



Building the Smart Grid: Roles for Building Commissioning and Energy Efficiency

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Agenda

- What is the Smart Grid?
- The Smart Grid and Buildings
- How could the Smart Grid lead to energy savings?
- Policy issues for achieving energy savings
- New Opportunities

Smart Grid 101:

The IT boom for the electric grid

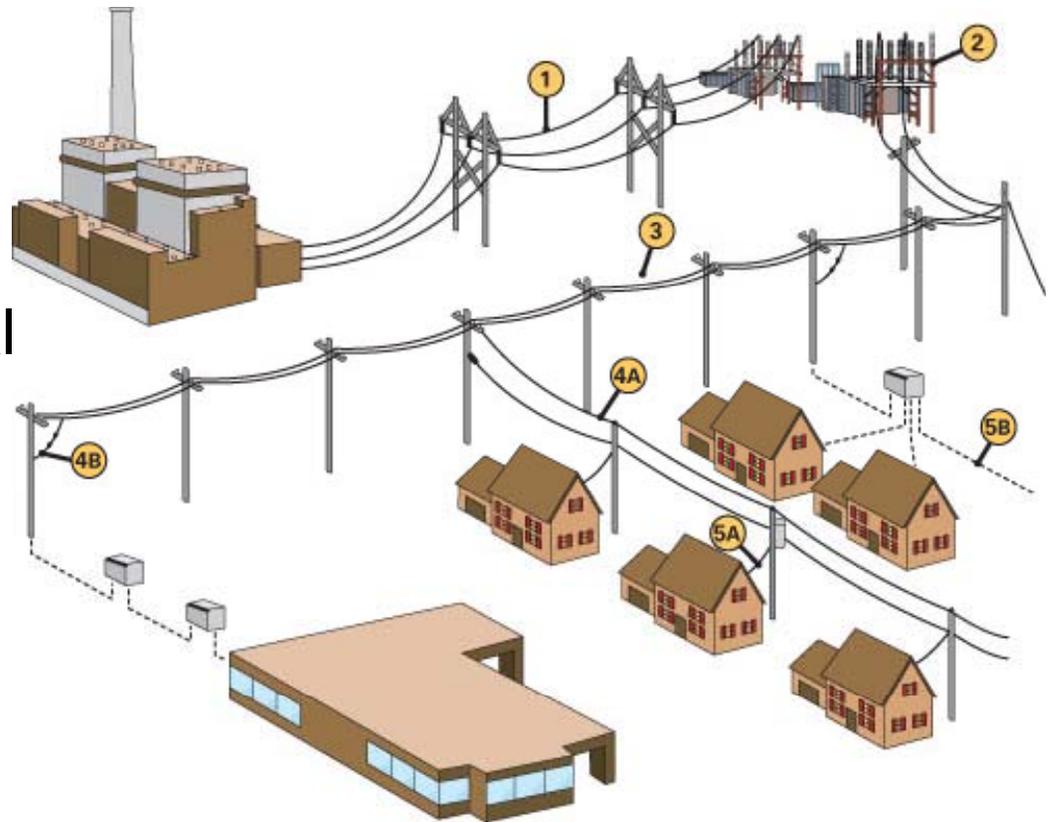
“Power system that has an **intelligent communications infrastructure** enabling the timely, secure and adaptable information flow needed to provide the right information to the right entity (e.g. end-use devices, T&D system controls, customers, etc.) at the right time to take the right action.”



