NARUC'S CENTER FOR PARTNERSHIPS & INNOVATION

INNOVATION WEBINAR SERIES

NOVEMBER 14, 2019

USING ENERGY EFFICIENCY TO MEET PEAK ELECTRICITY DEMAND

WHAT IS NARUC

- The National Association of Regulatory Utility Commissioners (NARUC) is a non-profit organization founded in 1889.
- Our Members are the state regulatory Commissioners in all 50 states & the territories. FERC & FCC Commissioners are also members. NARUC has Associate Members in over 20 other countries.
- NARUC member agencies regulate electricity, natural gas, telecommunications, and water utilities.

WHAT IS NARUC'S CENTER FOR PARTNERSHIPS & INNOVATION?

- Grant-funded team dedicated to providing technical assistance to members.
- CPI identifies emerging challenges and connects state commissions with expertise and strategies.
- CPI builds relationships, develops resources, and delivers trainings.

NARUC CPI Topical Areas

- Energy Infrastructure & Technology Modernization
- Electricity System Transition
- Critical Infrastructure, Cybersecurity, Resilience
- Emerging Issues

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USING ENERGY EFFICIENCY TO MEET PEAK ELECTRICITY DEMAND

MODERATOR:

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Peak Demand Impacts from Electricity Efficiency Programs

National Association of Regulatory Utility Commissioners
Center for Partnerships & Innovation Webinar Series
November 14, 2019

Presented by Natalie Mims Frick

This work was supported by the U.S. Department of Energy's Office of Electricity, Transmission Permitting and Technical Assistance Division

[Peak Demand Impacts From Electricity Efficiency Programs]

[Infographic available here]

Report authors: Natalie Mims Frick, Ian Hoffman, Charles Goldman, Greg Leventis, Sean Murphy and Lisa Schwartz

Agenda

- Background: Berkeley Lab's Research on Cost of Saving Electricity (CSE)
- Approach: Data Collection and Analysis
- Results: Cost of Saving Peak Demand (CSPD) by State and Program
- Sensitivity Analysis: Climate Zone and Peak Period
- Next Steps

Why the Cost of Saving Electricity and Cost of Saving Peak Demand Matter

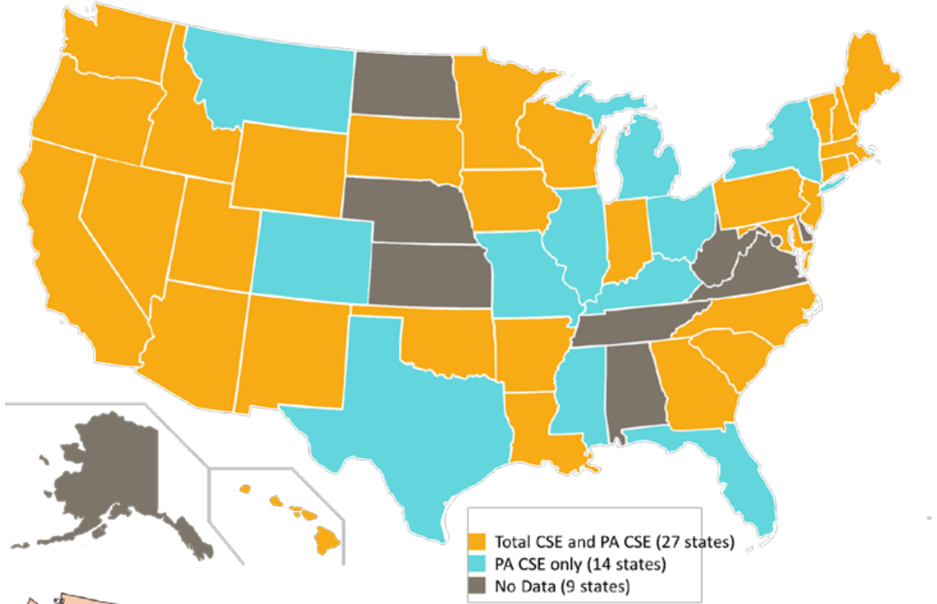
Program Administrator **Cost of Saving Electricity** is expressed in dollars per kilowatt-hour ($/kWh)

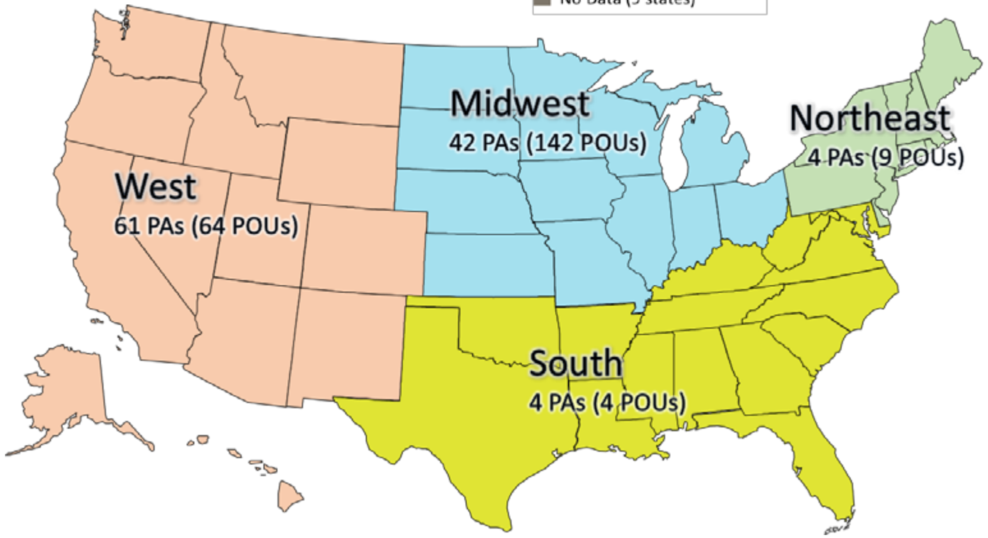
Program Administrator **Cost of Saving Peak Demand** is expressed in dollars per kilowatt ($/kW)

- To help ensure electricity system reliability at the most affordable cost as part of resource adequacy planning and implementation activities
- To project efficiency's impact on electricity load forecasts
- To benchmark program results with regional and national estimates
- For initial screening of electricity resource alternatives
- To evaluate how program costs are likely to change over time with funding levels and participation

Berkeley Lab's Research on Cost of Saving Electricity

- More than 13,000 program years* in database
- Investor-owned utilities (IOUs)
  - Analysis at the program level
  - Both program administrator (PA) CSE & total CSE
  - 116 PAs in 41 states, 2009-2015
- Publicly owned utilities (POUs)
  - Initial CSE study for POUs will be published soon
  - PA analysis at market-sector level
  - 111 PAs, representing 219 POUs in 14 states, 2012-2017 (90% of utilities reporting to EIA)
- Data collected
  - kW and kWh savings, budgets & expenditures
  - Program average measure lifetimes
  - Other data may include lifetime savings, net savings, and number of participants, projects or units.
- Update on cost of saving natural gas to published soon

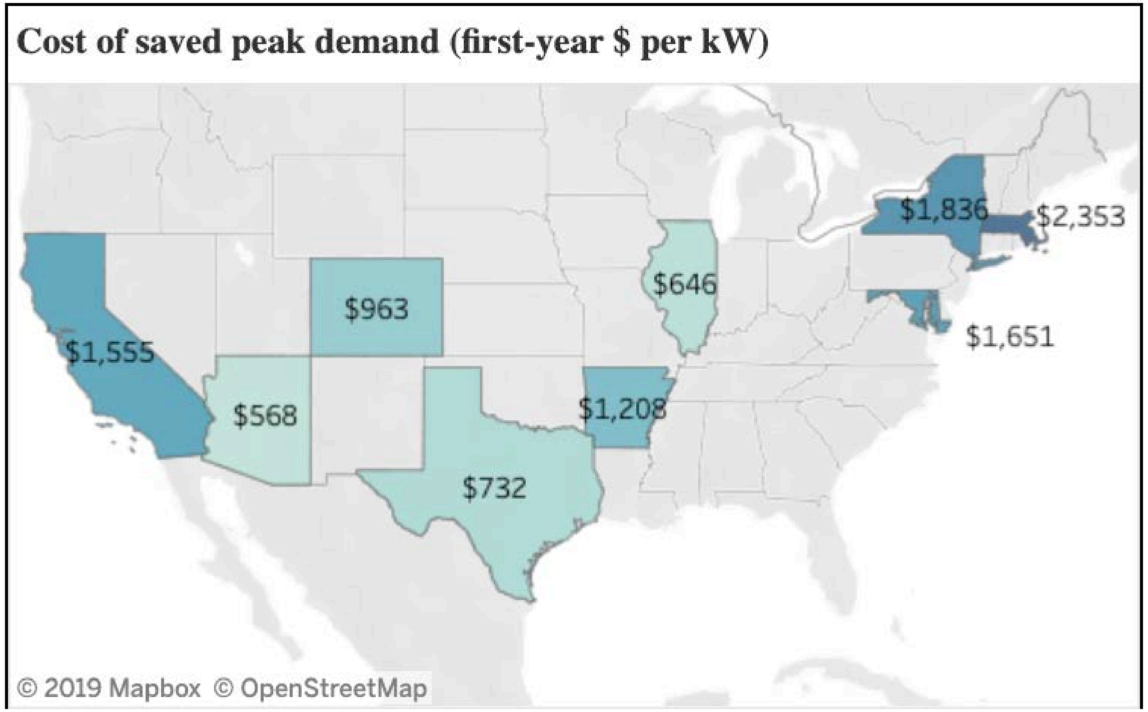




*Spending and savings data for a *single program* for a single year — e.g., data covering 4 years of spending and savings for a particular program represent 4 program years.

Berkeley Lab's Cost of Saving Peak Demand

- First-of-its kind analysis that explores questions such as:
  - To what extent are utilities and other program administrators reporting information on the peak demand impacts of their electricity efficiency programs?
  - How do program administrators define peak demand and calculate peak demand savings for their electricity efficiency programs?
  - For the nine selected states, what are the cost of saving electricity and the cost of saving peak demand at the portfolio level and for selected types of programs?



