Natural Gas EE Programs

Expanding Opportunities with Emerging Technologies

NARUC Gas Committee
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GTI Overview

ESTABLISHED 1941

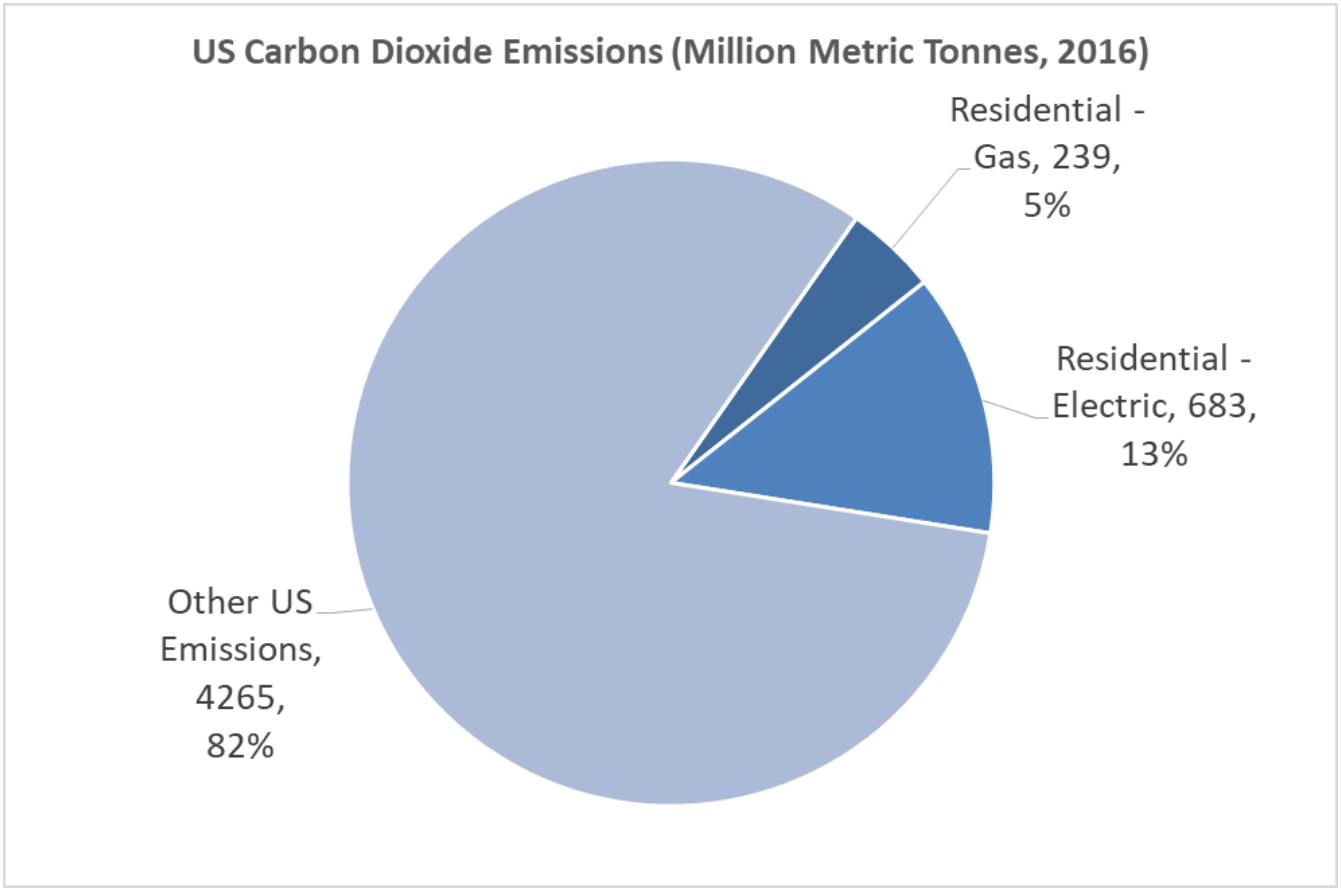
- Independent, *not-for-profit* company established by natural gas industry
- Providing natural gas and energy research, development and technology deployment services to industry, consumers, and government clients
- Performing contract research, program management, consulting, and training
- Wellhead to the burner tip including energy conversion technologies as well as renewables and energy efficiency

Residential Natural Gas Use Carbon Footprint

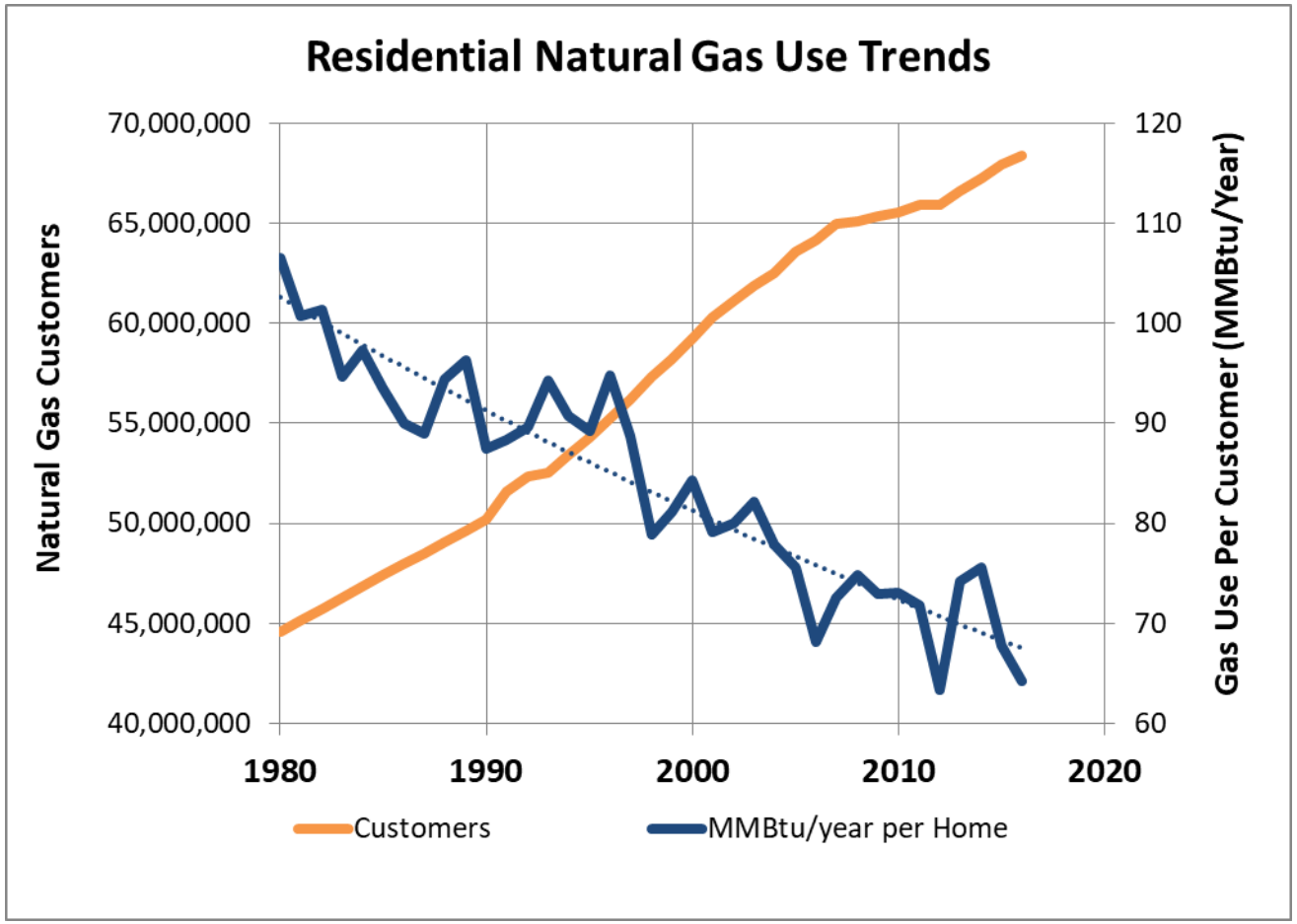
Improvements in EE for natural gas technologies and tighter building envelopes continue to reduce the carbon footprint of homes using natural gas.

As a result, residential natural gas use is a shrinking and small portion of U.S. carbon dioxide emissions.

