



EFFICIENCY CITIES NETWORK

# The Frontiers of Energy Efficiency

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Tuesday, June 25, 2013

3pm Eastern

## **Moderators:**

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American Council for an Energy-Efficient Economy

# ***Frontiers of Energy Efficiency: Next Generation Programs Reach for High Energy Savings***

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*Efficiency Cities Network  
25 June 2013*

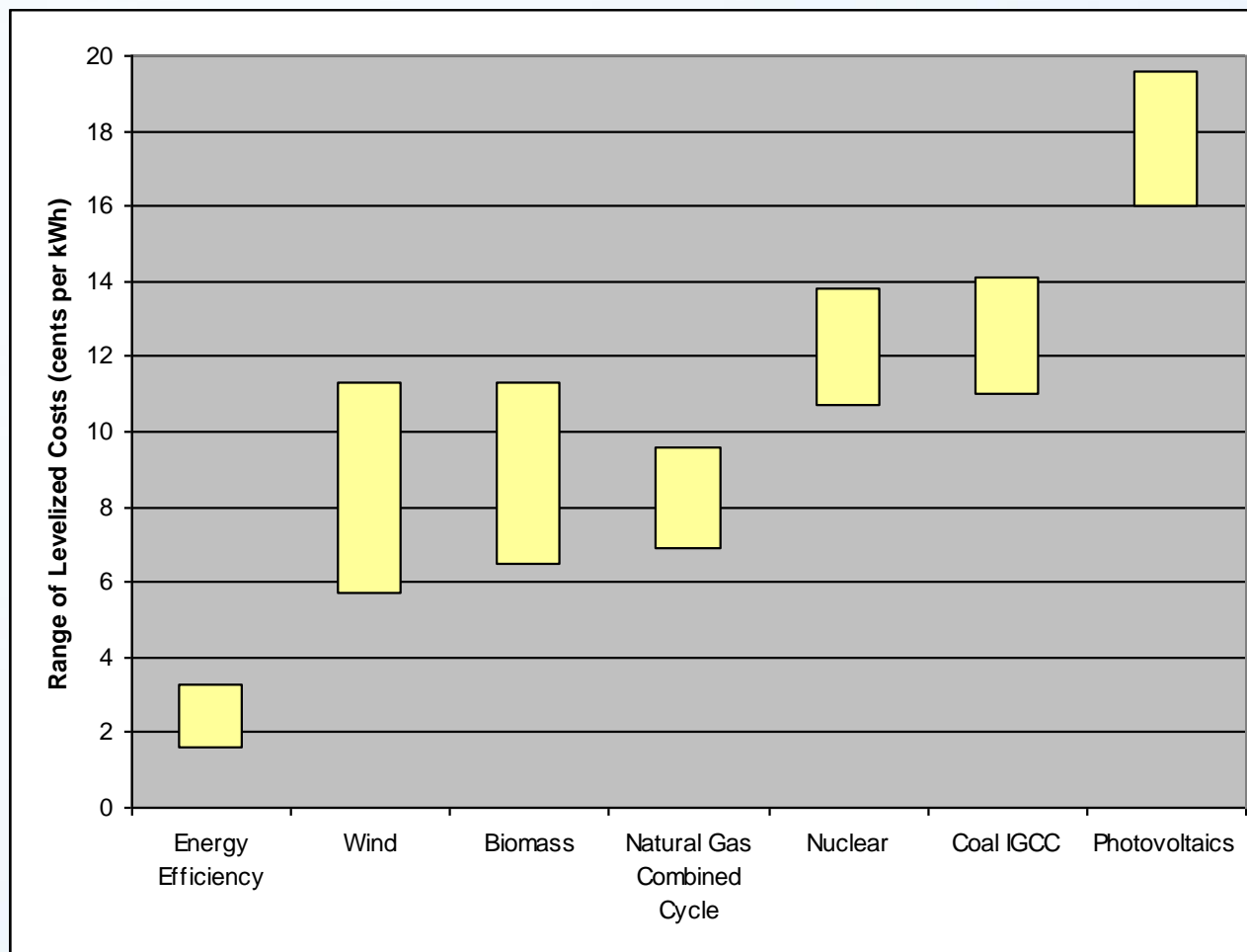
# American Council for an Energy-Efficient Economy (ACEEE)

The American Council for an Energy-Efficient Economy is a nonprofit, 501(c)(3) organization that acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, and behaviors.

ACEEE was founded in 1980 by leading researchers in the energy field. Since then we have grown to a staff of more than 50. Projects are carried out by ACEEE staff and collaborators from government, the private sector, research institutions, and other nonprofit organizations.