Links to Report and Infographic

Research Approach

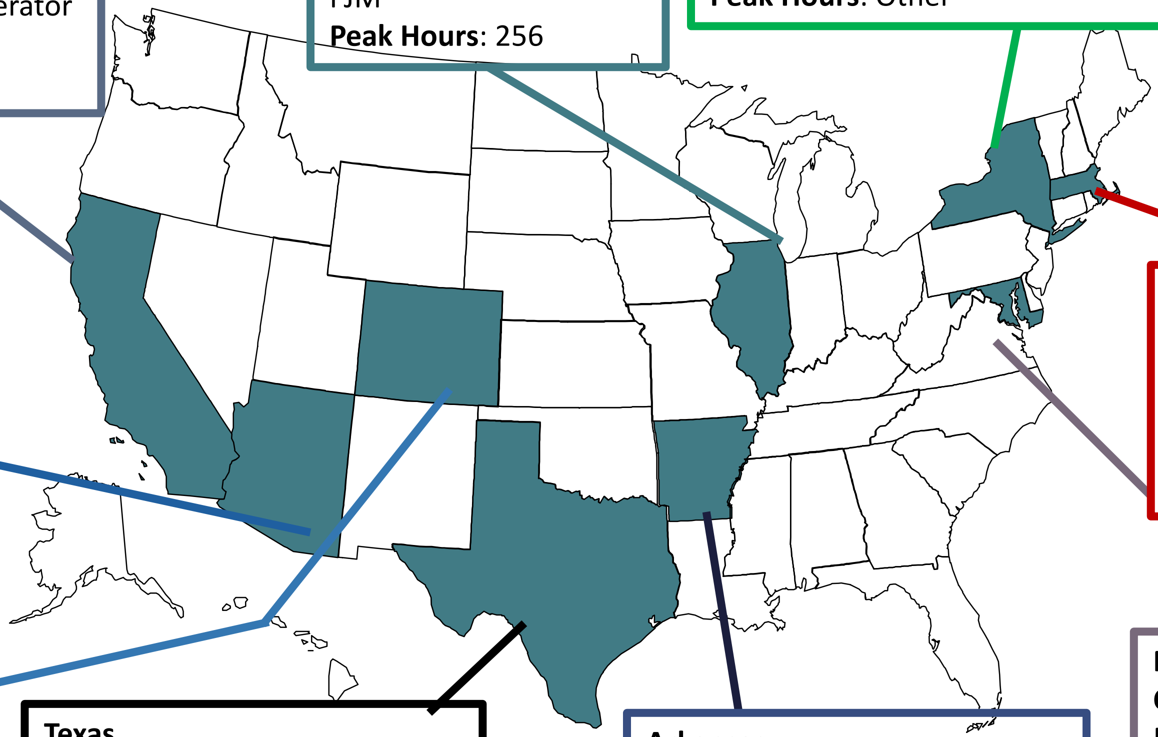
- Collected data from nine states for 2014-2017
  - Arizona, Arkansas, California, Colorado, Illinois, Maryland, Massachusetts, New York, Texas
  - Represents 43-49% of annual national spending on energy efficiency (2014-2017)
  - 36 utility/program administrators
- Added data to our Cost of Saving Electricity database
  - Program type
  - Program costs
  - Savings by program (kWh and kW)
  - Summer and winter kW were recorded where available (MA only state with winter peak data)
- Calculated savings weighted average Cost of Saving Peak Demand and Cost of Saving Electricity by state and program type
  - Cost of Saving Electricity - levelized over the lifetime of the program
  - Cost of Saving Peak Demand - first-year savings only
  - Metrics must be considered independently because the calculations rely on the same set of program costs
- Two sensitivity analyses on Cost of Saving Peak Demand
  - Climate zone
  - Duration of assigned peak period

States Included in Peak Demand Analysis

California
Climate Zones: Warm and Dry; Warm marine
ISO/RTO: California Independent System Operator (CAISO)
Peak Hours: 498

Illinois
Climate Zone: Cool and Humid
ISO/RTO: Midwest Independent System Operator (MISO) and PJM
Peak Hours: 256

New York
Climate Zones: Cold and Humid; Cool and Humid; Mixed and Humid
ISO/RTO: New York Independent System Operator (NYISO)
Peak Hours: Other



Arizona
Climate Zone: Hot and Dry
ISO/RTO: None
Peak Hours: Other

Massachusetts
Climate Zone: Cool and Humid
ISO/RTO: ISO–New England
Peak Hours: 256

Colorado
Climate Zone: Cold and Dry
ISO/RTO: None
Peak Hours: 256

Maryland
Climate Zones: Mixed and Humid; Cool and Humid
ISO/RTO: PJM
Peak Hours: Other

Texas
Climate Zones: Warm and Dry, Warm and Humid, Hot and Humid
ISO/RTO: Electric Reliability Council of Texas (ERCOT)
Peak Hours: Other

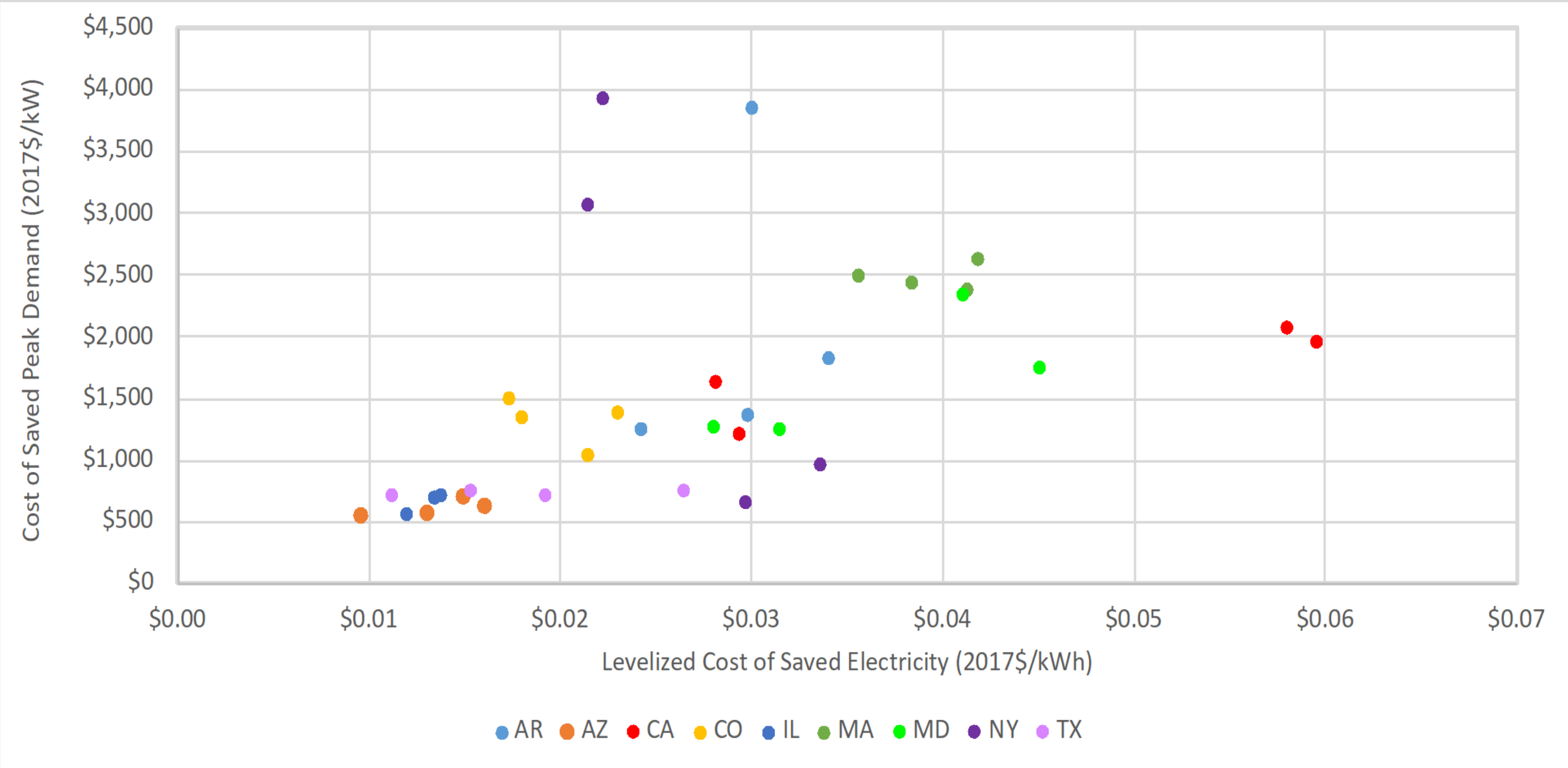
Arkansas
Climate Zone: Warm and Humid
ISO/RTO: Southwest Power Pool (SPP)
Peak Hours: 498

See slide 12 for more information on climate zones and slide 16 for more information on peak hours.

