



EPRI

ELECTRIC POWER
RESEARCH INSTITUTE

Update on EPRI Energy Efficiency Research Activities

CEE Program Meeting

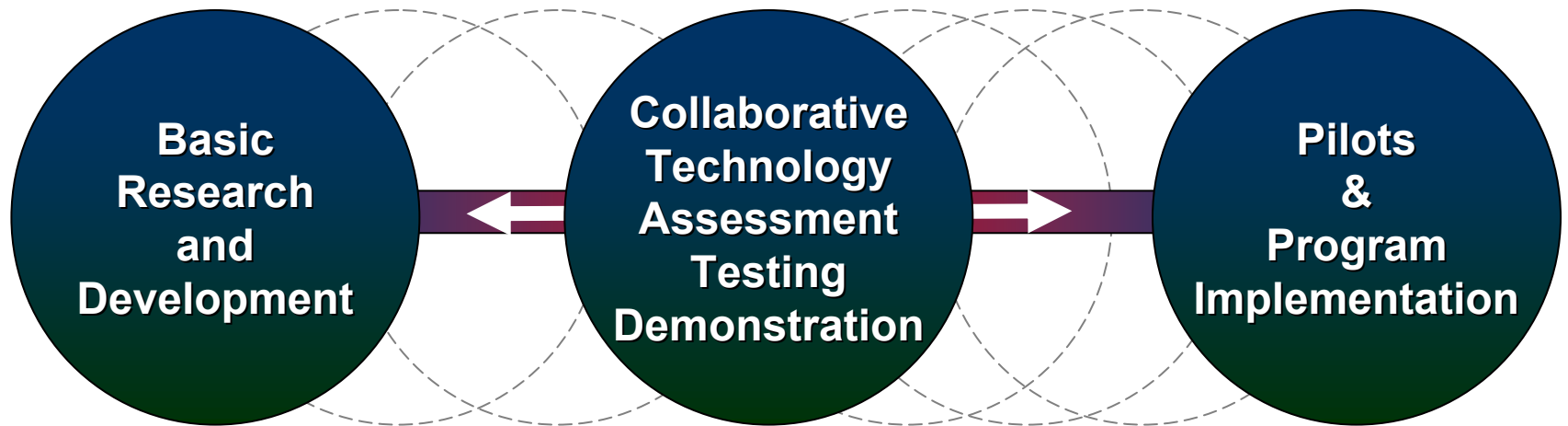
Omar Siddiqui

June 3, 2009



Collaboration to Advance Energy Efficiency

Accelerate Development of Emerging Technologies



National Laboratories
Universities
Industry R&D
Private Inventors

EPRI → CEE



Utilities
Program Implementers
Suppliers
Vendors

EPRI End-Use Energy Efficiency Program (P170)

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 (CO₂)
 - Economic impact
- **Rationalize** effects of feedback and price



