Energy+Environmental Economics

Rate Design Options for Demand Side Management: Energy Efficiency and Climate Perspectives

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Agenda

Topics

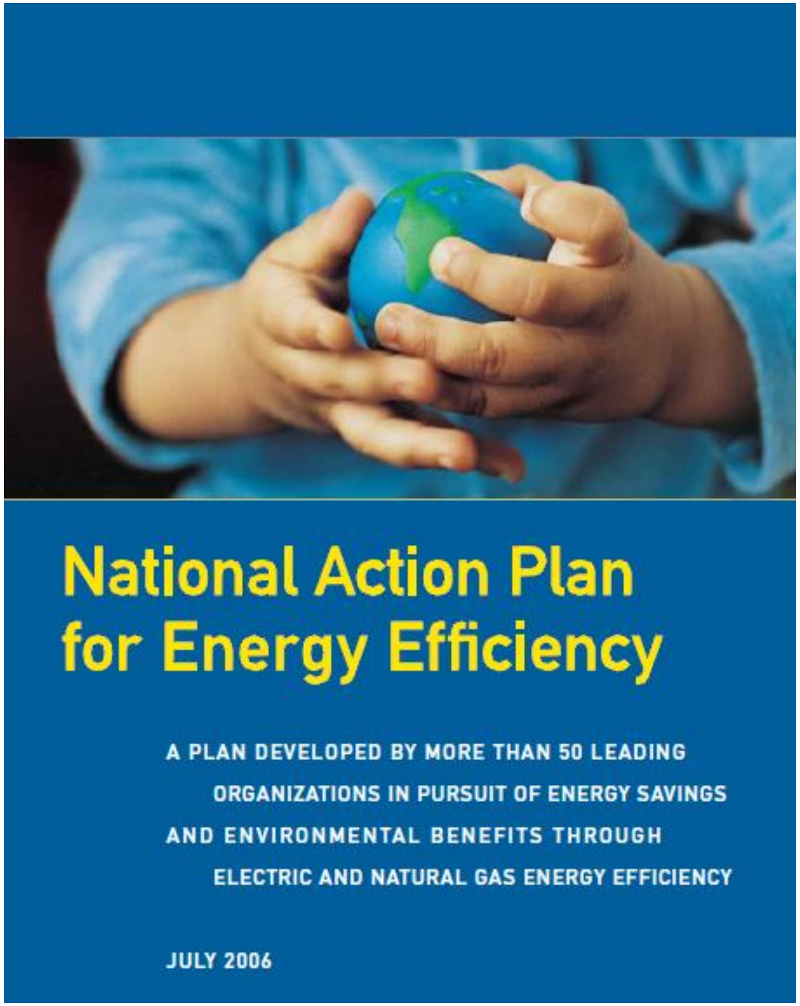
- National Action Plan for Energy Efficiency Rate Design Briefs
- Climate Perspectives on Rate Design

Questions

- What rate options promote energy efficiency and conservation?
- What are the non-tariff methods for promoting energy efficiency and conservation?
- What are the impacts on greenhouse gas emissions from different options?