Cost of Saving Peak Demand and Cost of Saving Electricity, by State

State	Savings-Weighted PA CSPD (2017$/kW)	Savings-Weighted PA CSE (2017$/kWh)
Arizona	568	0.013
Illinois	646	0.020
Texas	732	0.021
Colorado	963	0.020
Arkansas	1,208	0.030
California	1,555	0.036
Maryland	1,651	0.036
New York	1,836	0.025
Massachusetts	2,353	0.039
All Nine States (average)	**1,483**	**0.029**

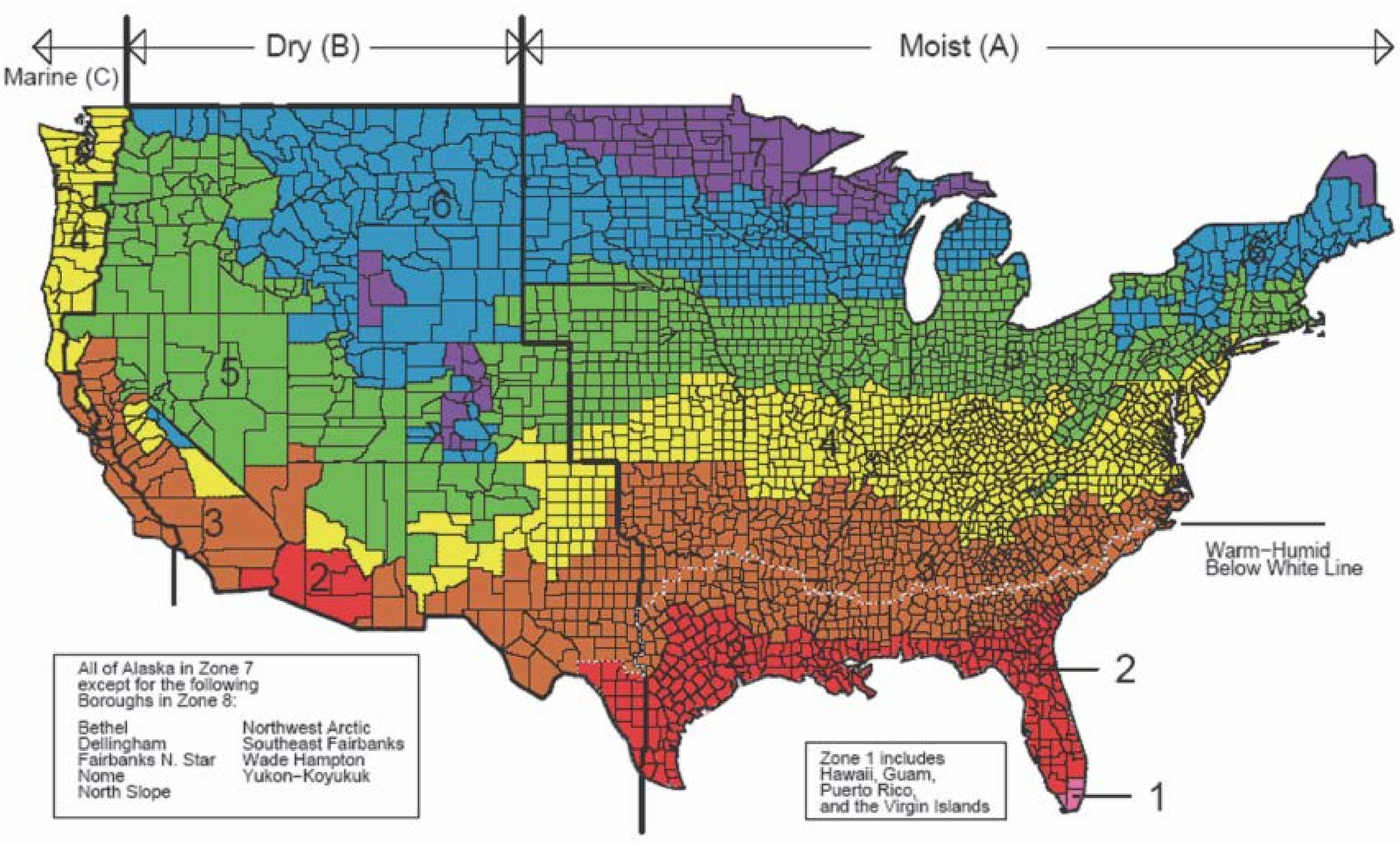
Cost of Saving Peak Demand and Cost of Saving Electricity, by State and Year



Cost of Saving Peak Demand and Cost of Saving Electricity, for Select Programs

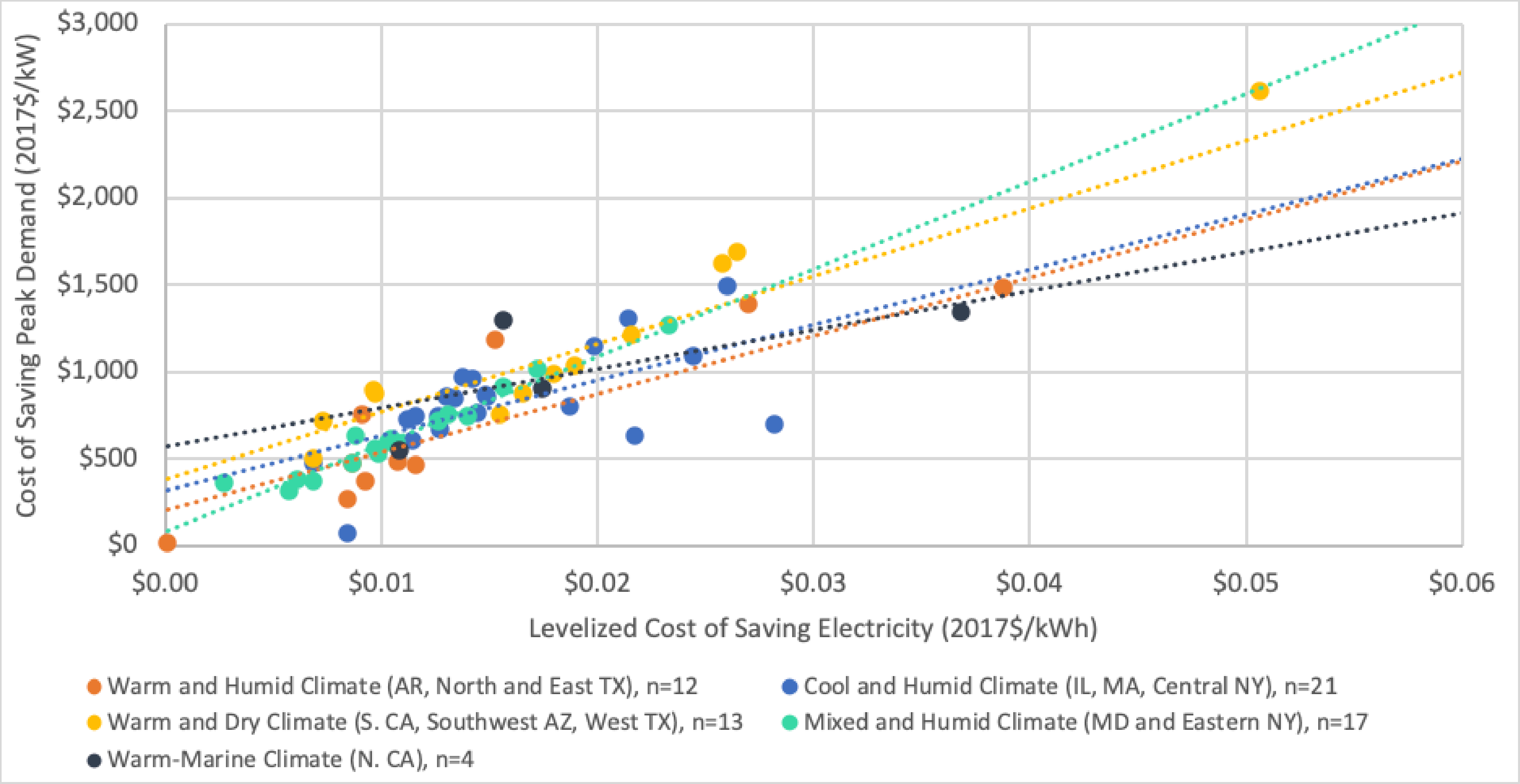
Program Type	Savings-Weighted Average CSPD (2017$/kW)	Median CSPD (2017$/kW)	Savings-Weighted Average CSE (2017$/kWh)	Median CSE (2017$/kWh)
Residential Lighting	733	738	0.013	0.013
C&I Prescriptive Rebate	1,331	1,332	0.026	0.027
C&I Small Commercial	2,071	1,993	0.050	0.042
Residential HVAC	2,331	2,202	0.078	0.094
Whole-Home Retrofit	2,543	1,960	0.056	0.072
C&I Custom Rebate	3,339	1,784	0.023	0.029
Low Income	5,751	2,099	0.135	0.091