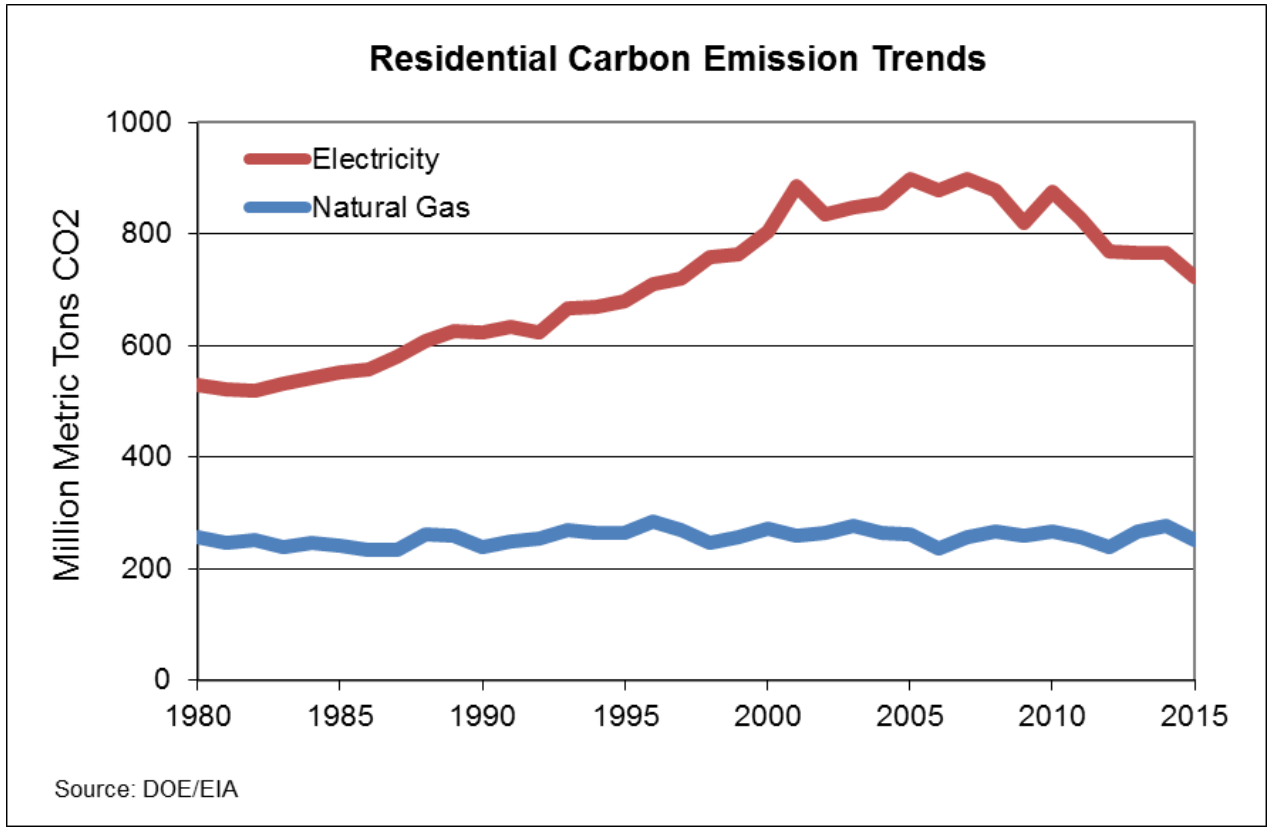
Additionally, further improvements in gas appliance efficiency and even tighter building envelopes – along with blending renewable natural gas (RNG) – is the future low cost option for continued and dramatic reductions in residential carbon emissions.



Trends In Natural Gas Customer Efficiency



Residential Carbon Emissions



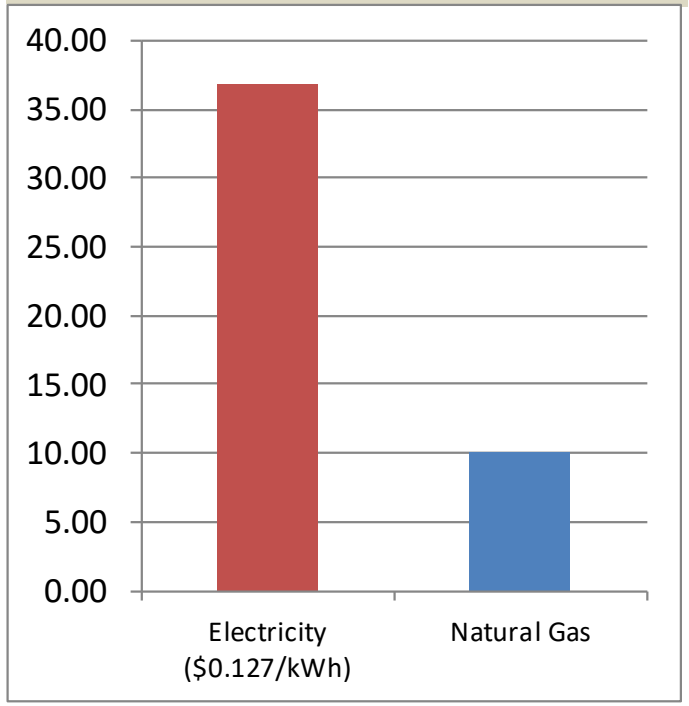
Carbon emissions from home electricity use have peaked and are in a decline phase.

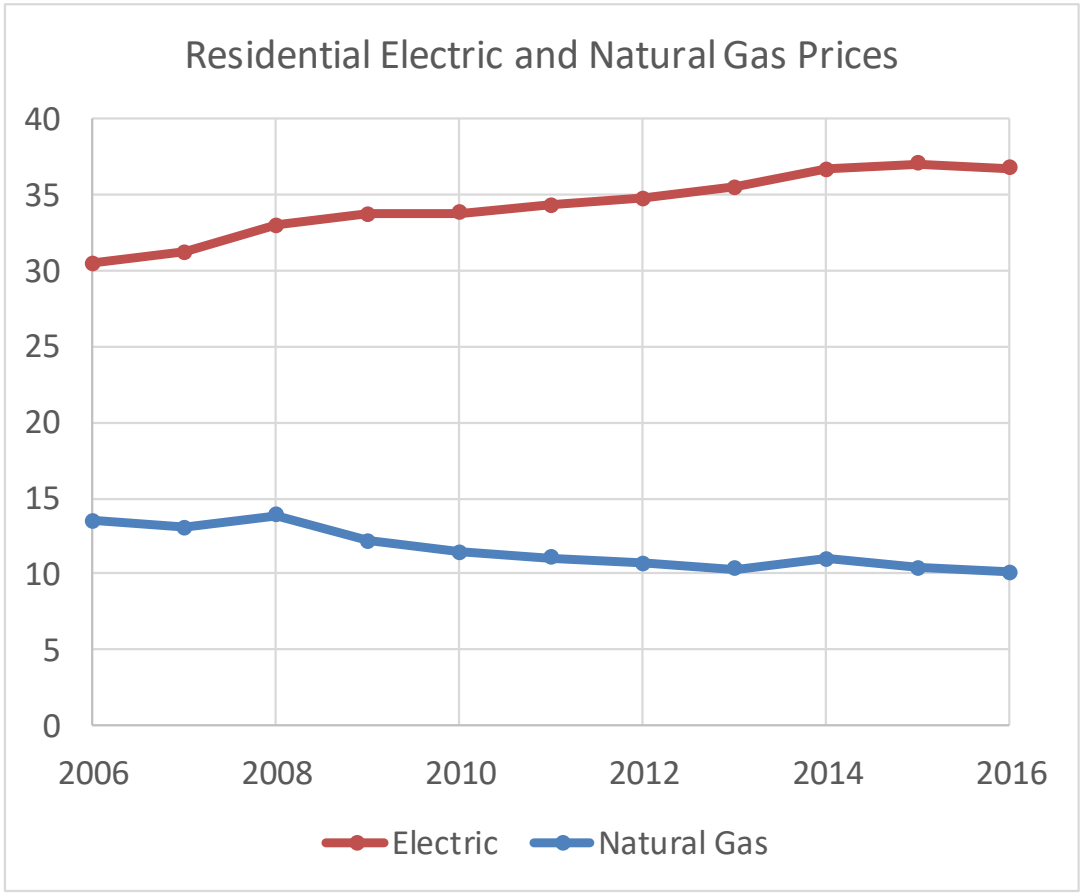
Reductions driven by natural gas displacing coal (about 75%) and wind and solar generation (about 25%).