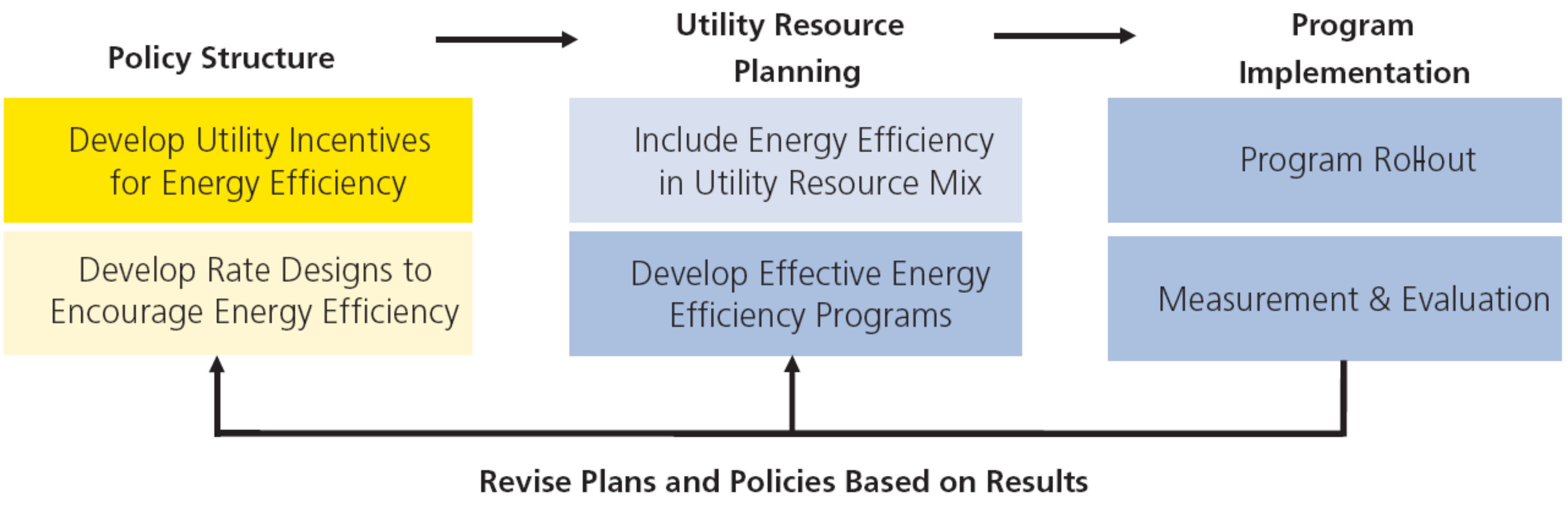
National Action Plan for Energy Efficiency (Action Plan)

- A public-private initiative to create a sustainable, aggressive national commitment to energy efficiency through the collaborative efforts of gas and electric utilities, utility regulators, and other partner organizations.
- Leadership Group includes more than 60 participants
- Facilitated by the EPA & DOE
- E3 authored Chapter 5, “Rate Design”, of the Action Plan