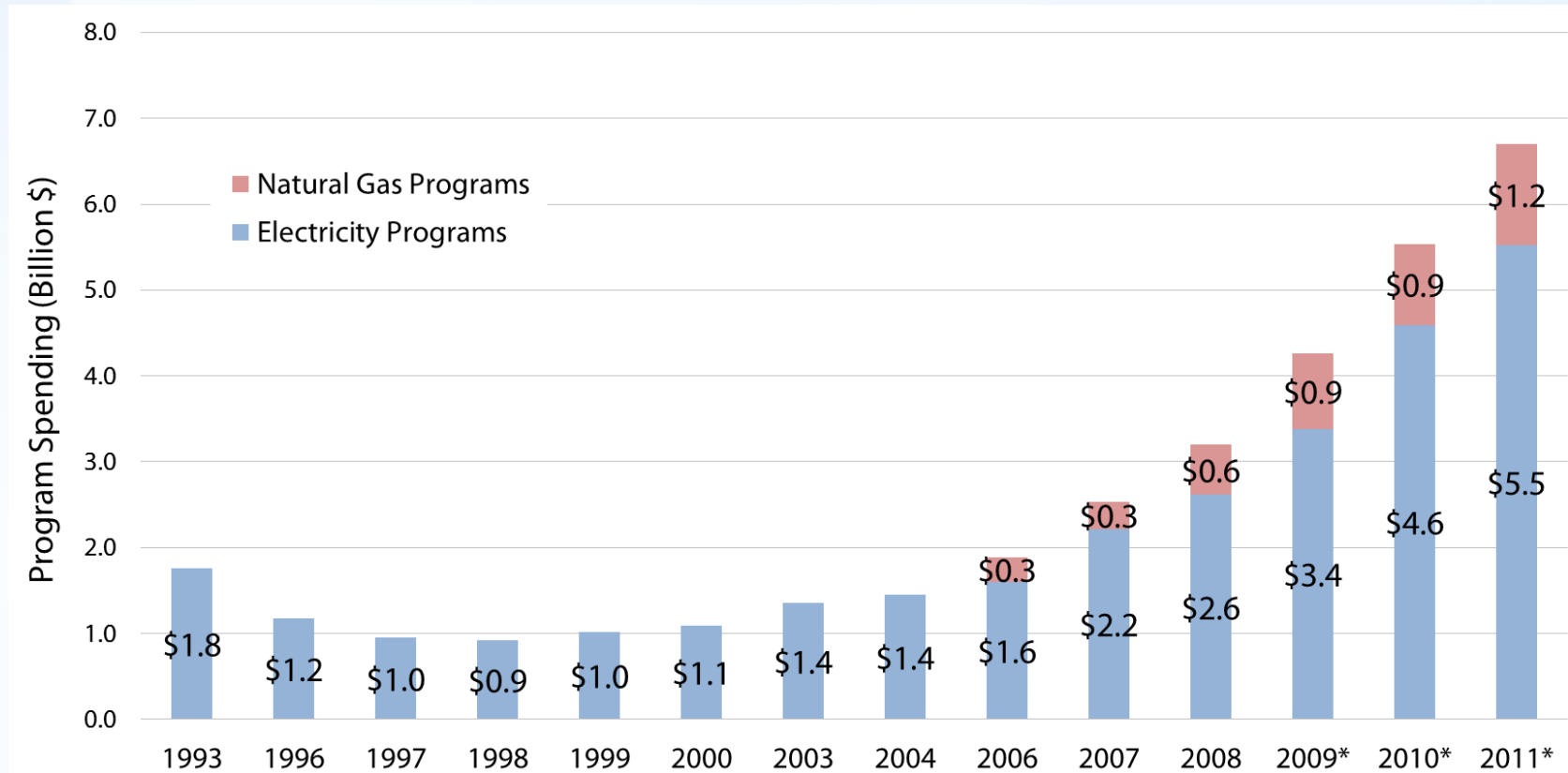
ACEEE also organizes major national conferences on energy efficiency programs, technologies and policies, including the National Symposium on Market Transformation (March 2013, Washington DC) and the National Conference on Energy Efficiency as a Resource (Sept 2013, Nashville).

# A fundamental tenet of ACEEE's work: Saving a kWh through energy efficiency (EE) is significantly cheaper than generating a kWh