Even with the large increase in the number of homes using natural gas carbon emissions has been flat and recently declining.

Residential Energy Prices

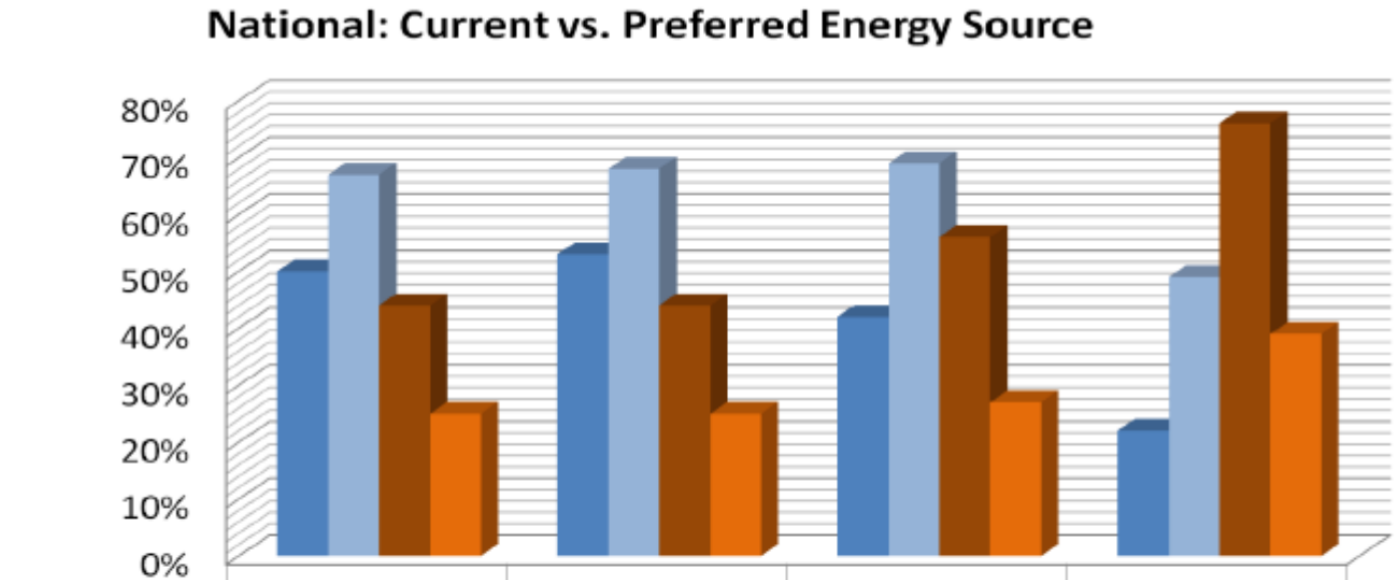
Residential Energy	$/MMBTU
Electricity ($0.127/kWh)	36.78
Natural Gas	10.06
Ratio	3.66





Consumers' Preferences

Home energy consumers have a strong preference for using natural gas.

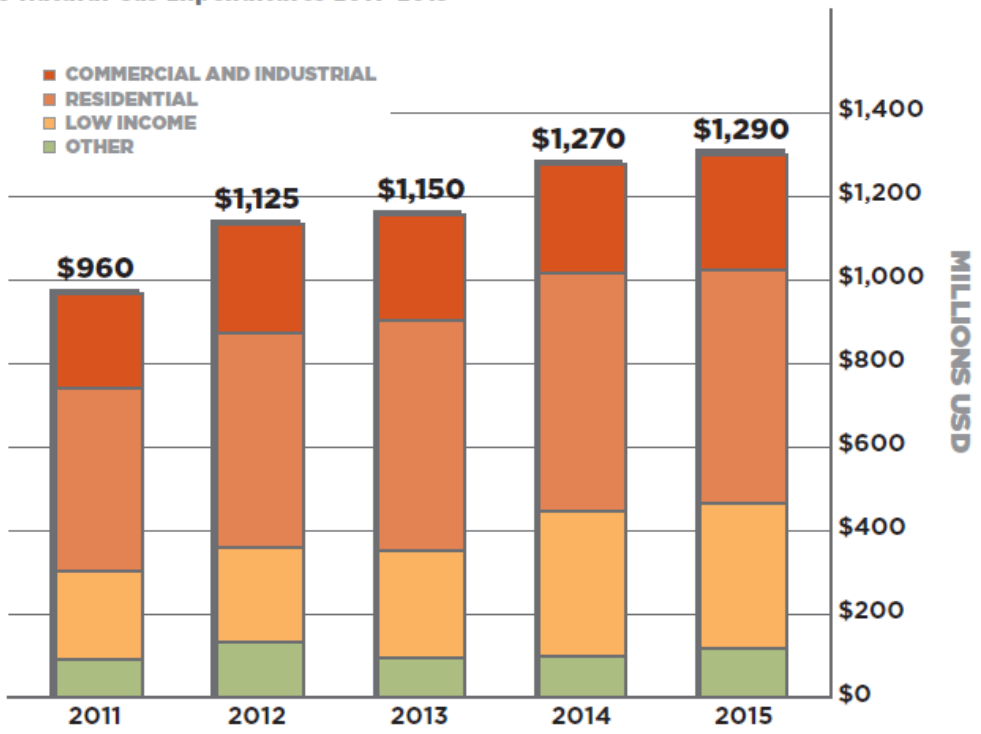


	Home Heating	Water Heating	Cooking	Clothes Drying
Current Gas	50%	53%	42%	22%
Preferred Gas	67%	68%	69%	49%
Current Electric	44%	44%	56%	76%
Preferred Electric	25%	25%	27%	39%

From Energy Solutions Center Report:
"New Homeowner Energy Preference Survey Closings March 2015 through February 2016"

Natural Gas Energy Efficiency Programs

Figure 9 US Natural Gas Expenditures 2011-2015



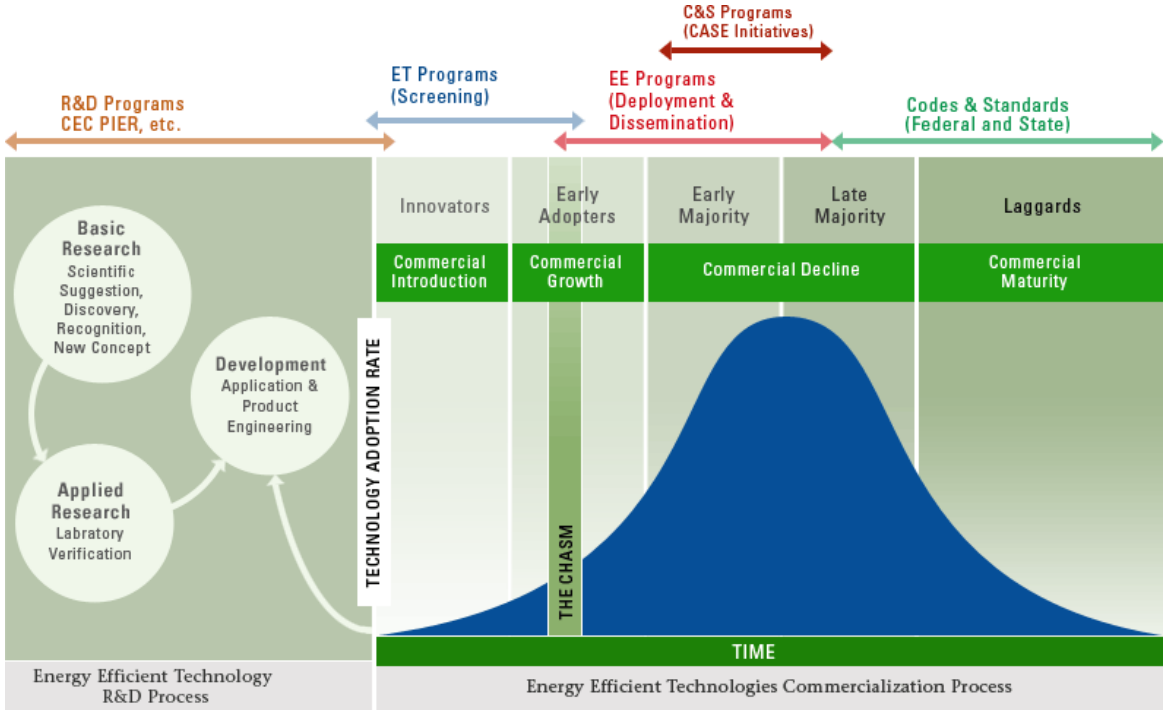
Source: CEE Annual Industry Report 2016

- As energy efficiency programs, codes & standards, and markets mature, low hanging fruit disappears. (e.g. CFLs)
- Low natural gas prices make paybacks longer and efficiency gains more challenging.
- High capital cost efficiency 'upgrades' present adoption barriers across all market sectors.
- Higher measure costs during initial program launch discourage the inclusion of new measures or concepts which may provide meaningful value to ratepayers and the program.