The Role of Rates in the Overall Process for Energy Efficiency

Timeline: Actions to Encourage Greater Energy Efficiency

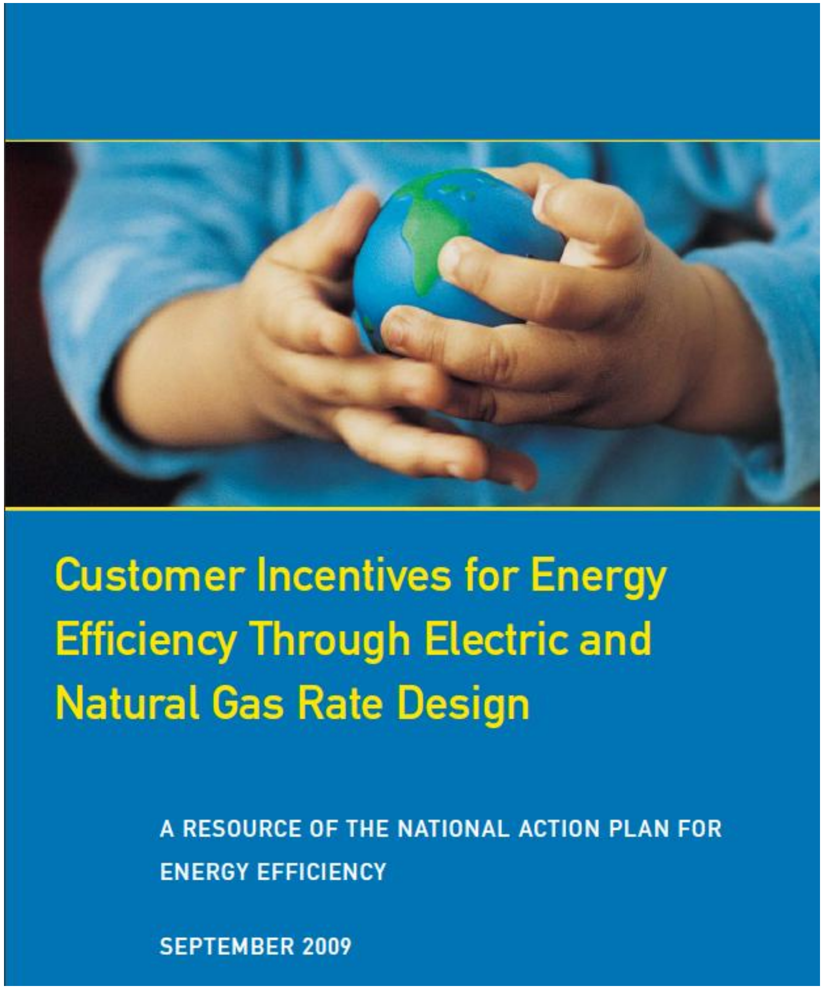


National Action Plan for Energy Efficiency and Rate Design

- National Action Plan for Energy Efficiency (Action Plan) identified barriers and policy options to reduce energy consumption
- Rate design identified as a tool for promoting energy efficiency
  - 2006 consensus recommendation "…modify ratemaking practices to promote energy efficiency investments."
  - Action Plan Vision Goal 7 encourages utilities and PUCs to align customer pricing to encourage investment in energy efficiency
- **Rate design for energy efficiency identified as area of minimal state progress to date**

Customer Incentives for Energy Efficiency Through Electric and Natural Gas Rate Design Briefing

- Released September 2009
  - Prepared by ICF Consulting
  - Builds from E3 rate design chapter
  - Reflects review and comment by diverse Leadership Group
- Discusses key issues and concepts specific to rate design and motivating customers to save energy



Overarching Findings

- Encouraging energy efficiency is one of many business and policy goals in ratemaking
- Utilities and regulators should examine rate approaches to encourage efficiency, while pursuing non-price approaches.
- High rates and prices **alone** are not likely to overcome the well-documented barriers to cost-effective energy efficiency
- Price transparency and ability for customers to understand their rates and energy usage are important elements of providing customer incentives through rate design

Fundamental Rate Design Issues

- Rate design must balance numerous goals such as
  - Recovery of revenue requirements,
  - Fair apportionment of costs,
  - Economic efficiency,
  - Rate and revenue stability,
  - Social equity, and
  - Simplicity
- Many jurisdictions do not include promotion of energy efficiency among those goals.
- Recovery of revenue requirements can dominate

Rate Design forms that discourage energy efficiency

- Rate designs such as declining block rates focus on encouraging sales.
  - Consistent with economies of scale of the past and reducing the average energy rate.
- Declining block rates shrink the bill savings that customers could achieve from reducing energy usage.
- Large fixed charges (ie. $/customer-month) also discourage energy efficiency because customer cannot reduce that portion of their bill.

Rate Designs to Promote Energy Efficiency

If energy efficiency is the goal, use a rate design that aims to reduce total kWh.

- Residential inclining block rates
  - Have per-unit prices that ↑ as consumption ↑
  - Provide lower bills to small low income customers while encouraging reduced usage from the large users.
- Commercial two-part rate
  - Historic consumption at the existing rate
  - Consumption deviation at a rate that tracks rising marginal cost.
  - No consumption change, no bill impact
  - Can be complex to implement

Other Rate Design Forms

- TOU Rates
  - Higher on-peak prices and lower off-peak prices encourage on-peak efficiency and shifting energy use off-peak
- Dynamic Rates (RTP, CPP, Non-Firm)
  - Complementary to energy efficiency, but more useful for demand response
  - Have delivered energy use reductions under specific, short-term conditions, although long-term impacts remain uncertain
- Demand Charges
  - Can target reductions for specific end uses, but generally less favorable for energy efficiency than volumetric charges.

How Might Rates Incent Customer Energy Efficiency?