- Electric Power Research Institute

The “old” electric grid

- Central station power plants
- Low load factor
- Consumers don't see real TOU price of energy
- Low RE and DG integration



Source: DTE Energy (<http://my.dteenergy.com/products/electricity/images/electricFlow.jpg>)

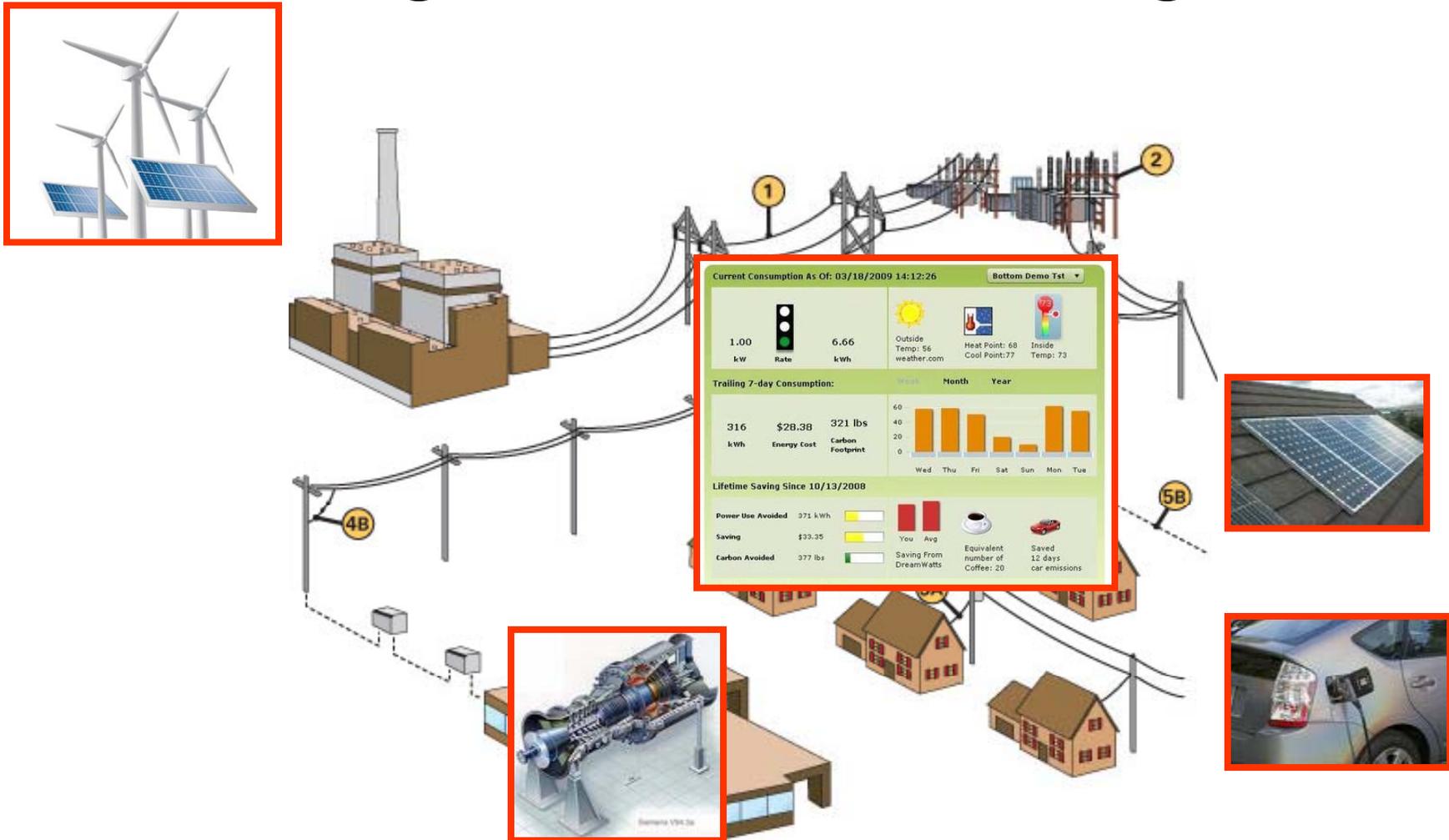
Smart Grid enabling infrastructure



- **Intelligent devices**
 - Smart meters (part of Advanced Metering Infrastructure)
 - Sensors
 - Grid aware equipment
- **2-way communications (interoperable)**
 - Networking technology
 - Communication pathways like cable, Wi-Fi, powerline
- **Advanced control and data management systems**
 - Automated decision-making on supply and demand side
 - Meter data management systems

