

*The Brattle Group*

# The Rediscovery of Demand-Side Management

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TVA Board of Directors Meeting  
Monteagle, Tennessee

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# Demand-Side Management (DSM) today

- ◆ The Institute of Electric Efficiency estimates that utility-run DSM programs saved 112 million kWh nationally, sufficient to light 10 million homes in 2010
- ◆ There was a 21% jump in kWh saved over 2009 levels, largely due to higher spending on energy efficiency
  - Energy efficiency spending totaled \$4.8 billion, an increase of 28% over previous year
- ◆ The Midwest saw the biggest growth, followed by the Northeast, the South, and the West

# DSM at TVA

**TVA's vision revolves around six strategic focus areas, one of which is a desire to be “one of the lowest cost power providers in the region and the nation” and another one of which is to lead “the Southeast in energy efficiency”**

**TVA's rates are in the second quartile today and there are several factors at work which are exerting upward pressure on rates**

**In the near term, DSM usually raises rates**

**How should TVA proceed?**

# Outline

**History of DSM Programs**

**DSM Potential**

**DSM Financing Mechanisms**

**Frequently Encountered Objections**

**Role of Smart Meters**

# Outline

## **History of DSM Programs**

## DSM Potential

## DSM Financing Mechanisms

## Frequently Encountered Objections

## Role of Smart Meters

# The Pre-DSM era (through the 1960s)

- ◆ Utilities built capacity to meet demand, relying on forecasts, which were often made with a ruler and double-log paper
- ◆ Classic load management programs were used to preserve system reliability
  - These included direct load control of certain residential appliances such as water heaters and air conditioners and interruptible and curtailable rates for commercial and industrial customers

# Then came the oil shocks of the 1970s

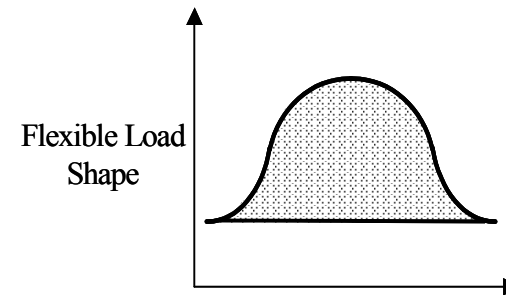
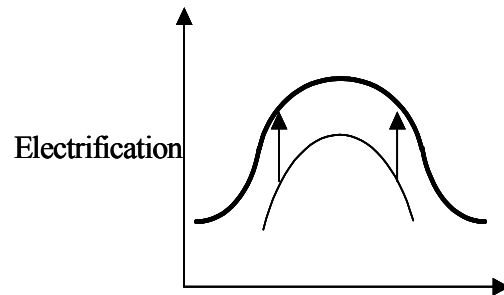
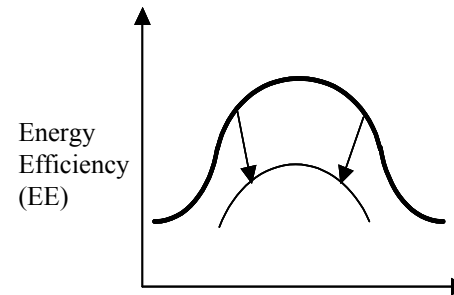
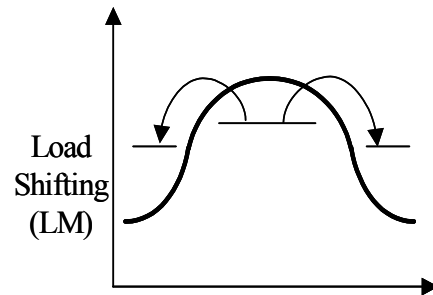
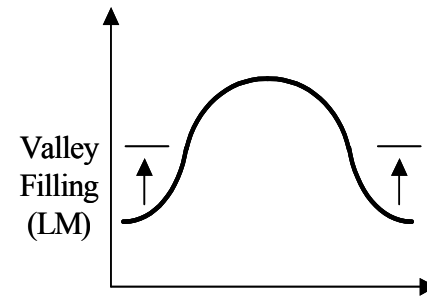
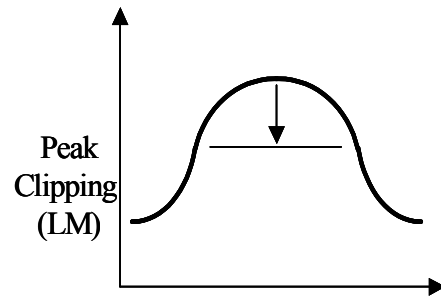
- ◆ Conservation programs were created in a hurry to minimize the use of imported oil
- ◆ They included informational messages, public appeals, energy audits, and home weatherization programs for residential customers and fuel switching programs for larger customers

# “DSM” was born in 1983

- ◆ At a conference room in the O’Hare Hilton, Chicago, during an emergency meeting of senior managers from EEI and EPRI
- ◆ It was designed to encompass a variety of customer-side activities including energy efficiency and load management, but also including beneficial electrification



# “Six days to Sunday”



# The first-generation programs (Mid-1980s to Mid-1990s)

- ◆ These programs emphasized cash rebates and low-interest financing to encourage customers to buy more efficient appliances and build more efficient buildings and industrial plants
- ◆ They were designed to change the demand-side of the electricity market in order to (a) better balance demand and supply, especially during critical times of the year, and (b) lower the customer's energy costs
- ◆ California developed a standard practice methodology for assessing the cost-effectiveness of DSM which was widely adopted by the other states

# Disenchantment with the “first-generation” programs

- ◆ These programs proved to be very cumbersome and not sustainable over the long haul
- ◆ DSM began to fall by the wayside as the industry restructured into generation, transmission and distribution companies
- ◆ Programs were redesigned to focus on less costly market transformation activities involving incentives and education for equipment manufacturers and builders and the enactment of government codes and standards
- ◆ They created cross-subsidies between participants and non-participants and required rate increases for all customers
- ◆ Utility shareholders were often left holding the bag as revenues and earnings fell

# The “second-generation” programs

- ◆ The power crisis in the Western U.S. in 2000/01 spurred great interest in introducing “demand response” into electricity markets, to prevent wholesale prices from rising exponentially and ruining the financial solvency of electric utilities
- ◆ Even a small amount of demand response would have helped contain the energy crisis in California
  - If real-time pricing had been offered to large commercial and industrial customers, peak demand would have fallen by 2.5 percent, resulting in a drop of 18 percent in wholesale market prices
- ◆ The crisis spawned the “second-generation” of DSM programs, which emphasized reductions in customer loads during critical times of low reliability or rising wholesale prices
- ◆ This crop of programs included (a) programs that involved cash payments to customers for demand and energy reductions during critical time periods (load curtailment) and (b) programs that involved variations in the price of electricity during critical time periods (dynamic pricing)

## California CPUC President Michael Peevey on why the state is pursuing demand response

"DR releases no air pollution, requires no imported fuel, kills no fish, pollutes no water supplies, requires no transmission lines and does not contribute to climate change and global warming. These are all benefits the state wishes to promote—in fact, the governor has a conference going on right this minute on this subject—and they are the reason that DR is at the top of the Loading Order [of Resources] with EE. Moreover, DR is becoming even more valuable to California because it helps us integrate clean, renewable energy resources."

# In the “third-generation,” now underway, the foundations of DSM rest on five pillars

1. Customer awareness, interest and engagement
2. Technological innovation
3. Codes and standards for appliances, buildings and machines
4. Energy price innovation
5. More sophisticated financial incentives

