Breaking Down the Silos:
The Integration of Energy Efficiency, Renewable Energy, Demand Response, and Climate Change

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Topics

- Changing evaluation landscape
  - Energy efficiency, demand response, renewable energy, climate change
- Paradigm shift
- New evaluation challenges
  - Evaluation issues
  - Evaluation approaches and methods
  - Evaluation protocols
- Breaking down the silos
- Conclusions

Changing Evaluation Landscape

- Historically:
  - Energy efficiency as a least cost strategy to help meet resource adequacy and transmission expansion needs, and to mitigate increasing energy costs

- Currently, there is a need to:
  - Integrate energy efficiency programs with other programs:
    - Renewable energy (to reduce dependency on fossil fuels)
    - Demand response (to reduce investments in generation)
    - Climate change (to reduce greenhouse gas emissions)

Energy Efficiency & Resource Adequacy in California

- Since its enactment in 2003, the Loading Order has been integrated into the major California Public Utilities Commission's decisions governing energy policy and procurement of new energy resources.
- In the Energy Action Plan, the Loading Order continued:
  - "Pursue all cost-effective energy efficiency, first."
- Energy resources are prioritized as follows:
  1. Energy efficiency/demand response
  2. Renewable generation, including renewable DG
  3. Increased development of affordable and reliable conventional generation
  4. Transmission expansion to support all of California's energy goals

California: The Most Aggressive Energy Efficiency Program in the Nation

- Energy Efficiency goals (2004-2013)
  - 26,506 GWh/year
  - 5,000 MW/year
  - 444 Million therms/year
- Eliminates need for 10 new power plants
- Eliminates 9 million tons of CO_2 emissions (equal to 1.8 million cars)
- $10 billion in net savings to consumers

Current Program Cycle (2006-2008)

- ~$2 billion in funding for 3 years
  - $581M in 2006, $646M in 2007, and $742 M in 2008
  - Annual funding from utility procurement dollars and from the Public Goods Charge
  - Levelized cost of 3 cents/kWh and 21 cents/therm
  - $2.7 billion in net savings to consumers over 3 years

Energy Efficiency & Transmission and Distribution Congestion

- Energy efficiency: cost-effective way to defer or eliminate the need for transmission and distribution expansion
- Examples:
  - Pacific Northwest
  - New York
  - Vermont
  - Connecticut
  - City of San Francisco

Increasing Attention to Demand Response

- Demand response programs
  - Designed to reduce short-term capacity needs and/or transmission constraints
  - Changes in energy use in response to signals in the form of electricity prices, incentives, or alerts
- California:
  - 5% of system peak demand must be met by demand response programs
  - $262 million budgeted for 2006-2008
  - Federal Energy Regulatory Commission - CAISO's Market Redesign and Technology Upgrade proposal
    - Conditionally approved if CAISO incorporates price-responsive demand response programs

Increasing Attention to Renewable Energy

- Renewable portfolio standards - 21 states
  - California
    - Goal: 20% of state needs met by renewable energy by 2010 & 33% by 2020
- California Solar Initiative
  - Lower the cost of solar systems for consumers and build a self-sustaining solar market
  - $2 billion in incentives over 2007-2016 (all sectors, except new residential)
  - $350 million in incentives: New Solar Homes Partnership
    - Builders must exceed the performance of current state's energy efficiency standards (Title 24) by 15%

Increasing Attention to Climate Change

- Interest and awareness of potential climate change impacts are at an all-time high in the U.S.
  - Intergovernmental Panel on Climate Change (IPCC) reports, Al Gore's *An Inconvenient Truth,* Nobel Price for IPCC and Gore
- Regional and state government response
  - Regional cap and trade systems
    - Regional Greenhouse Gas Initiative (RGGI) in the Northeast
  - California goals established (AB 32)
    - Reduce GHG emissions to 2000 levels by 2010, to 1990 levels by 2020 and to 80% below 1990 levels by 2050

Paradigm Shift

- Energy efficiency is an important strategy for addressing climate change
  - National Commission on Energy Policy
  - Pew Center on Global Climate Change
  - Pacala and Socolow's *Science* article (4/15 wedges)
  - Paradigm shift from "energy paradigm" to "climate change paradigm"

New Evaluation Challenges

1. How can the evaluation of energy efficiency programs provide guidance on the design and evaluation of renewable energy, demand response & climate change mitigation programs?
2. What energy efficiency program evaluation approaches are useful for evaluating the above programs?
3. How are energy efficiency evaluation protocols being expanded to include the above topics?
4. What policy mechanisms are needed for integrating energy efficiency programs with these other types of programs?