“The Electricity Economy: New Opportunities from the Transformation of the Electric Power Sector”,
Global Environment Fund and Global Smart Energy - 2009

Next generation electric grid



Source: DTE Energy (<http://my.dteenergy.com/products/electricity/images/electricFlow.jpg>)

Keeping Goals in Sight

- Smart Grid is not the end, it's the means to the end
- It's what we DO with a smarter grid that matters
 - E.g., Installing monitoring equipment alone does not save energy
- Smart Grid infrastructure may enable clean energy opportunities from generation to loads

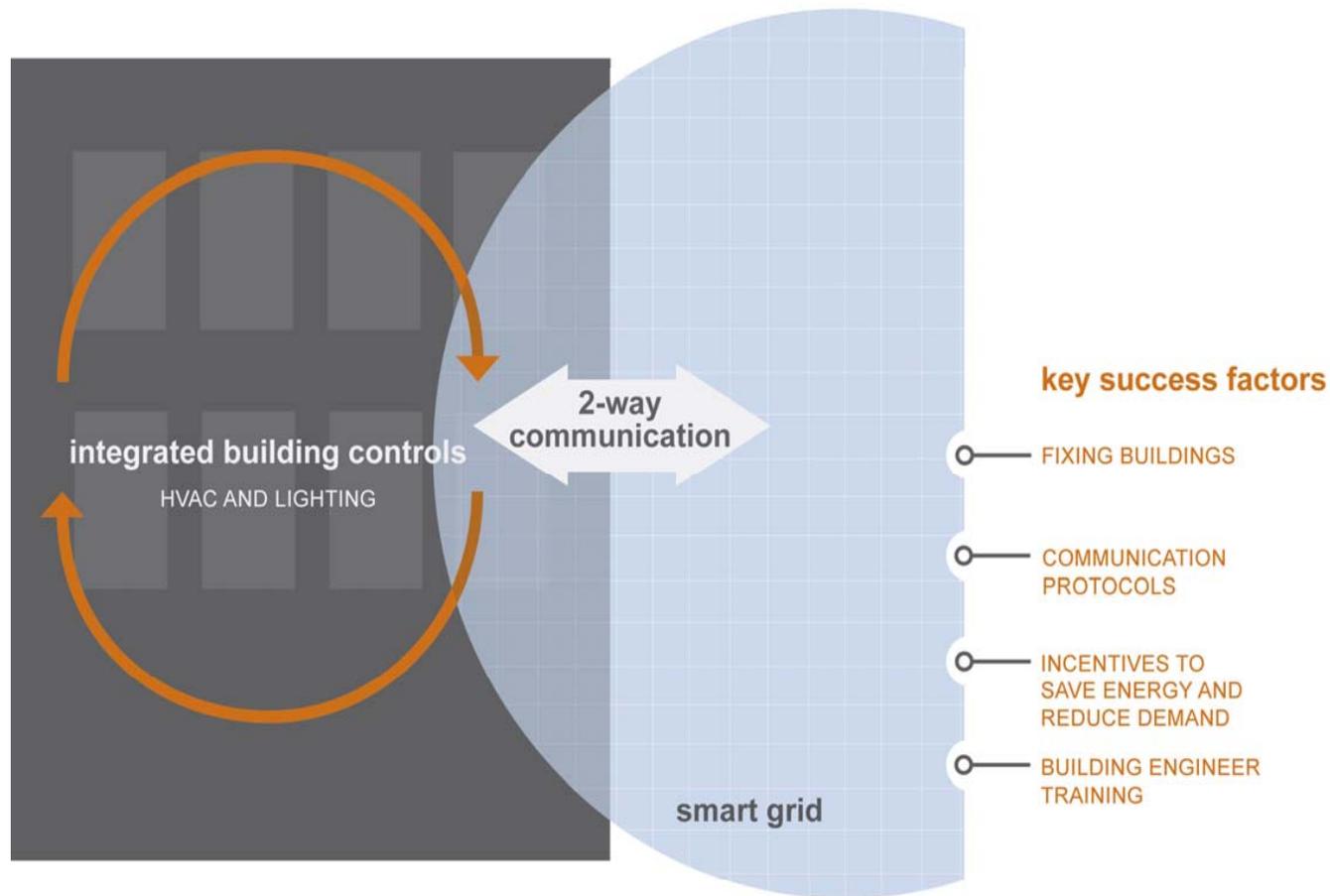
The Smart Grid requires controllable buildings