# Program types

## ◆ New rate designs

- Inclining block rates
- Dynamic pricing rates

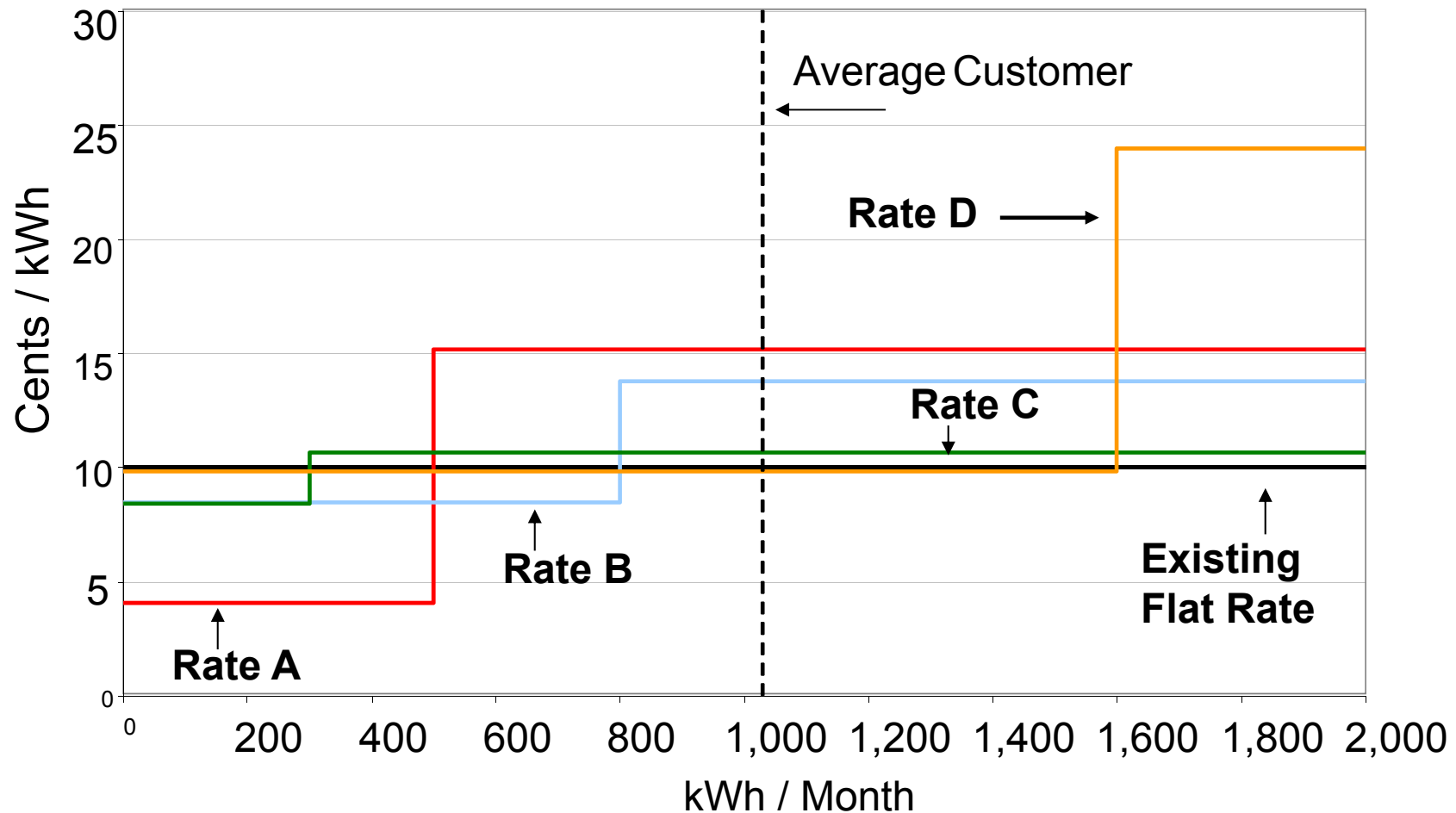
## ◆ Behavioral change programs

- Peer group comparisons
- Web portals

## ◆ Financing programs

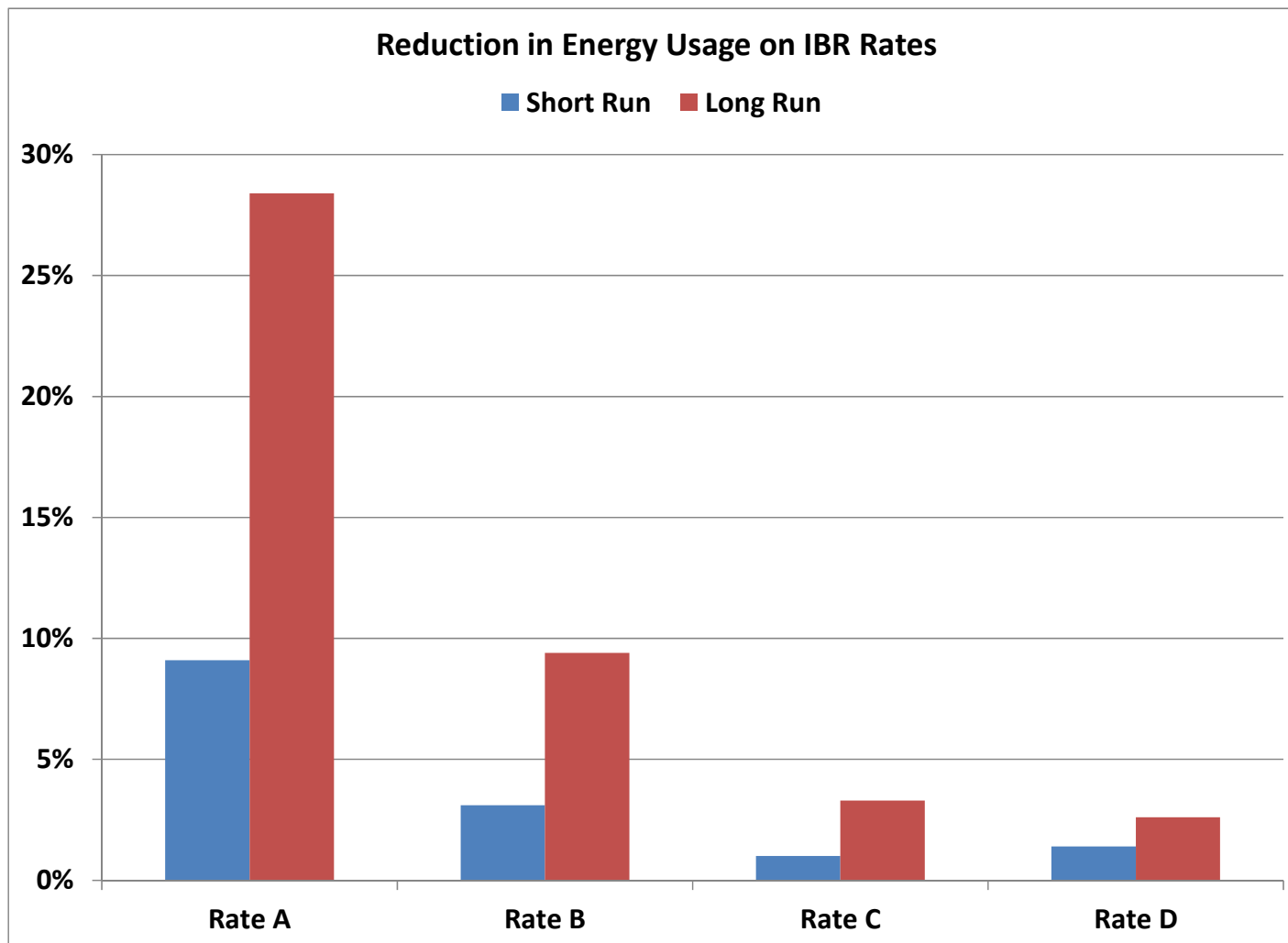
- Low interest loans and on-bill financing
- Rebates to end users
- Incentives to equipment manufacturers and builders

