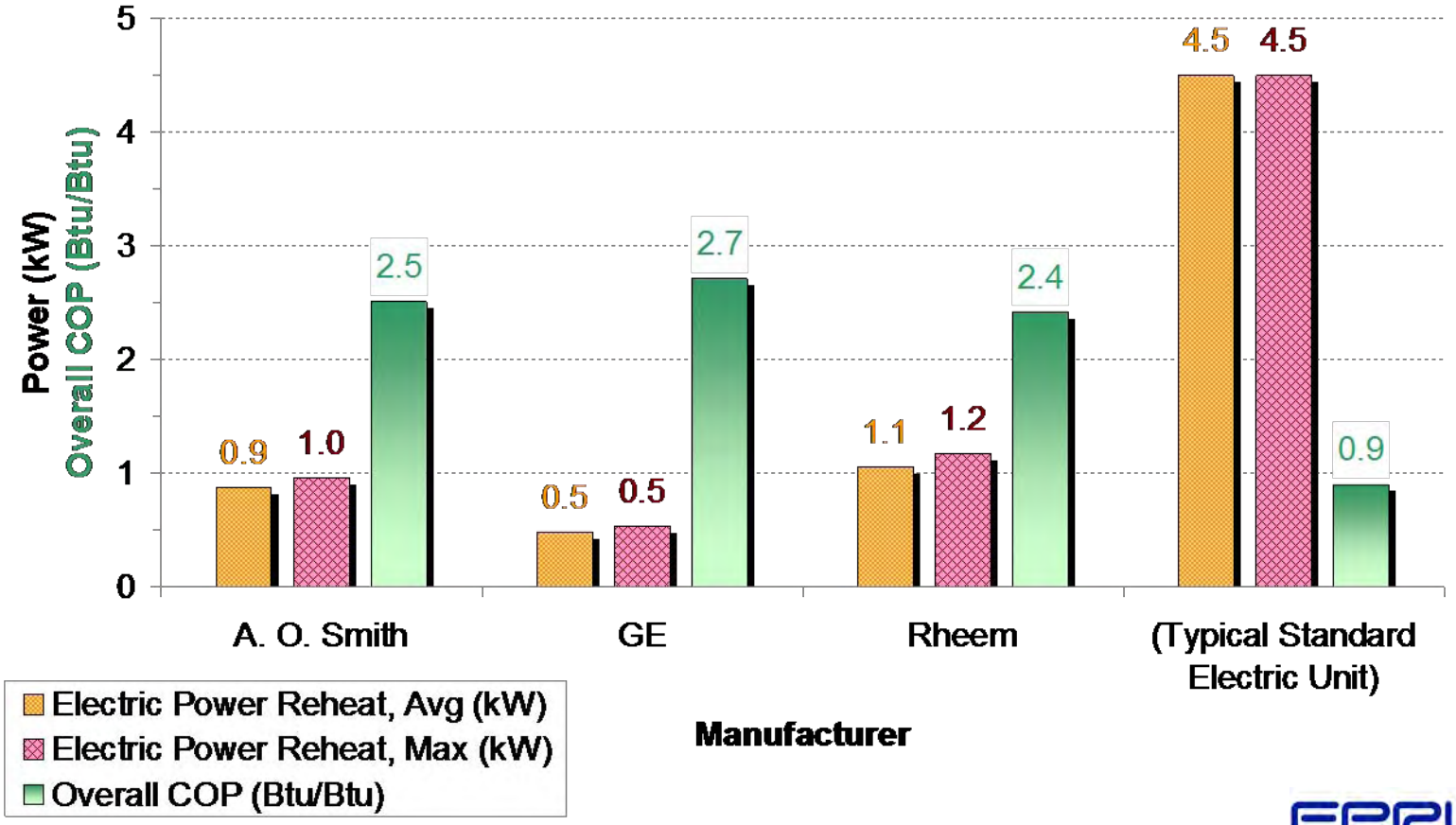


2009 HPWH Test: 3x Efficiency Improvement; Power Draw Reduced ~ 75-85%

Six hourly draws, 10.7 gal each