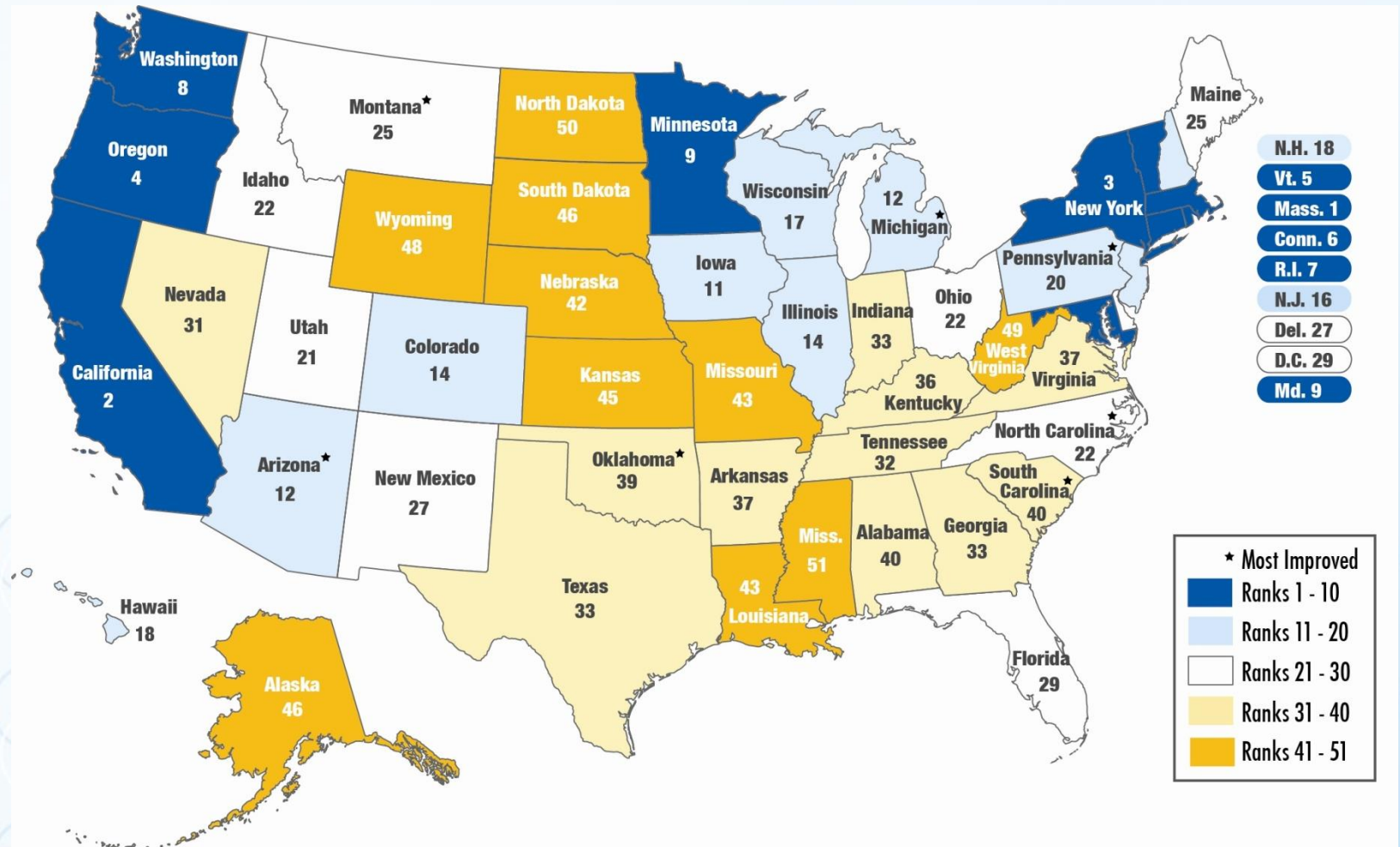


# Value of utility energy efficiency programs evident by rapid increases in program budgets: evaluation results typically show a 2-3x (or more) return in terms of benefits to costs

**State-Level Energy Efficiency Program Spending or Budgets by Year, 1993–2011**  
(note: natural gas data series begins 2006, programs existed prior but not national data)