Climate Zone Sensitivity Analysis

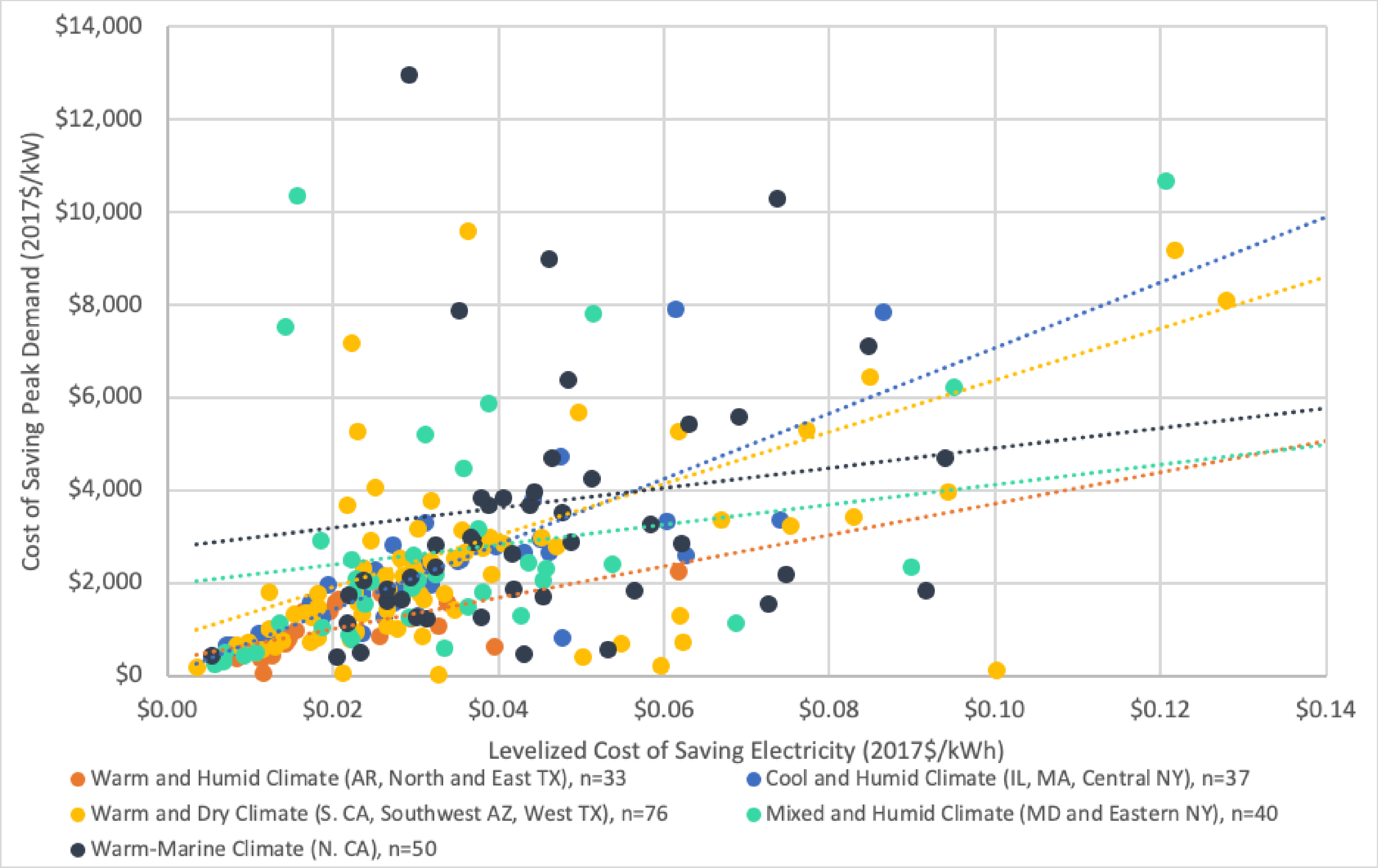


ASHRAE Climate Zones

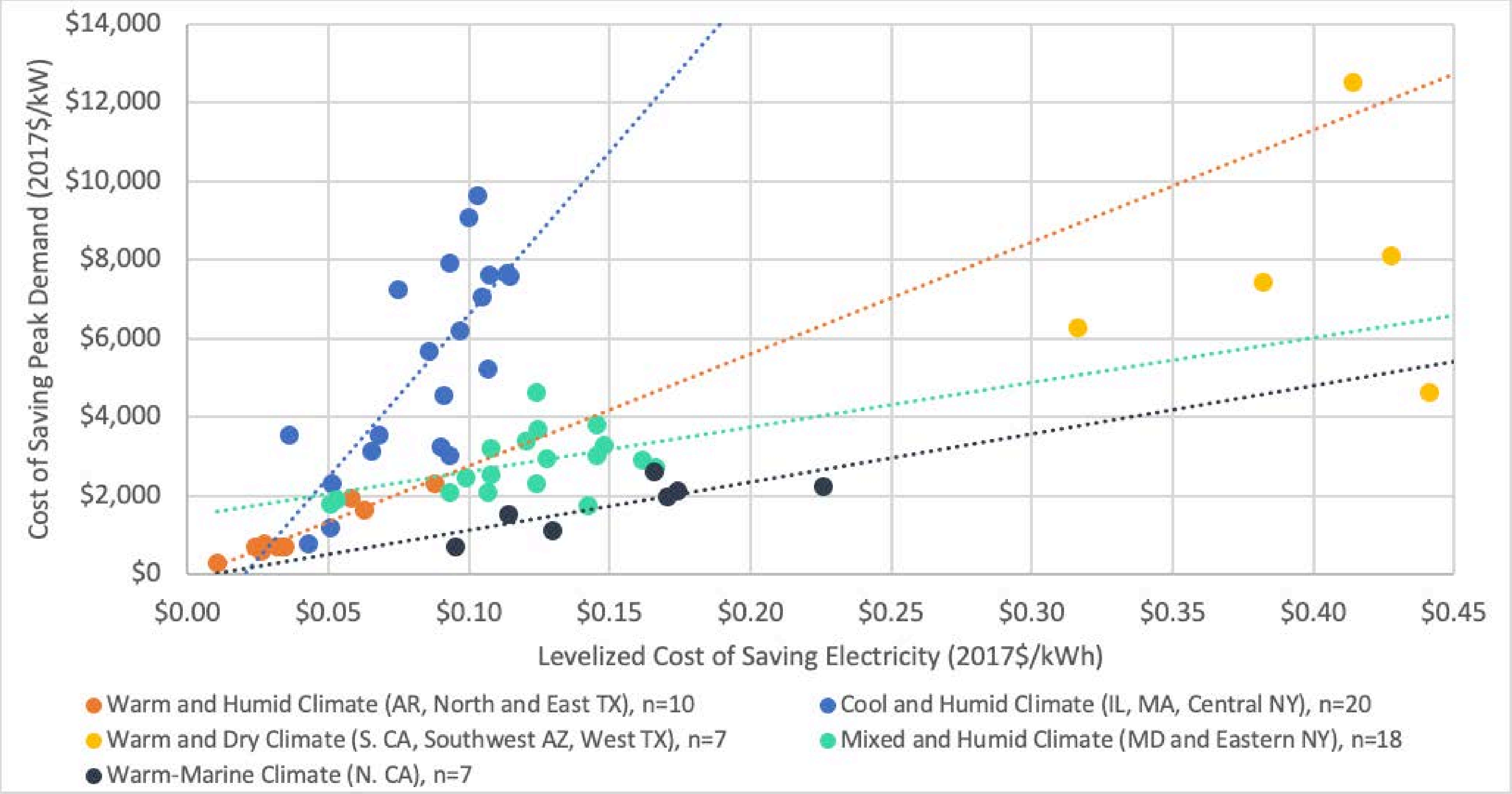
Residential Lighting: Cost of Saving Peak Demand, by Climate Zone



C&I Custom Program: Cost of Saving Peak Demand, by Climate Zone



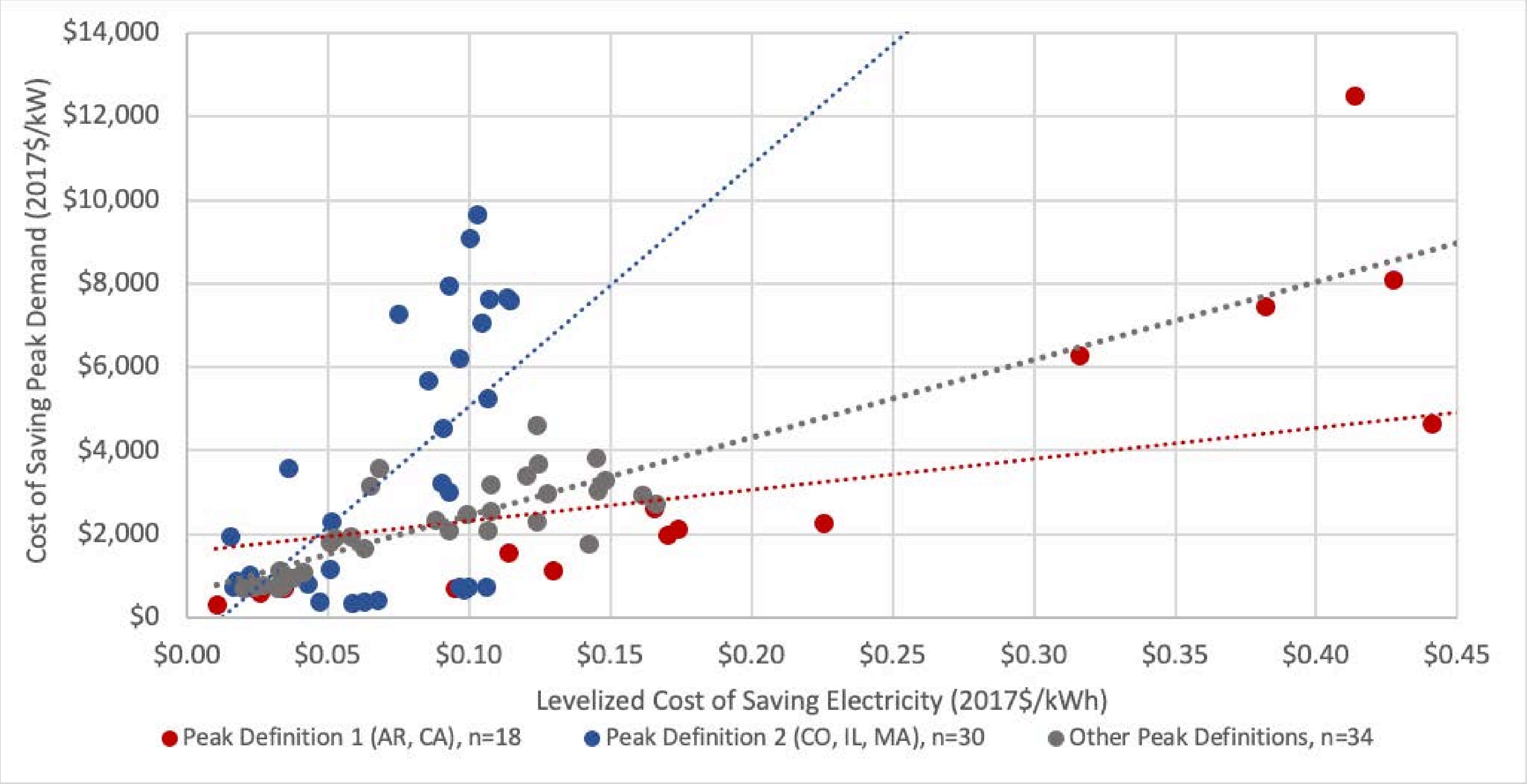
Residential HVAC: Cost of Saving Peak Demand, by Climate Zone



Duration of Peak Period

- The peak periods are different for most states in our analysis (see slide 20).
- For our sensitivity analysis, we grouped states into three categories to explore the relationship between CSPD and the defined peak periods.
  - 256 hours (Colorado, Illinois, Massachusetts)
  - 498 hours (Arkansas and California)
  - Remaining states (Arizona, Maryland, New York, Texas)
- We reviewed approaches that utilities and ISO/RTOs use to define peak periods and methods to estimate savings during period periods. Findings included:
  - Missing data on peak period savings and different definitions of peak periods hinder comparisons of CSPD across utilities, states and regions.
  - Inconsistent reporting and varying methods to calculate peak demand reductions, including the source of coincidence factors creates challenges for determining the robustness of the reported savings.