Common Evaluation Issues (1)

- Baselines and additionality
  - What would have happened if the program had not been implemented?
  - Unit of analysis: energy use, energy production, loads, GHG emissions
  - Baselines: standards, existing efficiencies, replacement practices, comparison groups
  - Need to be consistently defined
  - Clean Development Mechanism (CDM) Rules for additionality

Common Evaluation Issues (2)

- Free riders and spillover
  - Free riders: program participants who would have installed the same measures if there had been no project
  - Spillover:
    - Participant spillover: program participants who installed additional measures that were not incented by the program
    - Non-participant spillover: end users who were influenced by the program to install measures but did not participate in the program
  - Gross savings versus net savings (accounting for free riders and spillover) => need for consistency
  - Less an issue now for demand response and renewable energy, but may become more relevant with widespread use of demand response and renewable energy
  - Important for climate change
    - Market transformation perspective (free drivers)

Common Evaluation Issues (3)

- Reliability, uncertainty, and precision [1]
  - Uncertainties in estimating energy savings and reducing emissions
    - Supply-side uncertainties: just as great
    - Risk-reducing value of energy efficiency
  - Need to identify level of precision and confidence levels associated with measurement of savings or production
    - Quantitatively (standard deviation, confidence intervals, sensitivity or probability assessments)
    - Qualitatively (low, medium, high)
    - Protocols/guidelines:
      - California M&E protocols: sampling and rigor levels
      - New England ISO M&V manual: precision is important

Common Evaluation Issues (4)

- Reliability, uncertainty, and precision [2]
  - Demand response: similar to energy efficiency
  - Renewable energy: similar but with less concern about precision
  - Climate change mitigation: similar to energy efficiency, but precision will vary by how emissions are calculated:
    - Default emissions factor
    - Utility dispatch model
    - Something in between
  - Possible responses:
    - Discounting
    - Minimum uncertainty and reliability standards

Common Evaluation Issues (5)

- Persistence
  - Is the installed measure still there and operating as designed?
  - High persistence for energy efficiency measures
  - Not important for demand response (short-lived measures)
  - More important for renewable energy projects (PVs)
  - Reflected in duration (lifetime) of GHG emission credits

Evaluation Approaches and Methods (1)

- **Impact evaluation**
  - Gross and net energy savings; peak demand savings
  - Protocols: California, US EPA, National Action Plan for Energy Efficiency (NAPEE), International Energy Agency
  - Methods: stipulated savings, billing analysis, or building simulations
  - Demand response
    - Time period of analysis is shorter (hourly) and specific impacts vary by temperature, weather, day of week, time of day, location, type of system emergency, etc.
  - Renewable energy
    - Energy production; methods are the same as for energy efficiency; more emphasis on capacity (kW) savings
  - Climate change
    - Similar to energy efficiency; emissions calculated:
      - Default emissions factor
      - Utility dispatch model
      - Something in between

Evaluation Approaches and Methods (2)

- **Market effects evaluation[1]**
  - Energy and demand savings associated with changes in the market that are induced by sets of program interventions
  - CA M&E protocols: Market Effects Protocol
  - Logic models and market theory are useful for:
    - Guiding the market effects evaluation (also used in process and impact evaluations)
    - Developing a list of indicators
    - Identifying market infrastructure development needs that can contribute to program success
    - Identifying barriers limiting program success
    - Identifying program design and implementation strategies that are market focused

Evaluation Approaches and Methods (3)