- Does it make sense to use smart grid technology to communicate with buildings that are not well functioning?
 - Buildings need to work to participate in DR programs
 - Implement Cx with DR programs
 - DR signals lead to predictable responses

Interoperability is key

- Control systems will need to work together seamlessly
 - Integration of different control systems
 - Integration of cogeneration and other DG into buildings and with the grid

Commissioning the Smart Grid



Energy Savings using Smart Grid Infrastructure

- Improved energy efficiency and conservation due to:
 - Dynamic pricing programs
 - Improved energy use information
 - Utility program benefits
 - Automated diagnostics

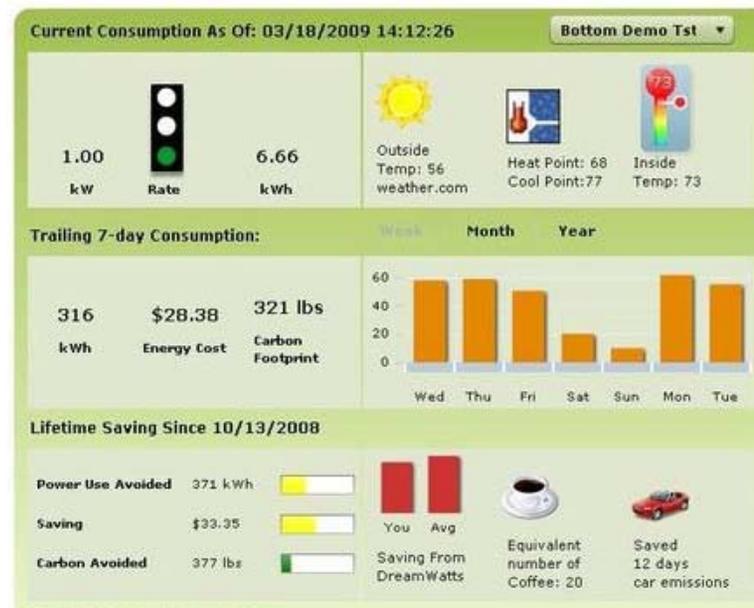
1. Energy savings due to dynamic pricing programs

- Conservation effect from CPP or TOU pricing programs
 - Average 4% savings; mostly residential studies¹
 - Either active or automated participation
 - Example: Avoiding usage (lighting) vs. load shifting (clothes washer)
- Paying the “true” cost of power through day
 - Increased awareness/reduced consumption

¹ King, Chris and Dan Delurey. “Twins, Siblings or Cousins? Analyzing the conservation effects of demand response programs.” *Public Utilities Fortnightly*, March 2005.