- Effective rate designs can incent customers to pursue EE by
  - Reducing perceived payback period
  - Providing clearer and more timely energy use and price information
- Providing a short payback period with high degree of certainty to consumers can help remove a key financial barrier
  - Requiring a short payback is just one key barrier to energy efficiency*
- Response to prices vary by customer type and end use

* For more information on barriers, see additional Action Plan documents (full report, Vision for 2025, Sector Collaborative on Energy Efficiency) and McKinsey's *Unlocking Energy Efficiency in the U.S. Economy* Report.

Customer Classes Respond Differently to Prices

- Key factors behind customer type differences:
  - Ability to prioritize energy cost control and invest in energy efficiency
  - Ability to get usage and rate information that enables them to connect energy usage with total bill effects
  - Availability of technical options to change usage
  - Inelasticity when energy is used to provide an essential service
  - Additional persistent market barriers to energy efficiency
- Estimate price elasticities by customer type and location:
  - Residential and small business are typically seen as less price-responsive than larger commercial and industrial.
  - Study continues on magnitude of elasticity effects and differences between short and long-term elasticities

Customer Incentives and Utility Perspectives of Different Rates (1)

Rate/Price Type	Customer Type	Customer Incentive for Total Savings	Customer Incentive for Peak Savings	Financial Risk to Utility	Financial Risk to Customers
Fixed Rate Options					
Flat Rates	All	Moderate	Low	Moderate	Low
Inclining Block Rates	All	High	Moderate	Moderate	Moderate
Seasonal Rates	All	Moderate	Moderate	Moderate	Moderate
TOU Rates	All	Moderate	High	Low	Moderate
Declining Block Rates	All	Low	Low	Moderate	Low
Bill adder/surcharges	All	Low	Low	Low	Moderate
Demand charges	Com/Ind	Moderate	High	Low	Moderate
SFV rates	All	Low	Low	Low	Moderate
Flat/fixed bill rates	Res/Com	Low	Low	Moderate	Low

Customer Incentives and Utility Perspectives of Different Rates (2)

Rate/Price Type	Customer Type	Customer Incentive for Total Savings	Customer Incentive for Peak Savings	Financial Risk to Utility	Financial Risk to Customers
Variable Rate/Dynamic Pricing Options					
Critical Peak Pricing	Res/Com	Moderate	High	Low	High
Peak Time Rebate	Res/Com	Moderate	High	Low	Low
Variable Peak Pricing	Com/Ind	Moderate	High	Low	High
Real-time Pricing	Com/Ind	Moderate	High	Low	High
Blended Fixed and Variable Rate Options*					
	All	Moderate	Moderate	Low	Moderate

* Emerging blended rate options are mainly unregulated price options for generation only.

States are Taking Action on Electricity and Natural Gas Rates and Pricing

Table 2. Summary of State Actions on Electricity and Natural Gas Rates

	States That Have Taken Electricity Rate Action	States That Have Taken Natural Gas Rate Action
Impact on energy efficiency a consideration when designing retail rates?	AZ, CA, IA, ME, NY, OR, WI	IA, NY
Declining block/fixed-variable rates eliminated?	CA, ID, OR, VT, WI	
Time-sensitive rates in place?	AL, CA, CT, DC, DE, GA, IA, ID, IL, KY, MD, MI, MN, MO, ND, NM, NV, NY, OK, SD, TX, VT, WI, WY	IL, NM
Usage-sensitive rates in place?	CA, DC, DE, MD, OR, VT	

Source: Supporting data used in National Action Plan for Energy Efficiency (2008a).

Note: Table 2 reflects state actions through December 31, 2007, as compiled in support of the Action Plan's Vision measuring progress efforts. See Appendix D of the Vision 2025 report (National Action Plan for Energy Efficiency, 2008a) for more information on this methodology.