# Illustrative inclining block rate (IBR) designs



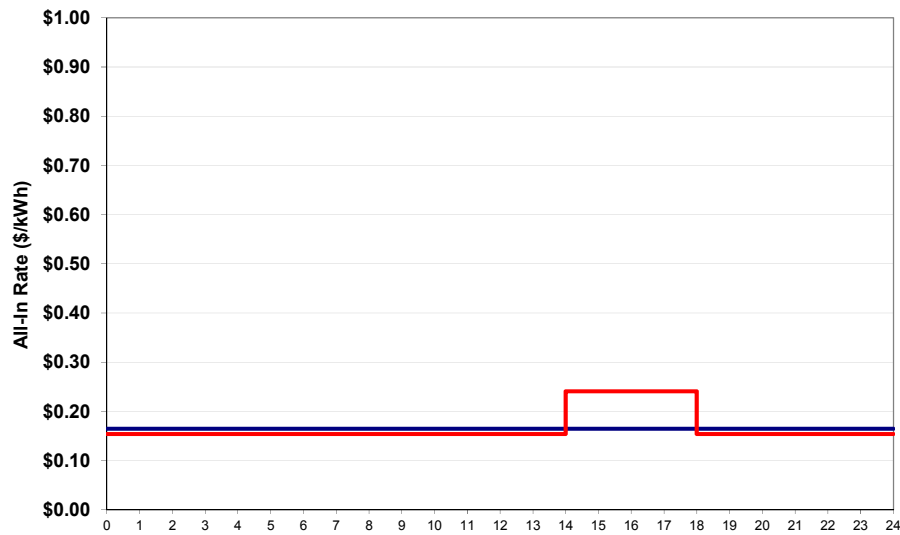


# Impacts of IBR designs

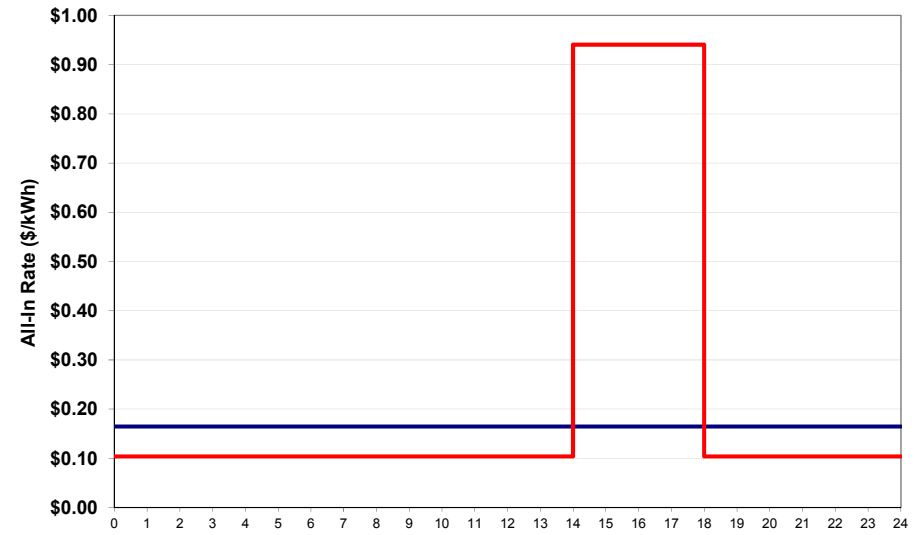


# Illustrative dynamic rate designs

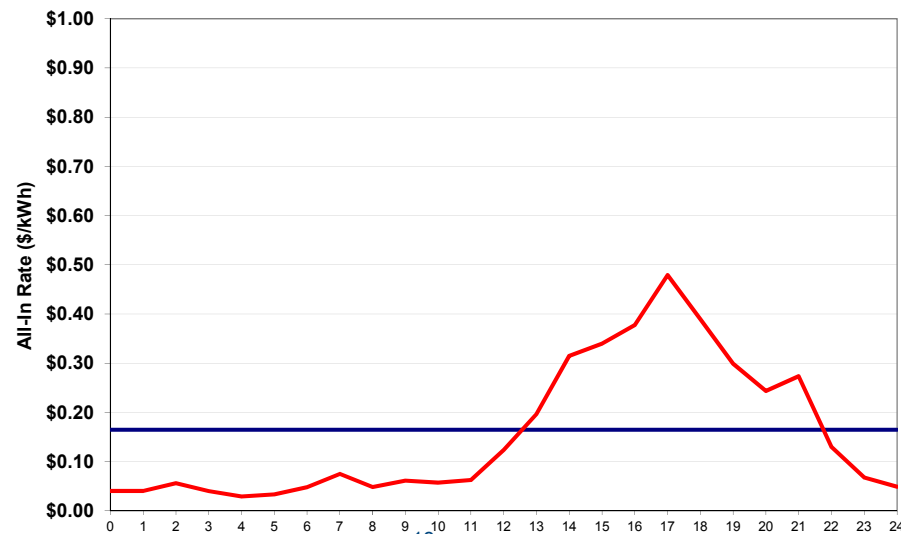
Illustrative TOU



Illustrative CPP

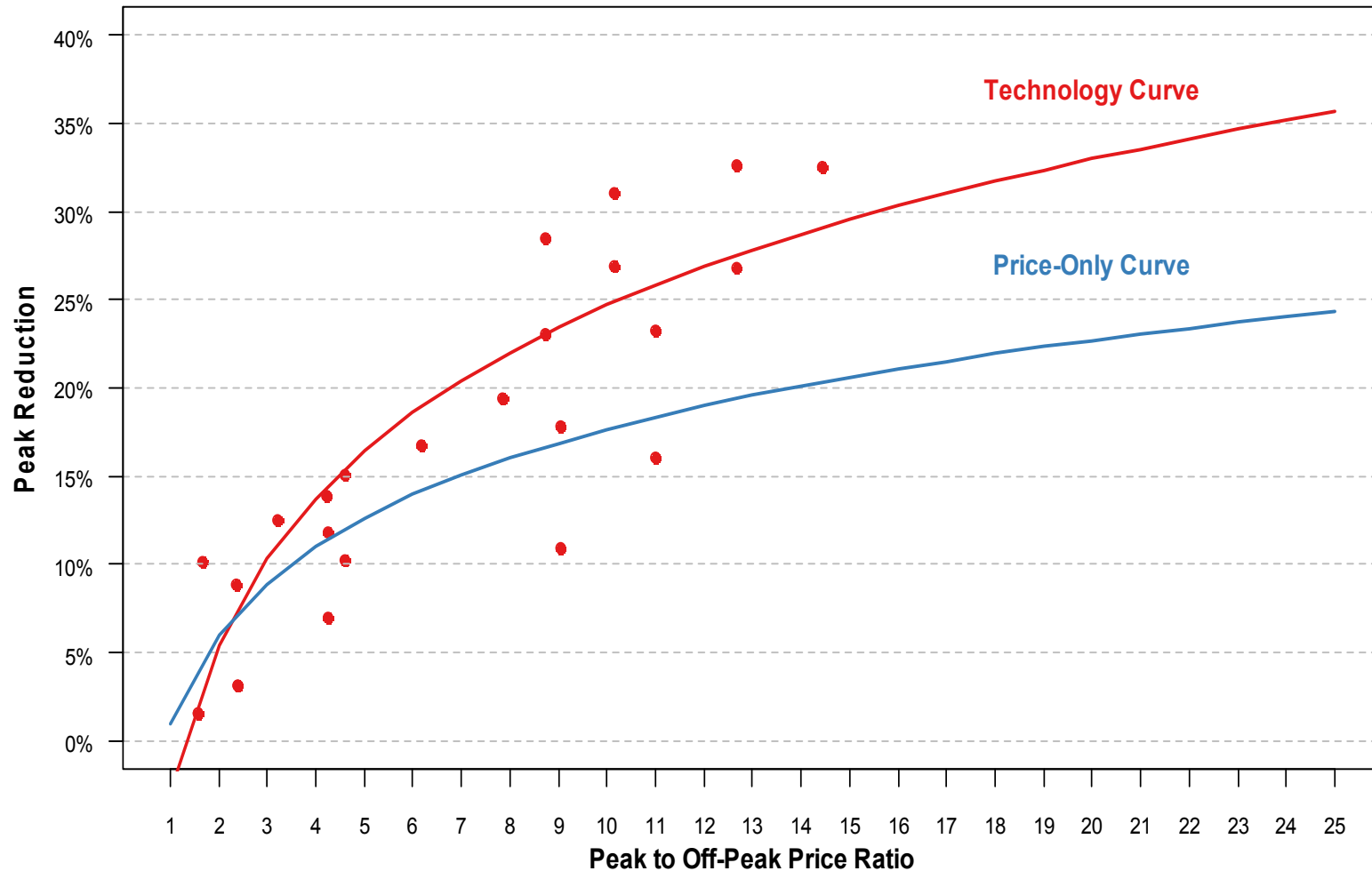


Illustrative RTP



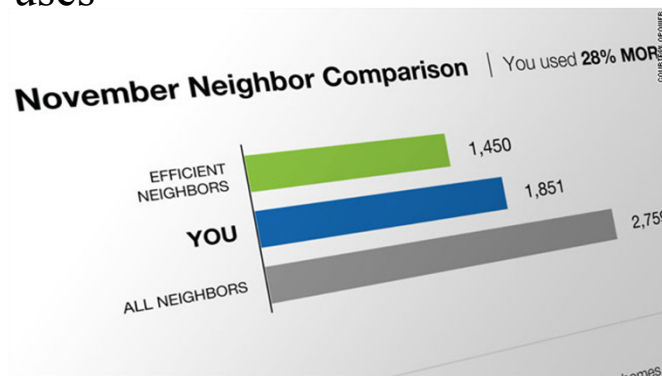
# Likely impacts of dynamic pricing rates

Pilot Results by Peak to Off-Peak Price Ratio  
Results with Enabling Technology



# Behavioral programs

- ◆ Bill comparisons with a group of peers sent through the mail with smiling faces and tips how to move up in the ranking
- ◆ Web-portals that provide you your load profile and a disaggregation to large end-uses
- ◆ In-home displays that show how much power you are using when and how much it is costing you
- ◆ Energy Orbs that signal expensive and inexpensive times to use energy



# Energy Efficiency (EE) financing programs are operating on a scale comparable to power plant construction

## ◆ Leading state examples

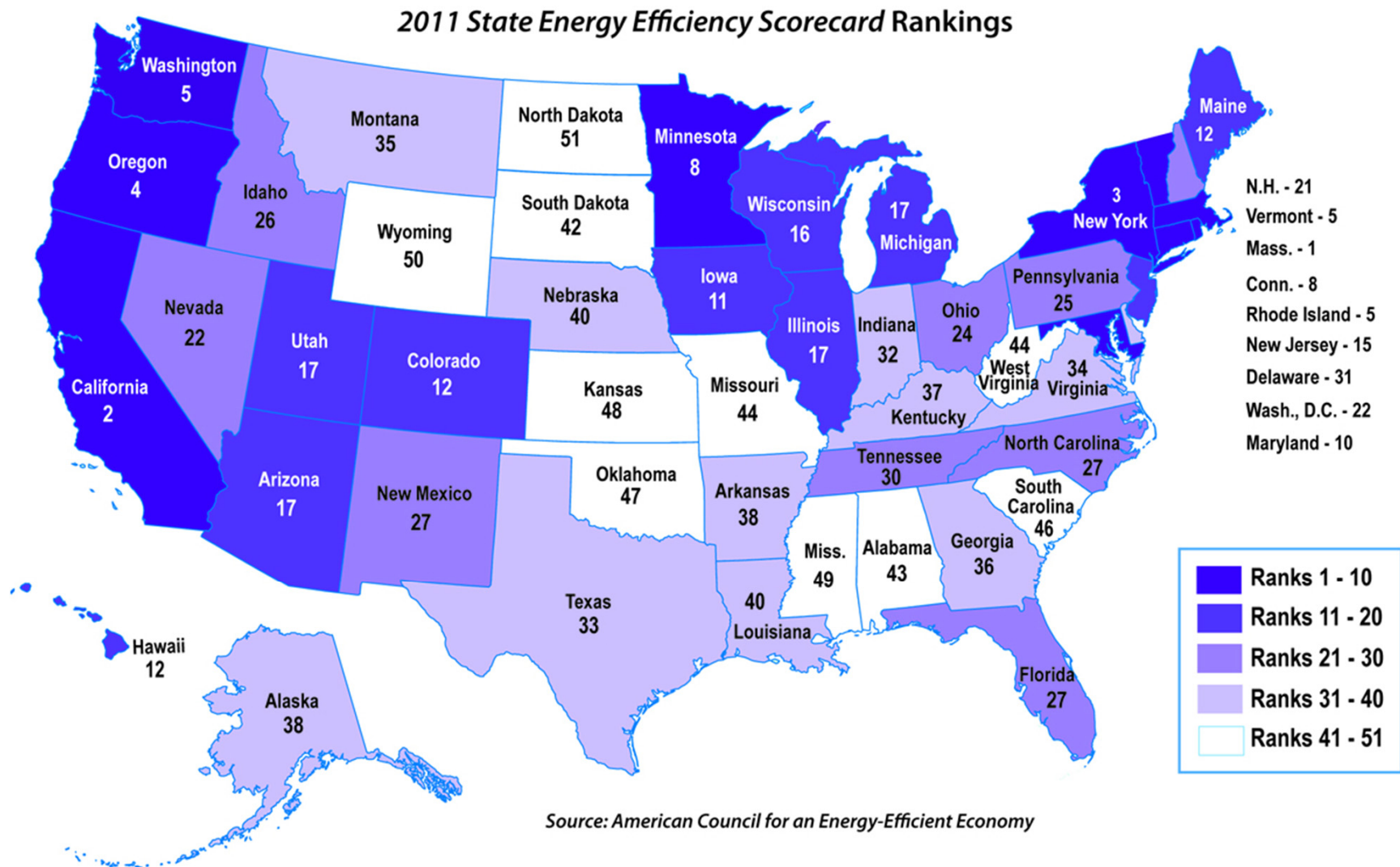
- The Northwest has saved about 4,500 MW (on average) over the past thirty years
- California has saved 500-600 MW annually over the past 5 years

## ◆ Ten states have EE programs on a scale large enough to displace power plants (saving an additional 0.4% to 1.0% or more of load each year)

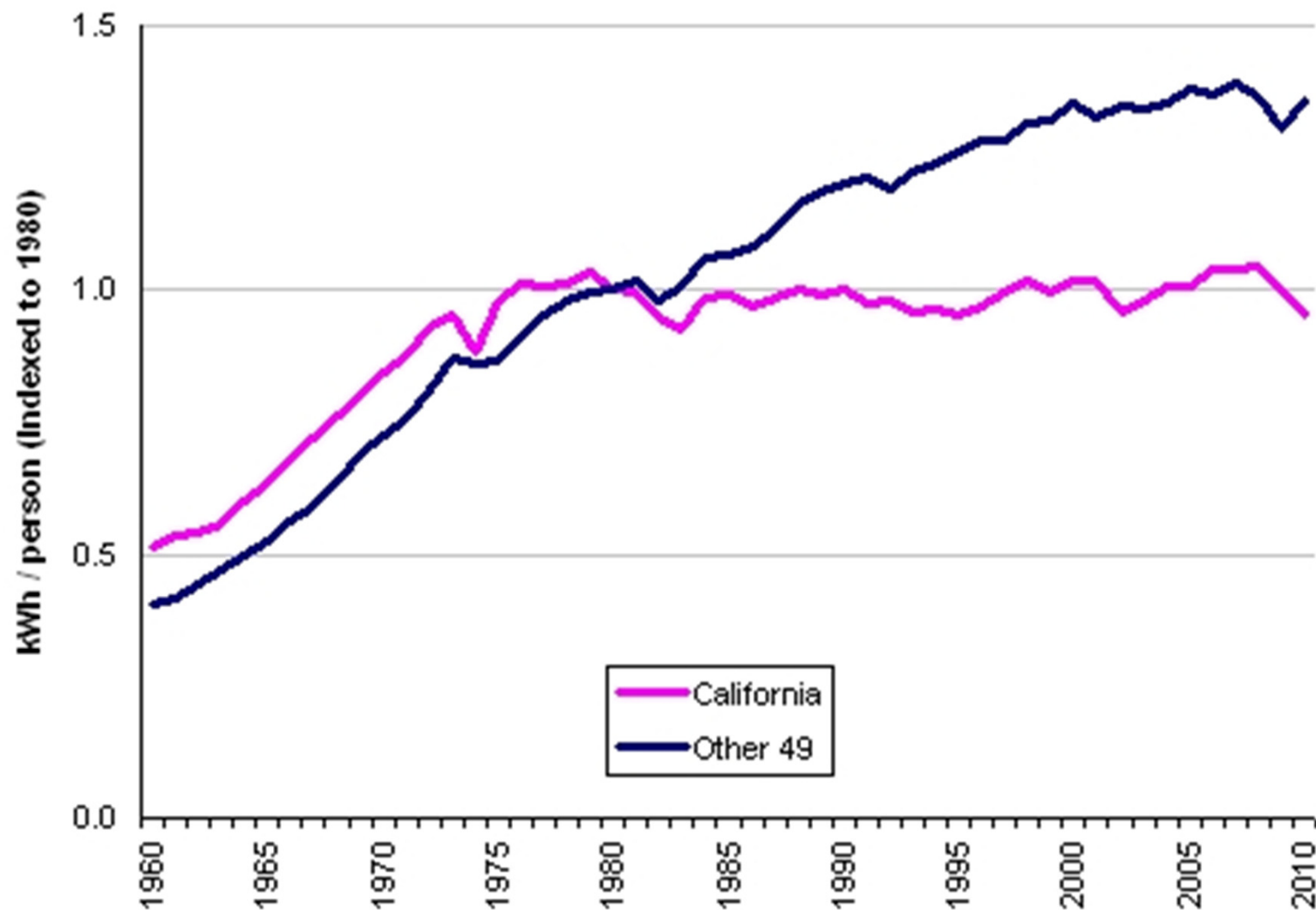
- California, Connecticut, Iowa, Massachusetts, Minnesota, New York, Oregon, Rhode Island, Vermont and Wisconsin