2. Energy savings due to improved energy use information

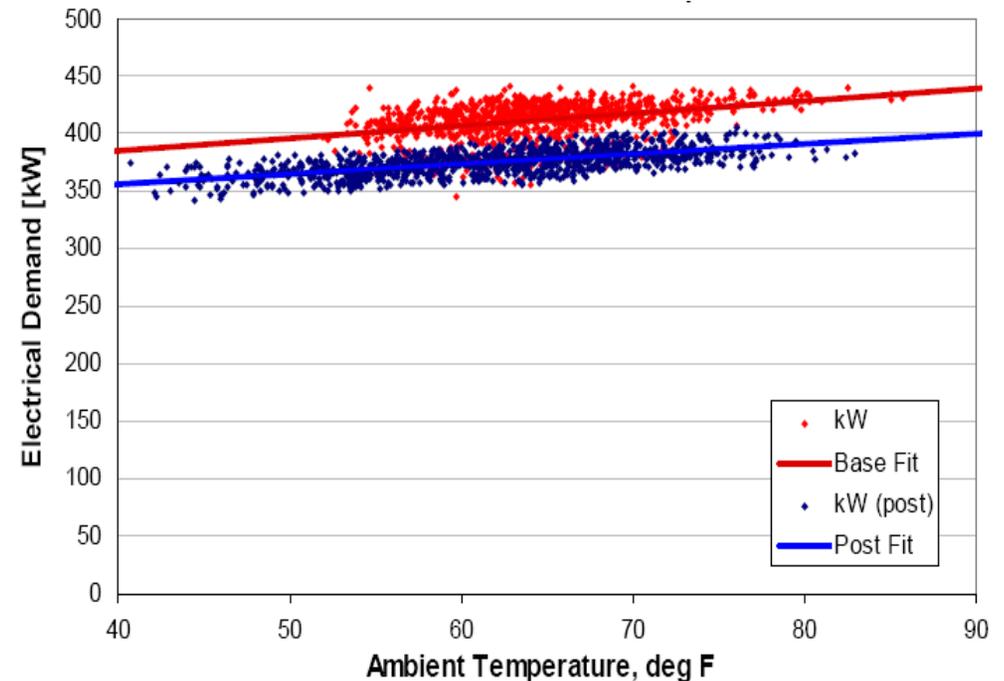
- Active participation and behavioral changes
 - 11% energy savings in early (mostly residential) studies²



² Darby, Sarah. "The Effectiveness of Feedback on Energy Consumption" Oxford University Environmental Change Institute. April 2006.

3. Utility program benefits

- Better data to assess potential savings in target markets; better benchmarks
- Use of data for EM&V



Source of graphic: California Commissioning Collaborative, *Guidelines for Verifying Existing Building Commissioning Project Savings - Using Interval Data Energy Models: IPMVP Options B and C*

4. Automated diagnostics

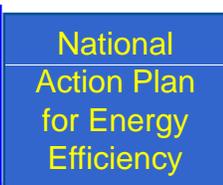
- Will utilities start providing diagnostic services on a large scale?
 - Scheduling
 - Unoccupied energy use
 - Demand peaks
 - Correlations of outside temperature and energy use
- How far will Smart Grid data systems “see” and “control” end-uses?
 - Utilities may stop at the meter
 - May be deeper opportunities for companies that bundle solutions (Controls upgrades, DR, MBCx, DG)
 - Depends on building type

Some unresolved challenges

- What will motivate customers to be active participants with the grid?
 - What is the “killer app” to increase motivation?
 - How much will improved energy use information lead to changed behavior?
- How will we get all these buildings ready to interface with the Smart Grid infrastructure?
 - Cx industry workforce expansion
 - Automated techniques

Smart Grid from an environmental policy perspective

- *Climate Protection Partnerships Division Mission Statement: Protecting public health and the environment from the adverse impacts of global climate change, by driving demand for and reducing marketing and policy barriers to energy efficiency and clean energy supply, through education; objective information and measurement; actionable solutions; and strategic partnerships.*
- Can Smart Grid help mitigate greenhouse gas emissions (GHG)?
- How, how much, & at what cost?
- What challenges prevent Smart Grid from achieving GHG mitigation?
- What policies are needed for Smart Grid to promote clean energy?



Smart Grid and GHG reductions

- May reduce GHGs by advancing clean energy
- Many GHG reduction mechanisms are indirect
 - building energy savings enabled by energy information
 - greater wind energy enabled by dynamic line ratings
- Depend on several factors
 - E.g., How persistent is behavioral change?
- Quantifying possible GHG impacts is challenging
 - Uncertainty and variability
 - *Incremental* benefit from Smart Grid?
e.g., *Additional* renewable energy via Smart Grid
 - EPRI “Green Grid” estimates ~ 60-211 MMTCO₂e in 2030
- **GHG reductions & Smart Grid requires additional clarity**