Other Ways to Promote Energy Efficiency

- Tariff savings are not the only economic tools for a utility to encourage energy efficiency.
  - Discount for efficiency (California's 20/20 program)
  - Benefit sharing (payment for a specific action)
  - On-bill financing (reduce or eliminate up-front costs for customers)
- Fund best practice energy efficiency programs
- Emerging technologies and programs have been shown to also increase customer savings
  - Energy information to customers

Overall Recommendations and Options

- Modify ratemaking practices to promote energy efficiency
  - Include energy efficiency as a rate design goal
  - Eliminate rate designs that discourage energy efficiency
  - Adopt designs that encourage energy efficiency and consider customer class characteristics
  - Partner rate design changes with other bill mechanisms such as on-bill financing
- Price transparency and ability for customers to understand their rates and energy usage are important elements of providing customer incentives through rate design

Guiding Principles for Implementation

- Many issues are driving changes to rates (rising supply prices, smart grid, new efficiency policies)
- Three key guiding principles on changing rates for energy efficiency:
  - Incremental vs. radical changes can be effective
  - Implementation should keep focus on rate design policy goals
  - Communicate actively with key stakeholders
- Key elements of proceeding to explore new rate and pricing plans
  - Documenting expected customer response and net impacts
  - Documenting benefits and costs on short and long-term basis
  - Balancing customer equity and stakeholder interests
  - Staging / pilots

Future Needs Identified

- Additional and more consistent data on emerging rate and pricing options and their effect on long-term total energy consumption
  - Including dynamic pricing options, such as real-time pricing, critical peak pricing, etc.
- Assessing the limits of rates to achieve desired energy efficiency levels, maintain political acceptance, and meet other ratemaking objectives.
- More reliable methods for projecting the longer-term impacts of rate and pricing designs on load forecasts, so as to better incorporate their effects into resource plans.
- Better understanding of behavioral energy efficiency, including how to evaluate their energy savings

Additional Action Plan Resources

- All Action Plan documents are available at www.epa.gov/eeaactionplan
- In addition to the rate design briefs:
  - For energy efficiency programs information - See “Customer Incentives through Energy Efficiency Programs”
  - For utility motivations information - See “Aligning Utility Incentives with Investment in Energy Efficiency”
  - For comprehensive policy framework for EE – See Vision for 2025

Climate Perspectives on Rate Design

Residential Green Pricing

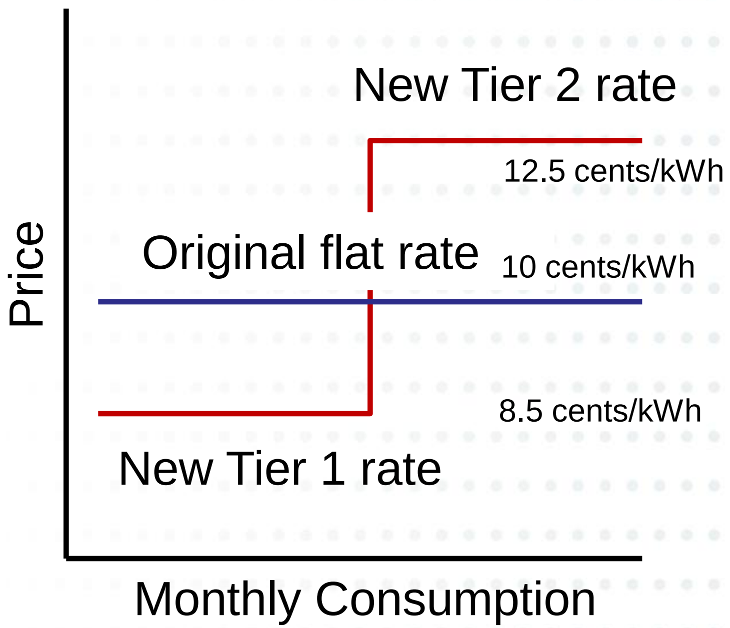
- **Inclining block rates are an underutilized tool for promoting energy efficiency & conservation**
- **E3 developed rates that promote energy efficiency for BC Hydro**
  - Inclining block rates for residential
  - Two-part rates for general service customers that incorporate inclining block rate structures
- **Orans et al. * estimate 1-2 % potential of GHG savings in U.S. possible while maintaining revenue neutrality**

* Orans, R., et al., "Inclining for the climate: GHG reduction via residential electricity ratemaking" Public Utilities Fortnightly 2009
Orans, R., et al., "A Modest Proposal: After Cap and Trade" Published on Brookings