*Source: Ralph Cavanagh, Natural Resources Defense Council*

# Results vary greatly across states because of differences in regulatory mechanisms

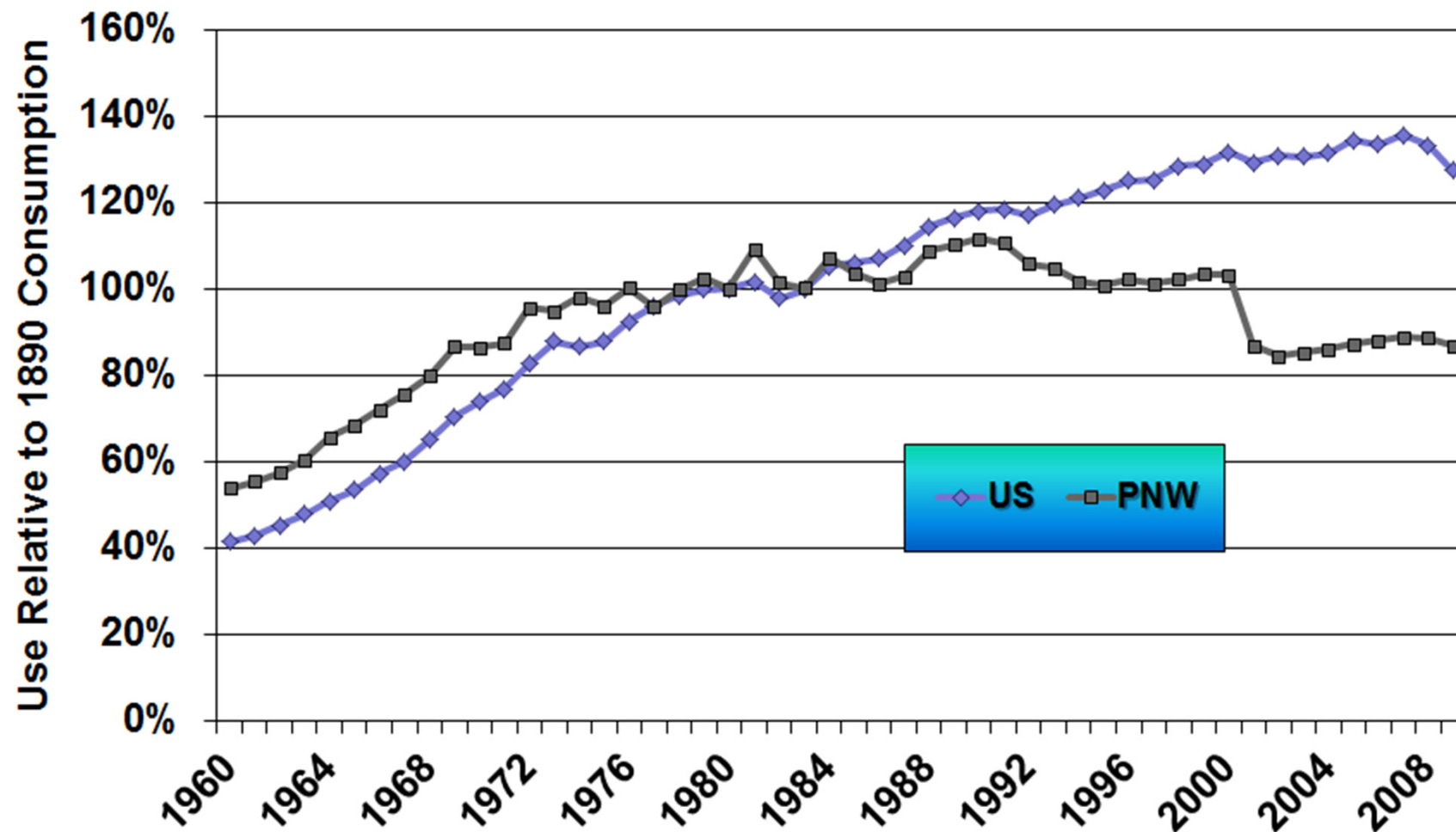


# California has demonstrated the viability of energy efficiency measures over many decades



Source: Sierra Martinez

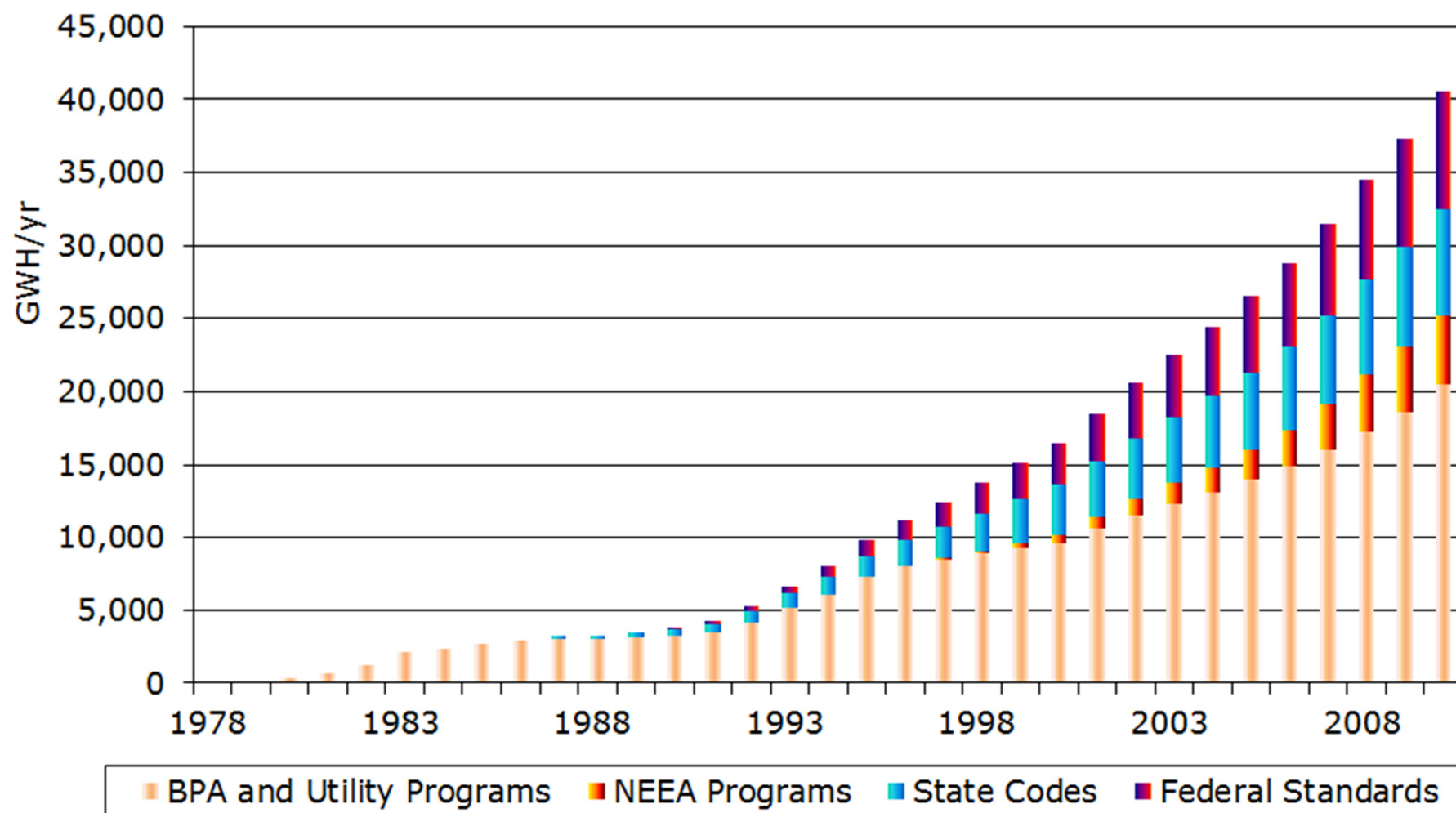
# The Northwest has also seen energy efficiency growth relative to the rest of the country



Source: Eckman, Tom. *In the PNW We Do More Than Plan!* September 27, 2011.



# State and federal standards account for a growing portion of the EE savings in the Northwest



Source: Eckman, Tom. *In the PNW We Do More Than Plan!* September 27, 2011.