Smart Grid policy background

Federal

- Energy Independence and Security Act 2007 Title XIII
- American Recovery and Reinvestment Act: ~\$4.5 Billion
- National Institutes of Standards (NIST): interoperability

State/ Utility

- Many utilities invested/investing \$ billions
 - Advanced Metering Infrastructure
 - Less attention in transmission & distribution
 - Buildings focus has been in residential sector
- Some pilots and deployments moving beyond AMI
 - E.g., Xcel Energy Smart Grid City project, Boulder

Policy considerations (1)

- Business case / consumer perspective:
 - What are the societal benefits? How certain are these?
 - How will Smart Grid fill consumer interests and needs?
- What/ where are low-hanging Smart Grid fruit?
 - Transmission & distribution; commercial & industrial?
- Performance & evaluation of Smart Grid investments
- Complementary policies
 - Are policies like dynamic pricing important?
 - Traditional barriers to “clean” energy remain

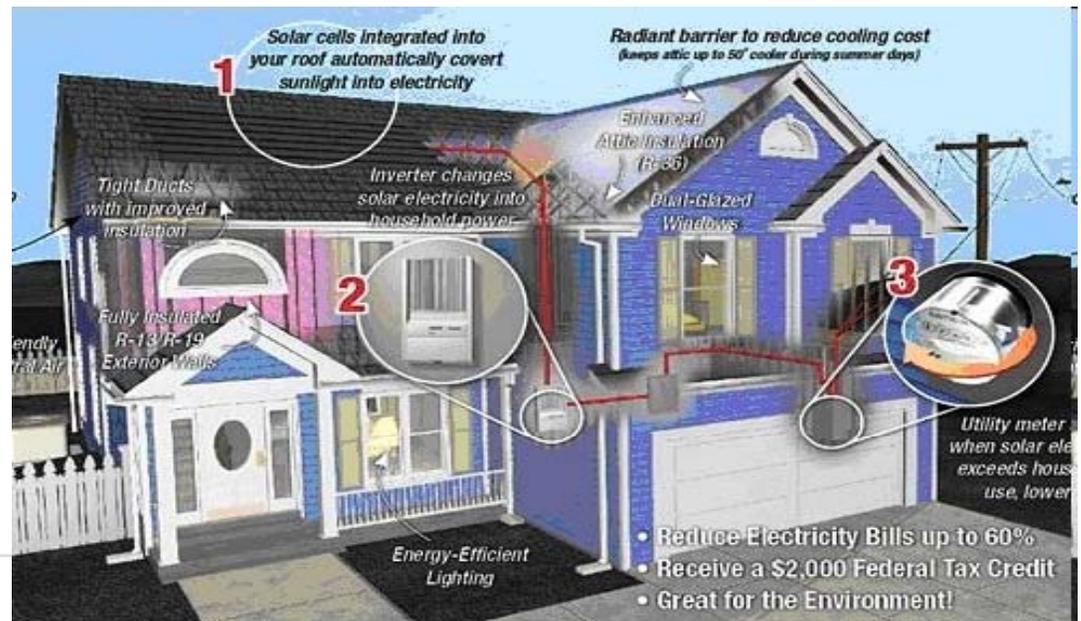
Policy considerations (2)

- Aligning utility financial incentives
 - Invest in energy efficiency
 - Optimize existing assets (e.g., T&D monitoring)
- Interoperability & NIST Priority Action Plans
 - Demand response discussions engage large commercial interests
 - Small commercial building needs are different
- Data ownership
 - Utilities or consumers?
 - Implications for new business opportunities?
 - Implications for verification in a future climate policy regime?
- Data management: who's & how's of data management

Viewing the grid as a system

- Information is shared across the grid, linking supply and demand
- Use Smart Grid to minimize total grid GHGs?
 - Systems design & operation
 - All clean energy options are relevant

Can Smart Grid influence the design, operations & evaluation of clean energy through systems thinking and using information systems?