# States Vary in Policies and Programs to Advance Energy Efficiency (ACEEE 2012 State Scorecard)



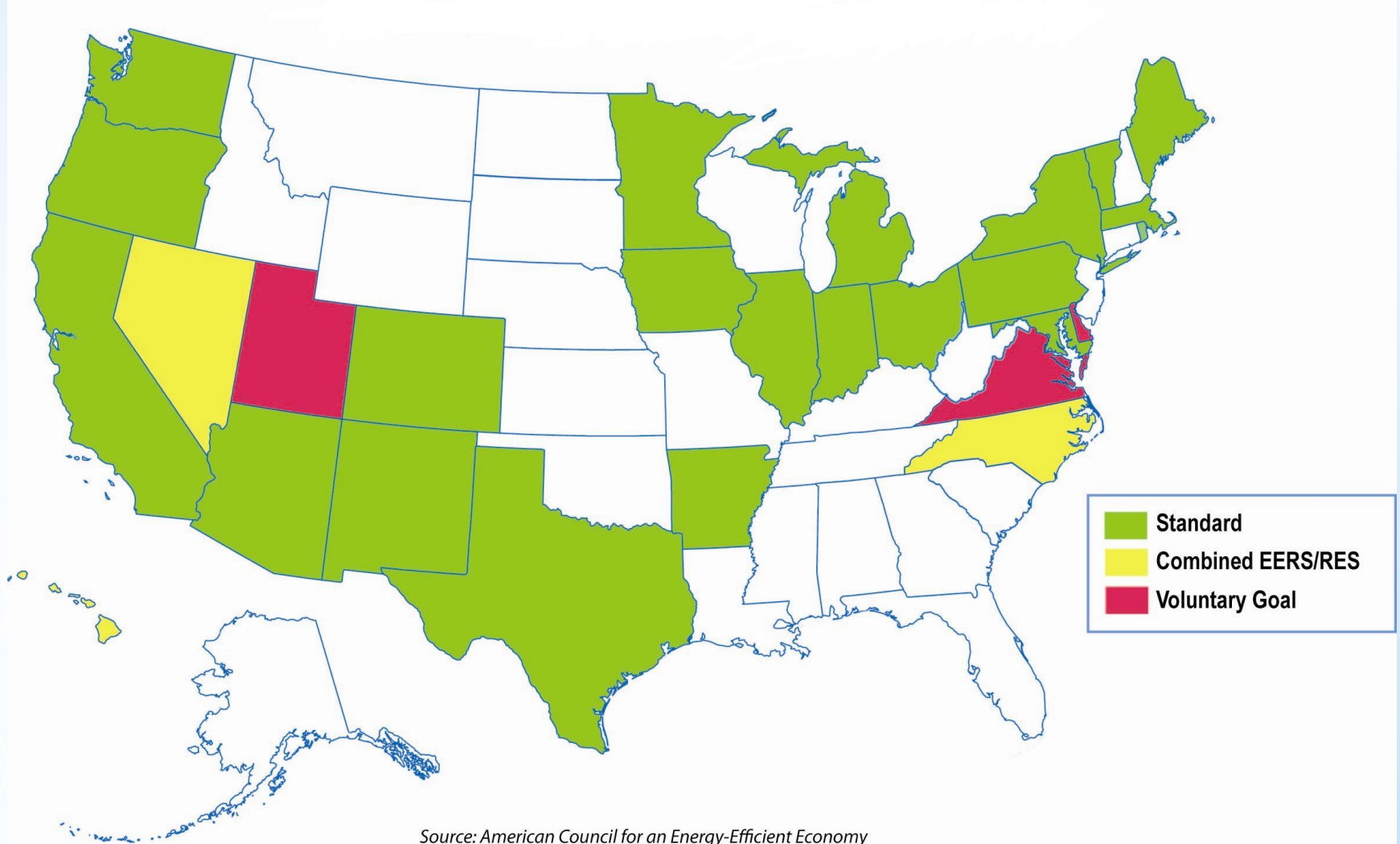


# Background: Policies and markets affecting energy efficiency have made great strides

- Programs must reach and sustain high savings levels in about half of the states.
- Just expanding traditional approaches isn't likely to achieve these targets.
- Need to go “deeper” and “broader,” but how?
- Baselines of energy efficiency are moving up due to more stringent building codes and appliance standards.