EPRI's EE & DR Living Laboratory Recently Featured in TIME

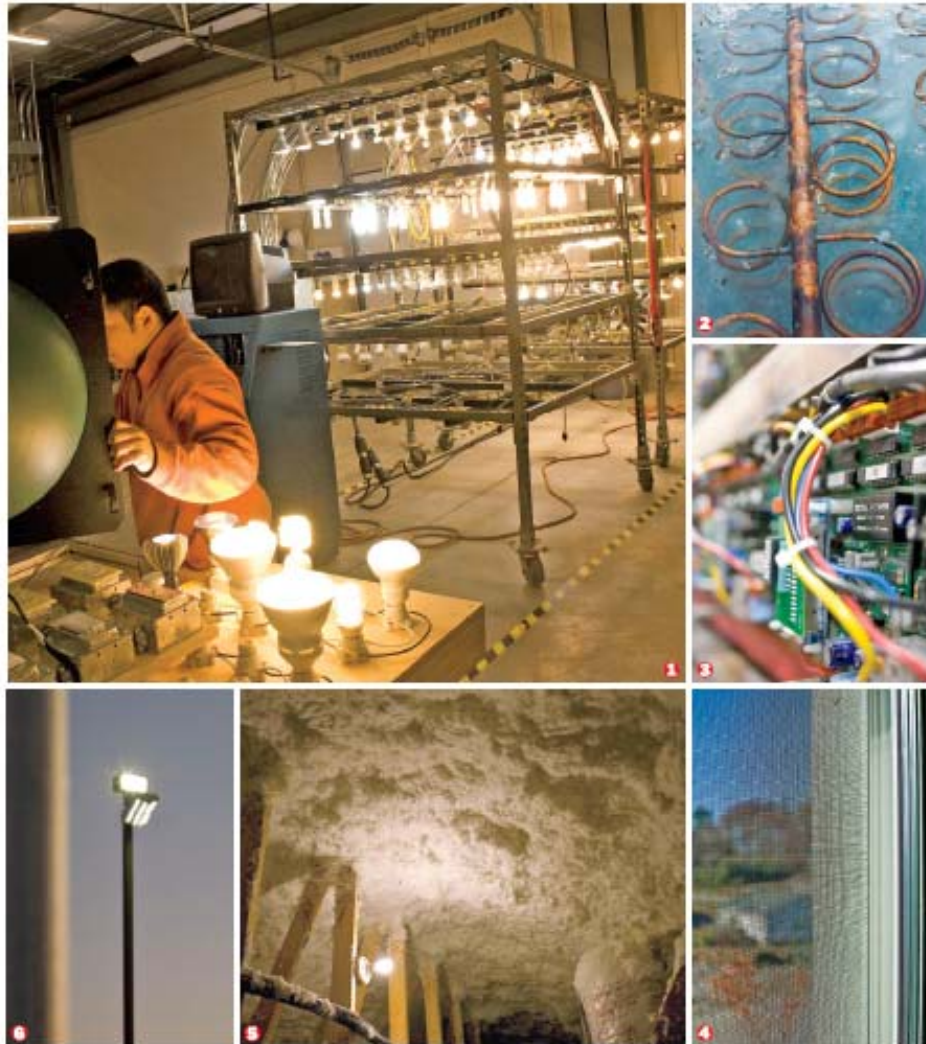
NATION

Wasting Our Watts

We don't need new drilling or new power plants. We need to get efficient

BY MICHAEL BRUNWALD

Evaluating and testing energy efficiency technology



Photographs for TIME by Jeff Jacobson—Redux



the greentech economy. Clearly, it needs an agent. But it's a simple concept: wasting less energy. Or more precisely, consuming less energy to get the same amount of heat for your shower, light for your office and power for your factory. It turns out to be much less expensive, destructive and time-intensive to reduce demand through efficiency than to increase supply through new drilling or new power plants. A nationwide push to save "megawatts" instead of building more megawatts could help reverse our unsustainable increases in energy-hogging and carbon-pewing while creating a slew of jobs and saving a load of cash.

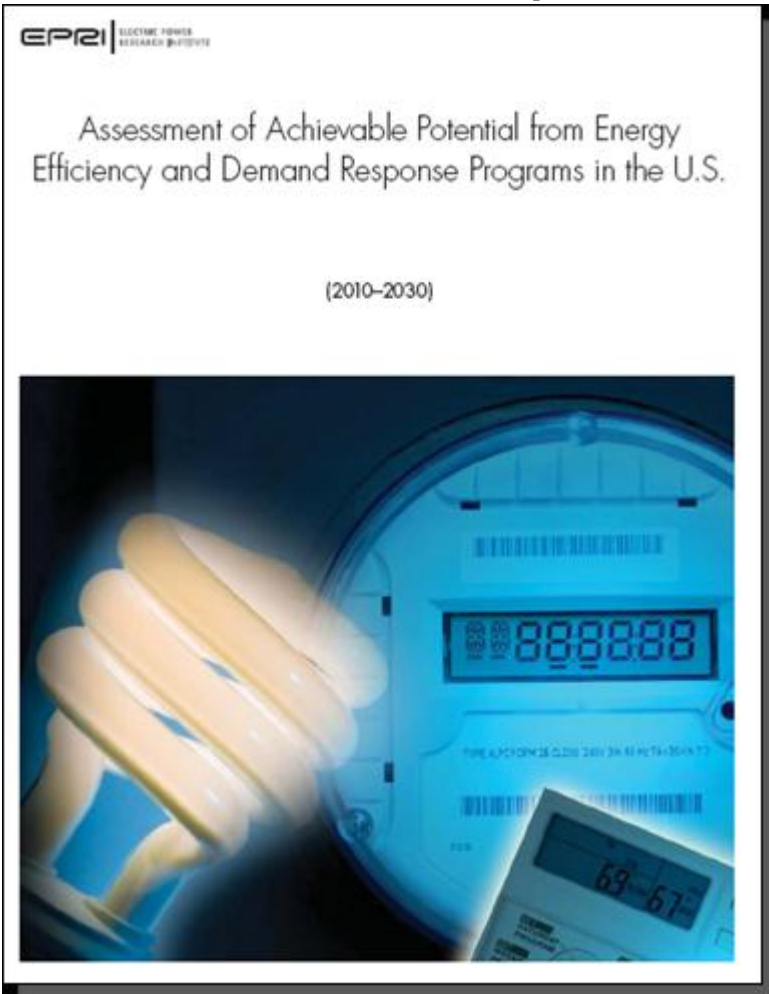
Now this may sound like Jimmy Carter's 30-year-old plea for us to turn down the heat and put on sweaters or like an eco-lecture nagging us to turn off lights, drive less and otherwise change our behavior to save energy. It would