Bridging the Gap Between R&D and EEPs with ETPs

- R&D investment creates innovations for energy efficiency programs, but the transfer to programs requires support.
- Realizing the potential of successful innovation in the marketplace requires an effective and **continuous link between upstream R&D and downstream energy efficiency programs (EEP)**
- To capture the full value created by R&D investments, it is necessary to invest in linkages between upstream R&D and energy efficiency programs.

ETP has a unique role to play within an energy efficiency portfolio, bridging the gap between research and development (R&D) and program implementation.



What Can ETPs Accomplish?
What is the Process?

ETP
As energy efficiency programs, regulations, and markets mature, low hanging fruit disappears. ETP helps **deliver a pipeline of new technologies and program solutions** enabling programs to meet tomorrow's energy efficiency goals with **less risk and more certainty**. ETP is designed to help **identify and evaluate the most promising products and integrated solutions,** assess their suitability for future use in utility energy efficiency programs, and **deliver comprehensive program guidelines for successful full scale deployment**.

1. Identification and review of technologies and program concepts using criteria such as market readiness, market and technical potential, potential for cost-effective energy savings, and enabling market infrastructure such as distribution and service network.
2. Deployment of assessments and scaled field placements that expand technical and market understanding of performance, reliability, and serviceability help to reduce risk to energy efficiency programs and consumers. Potential for better understanding of non-energy benefits.
3. Market transformation—information and infrastructure—including training guidelines, delivery challenges, contractor relationships—needed to remove market barriers.

ETPs Growing

Many States with long-running energy efficiency programs are recognizing the value of ETP and direct a portion of their EE rate payer funding towards ETPs.

ETP Envisioned and Enabled in EEP Legislation

In 2009, IL SB 1918, an amendment to Illinois Power Agency Act, allowed **Illinois** energy efficiency programs to allocate up to 3% of EEP revenue for 'demonstration of breakthrough equipment and devices.'

In 2017 new energy legislation increased the percentage to 6% of EE funds to be use for 'demonstration of breakthrough equipment and devices.'

ETP Added to Existing EEP During EEP Plan Filing

California stakeholders, including IOUs and the CPUC, identified the need for ETPs. Based on multi-lateral discussions, it was decided that IOUs, with their lead role in energy efficiency program administration, were best positioned to address the ET function.
Beginning in late 1990s, IOUs included an ET function within their overall energy efficiency program filing. California's ETPs have grown and matured ever since.

ETP Administered by the State, For EEPs

In States like **New York** and **Minnesota**, ETPs are administered by state agencies for the benefit of energy efficiency programs, often administered by IOUs.

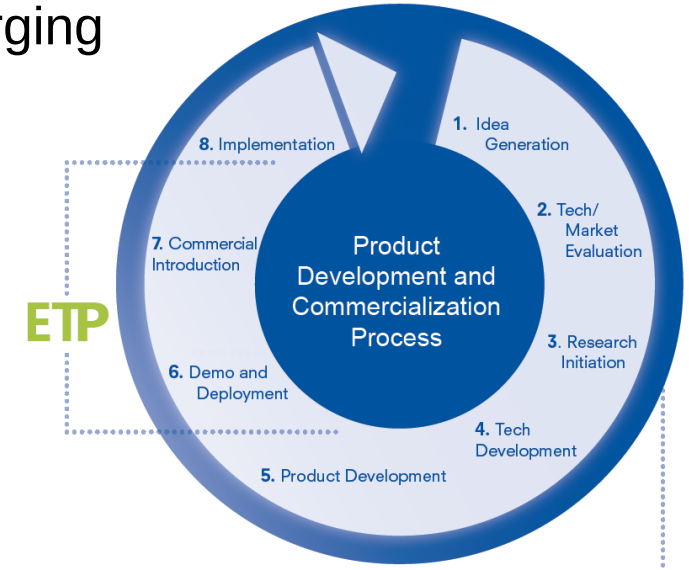
Selected States with ETP-Type Approval
• California
• Illinois
• Massachusetts
• Michigan
• Minnesota
• New York
• Oregon
• Rhode Island
• Washington
• Wisconsin

Energy Efficiency Program Collaboration
Emerging Technology Program

ETP Emerging Technology Program

> Gas Technology Institute led, utility supported, **North American collaborative** targeting **residential, commercial,** and **industrial** solutions

> ETP's principle goal is to **accelerate** the **market acceptance** of emerging energy efficient technologies



ETP activities are "beyond development" stage: Field Testing, Demonstration, Pilot Programs, and Deployment – a focused effort to ensure market acceptance of next-generation emerging technologies

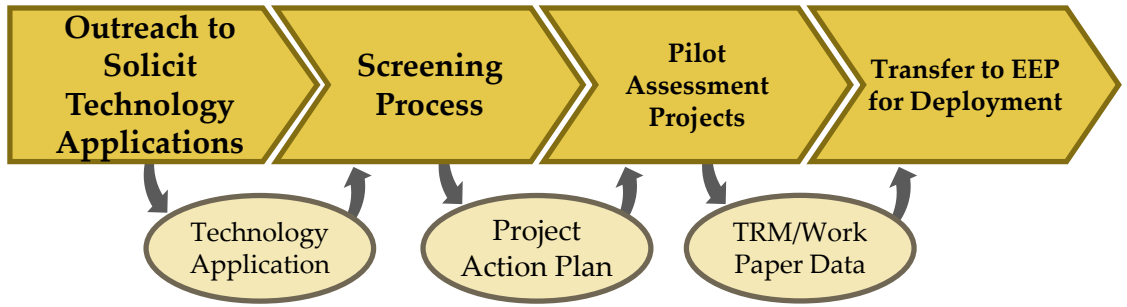
Nicor Gas Emerging Technology Program

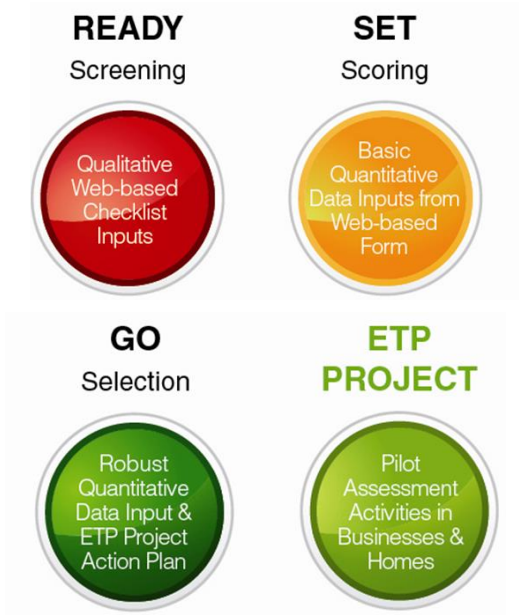
GTI implements the Nicor Gas ETP. Nicor Gas serves more than **2.2 million gas customers** across Chicagoland

75+ applications
Received more than **75 applications** from manufacturers, sales representatives and contractors

20+ pilot projects
Launched more than **twenty pilot projects** in residential, commercial and industrial markets

5 new rebates launched (*2 more to be added in 2018-2019*)
Identified, evaluated and facilitated **5 emerging technologies** as new rebates through energySMART, a Nicor Gas program.





Nicor Gas Emerging Technology Program (Continued)

ETP Benefits to a Startup Company Applicant!