Example Calculation of IBR

- **Rate Characteristics**
  - Original Flat Rate: 10-cents/kWh
  - Hypothetical IBR: Tier 1 15% lower, Tier 2 25% higher
  - Tier 1 quantity = 1000 kWh
- **Two customers: 667 kWh & 2000 kWh**
- **Flat rate revenue: (667+2000)kWh x $0.10/kWh = $267**
- **IBR revenue: 1667 kWh x $0.085/kWh + 1000 kWh x $0.125/kWh = $267**

Two-Tier Inclining Block Rate Design



Additional Characteristics of Inclining Block Rates

Benefits

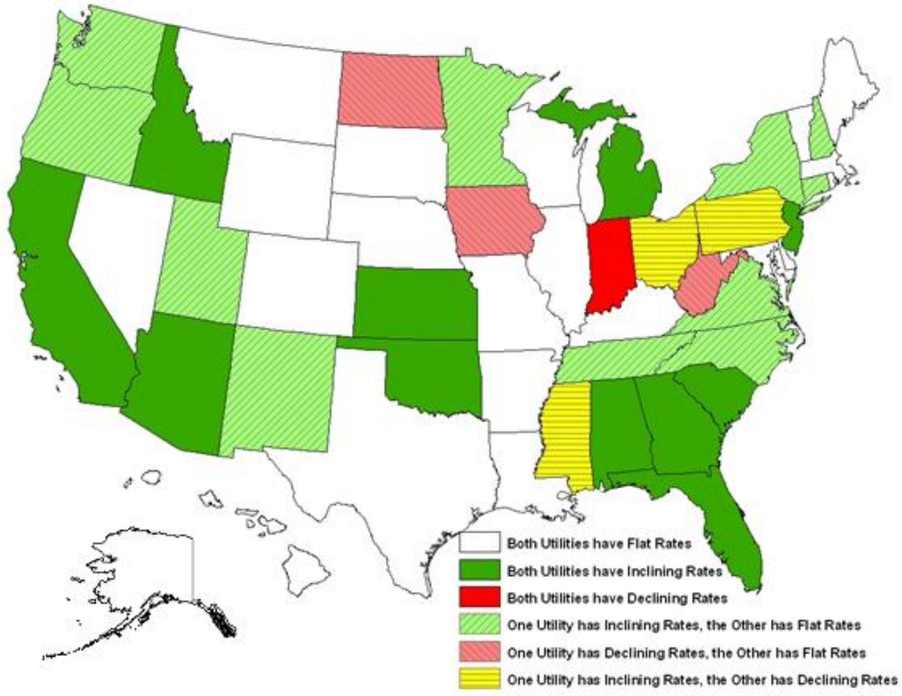
- Promotes efficient consumption
- Sends correct price signal in a rising marginal-cost environment
- Assigns higher proportion of costs to large customers who bear greater responsibility for increasing costs
- Easy to understand & implement
- Consistent with accepted criteria for utility ratemaking