'A lot of simple answers are just sitting around waiting for us to execute.'

—TOM REDDOCH, ELECTRIC POWER RESEARCH INSTITUTE

U.S. Energy Efficiency Potential Study

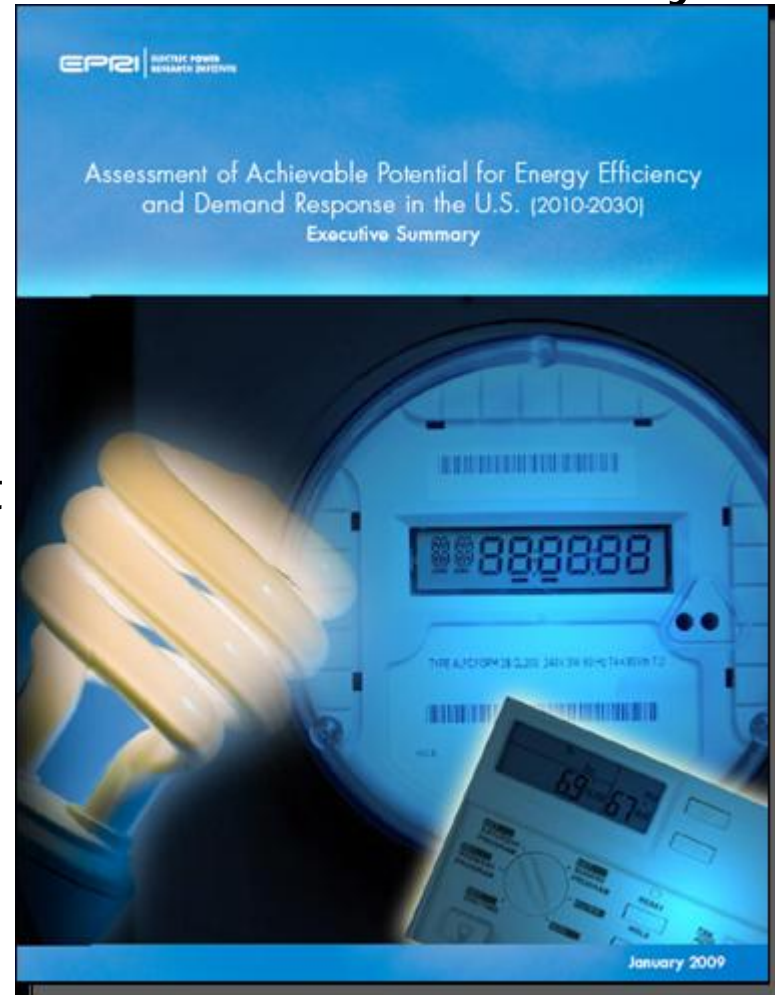
Technical Report



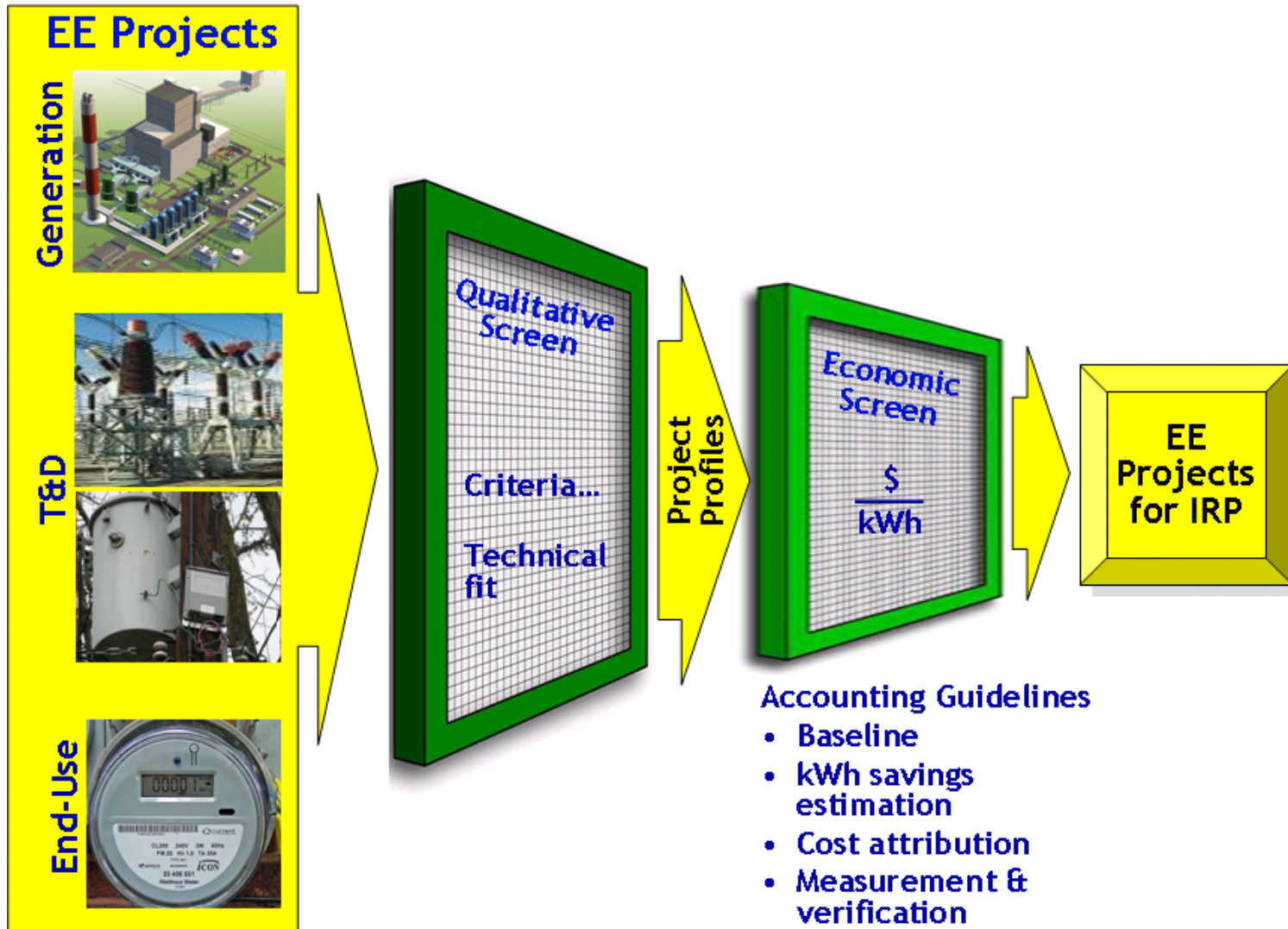
Released
1/14/09

Publicly
available at
EPRI.com

Executive Summary



End-to-End Efficiency Analysis



2009 Analytical Frameworks Project Set

2009 Analytics is organized around three disciplines



Modeling Impact of Energy Efficiency on CO₂ Emissions



Customer Behavior (Feedback)