Here is what - #1077: Dynamic Air Balancing System ETP Applicant had to say:

"…We made a number of improvements that have made our system much easier to install, less prone to installation mistakes, and more reliable. Working with a patient, experienced installer was extremely valuable and influential to our product design and commercialization process."
"…studies conducted by independent third-parties are the most valuable tool we have when discussing the new technology with potential businesses and is foundational to our business development and growth."

Pilot #1001 - High efficiency heating rooftop units (RTU)

The pilot is helping to transform the early market development of 100% outdoor air (OA) condensing RTUs. The pilot work is being cited by Consortium for Energy Efficiency (CEE).
"The pilot identified commercial applications that can address the adoption of condensing RTUs. 100% OA systems are emerging as the most promising early market entry point for the condensing RTUs."

Case Study: High Efficiency Gas Rooftop Units

Collaboration with NREL, DOE, **manufacturers**, **national accounts**, and utilities

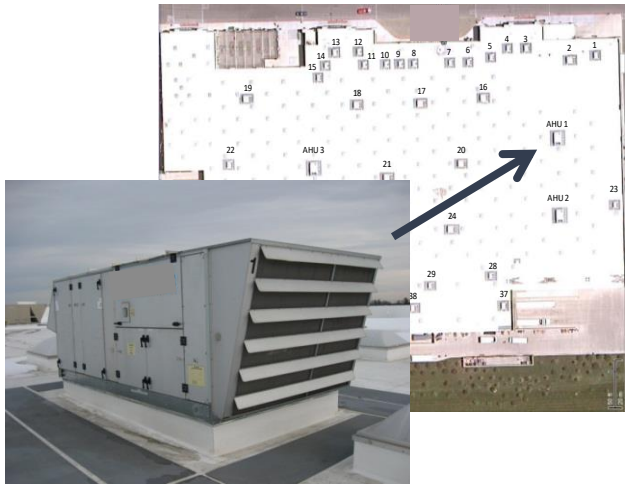
Large-scale monitoring shows **diverse runtimes for RTUs** and more therm use than energy models suggested

Based on monitoring results, targeted deployment of dedicated outside air systems (DOAS) as high efficiency **market entry point** application

Deployed condensing DOAS systems at “big box” retail accounts. Demonstrated practical and technical viability highlighted by roughly 4 year ROI w/o rebates.

Using UTD and ETP project results, **GTI developed** custom program **calculator and technical reference manual calculation methodology** to support deployment under efficiency programs

GTI lead effort to **increase thermal efficiency of DOAS from 90% to 93%** through lab-based R&D



Nicor Gas ETP demo pictured

Modulating Dryer Technology

- Two-stage modulating gas valve, temperature sensor, control unit.
- Industrial-sized modulating dryers are available at a high up front cost, but modulation is rare in smaller capacity dryers.
- Modulation technology is very mature but its application in dryers is more recent.
- Good fit in hospitality, laundromats, healthcare, dry cleaners, etc.
- Relatively modest installed cost of $700.
- Payback time of 2-3 years.

Modulating Dryer Technology: Nicor Gas ETP Field Demo

- 11 dryers were monitored in Nicor Gas territory:
  - Hotel (4 dryers – one 75 lb, one 120 lb, two 170 lb)
  - Laundromat (4 dryers –two 30 lb, two 45 lb)
  - Healthcare (2 dryers – two 75 lb)
  - Dry Cleaner (1 dryer – 50 lb)

- Long term monitoring is considered more accurate

	Long-Term Monitoring	Standardize Test
Average Annual Gas Savings	333 therms	286 therms
% Annual Gas Savings	13.8%	12.4%
Average Annual Electric Savings	N/A	N/A
% Annual Electric Savings	N/A	N/A
Annual Cost Savings	$250	$215
Payback Period	2.10 years	2.44 years

Modulating Dryer Technology: Transition to EE Programs

- Included in Illinois Technical Reference Manual, indicating the following savings numbers:

Application	ΔTherms
Coin- Operated Laundromats[762]	267
Multi-family Dryers[763]	193
On-Premise Laundromats[764]	649

- Nicor now offers a $100 rebate for clothes dryer modulating controls which includes one qualifying product at this time: EZ-Efficiency BIO-Therm
- 30 to 250 lb capacity commercial dryer retrofit covered

Rheem H2AC™ Integrated Air & Water System

- **Technology:** The Rheem H2AC™ Rooftop Unit (RTU) takes the heat removed from an air conditioned space—which is typically exhausted—and transfers it to a water heater storage tank.
  - When cooling is required, it will recover the waste heat, and preheat hot water to as high as 125°F.
  - Waste heat recovery components are factory installed in the RTU, and leak checked. Minimizes installation error.
- **Proven Through Third Party M&V**
  - 3 GTI ETP project demonstrations complete.
  - 3 SoCal Gas technology assessments complete.
  - Industrial site with the California Energy Commission underway.
- **Best Applications**
  - Southern, Cooling-Dominated Climates (1,800 CDD+ year).
  - Target sites use the 15-ton system, and 1,500+ gallons hot water per day:
    - Restaurants (4,700 ft2 or larger), food processing, health clubs, hotels, assisted living.

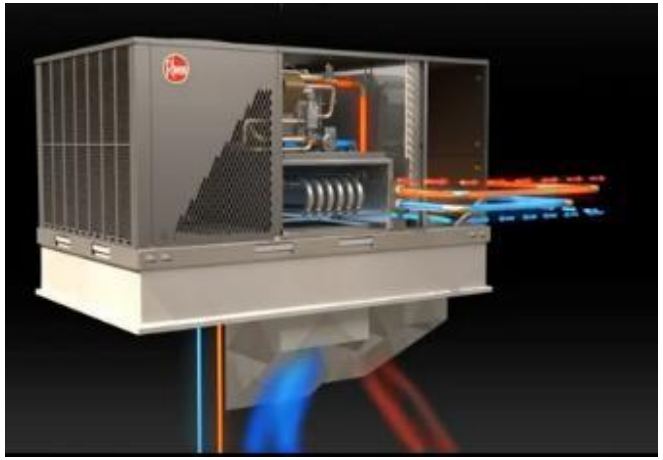


Photo provided by Rheem

ETP Field Demos

Spire Territory	APGA RF Territory	SDG&E Territory
Full-Service Restaurant National Chain #1	Full-Service Restaurant National Chain #2	Full-Service Restaurant National Chain #3
10-Ton Unit	15-Ton Unit	10-Ton Unit
100 Gallons	119 Gallons	80 Gallons
H2AC Installed May ‘14	H2AC Installed Aug. ‘14	H2AC Installed Nov. ‘14
Monitoring Concluded	Monitoring Concluded	Monitoring Concluded
1400 Hot Water GPD	1750 Hot Water GPD	1300 Hot Water GPD
~35% hot water energy savings	~25% hot water energy savings	~30% hot water energy savings

Performance Conclusions

- Provided significant energy savings (25-35%).
- Simple paybacks ≤5 years under most scenarios.
- Both contractors and host sites would recommend the technology.
- Transition to programs:
  - GTI developed a performance model/calculator to estimate savings across many climates, hot water loads (based on # of meals served), and baseline water heater / RTU scenarios.

Energy Savings and Payback	Units	Tampa, FL 15 ton RTU	Birmingham, AL 15 ton RTU	Laguna Hills, CA 15 ton RTU	El Cajon, CA 15 ton RTU
Incremental Cost	$	$7,500	$7,500	$7,500	$7,500
Adjusted Annual Gas Savings	Therms	3,314	2,962	3,602	3,319
Annual Gas Savings ($1.00/therm)	$	$3,314	$2,962	$3,602	$3,319
Annual Gas Savings ($0.70/therm)	$	$2,320	$2,073	$2,521	$2,323
Simple Payback ($1.00/therm)	Years	2.3	2.6	2.1	2.3
Simple Payback ($0.70/therm)	Years	3.2	3.6	3.0	3.2

Figure 1: Rheem H2AC™ Energy Savings and Payback
Savings based on GTI calculator, developed with actual field results. Assumes 1,750 daily hot water use, .77 EF storage water heater, and 30 year average weather for each location. Table values should be used for discussion purposes only. Actual costs will vary by vendor, site, and contractor.