# Energy Efficiency Resource Standards

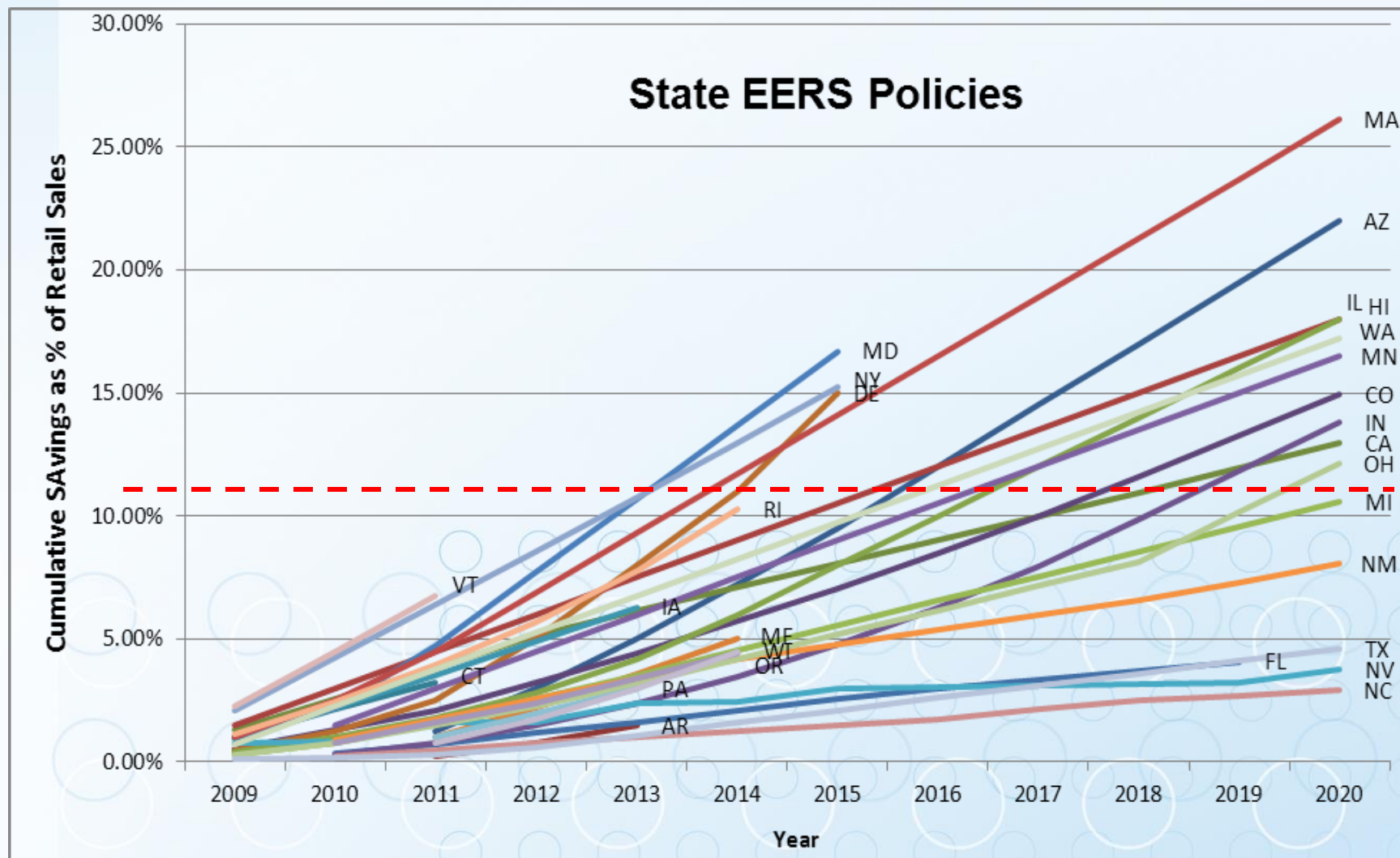
## 24 States – October 2011



Source: American Council for an Energy-Efficient Economy

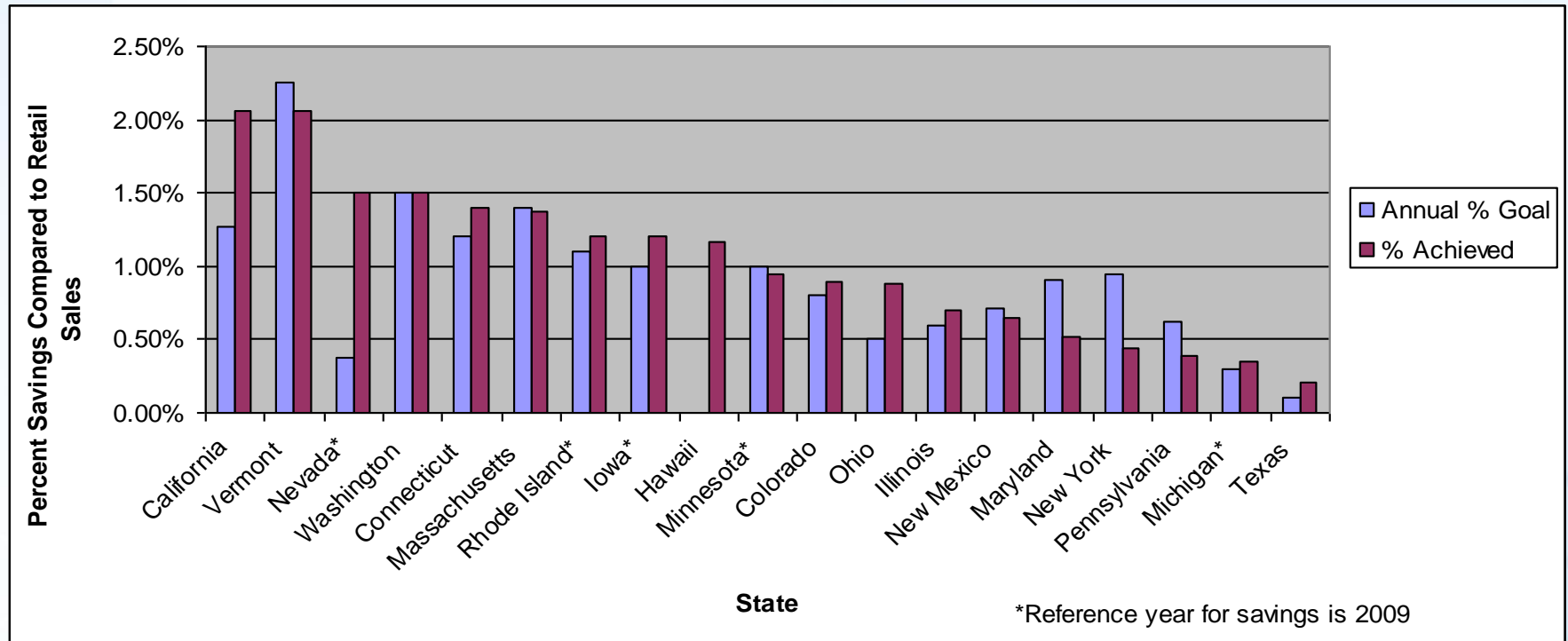


**“Small” annual savings can add up to big cumulative savings!**  
(1-2% savings/year may not seem big)



# Implementation of EERS Policies in 2010

*Sciortino et al. 2011. Energy Efficiency Resource Standards: A Progress Report on State Experience. ACEEE Research Report U112*



- 13 of the 20 states with EERS policies in place for over 2 years achieved 100% or more of their 2010 goals.
- Only 3 states realized savings below 80% of their goals.
- ACEEE will be updating this review of EERS progress in 2013.

# Research question: What are the next-generation energy efficiency program designs and approaches?

- “Next generation?”
  - Near-term (1-3+ years)
  - Technologies commercially viable now or within the near term
  - Program designs likely already in place (pilots or about to be launched)
  - Can also mean refinements and enhancements to successful existing programs
- *[Hint: mostly NOT rocket science!]*



# Scope (program types included in our research)

## Residential Programs

- Residential Lighting
- Residential Appliances
- Residential Plug Loads and Consumer Electronics
- Residential Mechanical Systems
- Low-Income Weatherization
- Residential Home Retrofit Programs
- Residential New Construction
- Manufactured Housing
- Multifamily Housing
- Behavior-based Energy Efficiency Programs

## Commercial , Industrial, Other Programs

- Commercial Lighting
- Commercial HVAC
- Commercial Building Operations and Performance Programs
- Commercial Major Retrofit and Renovation
- Commercial New Construction
- Small Business
- Industrial
- Agriculture
- Combined Heat and Power
- Distribution System Efficiency Improvements

## Additional Program Concepts

- Miscellaneous Energy Use in Commercial Buildings
- Commercial Sector Behavior Programs

# Residential Lighting Programs

- EISA (federal) standards will profoundly affect existing programs; baseline efficiency will be higher—meaning program energy savings will be less per installation (lamp)—by ~1/3.
- But CFLs still will be a big part of the picture; ~70% of sockets still don't have them. Market share of CFLs varies widely in different markets—closely related to program history.