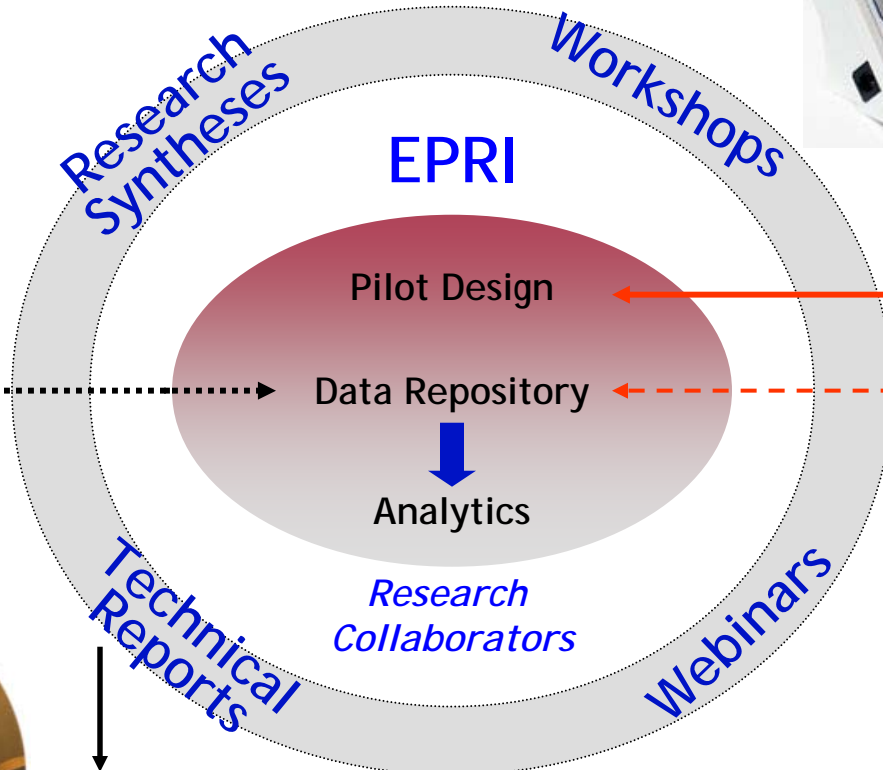
Impacts and Value of Demand Response

Analysis and Design of Energy-Use Feedback Pilots



Ongoing pilots

Completed pilots



New pilots

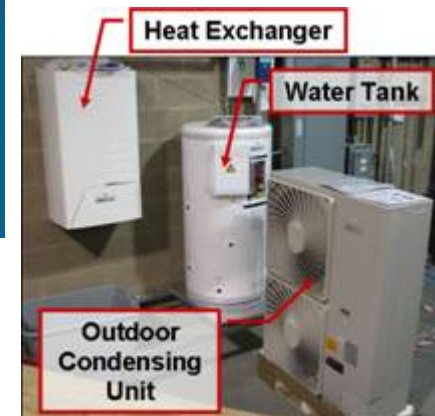
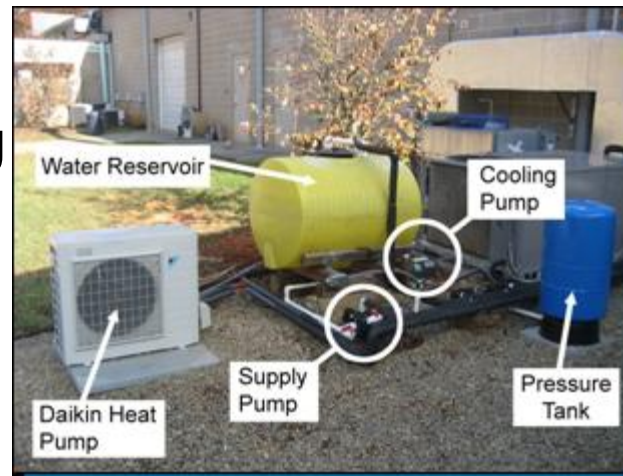
Energy Display Devices (#1016088)
 Residential Electricity Use
 Feedback: Research Synthesis and
 Economic Framework (#1016844)



2009 Energy-Efficient Technologies Project Set

Advanced Heat Pump Assessment & Testing

- VRF testing
- HP Water Heater testing
- Integrated space heating, space cooling, water heating
- Geothermal HP field tests & economic assessment



2009 Energy-Efficient Technologies Project Set

Advanced Lighting

- Digital signage power usage and efficiency
- Advanced LED
- CFL distribution system impact study