Summary

- Natural gas continues to be a low cost, low carbon fuel of choice for homeowners.
- Natural gas EE programs continue to grow in number and dollar amount across the country.
- As energy efficiency programs, codes & standards, and markets mature, low hanging fruit disappears. (e.g. CFLs)
- Low natural gas prices make paybacks longer and efficiency gains more challenging.
- High capital cost efficiency ‘upgrades’ present adoption barriers across all market sectors.
- Utilizing EE natural gas program dollars for emerging technologies is taking hold in many states and could be expanded to others.
- ETPs help **deliver a pipeline of new technologies and program solutions** enabling programs to meet tomorrow’s energy efficiency goals with **less risk and more certainty**. ETP is designed to help **identify and evaluate the most promising products and integrated solutions,** assess their suitability for future use in utility energy efficiency programs, and **deliver comprehensive program guidelines for successful full scale deployment**.

Questions?

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Natural Gas Efficiency: Progress & Opportunities

Steven Nadel, Executive Director

Presentation to NARUC Gas Committee

Feb. 13, 2018

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American Council for an Energy-Efficient Economy

The American Council for an Energy-Efficient Economy is a nonprofit 501(c)(3) founded in 1980. We act as a catalyst to advance energy efficiency policies, programs, technologies, investments, & behaviors.

Our research explores economic impacts, financing options, behavior changes, program design, and utility planning, as well as US national, state, & local policy.

Our work is made possible by foundation funding, contracts, government grants, and conference revenue.

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aceee.org/research-report/u1708

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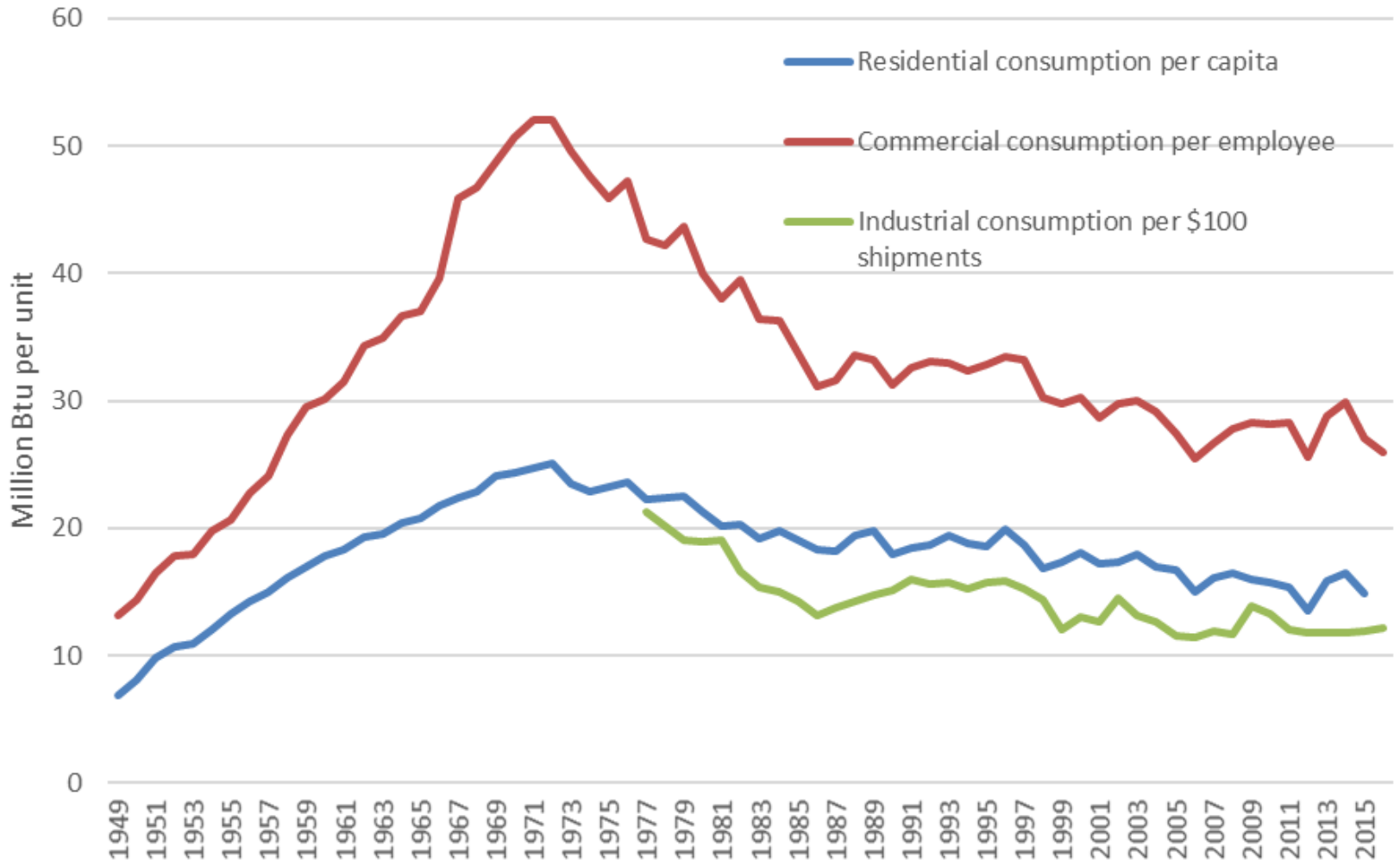
Normalized Natural Gas Consumption



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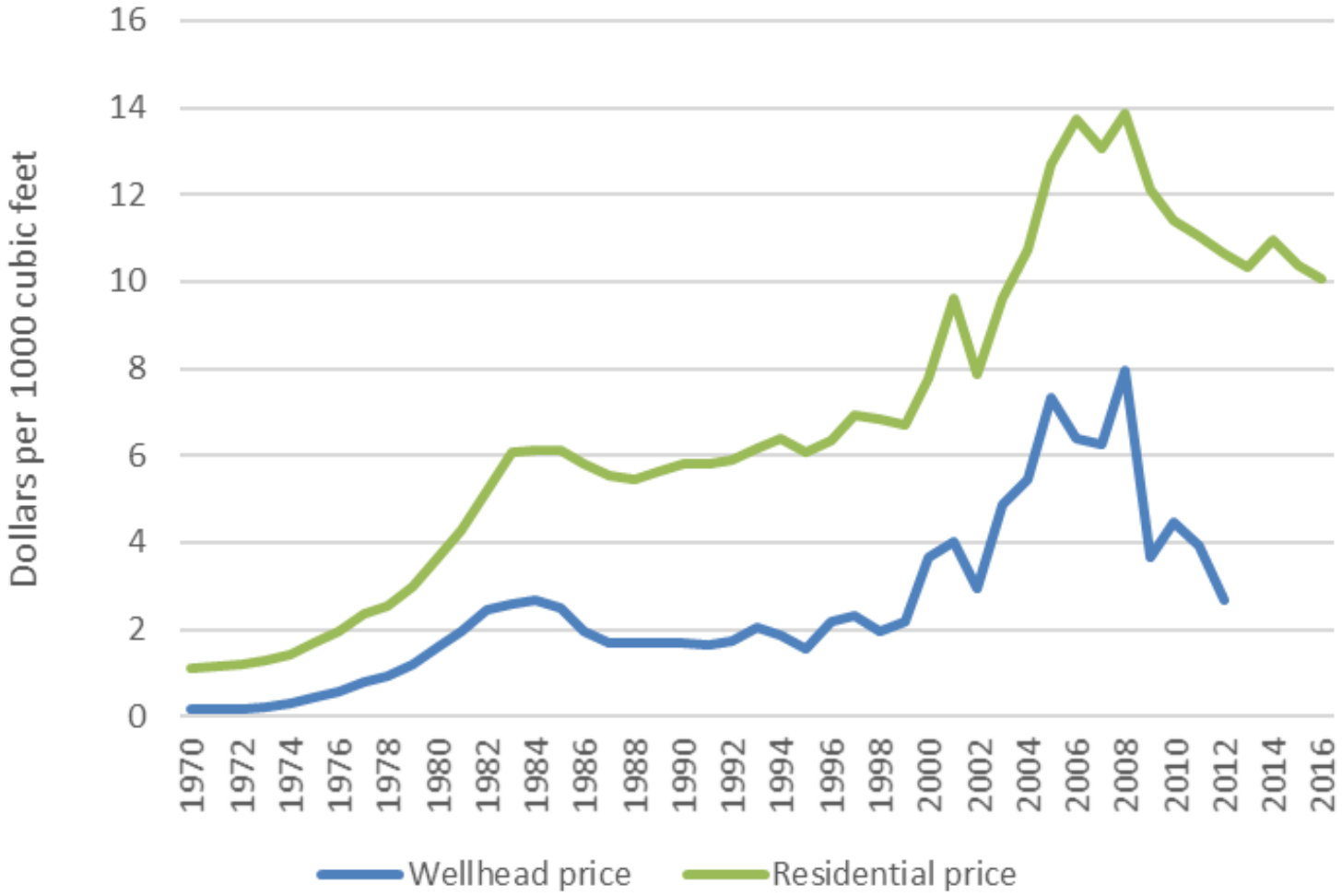
Source: ACEEE, Nadel 2017 (based on EIA, BLS and FRED data)