Drawbacks

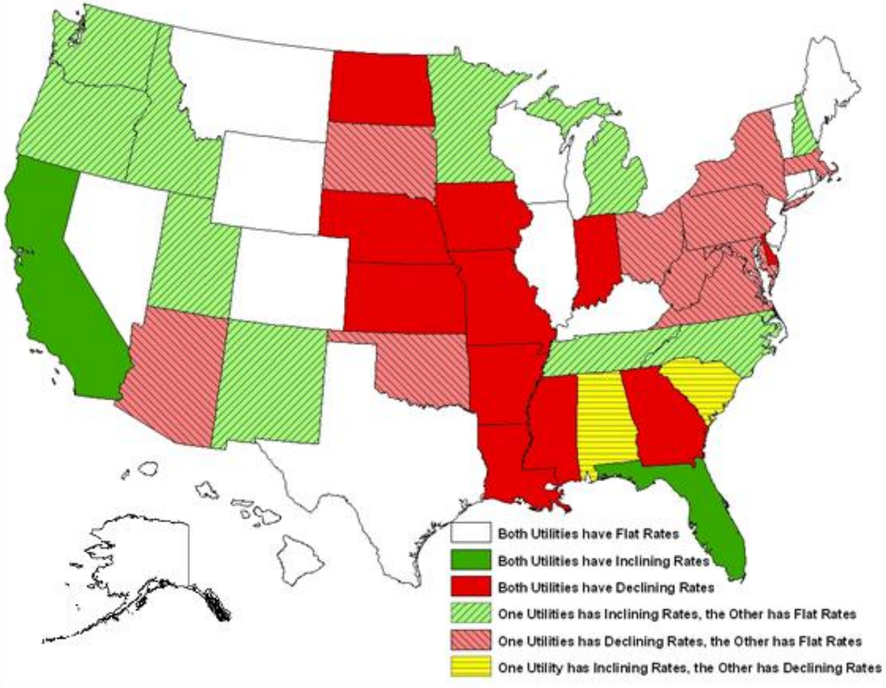
- May result in less stable bills, compared to flat rate
- Large bill spikes can be mitigated by optional payment plan that smoothes large bill fluctuations
- Possible objection in some places because of need to maintain affordable electric space and water heating for low-income customers
- Can be mitigated with larger Tier 1 block for customers with electric heating

Rates in the States

Summer residential rate structures



Non summer residential rates



This rate design map is based on the authors' review of the residential tariffs of the two largest energy providers, in terms of residential sales, in each of the 50 states, plus Potomac Electric Power in the District of Columbia. The top two providers of residential energy in each state are based on the data from the U.S. Department of Energy, Energy Information Administration (EIA). This review is not exhaustive, but in many cases the top two providers of residential energy in a state serve a significant portion of that state's residential load. The utilities reviewed account for 57 percent of total U.S. residential electricity consumption. Moreover, other providers in the state often have residential rate structures similar to those of the top two providers. Thus, the review provides a reasonable representation of the geographical dispersion of residential rate structures in the United States.

Opportunity for Savings

+ **Jurisdictions with flat or declining block rates serve ~ 350 TWh/year of residential load (using EIA data)**
  - Excludes sales by utilities that use IBR in any portion of year
  - Sales by utilities not in sample
+ **Assume jurisdictions adopt simple two-tier IBR 15% lower for Tier 1 and 25% higher for Tier 2**
+ **Small users (1000 kW and below) facing Tier 1 have short term price elasticity of -0.05; larger users facing Tier 2 have -0.1 (elasticities are conservative)**
+ **Estimated savings ~ 6 TWh in the first year, 1.7% savings in total sales**

Savings In Perspective

- **Equivalent to ~ 4 MMTCO2 savings (at 0.67 Ton/MWh) in the first year**
  - ~1% of what's required to reduce electric sector's CO2 emissions to 1990 levels
  - Conservative estimate: savings would double if calculation was expanded to utilities not in review
  - Faruqui (2008) estimated savings of ~1-20% from IBRs*
- **May seem small but significant when ease of implementation is considered**
  - No new technology is required, though technology will improve the savings realized
- **Where marginal cost is high, upper-tier rates will be higher than assumed here, spurring greater savings (e.g., PG&E has upper tier of nearly $0.30/kWh)**

* Faruqui, A. "Inclining Towards Efficiency", Public Utilities Fortnightly, August 2008.

Emissions Reductions Perspective on Rate Design Changes

- **Regional and local conditions impact GHG emissions reductions from rate design**
  - Not all peak reductions = emissions reductions
  - Driven by differences in generator type and dispatch curve*
- **Key questions for PUCs Exploring Rate Design**
  - How do on-peak and off-peak emissions changes compare?
  - Will the rate design changes maximize year-round reductions?
  - Will rate design change encourage clean distributed generation?
  - Will the benefits from rate design changes help lower cost of compliance to upcoming environmental regulations?

* Source: Stephen P. Holland and Erin T. Mansur's "IS REAL-TIME PRICING GREEN? THE ENVIRONMENTAL IMPACTS OF ELECTRICITY DEMAND VARIANCE" The Review of Economics and Statistics, August 2008, 90(3): 550–561.

Additional Resources

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