at 3 gpm, then standby for 18 hours

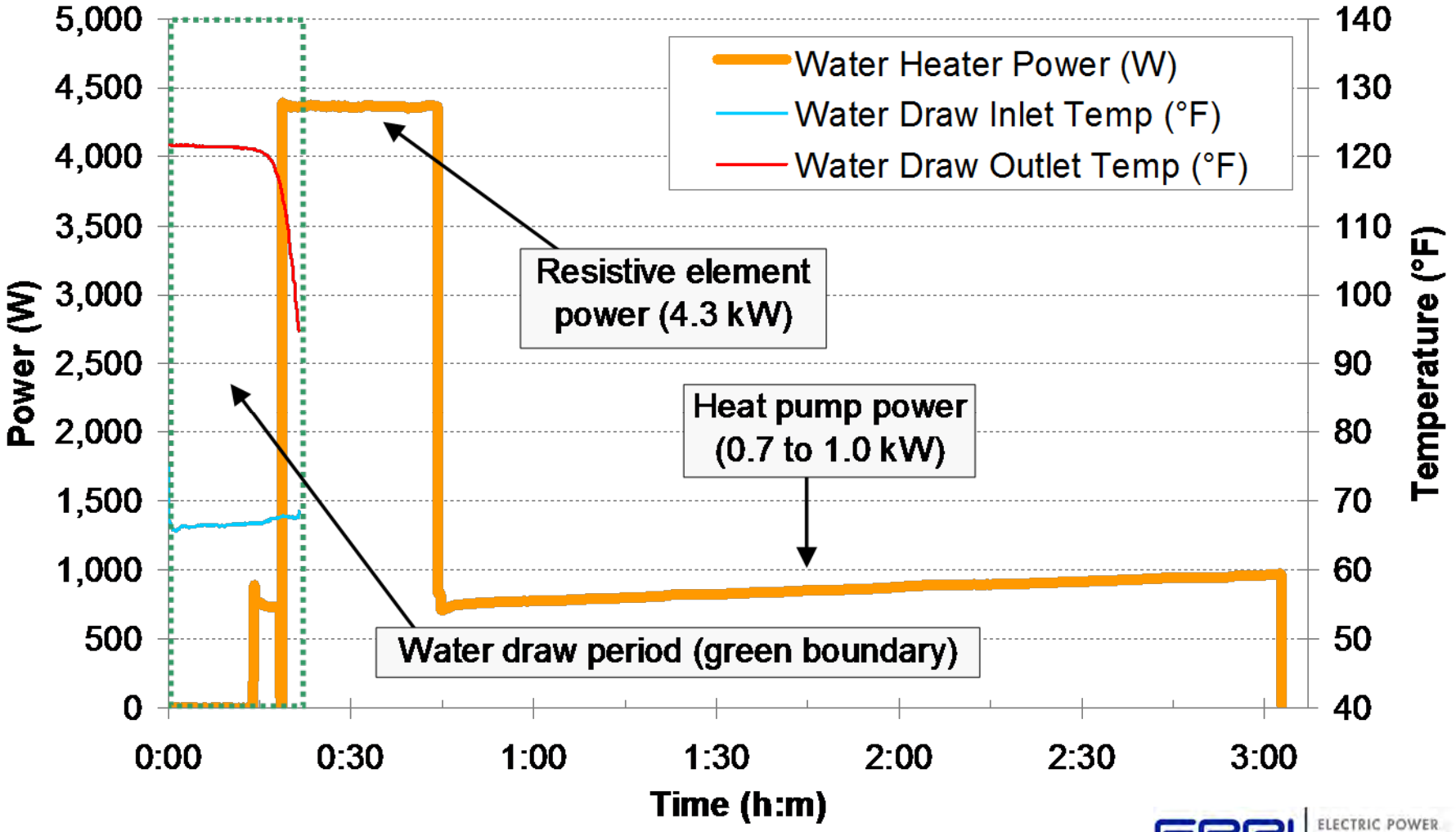
Default operating mode (Hybrid or Energy Saver) at 120°F setting