Real Natural Gas Prices



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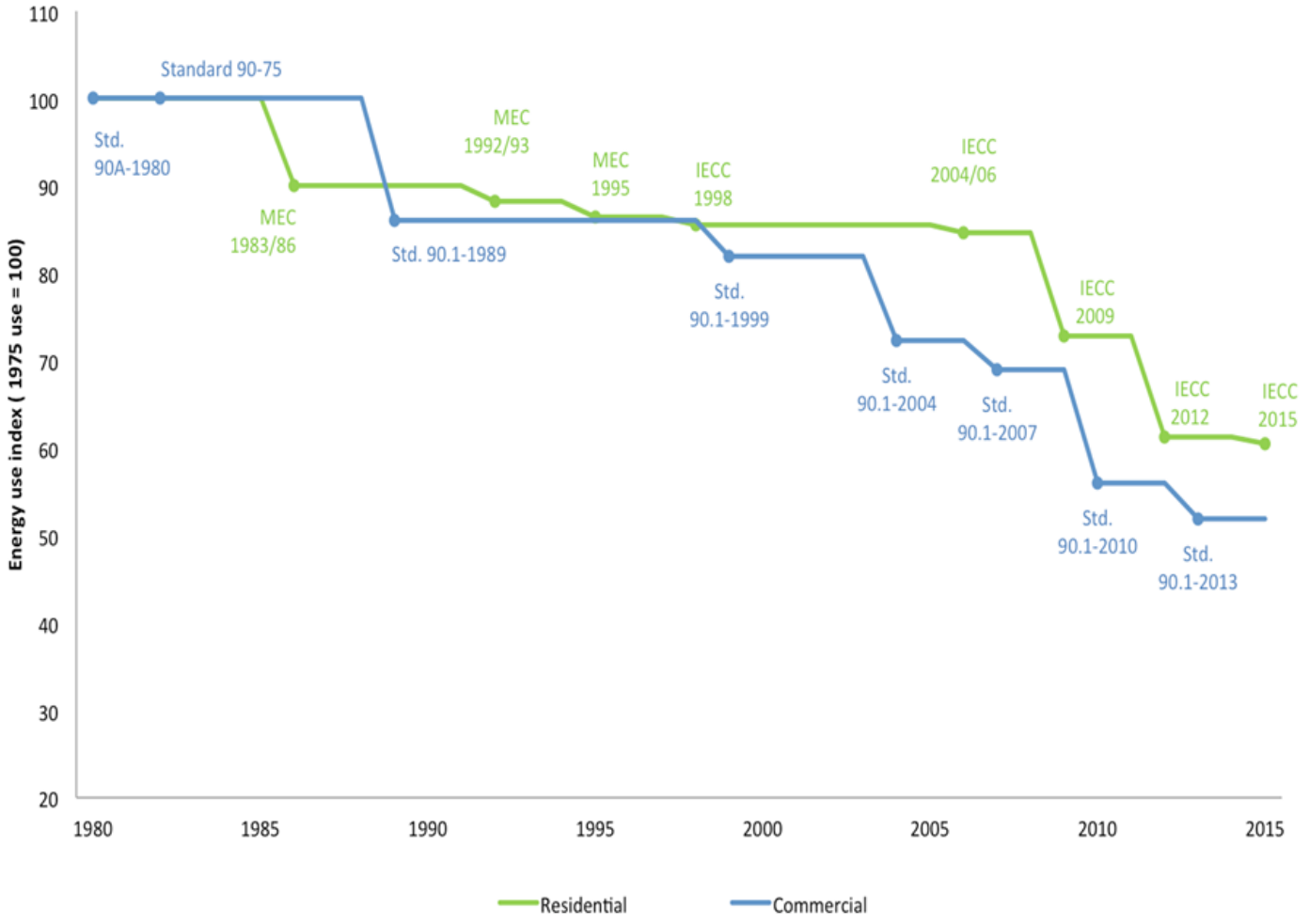
Source: ACEEE, Nadel 2017 (based on EIA data)