New opportunities

- Making the most of Smart Grid
 - New ways of business: working across and within organizations
 - New ways of thinking about clean energy technology
e.g., enabling more renewables by integrating demand response, efficiency & storage
 - What will clean energy programs look like in the future?
- Ubiquitous energy data may generate opportunities
 - Building diagnostics
 - EM&V for energy programs & possible future climate policies
 - Data management for T&D monitoring
- Future climate and/or aggressive energy legislation
 - GHG mitigation likely to require all flavors of clean energy
 - What services can you provide to leverage Smart Grid infrastructure for clean energy purposes?

Summary

- Smart Grid is an enabling infrastructure, it's what we do with it that matters
- The Smart Grid requires that buildings work and control systems integrate
- With focus, proper planning and thoughtful policies, Smart Grid investments may enable energy savings and change how we think about clean energy
- Keep Smart Grid in perspective: Smart Grid does not negate the need for good design, low-tech EE, or complementary policies for clean energy

Questions?

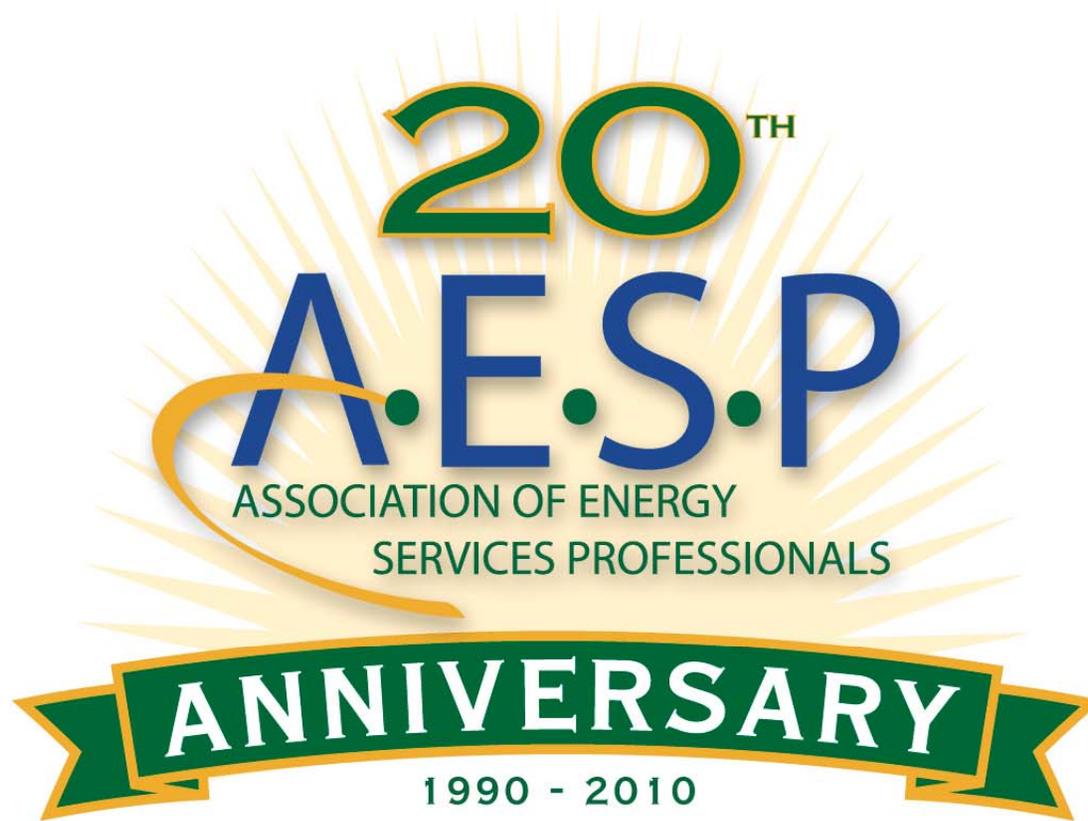


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**Whitepaper: “Wiring the Smart Grid
for Energy Savings: Integrating
Buildings to Maximize Investment”**
available at www.peci.org

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