*CFLs are not going away*





# Residential Lighting Programs

- New technologies key part of the picture: LEDs, 2X halogens, advanced CFLs.
- Sharpen focus/marketing to certain markets and for certain products—also more customer education.
- Move “upstream” (e.g., “market lift”): paying incentives to retailers for increased sales.

*Lighting goes digital*



100 W equivalent

## Example: Pacific Gas & Electric (PG&E)

Long, successful record with residential lighting---millions of CFLs moved by the program over the years.

Changes underway with its residential lighting programs:

- Short-term push for “regular” CFLs; will no longer offer incentives for standard, bare spiral lamps by end of 2013.
- Ramping up specialty CFLs (“advanced CFLs”).
- Expanding promotion of LEDs, beginning with “reflector” LEDs.
- By 2014 likely to be putting most incentive funding into LEDs.
- Also looking to change program design, including relationships with retailers, such as “market lift” (providing incentives directly to them for increased sales of targeted products) and “Full Category Sales Model” (more comprehensive sales data and more incentives to retailers).
- Increased customer education and training for retailers on new lighting technologies.

# Commercial Lighting



- EISA will have large impacts as T8s and similar high efficiency products become the standard.
- Still room for more advanced fluorescents and improved fixtures.
- New technologies like LEDs are entering the market in certain niches (linear LED lamps not yet ready for prime-time).
- Programs will look “beyond technology replacements” to integrated design, lighting quality, controls and use of daylighting.

## Example: Mass Save Bright Opportunities

Massachusetts has 11 utilities administering programs under a common umbrella, “Mass Save.”

The “Commercial Upstream Lighting Initiative:”

- Achieved 50,000 MWH in new annual savings within 1<sup>st</sup> 90 days.
- Works with electrical distributors to provide discount prices on the most-efficient LED directional lamps and reduced-wattage fluorescents lamps.
- Targets customers, lighting design community, architects and contractors.
- “Buys down” the price of most-efficient technologies.
- Product quality and performance are keys; must be ENERGY STAR® or CEE qualified products.
- Consistent branding, marketing and communications also important.



# Commercial Retrofit/Renovation Programs

- Overall goal is deep savings for each building, 30-50% savings.
- Focus on integrated designs—improve overall building performance and increase building value.
- Promote disclosure (energy use) data in commercial markets.
- Offer performance-based incentives.
- Require building commissioning and provide training for building operators.





# Example: Pay for Performance Program, New Jersey Office of Clean Energy

A whole building program designed to achieve deep energy savings in commercial and industrial buildings. Core elements:

- Work with owners to create an “Energy Reduction Plan”—strategic, long-term planning document to guide work.
- Contract with an approved trade ally (“Partner”) to act as energy expert and work with owners through entire process.
- Use building benchmark to guide work and establish targets; Partners use “ENERGY STAR® Portfolio Manager for this.
- Must achieve at least 15% total reduction from baseline benchmark.
- Incentives structured to reward projects at key milestones---a tiered, sequential structure rather than single end-of-project lump sum.

# Residential Retrofit Programs

- There is a large potential remaining.
- Are no real technological breakthroughs; emphasis is on improving program design and delivery, and increasing participation, such as through better marketing and financing options.
- Make things simple for homeowners—and improve administration.
- Make energy efficiency improvements integral to home improvements, demonstrate value to homeowners and home markets (greater use of home energy ratings, for example).



# Multifamily Housing

- Historically an underserved market with large potential.
- Are good examples of effective program designs, characterized by:
  - Comprehensive approach.
  - Multi-fuel, integrated approach.
  - Collaboration among utilities, program providers, housing authorities and financing organizations.
  - Attractive terms (“one-stop” shopping), financial packages and project management.



# New Commercial Construction

- Building codes continue to advance.
- Leverage code changes; program operators involved in code development and compliance can receive credit.
- Whole building, integrative design is a successful, proven approach for large savings.