# Outline

History of DSM Programs

**DSM Potential**

DSM Financing Mechanisms

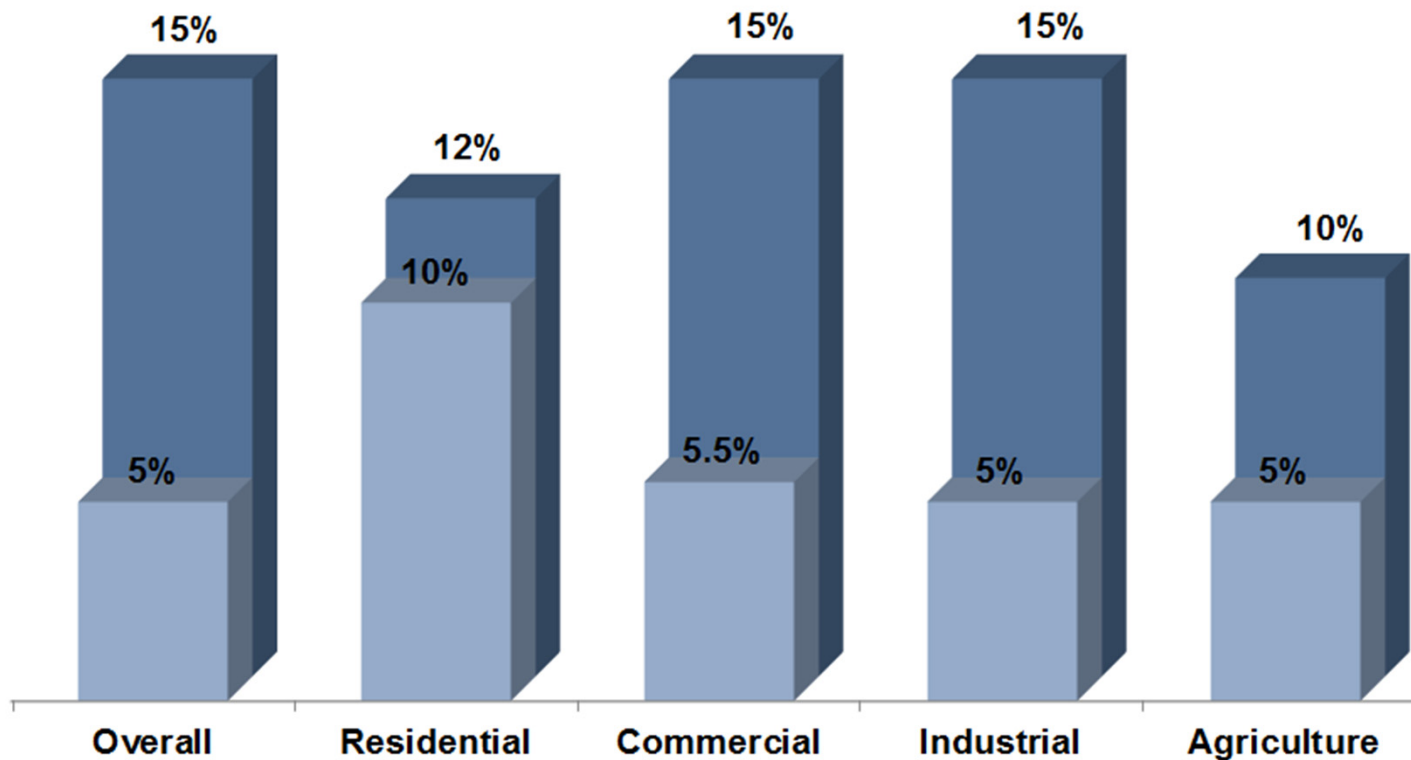
Frequently Encountered Objections

Role of Smart Meters

# A survey of 50 experts shows that energy efficiency is likely to have a big impact by 2020

## Electric Energy Efficiency Savings Forecast

*Reduction in electricity consumption from EE, relative to baseline forecast*

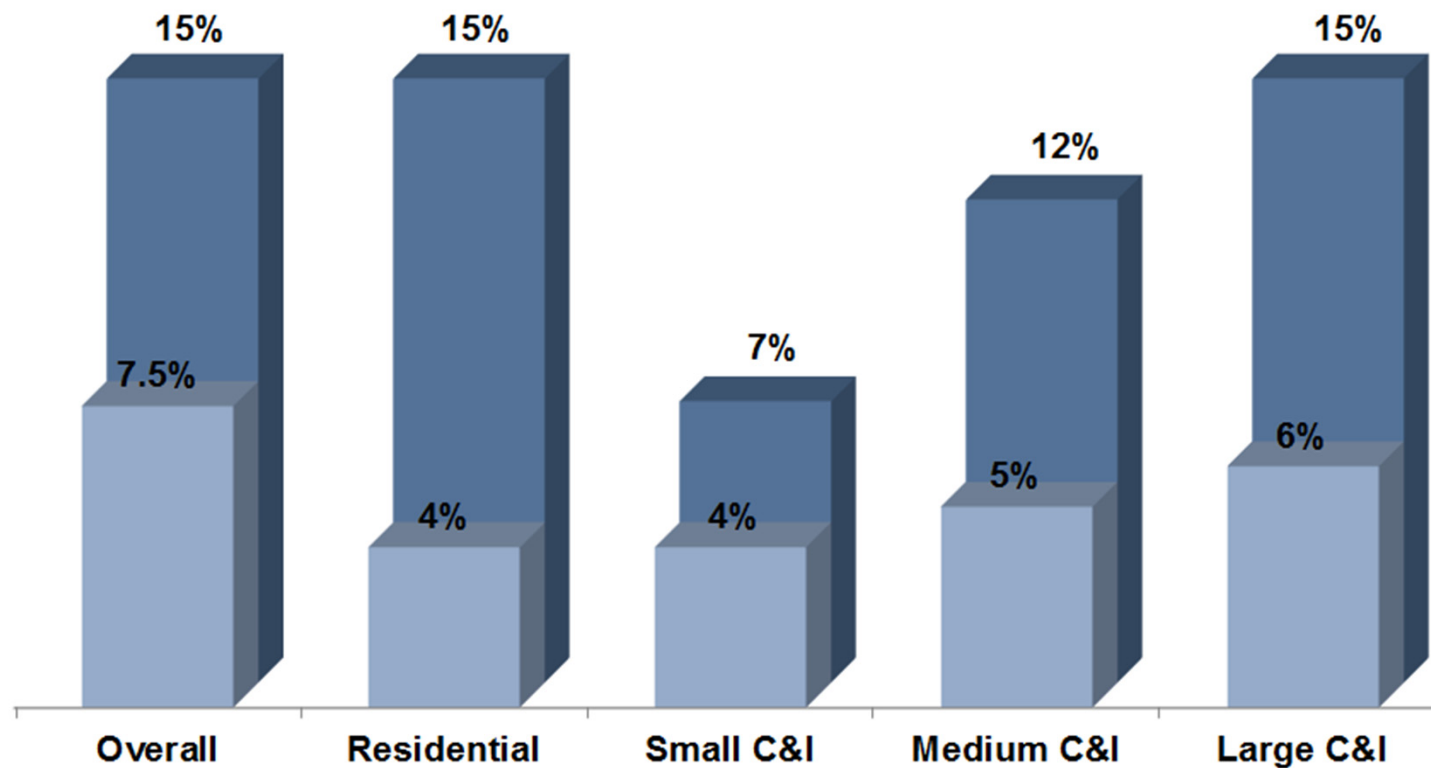


Median Low and High Estimates  
10 Years From Now

# The likely range of demand response ranges from 7.5% to 15%

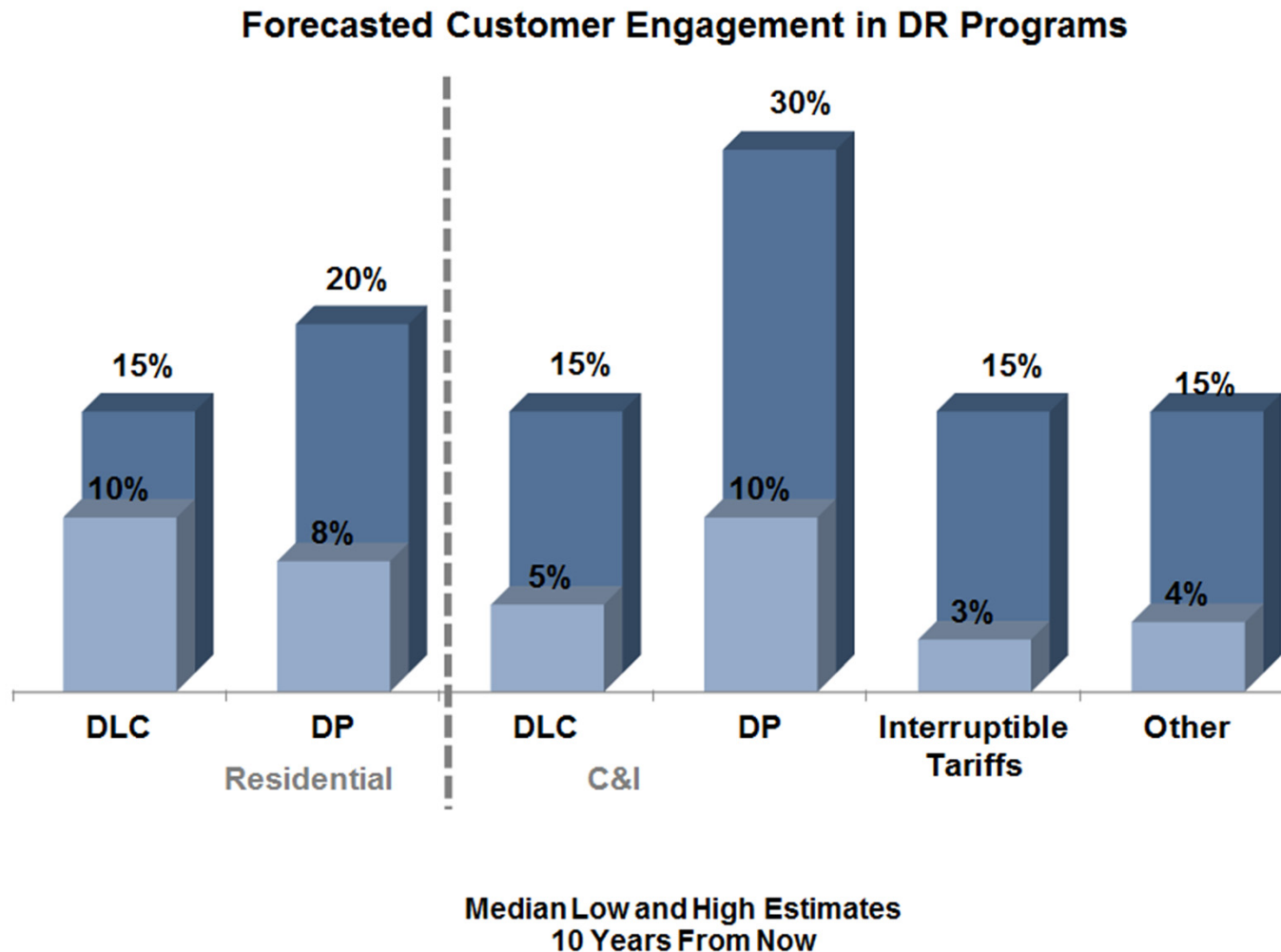
## Forecasted Peak Demand Savings

*Reduction in peak electricity consumption from DR, relative to baseline forecast*



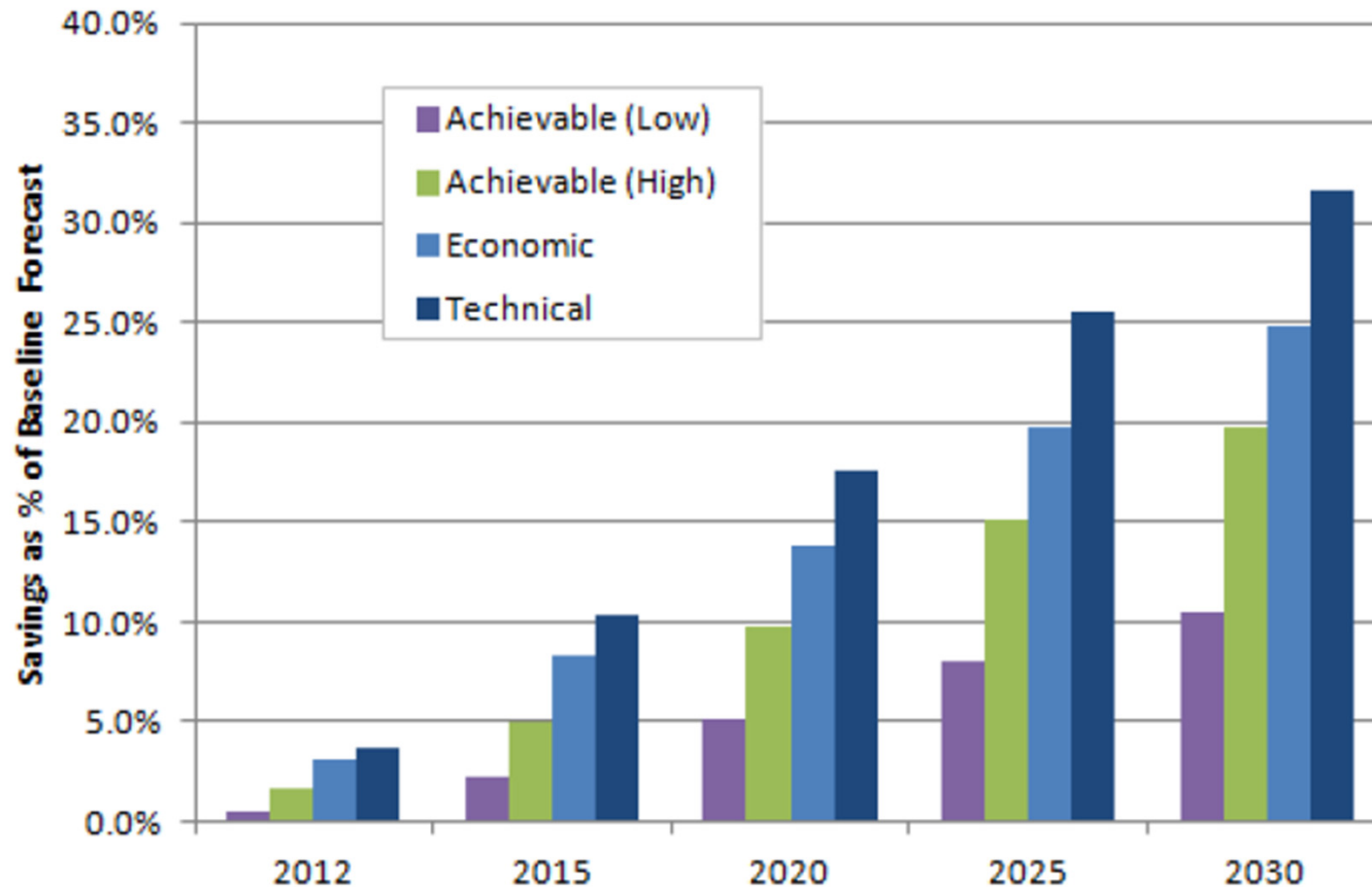
Median Low and High Estimates  
10 Years From Now