Advanced Motors

- Assessment and Testing
- Impacts of new standards



Web-based Industrial Energy Management Tool

- Continued development



Data Center and Power Electronics Efficiency

- Component testing of UPS, server power supplies, and gaming consoles
- Complements EE Demo



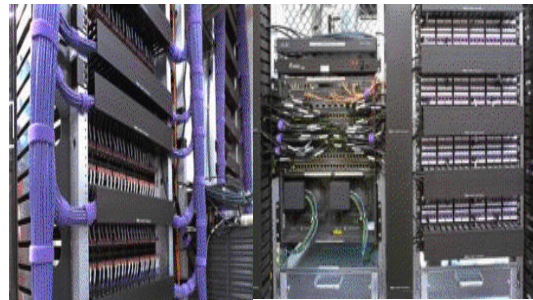
Energy Efficiency Demonstration Initiative

National field demonstrations of six key technology categories with potential to significantly reduce energy consumption in U.S. buildings

COMMERCIAL



**Variable Refrigerant Flow
Air Conditioning**



Efficient Data Centers



**LED Street and
Area Lighting**

RESIDENTIAL



**Heat Pump
Water Heaters**









**Ductless Residential Heat
Pumps and Air Conditioners**



**Hyper-Efficient
Residential Appliances**

Planned Scale of Sites and Devices

		Technology	Number of Sites	Devices per Site	Total Devices
Commercial		Variable Refrigerant Flow AC	5	1	5
		LED Area Lighting	9	12	108
		Data Centers	4	1	4
Residential		Ductless Heat Pump	4	20	80
		Heat-Pump Water Heater	5	40	200
		Hyper-Efficient Appliances	5	20	100
		TOTAL	32		497

Major Phases

Phase	Design & Staging	Execution	Wind Down
Timeline*	(Q1:09 - Q3:09)	(Q4:09 - Q3:11)	(Q4:11)
Major Activities	<p>EPRI</p> <ul style="list-style-type: none"> Experimental design Test protocols Instrumentation plans Installation process Equipment selection and procurement <p>Hosts</p> <ul style="list-style-type: none"> Participant recruitment and enrollment Equipment installation 	<p>EPRI</p> <ul style="list-style-type: none"> Monitoring and tracking Tech transfer <p>Hosts</p> <ul style="list-style-type: none"> Data collection Participant support 	<p>EPRI</p> <ul style="list-style-type: none"> Tech Transfer <p>Hosts</p> <ul style="list-style-type: none"> Decommissioning Participant support

* Dates are approximate and overlap is expected. Some activities started in Q3:08.

Variable Refrigerant Flow Air Conditioning — Assessment & Demonstration in Knoxville

- Assessing novel air conditioning technology in a real-world, retrofit application - EPRI Knoxville offices
- Prelude to national-scale energy efficiency demonstration