# New Commercial Construction

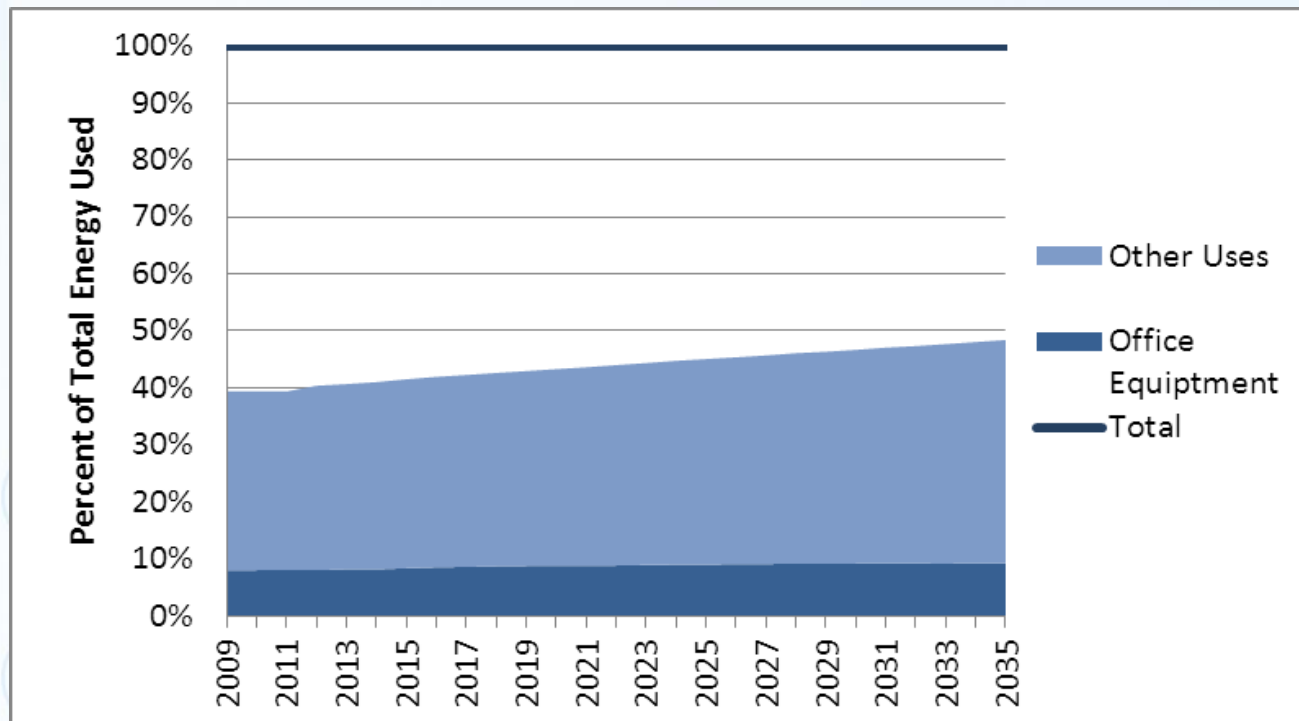
- Design, modeling and decision-making tools can be used to reach wide range spectrum of building types, sizes, owners.
- Emphasize advanced lighting, high efficiency HVAC systems, high efficiency envelopes; don't ignore plug-loads.
- Labeling and rating systems for green, high performance buildings are helping to drive market changes.





# Commercial Behavioral and Miscellaneous Use Programs

- A lot of potential, much more work needed to develop programs.



EIA Projection of Energy Use for Office Equipment and “Other” Uses in the Commercial Sector as a Percent of Total Commercial Energy Use

# Industrial Programs



- Biggest opportunities for energy efficiency in industry exist in improvements and optimization of processes.
- Traditional prescriptive approaches providing incentives for energy-efficient equipment (e.g. motors and HVAC) will not realize this potential (but still have a role to play in programs).
- Next generation industrial programs must evolve toward whole-system and customized approaches.
  - Targeted support for incentives and technical assistance for specific industrial processes;
  - “Strategic Energy Management” (SEM) approaches to integrate energy management practices into overall company culture, standard operating procedures and profitability.
  - Work through market channels to serve small and medium businesses, such as regional trade associations or supplier networks.

# Example: Energy Trust of Oregon, Industrial Energy Management

- Offers “Strategic Energy Management” (SEM) product based on “continuous energy improvement” work completed by the Northwest Energy Efficiency Alliance.
- SEM engages industries of all sizes and incorporates a peer support approach to delivery training and motivate participation among non-competing companies.
- Offers several technical assistance incentives, such as energy team training sessions, one-on-one consultation with program expert, employee coaching and engagement with executive management of industries.
- Provides financial incentives based on energy savings achieved after 12 month engagement in program (\$0.02/kWh and \$0.20/therm).
- Since 2009 has gained participation of 57 firms, savings from operational and behavioral change of 7-9% alone (doesn’t include major equipment upgrades or process changes).

# Results: Overall Trends and Themes, Residential

- Technologies:
  - Promising new/advanced technologies: LED lighting, ductless heat pumps, heat pump water heaters, high efficiency clothes dryers and clothes washers, advanced power strips, homes energy displays , smart meters (tool for EE).
  - Increased emphasis on system efficiencies as well as installation and buildings practices.
  - Still plenty of market share to be gained by existing high efficiency technologies.
- Markets
  - More focusing and segmentation within larger mass markets.
  - Continued push on new construction.
  - Don't forget manufactured housing and multifamily markets.
- Program Design
  - More upstream approaches, e.g., “market lift.”
  - Refinements and enhancements to existing programs, like home performance.
  - Greater use of performance-based incentives, esp. new homes programs.
  - Behavior change both a program area on its own but also insights added across programs (improved feedback, comparative data can achieve ~2+% savings).