# Dynamic pricing is expected to play a significant role in the future



# Consistent with other national studies, GEP's study for the TVA region shows achievable potential of 10-20% by 2030

## Summary of Achievable Potential Energy Savings



Source: Global Energy Partners

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# State commissions are incentivizing the utilities to engage in energy efficiency

- ◆ Provide rapid energy efficiency *cost recovery*, which can become a major stumbling block
- ◆ *Decouple* sales from revenues, allowing fixed costs to be recovered
- ◆ *Reward shareholders* for engaging in a business that appears to be at counter-purposes with the core business



# Shareholder reward mechanisms come in three flavors

- ◆ Utilities get a share of the savings created by the EE programs (California, Colorado, Oklahoma, others)
- ◆ Utilities capitalize their DSM expenditures into the rate base and earn a bonus return-on-equity (Nevada)
- ◆ Utilities get a share of the avoided power plant costs (Duke Energy)

# The most popular one is shared savings

- ◆ Net benefits measured by the Total Resource Cost (TRC) test can be measured immediately after a program year is completed and installations are validated
  - Regulators choose a “share” for the utility, which is made contingent on the achievement of energy savings and peak demand reduction goals
  - The incentive can be collected in a succeeding year or spread over a longer collection period to allow for measurement and verification

# Capitalization is another model

- ◆ EE expenditures are capitalized as a regulatory asset, which earns the allowed return on equity (RoE)
- ◆ The regulatory asset is amortized just like a power plant, but over a shorter period
- ◆ This spreads the recovery of costs over time, lowering the near term impact on rates, but adds carrying costs which impact rates over the long haul
- ◆ Up to 2009, the Nevada PUC regularly approved RoE “adders” of 500 basis points on the equity portion; however, Nevada has recently changed the rules to allow expensing of DSM costs and allowing lost fixed revenue recovery

# Duke's “Save-a-Watt” model has evolved

- ◆ In return for doing a certain amount of EE, the utility “sells Save-a-Watts” at a price below the avoided costs of not building power plants, 50% - 75%
- ◆ No explicit cost recovery
- ◆ The utility proposed full control and risk of the EE programs, but has accepted significant limits to gain approval
- ◆ In exchange, Save-a-Watt now includes lost fixed cost recovery, with a limit of three years for impacts of the EE measures

# Legislation is being used to push the envelope

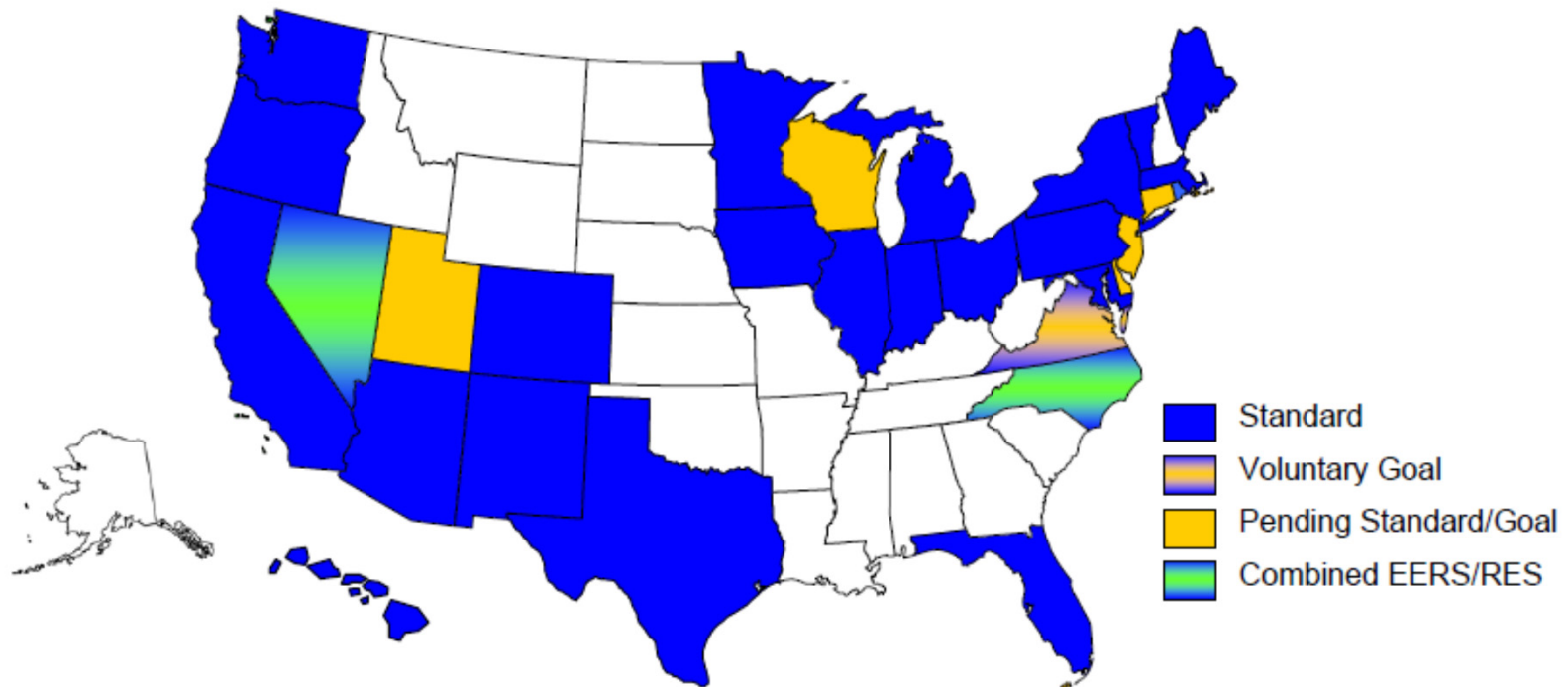
## Many states are setting targets for energy efficiency

- ◆ In 2008, Massachusetts passed the Green Communities Act, increasing spending on energy efficiency to roughly \$1.4 billion over the first three years
- ◆ Under Maryland's EmPOWER initiative, the state will reduce energy consumption by 15% by 2015
- ◆ Pennsylvania's Act 129 requires a 1% reduction in consumption by 2011, a 3% reduction in consumption by 2012 and a 4.5% reduction in peak demand by 2013
- ◆ The Arizona Corporation Commission requires electric utilities to reduce the amount of power they sell by 22% by 2020
- ◆ New Mexico has a stated goal of a 20% reduction by 2020

# Several states have instituted EERSs

## State Energy Efficiency Resource Standard (EERS) Activity

November 2010



Twenty-four states have enacted energy savings goals, or Energy Efficiency Resource Standards (EERS), through legislation and several states have a pending EERS

Source: Regulatory Assistance Project 2011

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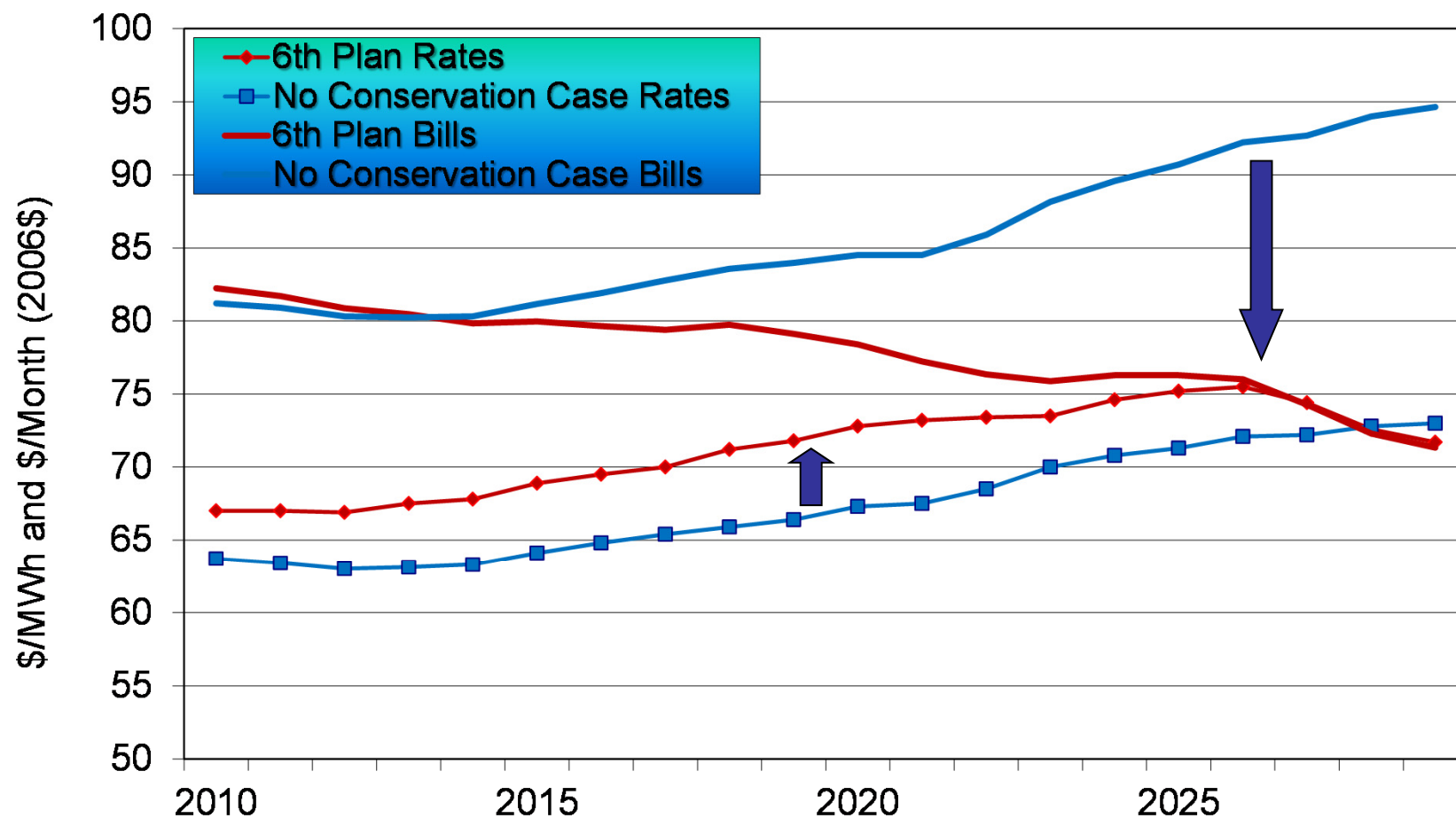
Role of Smart Meters

# **“DSM is ineffective because it results in higher costs for consumers and less profit for utilities”**

- ◆ Although DSM will raise rates in the short term, the increase is relatively small compared to other cost drivers which are causing rates to rise (environmental regulation, old fossil portfolio, nuclear safety)
- ◆ Cost-effective DSM programs will lower energy costs for all consumers by lowering the revenue requirements for the utility as seen on the next slide
- ◆ Customers probably care more about the size of their utility bills and less about rates
- ◆ Utility profits can be maintained by using the various regulatory incentive mechanisms discussed earlier
- ◆ DSM can assist utilities by lowering the need to make new capital investments and improving customer satisfaction by lowering bills



# In the Northwest, bills are lower because of conservation, even though rates are higher



Source: Eckman, Tom. *In the PNW We Do More Than Plan!* September 27, 2011.