Targeted conditions: ambient 68°F, 50% RH, and 58°F inlet water



HPWH Draw Test: Energy Consumption Halved, but Recovery Time Doubled

A.O. Smith HPWH: Draw Test Profile



Ductless Residential Heat Pumps and Air Conditioners (DHPs)

- Split system heat pumps
- No duct systems
- More efficient variable speed DC inverter driven fans and compressors
- Match heating or cooling load at any instance
- Improved comfort for the user
- Lower noise levels
- Easy to retrofit
- Commonly installed in Asia and Europe

Installation in Chattanooga, TN (TVA)

Data Centers – Demonstrating Three Energy Efficiency Strategies

Server Power Supply Retrofits
(Snohomish Public Utility District)

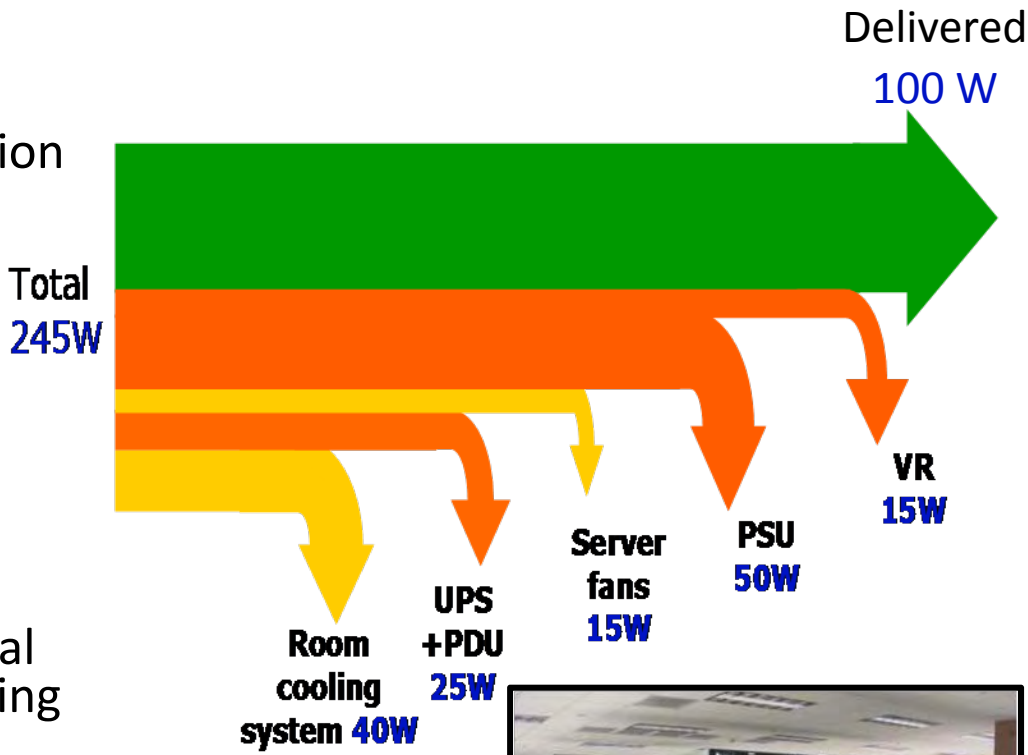
Direct Current (DC) Power Distribution
(Duke Energy)

- Reduction in AC-DC and DC-DC conversion losses

Airflow Management with Cooling Controls
(Salt River Project)

- Testing Federspiel software that automatically determines optimal temperature, selects which cooling units operate at any time, and coordinate operation to eliminate "fighting" between units

- Potential for 40-80% cooling unit fan energy savings and 20-30% **total** data center energy savings



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End-to-End Energy Efficiency R&D
The Full Portfolio…

Generation

Heat rate improvement

Efficient auxiliary loads

Transmission & Distribution

Green Circuits ™

Green Transmission ™

End Use

Together…Shaping the Future of Electricity