# Results: Overall Trends and Themes, Commercial

- Technologies
  - Devices: LED lighting clearly big; mechanical systems---continued improvements , including variable refrigerant flow systems, high efficiency rooftop systems, ground source heat pumps, radiant heating systems, condensing gas boilers. Also advances in building envelope materials , e.g., cool roofs, superinsulation and high performance windows.
  - Still much room for improvement due to operations; variety of advances in monitoring, communications , information and control technologies (smarter operation and diagnostics).
  - Emphasis on systems, especially integrated, whole building solutions when possible.



# Results: Overall Trends and Themes, Commercial

- Markets
  - Increase the number of high performance buildings, both for new construction and through major retrofits and renovations.
    - Expand high performance across building types, not just Class A offices and institutional buildings
    - Do this by more standardized designs for buildings and systems, as well as design and analytical tools to facilitate such transformation
  - Make energy use a visible and valuable attribute of commercial buildings, especially in real estate markets for commercial building space.
    - Mandatory disclosure
    - Building labeling
    - Case studies
  - Continued and expanded emphasis of best practices for operations of existing buildings.

# Results: Overall Trends and Themes, Commercial

- Program Design
  - For new construction and major renovation need to achieve deep savings as much as possible; one effective approach is to structure incentives based on performance.
  - Facilitate whole building, integrated approaches by providing: (1) design assistance, (2) design tools and (3) incentives.
  - Prescriptive approaches still can be important, but structure around systems, not single one-out replacements—include installation and operations elements.
  - For existing buildings, retro-commissioning still important; comprehensive retrofits growing in importance; improve effectiveness and administration , such as for better screening and quicker implementation.
  - Introduce and expand “strategic energy management”---with existing buildings staff and 3<sup>rd</sup> party approaches.
  - Refine and expand small business opportunities.

## Savings Potential: Residential (ballpark 2030)

Savings Estimates from Efficiency Programs	Electricity (TWh)	Natural Gas (TBtu)
Reference Case Delivered Energy for 2030 (AEO)	1,626	5,550
Residential Lighting	44	n/a
Residential New Construction	5	16
Plug Loads & Consumer Electronics	46	n/a
Low-Income Weatherization	24	68
Home Energy Retrofits	118	279
Residential Appliances	30	39
Residential Mechanical Systems	66	446
Behavior-Based Programs	39	48
Manufactured Housing	32	29
Multi-Family Housing	12	73
<b>Total Energy Efficiency Savings</b>	<b>417</b>	<b>997</b>
Savings as % of Reference Forecast	26%	18%

# Savings Potential: Commercial

## (ballpark 2030—preliminary)

Savings Estimates from Efficiency Programs	Electricity (TWh)	Natural Gas (TBtu)
Reference Case Delivered Energy for 2030 (AEO)	1,607	3,600
Commercial Lighting	68	n/a
Building Operations	50	83
Small Business Direct Install	12	n/a
Commercial Major Retrofit and Renovation	116	259
Commercial HVAC	53	176
Commercial New Construction	42	94
Combined Heat & Power (CHP)	9*	n/a*
Miscellaneous Energy Use	176	68
Commercial Behavior	40	90
<b>Total Energy Efficiency Savings</b>	<b>565</b>	<b>770</b>
Savings as % of Reference Forecast	35%	21%

## Potential Savings by 2030 (ballpark estimate)

Savings Estimates by Sector	Electricity (TWh)	% of savings by Sector	Natural Gas (TBtu)	% of savings by Sector
Reference Case Delivered Energy for 2030 (AEO)	4,242		10,030	
Residential Programs	417	36%	997	53%
Commercial Programs	565	48%	770	41%
Industrial Programs	109	9%	119	6%
Distribution System Efficiency	70	6%	n/a	n/a
Total Energy Efficiency Savings	1,162	100%	1,887	100%
<b>Savings as % of Reference Forecast</b>	<b>27%</b>		<b>19%</b>	



# Overall Strategic Recommendations

- Foster the development and deployment of new, high efficiency technologies across the spectrum of customer types and end-uses.
- Promote systems approaches to realize the greatest energy efficiency potential.
- Promote the development and advancement of best practices among building designers, contractors and building operators to achieve high building performance.



# Overall Strategic Recommendations

- Use market research and data analytics to improve market characterization to better design and target customer energy efficiency programs.
- Target behavioral change of all customer types as a key part of overall program portfolios.



*Full details available in final report*

## ***Frontiers of Energy Efficiency: Next Generation Programs Reach for High Energy Savings***

Dan York, Maggie Molina, Max Neubauer, Seth Nowak, Steven Nadel, Anna Chittum, Neal Elliott, Kate Farley, Ben Foster, Harvey Sachs and Patti Witte

<http://www.aceee.org/research-report/u131>



**And hot off the press...a related report,  
focus is leading existing programs**

***Leaders of the Pack: ACEEE's Third National  
Review of Exemplary Energy Efficiency  
Programs***

Seth Nowak, Martin Kushler, Patti Witte and Dan  
York

<http://www.aceee.org/research-report/u132>

Profiles of 63 Leading Programs

## With much gratitude to our project funders

- Commonwealth Edison
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- NSTAR
- Ontario Power Authority
- Southern California Edison
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# Thank you!

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<http://aceee.org/sector/state-policy>

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