# Sales are already down because of the recession and milder weather

- ◆ DSM could be phased in over time, with programs that pass both the TRC and RIM tests being implemented in the near term, followed by those programs that pass the TRC test but fail the RIM test
- ◆ Rim-failing programs could be fielded as pilots to gain insights about they can be improved and redesigned to minimize rate impacts
- ◆ When load growth resumes, DSM will help lower the impact of load growth on capital investments and operating costs

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# The role of smart meters...

- ◆ Much DSM can be achieved with existing analog meters
- ◆ However, more can be achieved with smart meters, which allow the provision of real-time energy information to consumers through the web and also make it much easier to introduce time-of-use and dynamic pricing

# Implications for TVA

**TVA desires to be a competitive supplier of electricity in the Southeast and may want to assess how much importance customers – particularly mass market customers -- place on utility bills versus utility rates in assessing competitiveness**

**Programs that pass both the TRC and RIM tests should be initiated in the near term**

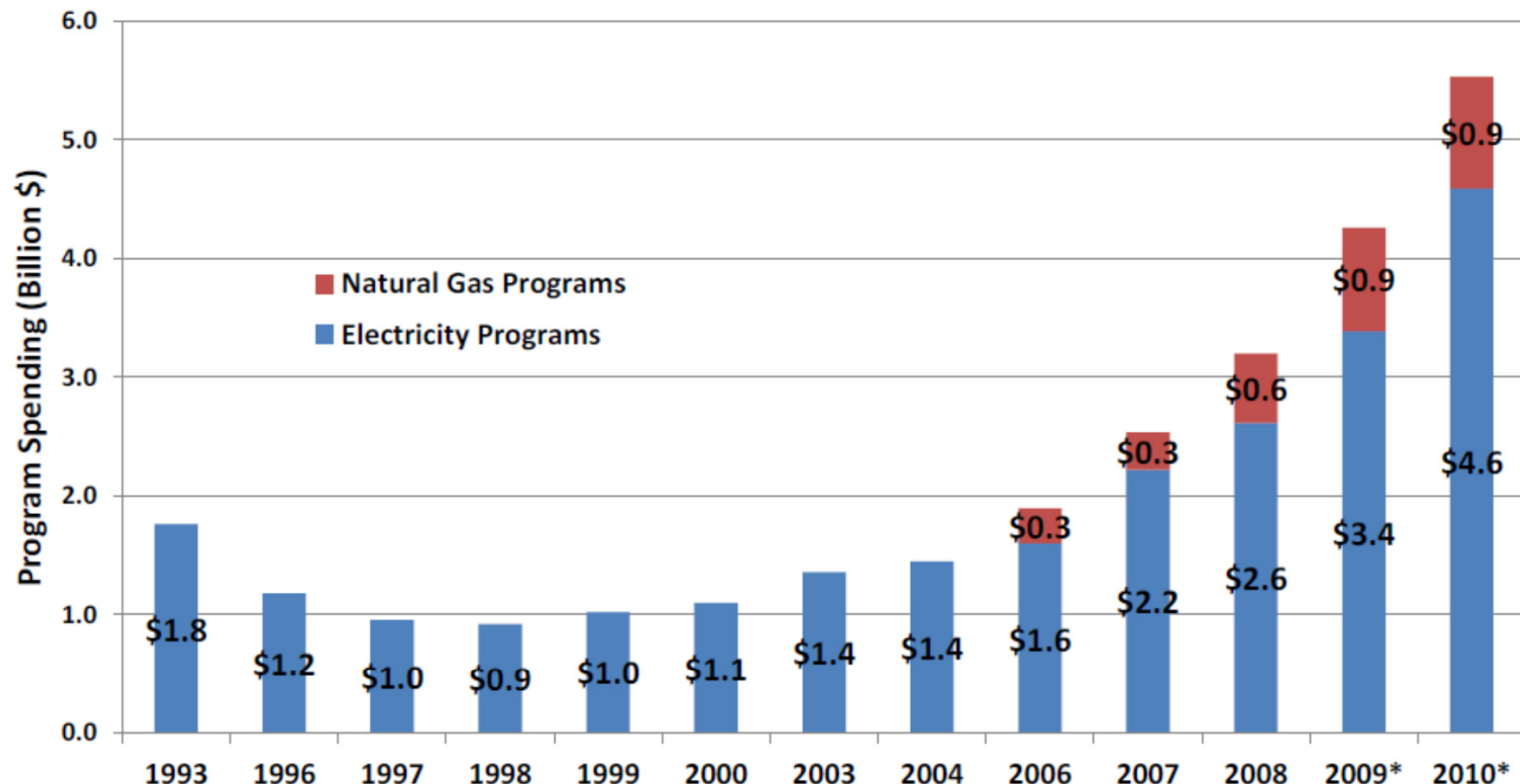
**Programs that pass the TRC but fail RIM can be fielded as pilots and insights gained from the pilots can be used to improve program design so that rate impacts can be minimized**

# References

- Consortium for Energy Efficiency, “State of the Efficiency Program Industry – 2009 Expenditures, Impacts and 2010 Budgets,” December 10, 2010.
- Cowart, Richard, “Efficiency Obligations and EE Resource Standards,” Regulatory Assistance Project, April 12, 2011. PowerPoint presentation.
- Eckman, Tom, “In the PNW We do More Than Plan!” September 27, 2011.
- Institute for Electric Efficiency, “Summary of Ratepayer-Funded Electric Efficiency Impacts, Budgets, and Expenditures,” IEE Brief, January 2012.
- Faruqui, Ahmad, “Inclining Toward Efficiency,” *The Public Utilities Fortnightly*, August 2008, [http://www.fortnightly.com/display\\_pdf.cfm?id=/08012008\\_CommissionWatch.pdf](http://www.fortnightly.com/display_pdf.cfm?id=/08012008_CommissionWatch.pdf)
- Faruqui, Ahmad and Doug Mitarotonda, “Energy Efficiency and Demand Response in 2020: A Survey of Expert Opinion,” *The Brattle Group*, November 2011, [http://www.brattle.com/\\_documents/UploadLibrary/Upload990.pdf](http://www.brattle.com/_documents/UploadLibrary/Upload990.pdf)
- Faruqui, Ahmad, Sanem Sergici, and Ahmed Sharif, “The Impact of Informational Feedback on Energy Consumption – A survey of the experimental evidence,” *Energy*, Volume 35, Issue 4, Special Demand Response Issue, April 2010, pp. 1598-1608.
- Fox-Penner, Peter, *Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities*, Island Press, 2010.
- Sciortino, Michael, et. al, “The 2011 State Efficiency Scorecard,” American Council for an Energy-Efficient Economy (ACEEE), report no. E115, October 2011.
- Sovacool, Benjamin and Marilyn A. Brown, Editors, *Energy and American Society – Thirteen Myths*, Springer 2007.

# APPENDIX

# U.S. energy efficiency spending is on the rise



\*All values actual program spending (EIA Form 861) except for 2009 and 2010, which are budgets (CEE Annual Industry Reports).

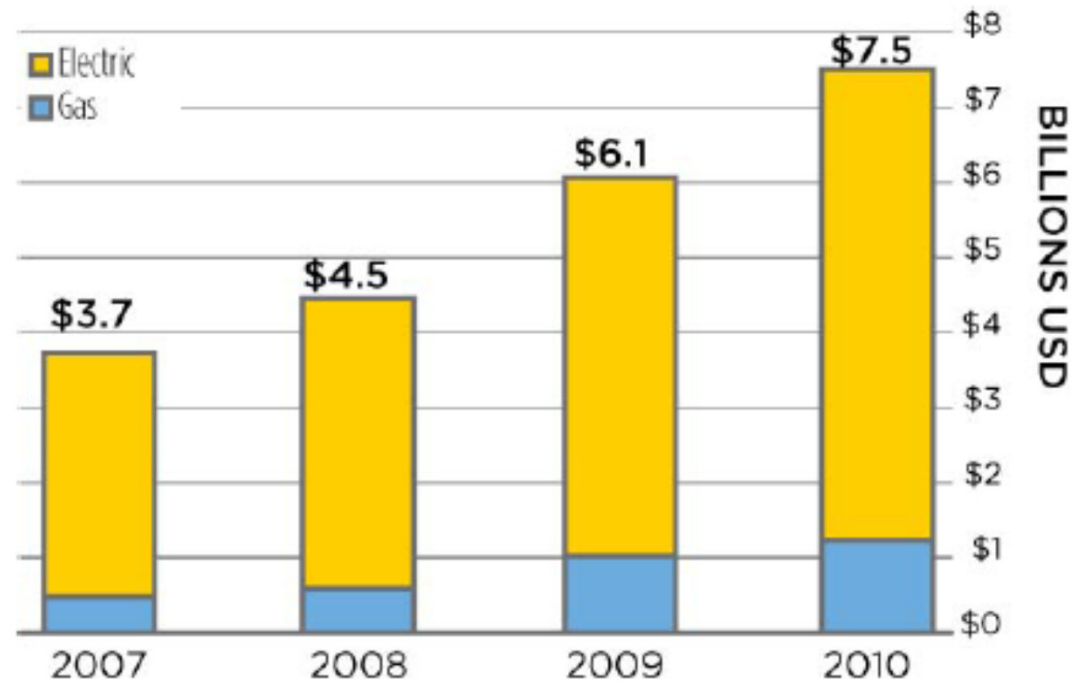
Notes: Includes ratepayer-funded programs. Natural gas efficiency program spending is not available for 1993–2004.