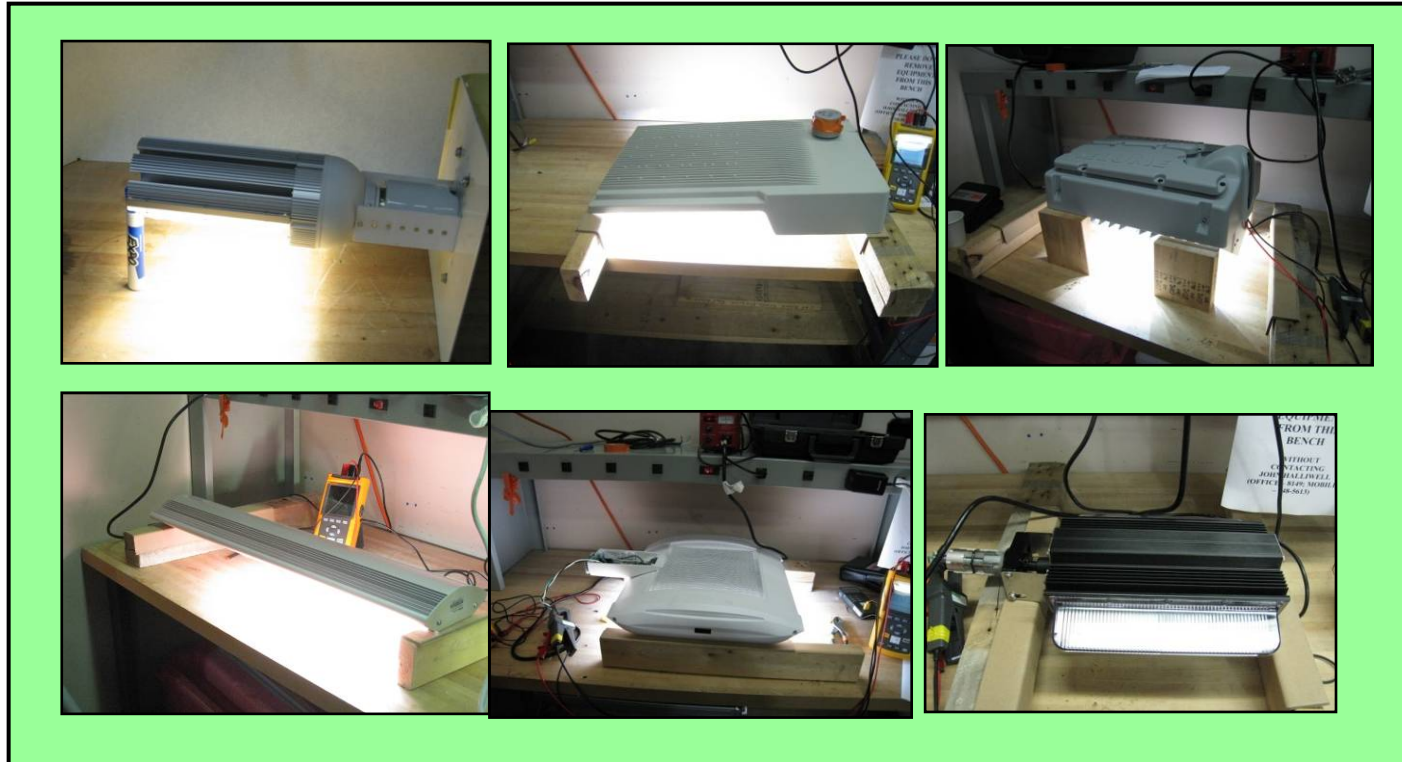
Photograph of the installed system (Daikin IS-VRV™) outside the EPRI Knoxville facility.

VRF Status Overview

- Variable Refrigerant Flow
 - Three vendors selected
 - All heat recovery systems
 - Software development
 - Effort to combine with other technologies
 - Instrumentation plan
 - Developed last year under the base-funded work
 - Site specific
 - Team is ready to install



LED for Street and Area Lighting



EPRI has tested fixtures from various manufacturers.

Field Demonstration of LED Street and Area Lighting



Photos courtesy of FirstEnergy

- **Understand potential energy savings to achieve the comparable perceived illumination**
- **Assess reliability of LED lighting electronics to survive real world electrical disturbances**
- **Contribute to revision of standards and codes for the effectiveness of LED “blue spectrum” light in dim condition**
- **Provide forum to evaluate public acceptance, durability, light performance and weather resistance across a large number of demonstration sites**

Data Centers

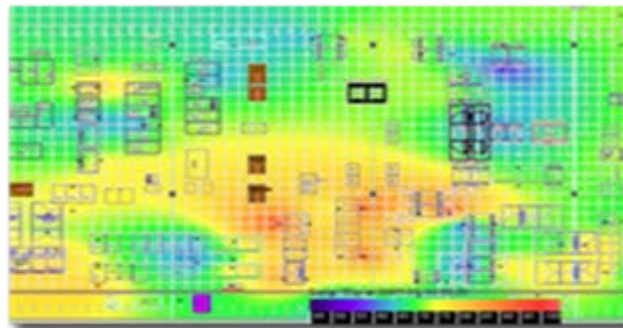
- Tested technologies from various manufacturers
- Working with National Laboratories on others