Residential HVAC: Cost of Saving Peak Demand, by Peak Period



Conclusion and Next Steps

- Cost of Saving Peak Demand for our initial nine-state sample averaged $1,483/kW
  - Electricity efficiency programs appear to be a relatively low-cost way for utilities to meet peak demand, compared to the capital cost of other resources that can be used to meet peak demand.
- Berkeley Lab is conducting additional research on this topic:
  - Update data for nine states included in initial study
  - Collect data for new states (2014 – 2018/2019)
  - Analyze broader dataset
  - Conduct additional research on state and PA approaches, including definitions and calculations
- Additional analysis we may explore in our ongoing research:
  - Lifetime peak demand savings
  - Template for peak demand costs and kW savings for PA energy efficiency reporting
  - Winter peak programs
  - Peak-to-energy ratios

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State or Program Administrator Peak Period Definitions

State/Program Administrator	Peak Period Hours	Peak Period Months	Total Peak Period Days*	Total Peak Period Hours
APS (Arizona)	3–8 pm (res and com)	May 1–October 31	128	640
UNS & TEP (Arizona)	3–7 pm (res) 2–8 pm (com)			512 (res) 768 (com)
Arkansas	1–7 pm	June 1– September 30	83	498
California	noon–6 pm	June 1– September 30	83	498
Colorado	2–6 pm	June 1–August 31	64	256
Illinois	1–5 pm	June 1–August 31	64	256
Massachusetts	1–5 pm	June 1–August 31	64	256
Maryland (statute)	none designated	June 1–September 30	83	N/A
Mid-Atlantic TRM Non-weather sensitive measures	2–6 pm	June 1–August 31	64	256
Mid-Atlantic TRM Cooling measures	4–5 pm	June 1–August 31	64	64
New York	4–5 pm	June 1–August 31	64	64
Texas	Utility peak period	June 1–September 30	1	1

Using Energy Efficiency to Meet Peak Demand: Programs and Policy Changes

Rachel Gold

Senior Manager, Utilities

14 November 2019

American Council for an Energy-Efficient Economy

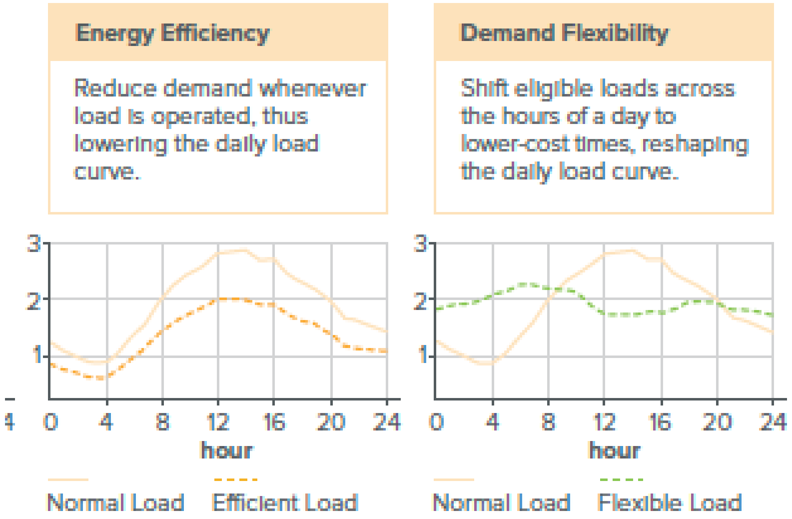
Agenda

- Integrating EE and DR in Programs
  - **Benefits and levels of integration**
  - **Enabling technologies**
  - **Program landscape and examples**
  - **Barriers to integrated programs**
- Integrating EE and DR in Policy
  - **Next-Generation EERS**
  - **Performance Incentive Mechanisms for Strategic Demand Reduction**

Integrated Energy Efficiency and Demand Reduction in Programs

Scope of integrated EE/DR research

- Research focused on programs that integrate energy efficiency and demand response
- Research goals:
  - **Characterize the landscape of integrated programs**
  - **Identify benefits, barriers, enabling mechanisms, and challenges to integration**
  - **Provide lessons for integrating programs**



Benefits of integration

Commonly realized benefits:	• Customer bill savings • Increased participation and program satisfaction • Lower program costs
Emerging benefits:	• Increased resource adequacy and grid reliability • Grid congestion relief • Earnings opportunities (e.g. shareholder incentives)
Benefits not yet realized:	• Increased wholesale competition & lower wholesale prices • Increased availability of ancillary services

Enabling Technologies

Residential	Commercial

Residential

- Smart and Wi-Fi enabled thermostats & appliances
- Advanced metering infrastructure (AMI)
- Direct load control switches
- Mobile apps and marketplaces

Commercial

Central control system

Equipment with embedded controls

Smart components

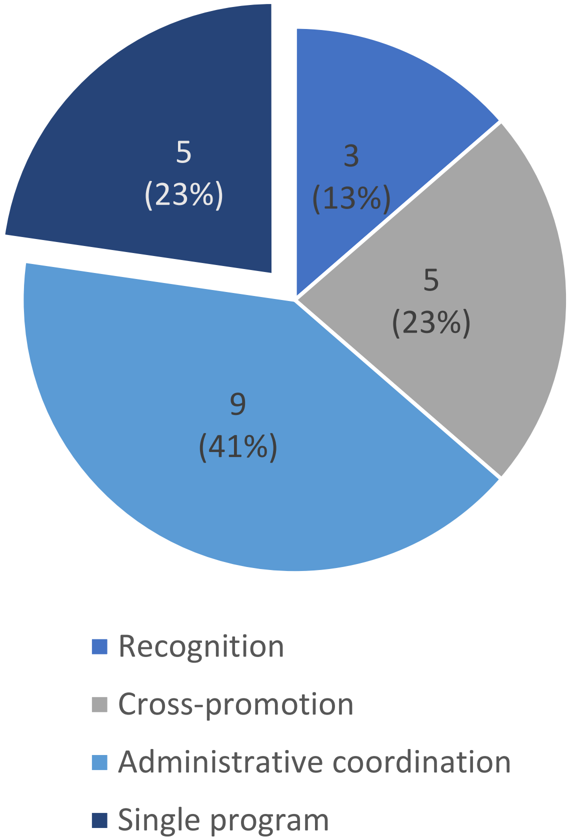
We found 4 levels of integration

- Level 1: Recognition of EE or DR capabilities
- Level 2: Cross promotion of programs
- Level 3: Administrative coordination
- Level 4: Single fully integrated program

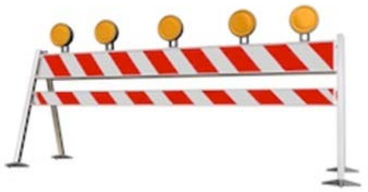
Research findings

Despite benefits— few fully integrated EE/DR programs in place

- Starting data set: 52 largest electric utilities (includes IOUs and munis)
- Of 44 utility plans ACEEE reviewed, found only 5 programs at highest level of integration
- Only 22 programs with some degree of integration
- Most programs are residential – few C/I programs
- Smart thermostats are prevalent: gateway to integration



Barriers and challenges



- Regulatory and policy context
  - Rate design, cost-effectiveness screening
- Siloed work streams and budgets
  - Conflicting internal objectives, different business cases
- High initial project cost for customers
- Contractor coordination
- Lack of metrics for evaluating benefits of integration

Takeaways and Opportunities

- Although there are few fully integrated programs, new technology and customer demand is driving interest from program administrators
- Residential smart thermostat programs are the most prevalent among current offerings, and can be a good place to start
- Focus on customers and trade allies and put forth clear value propositions in communications, online marketplaces
- Leverage existing data and partnerships
- Organizational changes and supportive policies will reduce barriers to integration

Administrators should pursue integrated programs when the net benefits outweigh the costs of integration.

Policy Tools to Encourage Peak Demand Reduction from Energy Efficiency

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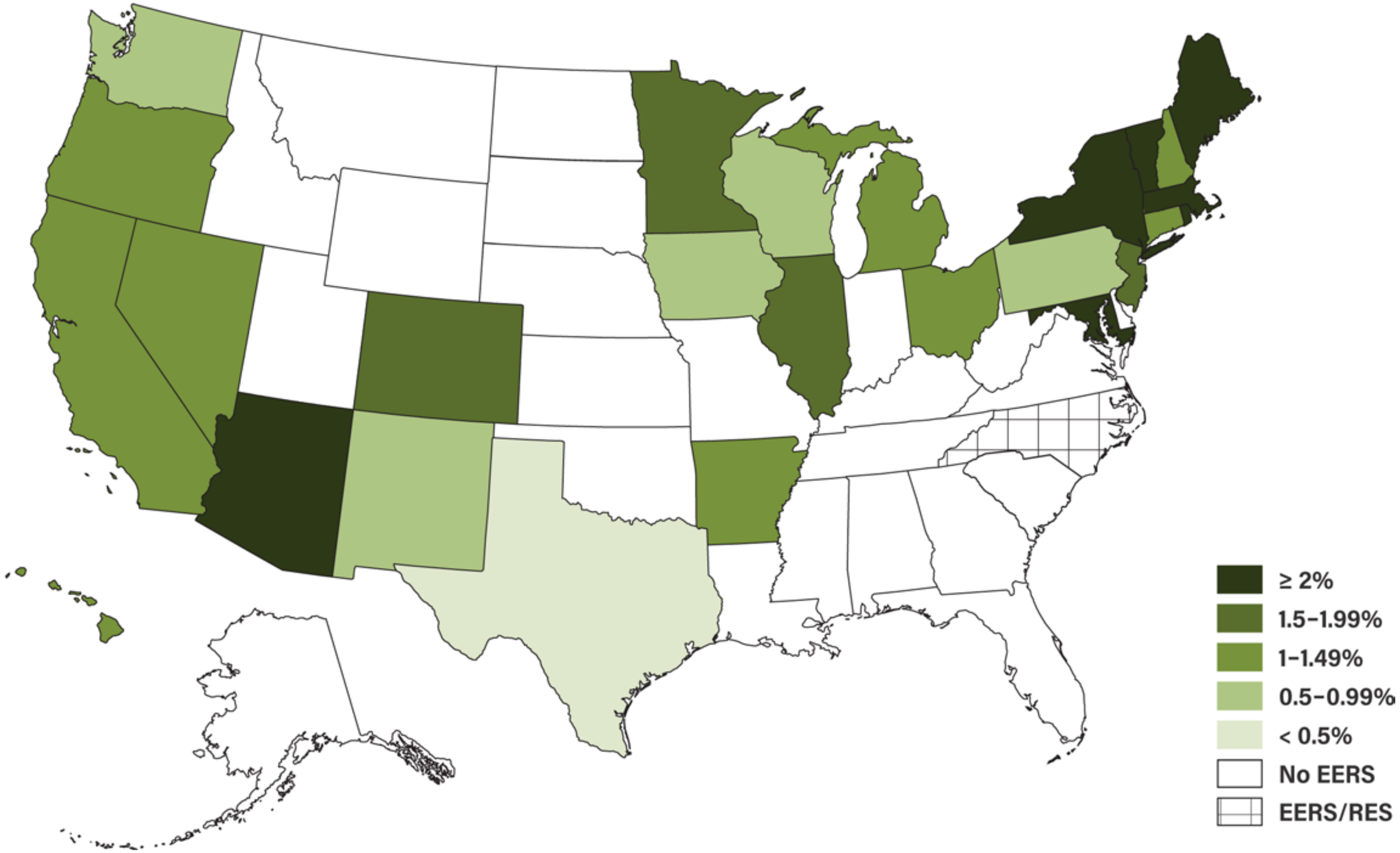
EERS policies are widespread, and typically focus on kWh and therms savings