Sources: Nadel et al. (2000); York and Kushler (2002), (2005); Eldridge et al. (2008 and 2009)

Source: ACEEE 2011

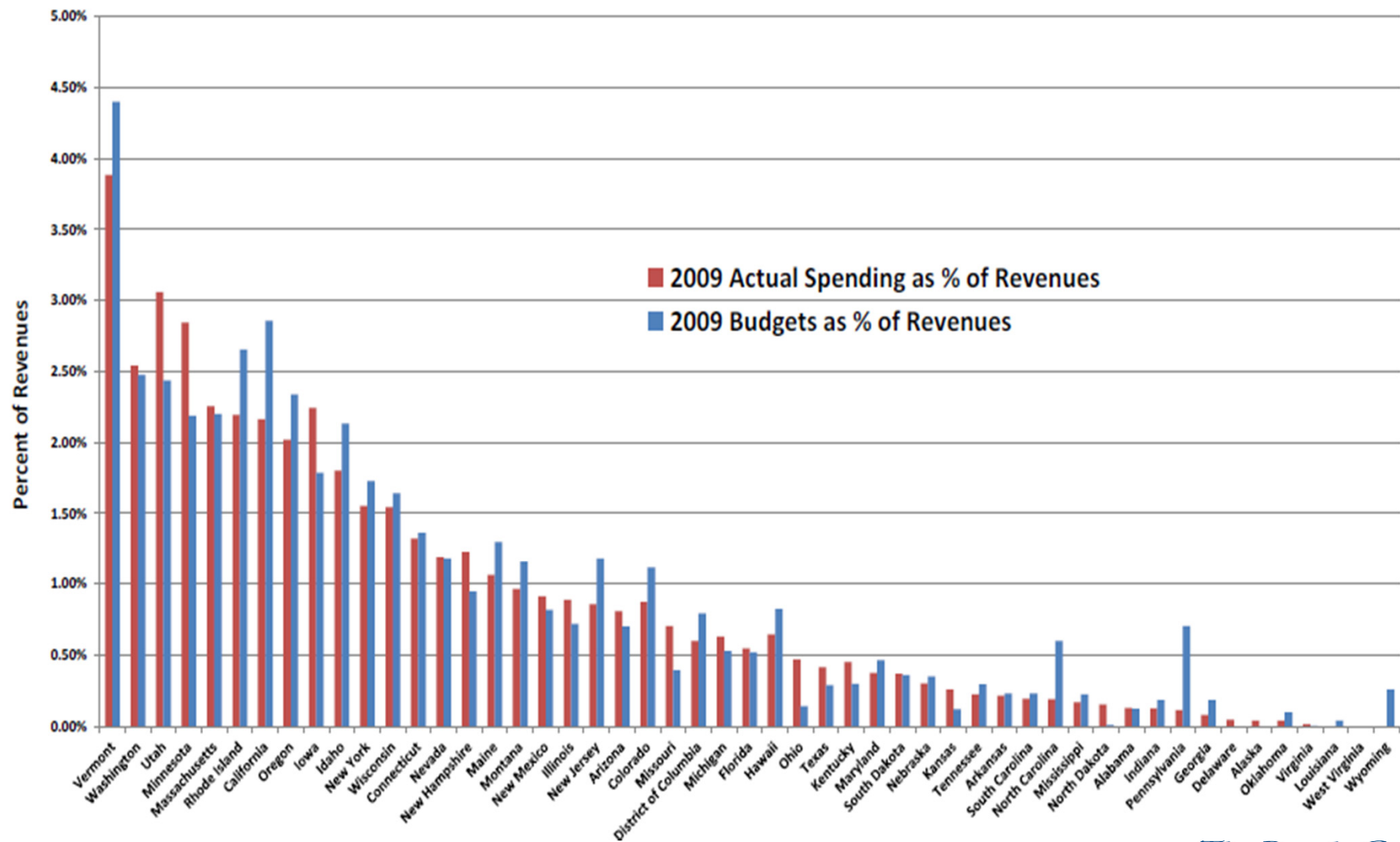


# North Americans are now spending \$7.5 billion on energy efficiency

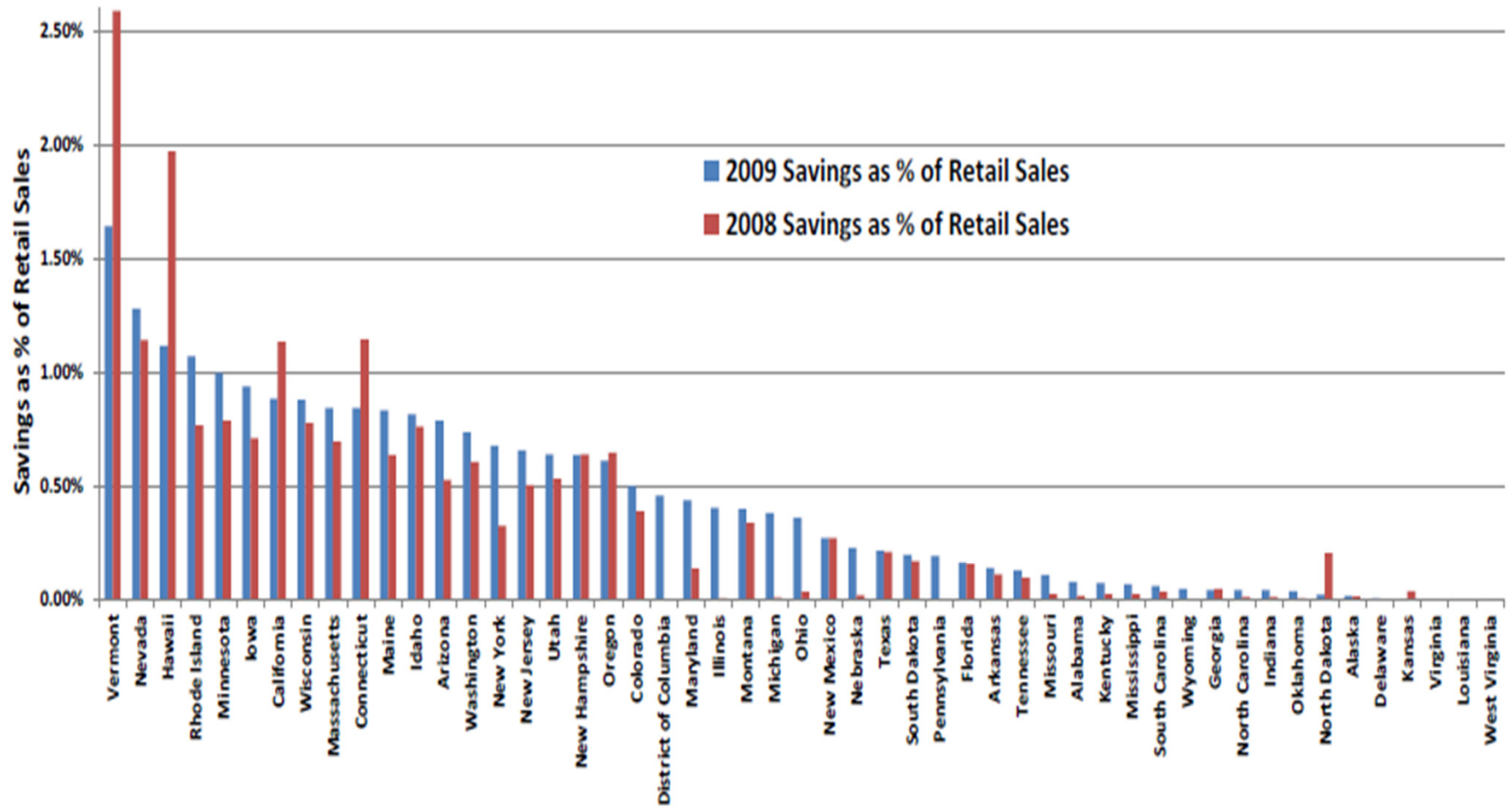


Source: Consortium on Energy Efficiency, 2010

# Spending varies by state



# And so do the impacts



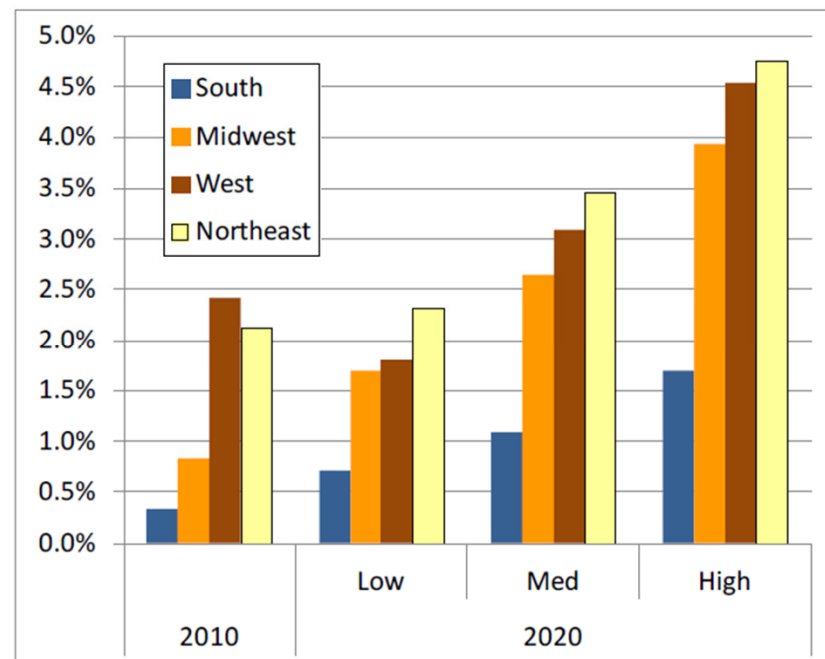
# Forecasted spending levels

## Funding Levels Are Projected to Rise in All Regions under Most Scenarios

- EE spending as percent of revenues remains highest in Northeast and West (3.5% and 3.1% in 2020 Medium Case)
- EE funding in the South and Midwest is expected to triple by 2020 under the Medium Case
- Funding trajectory in West is highly uncertain; depends on role of ratepayer EE in CA
- Also uncertainty in the Northeast (a little bump or a big one?); longevity and success of “all cost-effective EE” depends on continued political support

### Ratepayer-funded Electric EE Programs

(Projected Spending as Percent of Revenues)



Source: LBNL 2010

# Biography

Ahmad Faruqui is a principal with *The Brattle Group* whose practice is focused on helping clients in the electricity industry encourage the smart use of energy. He has helped design, monitor and evaluate demand-side investments for more than three dozen utilities including Duke Energy, Florida Power & Light, Southern Company, and the Tennessee Valley Authority. He has testified before a dozen state and provincial commissions and legislative bodies. He has also worked for the Alberta Utilities Commission, the Edison Electric Institute, the Electric Power Research Institute, the Federal Energy Regulatory Commission, the Ontario Energy Board and the World Bank. His work has been cited in *Business Week*, *The Economist*, *Forbes*, *National Geographic*, *The New York Times*, the *Wall Street Journal* and *USA Today* and he has appeared on *Fox Business News* and *National Public Radio*. The author, co-author or editor of four books and more than 150 articles, papers and reports, he holds a Ph.D. in economics from The University of California at Davis.

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