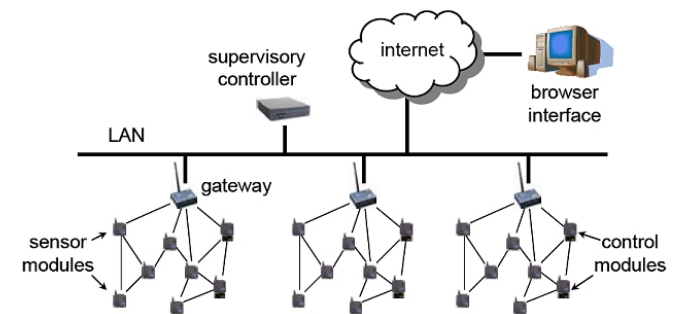
Efficient Power Supplies



DC Power Distribution

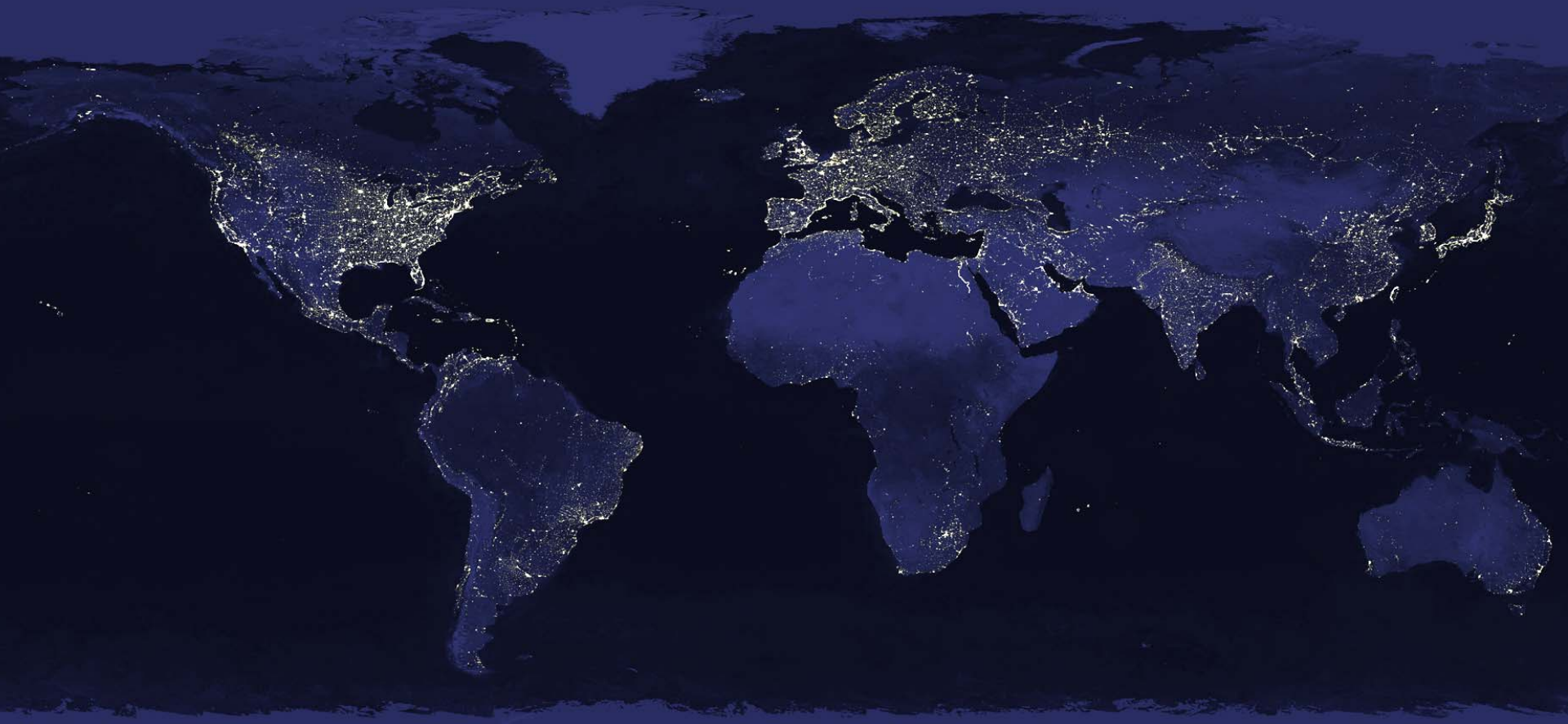


Thermal Mapping Software



Balancing Heat and Fan Load

Together...Shaping the Future of Electricity



EPRI

**ELECTRIC POWER
RESEARCH INSTITUTE**