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What is driving change?

- Market conditions
  - **Reduced savings from lighting**
  - **Increasing Availability of Controls and Flexibility**
  - **Decreasing Average Avoided Costs**
  - **Electrification**

- Policy priorities
  - **Decarbonization**
  - **Cost**
  - **Equity**
  - **Grid value**

Emerging Interest in “Multiple Goals,” including demand reduction

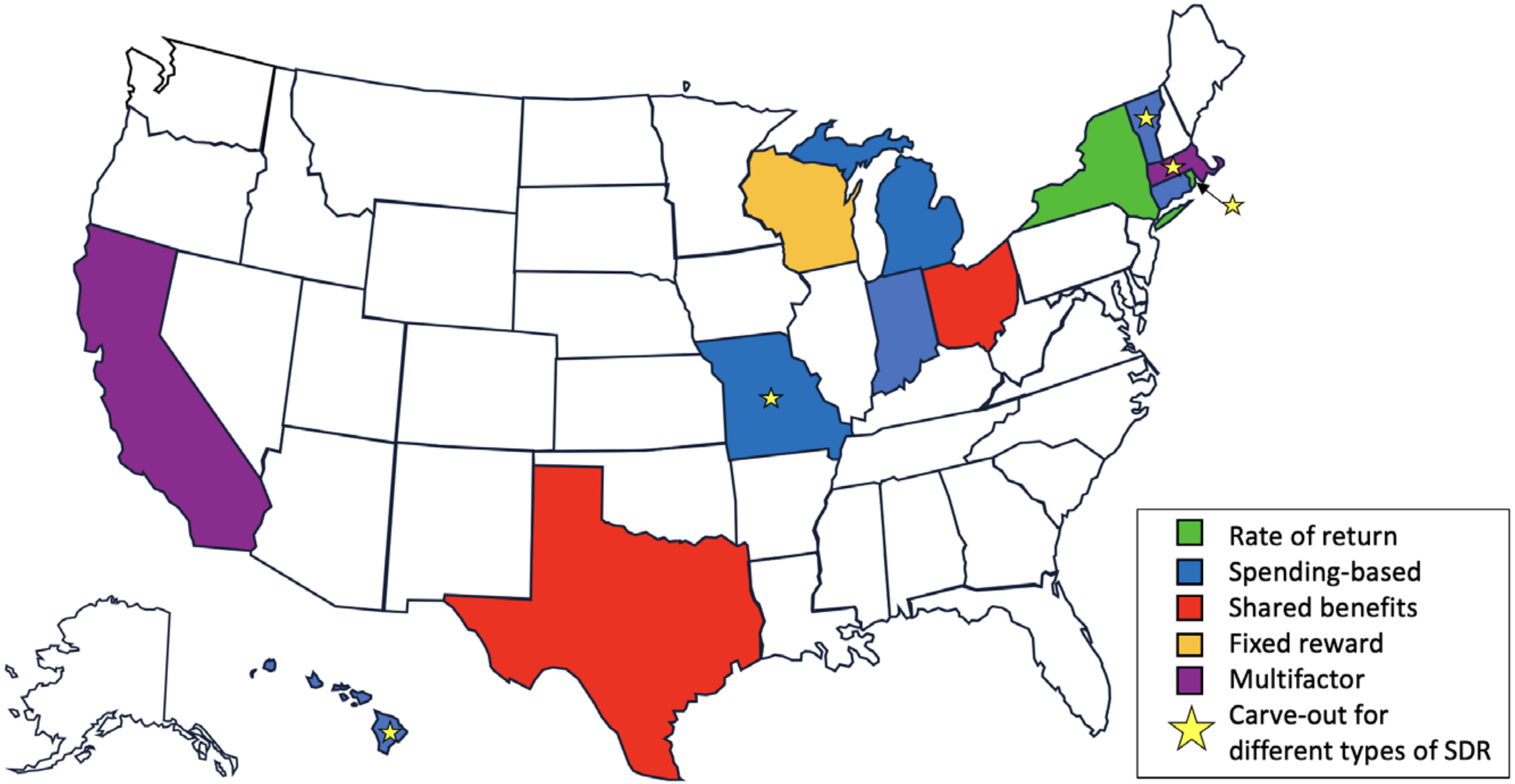
- Massachusetts
  - Multiple goals includes summer and winter peak demand savings, including “shape” and “shed” resources
- Hawaii
  - Under discussion: cumulative persisting peak demand
- New York
  - Decided against explicit goals, but included a “kicker” to customer incentives for measures that address specific grid needs
- Minnesota
  - Considering impacts on peak demand as a part of criteria for beneficial fuel switching in legislation (passed House, not Senate)

States are also using many other tools beyond goals to promote demand reduction

- Program design
- Carve-outs
- Tracking
- Cost-effectiveness rules
- Spending
- Separate portfolios
- Performance incentives

Performance Incentive Mechanisms for Strategic Demand Reduction

Preliminary Results



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13 examples of SDR PIMs – that require PA to meet SDR target measured in MW reductions, or paid based on performance in MW reductions

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Thank you!

ACEEE Publications

Integrated Energy Efficiency and Demand Response Programs
https://aceee.org/research-report/u1906

State of the Market: Grid-Interactive Efficient Utility Programs
https://aceee.org/white-paper/gebs-103019

Next Generation Energy Efficiency Resource Standards
http://www.aceee.org/research-report/u1905

Forthcoming: Strategic Demand Reduction PIMs

Contact us at: rgold@aceee.org

For more info on our GEB Utilities Working Group:
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Appendix

American Council for an Energy-Efficient Economy

Some residential programs creatively combine EE and DR value streams.

- AEP It's Your Power: Energy management app for homeowners
- PG&E ADR Program: Additional EE incentives for DR customers
- Southern Company Smart Neighborhoods: Aggregating DERs

AEP AMERICAN® ELECTRIC POWER

PG&E®

Southern Company

peak rewards℠
a BGE SMARTENERGY savers program®

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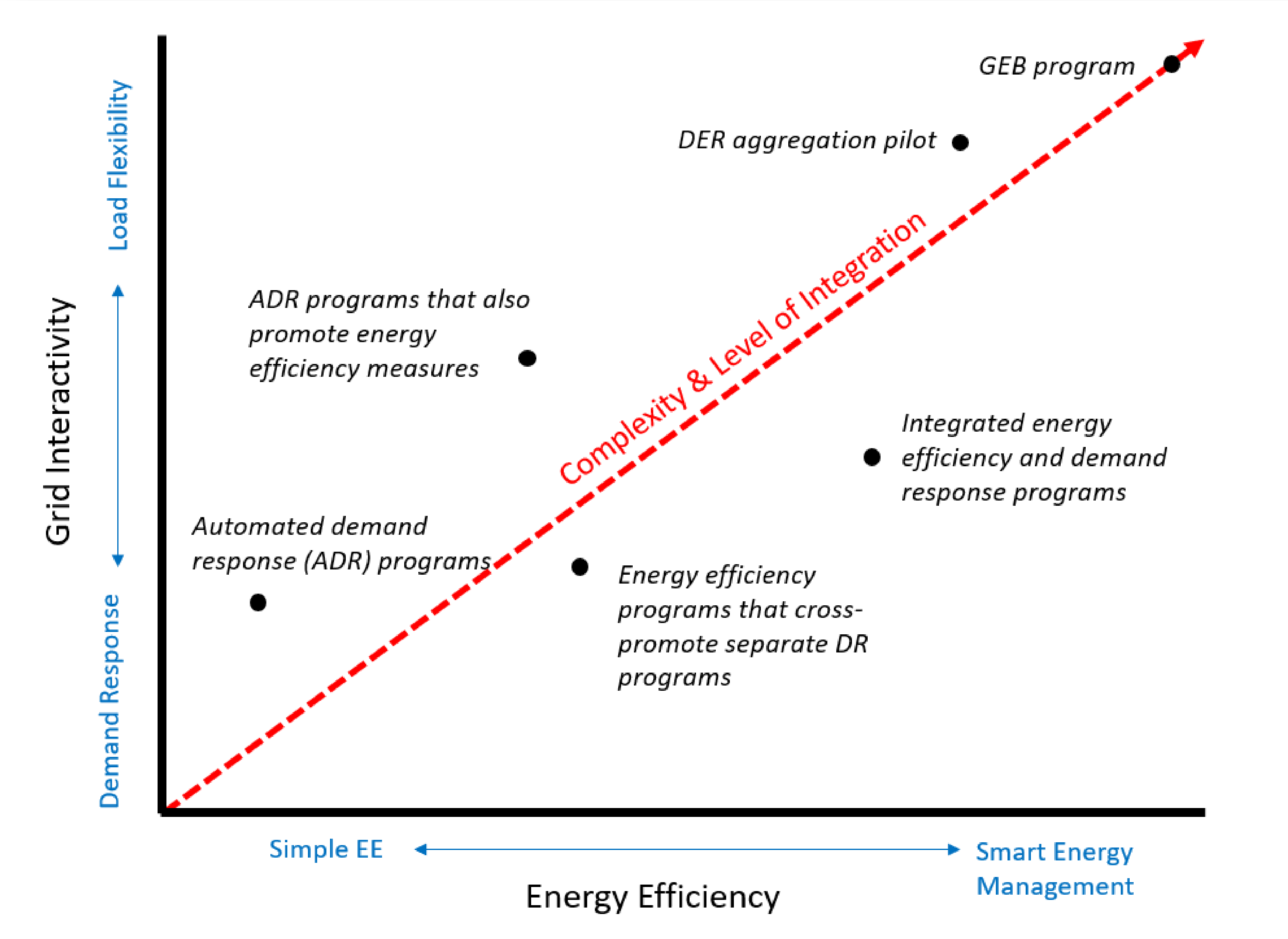
Commercial/industrial programs