- **Market effects evaluation [2]**
  - Market indicators
    - Awareness
    - Intention to purchase
    - Stocking practices
    - Product availability
    - Prices
    - Willingness to invest
    - Sales
    - Value of carbon credits

Evaluation Approaches and Methods (4)

- **Process evaluation**
  - Identify improvements or modifications to a group of programs, individual programs, or program components
    - Helpful for identifying training needs and understanding behaviors, barriers, participants, and non-participants
  - Focus: efficiency and effectiveness
  - Logic models and program theory are useful
    - Examination of social and behavioral issues
  - CA M&E protocols: Process Evaluation Protocol

Evaluation Protocols

- For measuring, verifying, and reporting energy efficiency and demand savings, renewable energy generation, and GHG emissions reductions
- International: US DOE/Efficiency Valuation Organization - International Performance Measurement Verification Protocol
  - Energy efficiency - building focus
  - Renewable energy - project focus
- National:
  - NAPEE: Model EM&V Guidelines - program focus & climate change
- Regionally: New England ISO
  - Energy efficiency and demand response - program focus
- State: California PUC
  - Energy efficiency - program focus
  - Demand response - program focus - under development

Breaking Down the Silos (1)

- Evaluation issues, methods, rules are being addressed in multiple policy arenas or regulatory proceedings ("silos")
- Regulatory policies are needed for integrating energy efficiency programs with demand response, renewable energy, and climate change mitigation, but difficult:
  - Inertia, due to many challenges & barriers; many stakeholder groups ("political parties"):
    - Differing interest levels
    - Power, budget, and control issues
    - Cultural differences (example: air quality and energy efficiency)

Breaking Down the Silos (2)

- Climate change as the driving force
  - Converting savings from energy efficiency, demand response, and renewable energy programs to GHG emissions reductions
    - Methods
    - Value of GHG emissions reductions in cost-effectiveness tests
    - Who owns the credits from reducing GHG emissions?

Breaking Down the Silos (3)

- Collaboration and coordination between different policy arenas
  - Energy efficiency and renewable energy
    - Program and building level: Zero energy new homes (ZENH)
    - Policy level: (1) builders of solar homes must exceed the current California's energy efficiency standards by 15% (New Solar Homes Partnership); (2) energy efficiency resource standards and renewable energy portfolio standards; (3) allocation of public benefits funds for energy efficiency and renewable energy
    - Corporate level: all existing customers must have an energy efficiency audit if applying for a solar incentive
    - Market level: development of markets for tradable energy saving certificates (ESCs) and renewable energy certificates (RECs)

Breaking Down the Silos (4)

- Collaboration and coordination between different policy arenas
  - Evaluation frameworks (e.g., NYSERDA)
    - Energy efficiency, demand response, and renewable energy
    - Impacts, efficiency and effectiveness of program implementation
    - Economic impact and cost-effectiveness of programs
    - Progress in transforming markets
    - Progress towards policy goals
  - Customer services (e.g., PG&E)
    - Package services in the following order: energy efficiency, demand response and renewable energy
    - Carbon offset program ("Climate Smart")
  - Local government & sustainable cities (e.g., Chula Vista)
  - Regional planning organizations & integrated resource planning to reduce carbon dioxide footprint of power systems (e.g., Northwest Power and Conservation Council)

Conclusions

- Breaking down the silos - reasons for hope:
  - Energy efficiency EM&V protocols are being expanded to address demand response, renewable energy, and climate change mitigation programs
  - Policy mechanisms are being developed for integrating the different programs
  - Utilities, local government, regional government are addressing this issue
  - The private market may force the issue

- Key challenge: who will make the final decisions on key policies and technical issues at the state, regional, federal, and international levels, and how will these policies and agreements be coordinated?

- Policy regulatory environment challenges:
  - Comprehensive methodology for evaluating all of the programs
  - Unified set of policy rules
  - Allocation of benefits and costs across activity areas

Final Comment

A more coherent and cohesive strategy for fostering the integration of these policy arenas is needed for responding to the threat of climate change and for creating a more sustainable society.

Time for Questions