Smart Grid:
Implications and Opportunities for Clean Energy and Greenhouse Gas Emissions Reductions

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Why Look at Smart Grid?

- Potential enabler for greater use of clean energy
- Early studies suggest 2-12% greenhouse gas emissions reductions in electricity sector by 2030
- *2007 Energy Independence and Security Act* recognizes a smart grid as characterized by*:*
  - Increased use of digital information & controls to improve reliability, security, efficiency of the grid;
  - Increased use of distributed generation & renewable energy, demand response, energy efficiency;
  - Use of smart technologies & appliances (like meters, distribution automation), storage, information to consumers
  - Development of interoperability standards for device to grid communication
  - Lowering of barriers to adopting smart grid

Smart Grid Technology Overview

ELECTRICITY GRID

- Transmission and distribution system sensors and monitoring
- Optimized voltage control
- Storage

- Plant optimization software

CONNECTIONS

- Advanced meter infrastructure
- Energy data management

Communications Backbone

CUSTOMERS

- Home area networks, energy monitors
- Communicating programmable thermostats
- Grid-connected appliances, solar PV

- Grid-connected controls and equipment

- Advanced building diagnostics
- Grid-connected building controls

- Grid-connected electric vehicles, charging systems

Smart Grid & GHG Emissions Reductions

- SG has *potential* to reduce GHGs by deploying communications and infrastructure technology which may:
  - Potential to enable additional end-use energy efficiency by providing information, affecting behavior
  - Help maintain reliability with high levels of renewable generation (>20-25%)
  - Reduce losses across electric transmission and distribution
- Smart grid does not directly reduce emissions
  - Highly dependent on how technology used
  - Complementary policies can help realize environmental benefits

Early Estimates of Smart Grid-Enabled Electric Sector Energy/CO2 Savings in 2030

ELECTRICITY GRID

- 2% from distribution system efficiency
- <0.1% from supporting more wind and solar generation
  - 5% if reinvest in demand response/ storage instead of power plants with renewables

CONNECTIONS

- 1% from enhanced EM&V of EE programs
  - 0.5% if reinvest saved M&V costs into additional efficiency programs

CUSTOMERS

- 3% from consumer response to information
  - 3% from diagnostics in homes and small/medium buildings

- <0.1% from using more efficient generation due to energy use changes

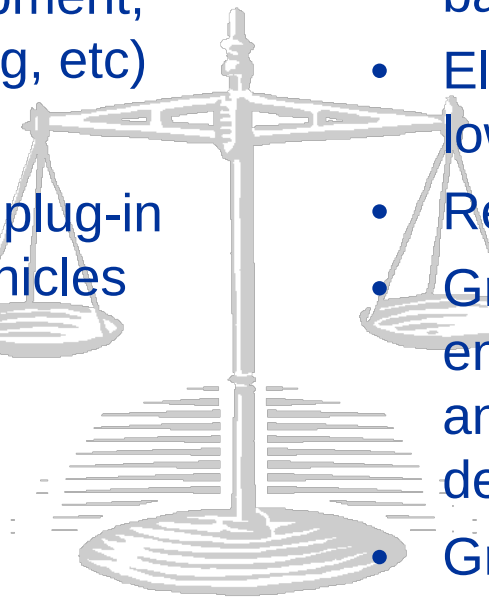
- 3% from supporting electric vehicles

* Data from PNL *The Smart Grid: An Estimation of the Energy and CO2 Benefits* (2010)

What is the *Net* CO2 Impact?

Potential CO_2 Increases from More Electricity Use

- Smart grid technologies (networking equipment, meters, computing, etc)
- Data center load
- Electric vehicles, plug-in hybrid electric vehicles



Potential CO_2 Reductions from Electric Grid Changes

- Reduction in informational barriers to EE in buildings
- Electric vehicle charging from low/no GHG generation
- Reduced T&D line losses
- Greater use of renewable energy (RE), combined heat and power (CHP), and clean demand response
- Grid support without fossil fuel combustion*

* Electric grid operators manage small fluctuations in power flow to maintain reliability. Such grid support services are often provided by coal-fired power plants. Use of clean demand response or storage is also being explored.

Savings Comparison: Smart Grid vs. Established Energy Efficiency Options

- 2-12% of electricity sector usage may be avoided with a smart grid by 2030.*
  - Technical potential estimate
  - Less than 1/3 of U.S. energy efficiency technical potential
- Economic efficiency potential estimates range from 11-24% of total electricity consumption by 2020.**
  - Savings from administered efficiency programs, codes, standards
  - Comparable economic potential for smart grid-enabled energy savings not found

* EPRI's *The Green Grid* (2009) and PNL *The Smart Grid: An Estimation of the Energy and CO2 Benefits* (2010)

** McKinsey: *Unlocking Energy Efficiency in the U.S. Economy* (July 2009) and EPRI: *Assessment of Achievable Potential from Energy Efficiency and Demand Response* (Jan. 2009)

Policy Considerations To Enable CO2 Reductions from Smart Grid Deployments

- Are energy and carbon savings goals established?
- Do customers have access to their energy usage?
- Are energy efficiency programs offered?
- Do electricity rates motivate customer savings?
- How much will it cost a clean distributed generator to interconnect with the grid?
- Will energy and emissions savings be measured?
- Who is informing pilot and program design?
- How will the smart grid deployment support other clean energy activities?
- Can greater granularity of energy information inform energy and air planning?

For more information, see: Regulator Assistance Project Issuesletter, “Smart Grid or Smart Policies: Which Comes First?” (July 2009) and Smart Grid Stakeholder Roundtable, “Perspectives for Utilities and Others Deploying Smart Grids” (Sept. 2009).

Additional Environmental Considerations

- Can electricity, water and natural gas technologies be integrated for additional resource efficiencies?
- Are there local air quality affects, such as increased emissions from onsite diesel generators?
- Can electronics waste be recycled? Will new equipment be upgradeable?
- Is there an affect on land use, such as from clean distributed generation?

Contact Information

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