- Level 1: Recognition
  - Duke Carolinas/Duke Progress: EnergyWise Business Program—HVAC cycling DR program, some t-stat EE savings
- Level 2: Cross Promotion
  - Eversource Massachusetts: facilitate enrollment in EE and DR – promote technologies eligible for both
  - National Grid New York: Electric C&I Retrofit Program – promotes connected tech to enroll customers in DR programs
- Level 3: Administrative coordination
  - Xcel Energy Colorado: Energy Management Systems Program offers incentives for peak demand and energy reductions
  - Southern California Edison: coordinates program administration-–applications, marketing, education, and outreach.
- Level 4: Integration
  - NV Energy: PowerShift Commercial Energy Services – single program and appointment to offer rebates for EE equipment, assessments, and smart t-stats that can be enrolled for DR

Next step for integration:
Grid-interactive efficient buildings (GEBs)
Smart, connected buildings

- Grid connectivity is rapidly becoming important --- response to/need created by rapid growth of DERS
- GEBs: Energy-efficient buildings with the ability to be demand flexible
- No real programs yet---mostly research and demonstration projects

ACEEE research on GEBs: We found no full GEB programs or pilots; Instead, a spectrum of EE and grid interactivity



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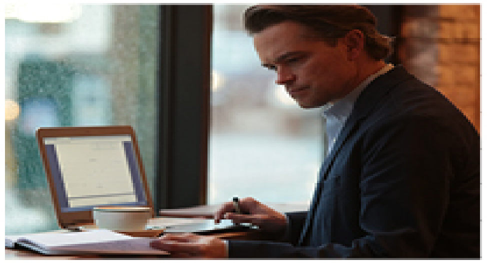
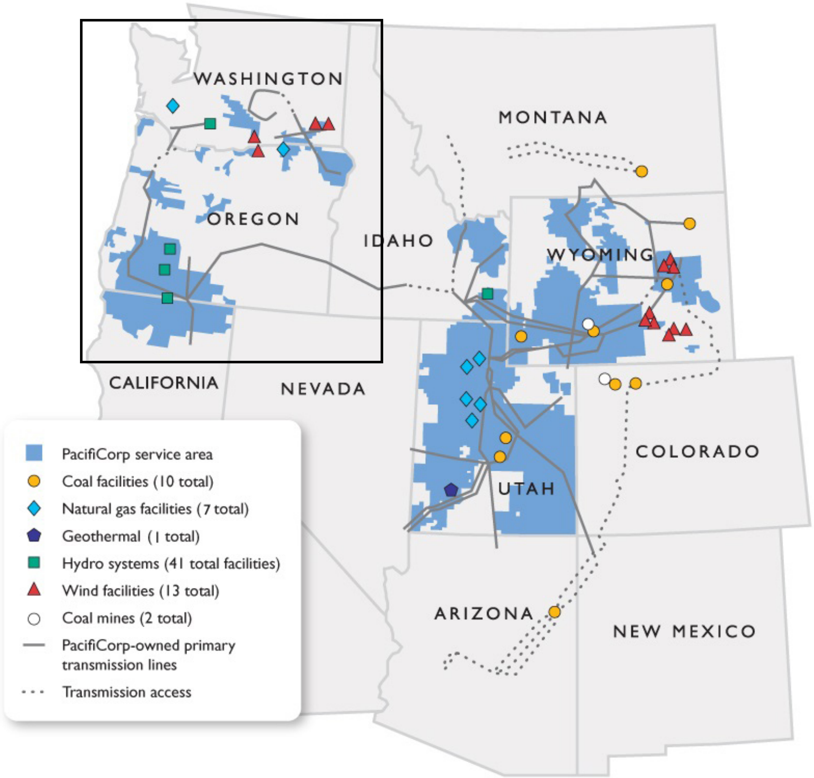
Valuing Energy Efficiency



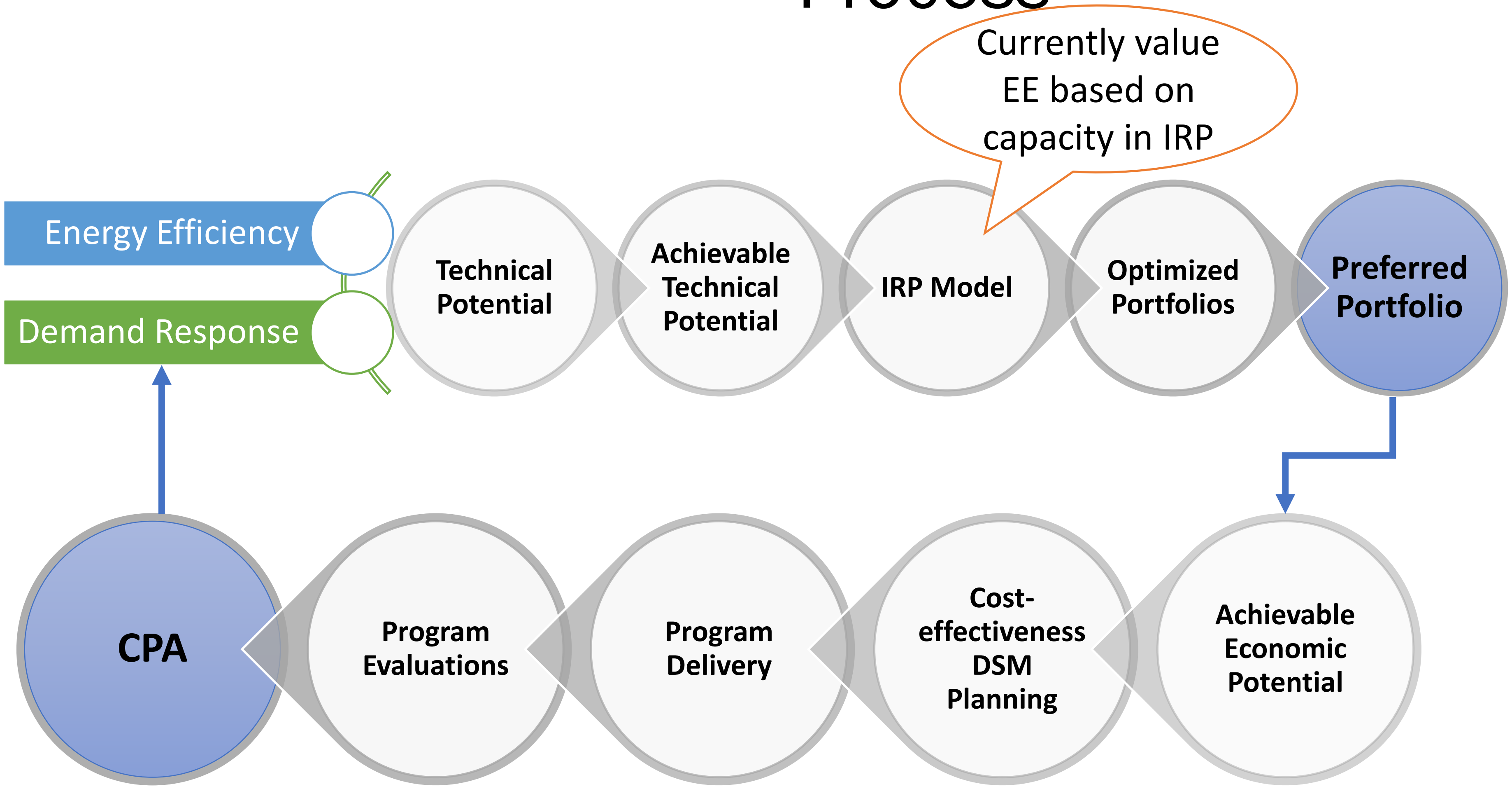

PACIFICORP
POWERING YOUR GREATNESS

About PacifiCorp (PAC)



- PacifiCorp is part of Berkshire Hathaway Energy family of businesses
- Six-state service area: Pacific Power (Oregon, Washington, California); Rocky Mountain Power (Wyoming, Idaho, Utah)
- 5,400 employees
- 1.9 million electricity customers
- 141,400 square miles of service area
- 16,500 transmission line miles
- 11,830 MW owned power capacity

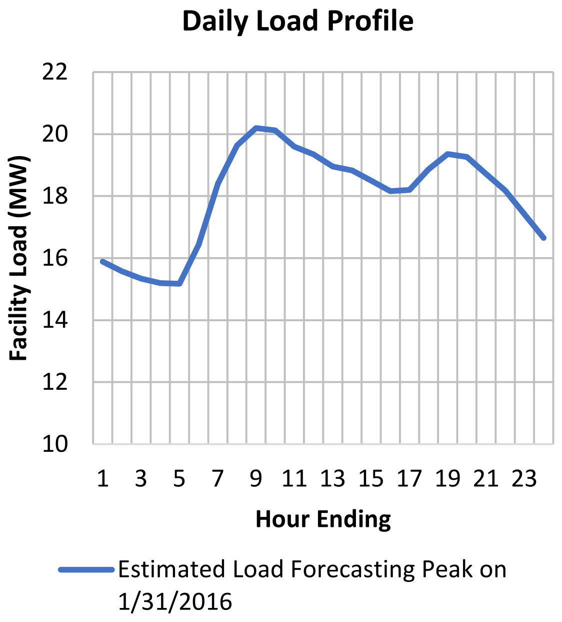
Traditional Energy Efficiency Process



Understanding System and Locational Peak Demand

Before determining the capacity of energy efficiency ask yourself what is the intended use case and what datasets are available

— In this case, it's energy efficiency's contribution on PAC's peak



Sector	**Load**			**Per-Customer**	
	Usage (MWh)	**Peak (MW)**	**Customers**	**kWh/Cust**	**kW/Cust**
Residential	29,297	4.2	2,504	11,699	1.7
Commercial	12,586	1.7	207	60,680	8.2
Industrial	60,979	7.3	53	1,145,260	137.9
Irrigation	177	0.0	2	85,167	0.2
Total	**103,039**	**13.3**	**2,767**	**37,238**	**4.8**

Residential	**Load**			**Per-Customer**	
	Usage (MWh)	**Peak (MW)**	**Customers**	**kWh/Cust**	**kW/Cust**
Single Family	22,051	3.1	1,890	11,665	1.7
Multifamily	1,171	0.2	131	8,935	1.3
Mobile Home	6,076	1.0	483	12,584	2.0
Total	**29,297**	**4.2**	**2,504**	**11,699**	**1.7**

Note: Numbers are for illustrative purposes only

Capacity Value for Energy Efficiency

- Developed an "capacity" value (kW)
  - Utilized PacifiCorp-specific end-use loadshapes to develop a peak factor
    - Averaged peak period + hour before and after
  - Used peak factor to create a primary peak contribution value and a secondary peak contribution (e.g., seasonal peak)
    - Peak factor multiplied by annual energy savings = capacity value

Available DSM (2025)

Sector	Feeder Peak (MW)	DSM Impacts in 2025 (MW) DLC	EE	DSRs	Total	Peak w/ DSM (MW)	% Reduction
Residential	8.3	*0.5*	*0.3*	*0.1*	0.9	7.4	11.4%
Commercial	3.3	*0.0*	*0.4*	*0.0*	0.4	2.9	12.1%
Industrial	14.3	*0.2*	*1.8*	*0.0*	2.0	12.4	13.8%
Irrigation	0.0	*0.0*	*0.0*	*0.0*	0.0	0.0	0.0%
Total	**26.0**	**0.7**	**2.5**	**0.2**	**3.3**	**22.6**	**12.8%**

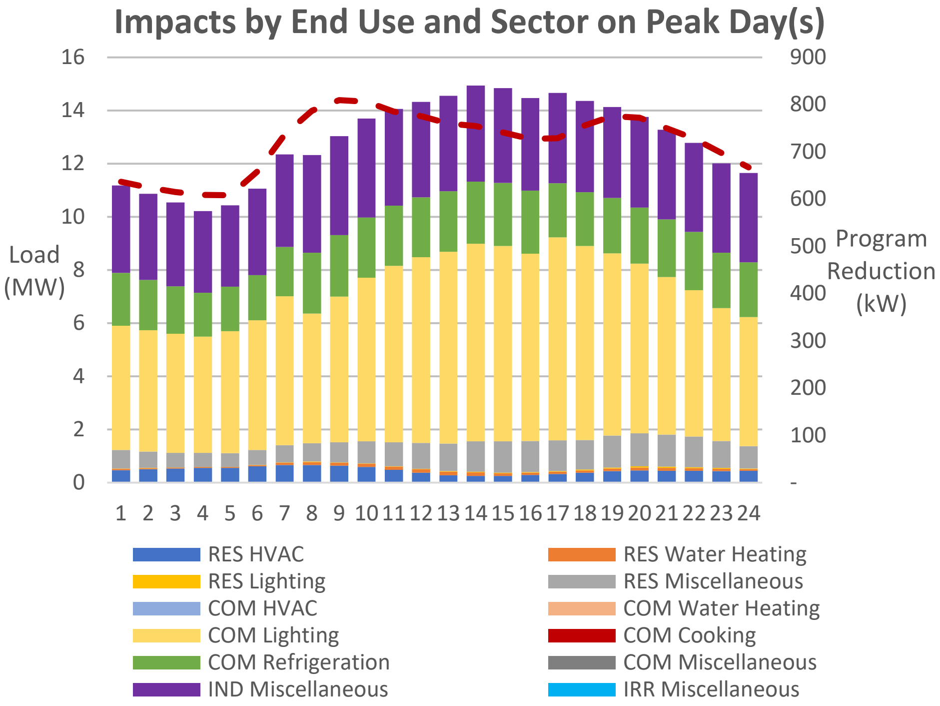
Assigned Load Shape	1st Peak Factor (kW/kWh)	2nd Peak Factor (kW/kWh)	Annual Energy Savings (kWh)	1st Peak Reduction over Specified Period (kW)	2nd Peak Reduction over Specified Period (kW)
OR_Commercial_Small Retail_Lighting	0.000169	0.000175	332	0.06	0.06

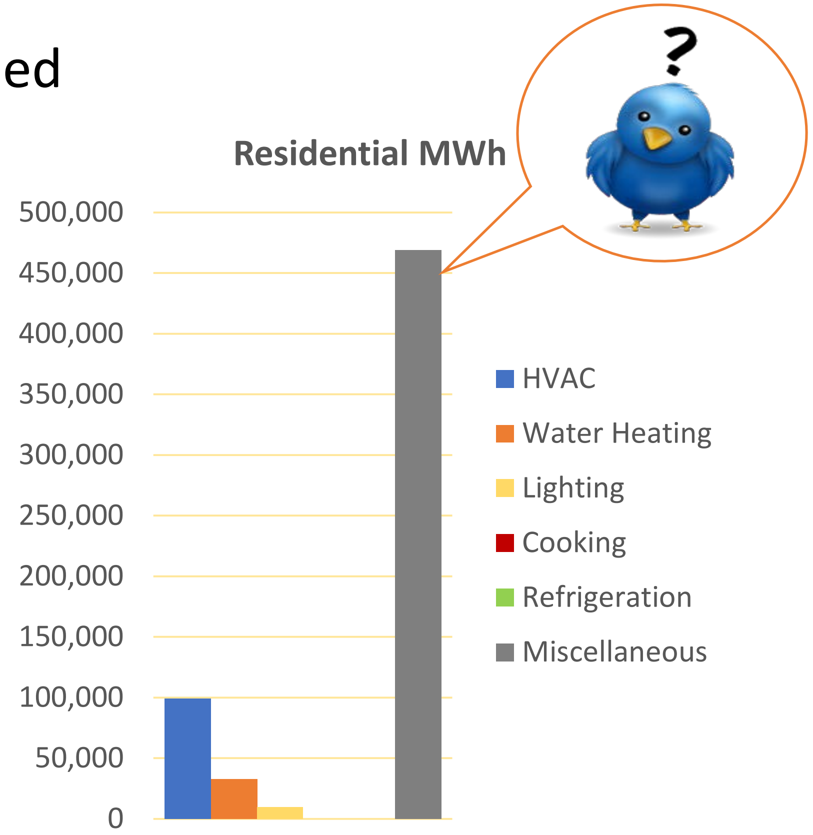
Note: Numbers are for illustrative purposes only

Ability to Measure Impacts

Once the peak factors were created, PacifiCorp designed a tool to calculate energy efficiencies contribution by end-use to PacifiCorp's system or locational peak

— Results are still being tested and refined





Note: Numbers are for illustrative purposes only

Estimated Results of Program Implementation

Energy Trust of Oregon and PacifiCorp partnered to implement a location-specific energy efficiency pilot

— With a goal to develop and implement a learning pilot focused on bringing additional value to the grid through the quick deployment of existing energy efficiency resources

Sector	End Use	Annual kWh	Summer kW	Winter kW	Measures	Incentives
Residential	HVAC	*99,071*	*7.2*	*16.9*	*49*	*$37,281*
Residential	Water Heating	*32,959*	*3.3*	*6.0*	*223*	*$1,336*
Residential	Lighting	*9,636*	*1.1*	*1.3*	*102*	*$3,317*
Residential	Miscellaneous	*468,822*	*78.2*	*62.4*	*12*	*$3,878*
Commercial	HVAC	*0*	*0.0*	*0.0*	*0*	*$0*
Commercial	Water Heating	*0*	*0.0*	*0.0*	*0*	*$0*
Commercial	Lighting	*2,984,616*	*404.9*	*409.2*	*91*	*$508,261*
Commercial	Cooking	*0*	*0.0*	*0.0*	*0*	*$0*
Commercial	Refrigeration	*1,259,439*	*272.5*	*127.8*	*15*	*$297,706*
Commercial	Miscellaneous	*0*	*0.0*	*0.0*	*0*	*$0*
Industrial	Miscellaneous	*1,597,389*	*179.4*	*199.1*	*23*	*$96,736*
Irrigation	Miscellaneous	*0*	*0.0*	*0.0*	*0*	*$0*
All	All	*6,451,932*	*946.6*	*822.8*	*515*	*$948,515*

Note: Results are preliminary and need to be verified

QUESTIONS

PLEASE ENTER INTO YOUR CHAT OR QUESTIONS BOX

IF YOU PREFER TO ASK VERBALLY, JUST “RAISE YOUR HAND” IN THE GOTOWEBINAR CONTROL PANEL AND WE WILL UNMUTE YOUR PHONE LINE

Upcoming NRRI Webinar
Wednesday, December 11, 2019
2:00 – 3:30 P.M. EST

Are Ratepayer-Funded Energy Efficiency Programs Still Relevant?

Many states have clean energy or climate goals, and energy efficiency is often the most cost-effective approach to reducing carbon emissions in the buildings sector. Yet studies show that billions of dollars of un-realized savings remain. At the same time, energy customers are increasingly investing in other, more visible indications of "green" or climate-protective behavior, such as installing solar panels, purchasing renewable power, and driving electric vehicles. This webinar will consider the question of whether and under what circumstances ratepayer-funded efficiency programs should continue to intervene in the residential and commercial buildings market.

To register, visit www.nrri.org

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