Energy Consumption of New Homes and Buildings Meeting National Model Codes



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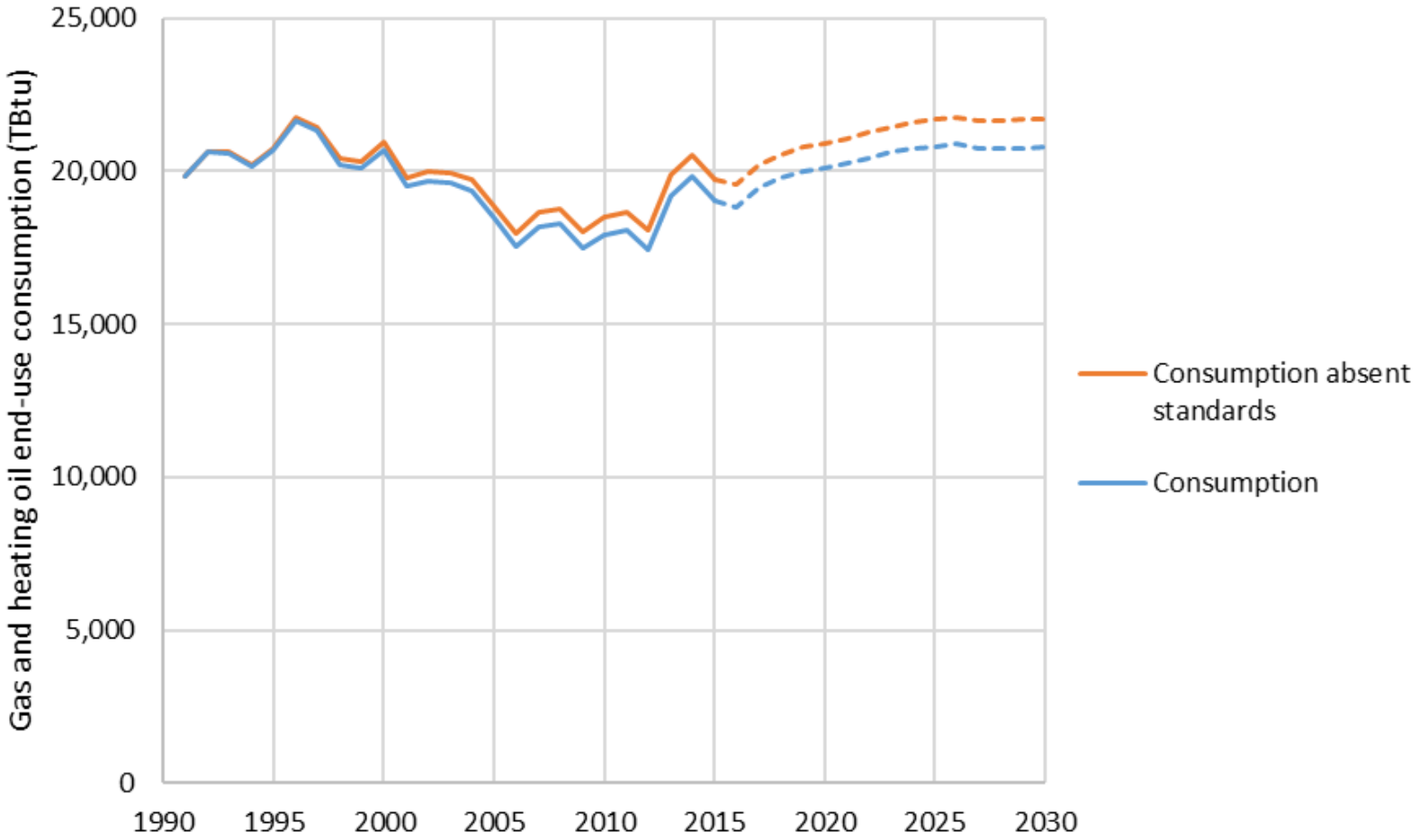
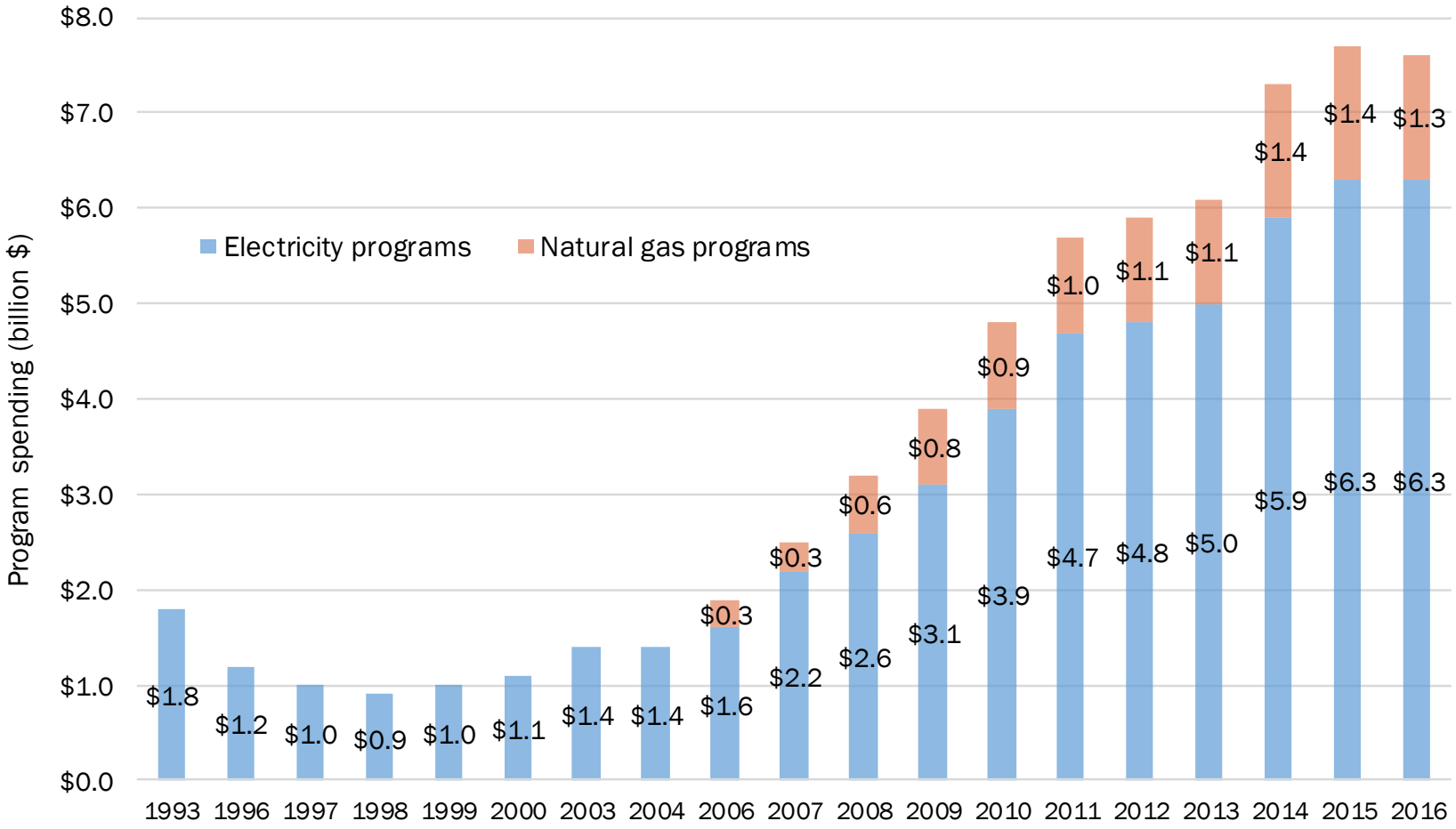
Source: ACEEE analysis using DOE data

Savings from Appliance Efficiency Standards



Source: ACEEE, Nadel 2017 (based on ASAP data)

Utility Energy Efficiency Spending



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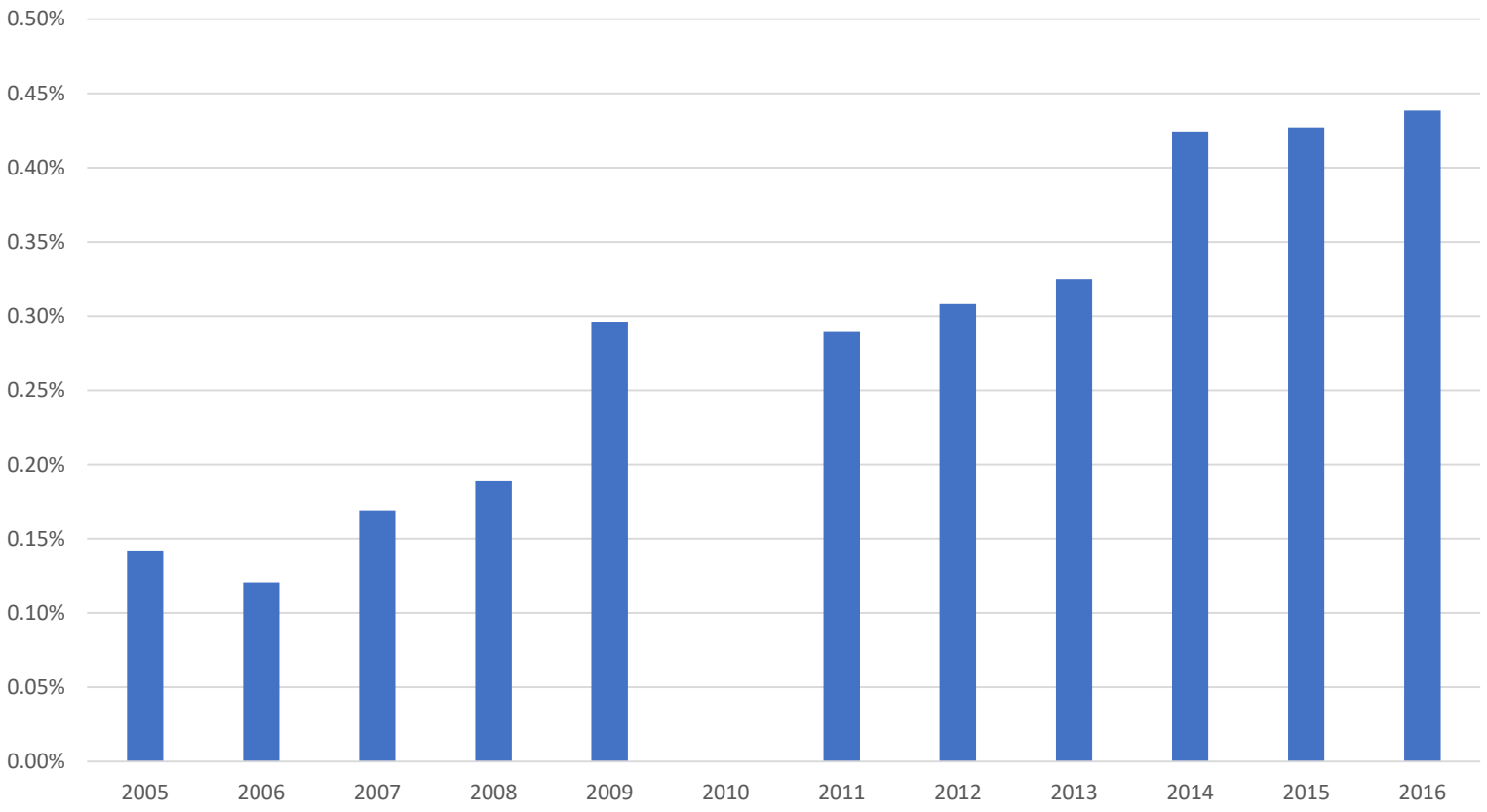
Source: ACEEE, Berg et al. 2017

Net Incremental Savings from Gas-Utility Funded Programs



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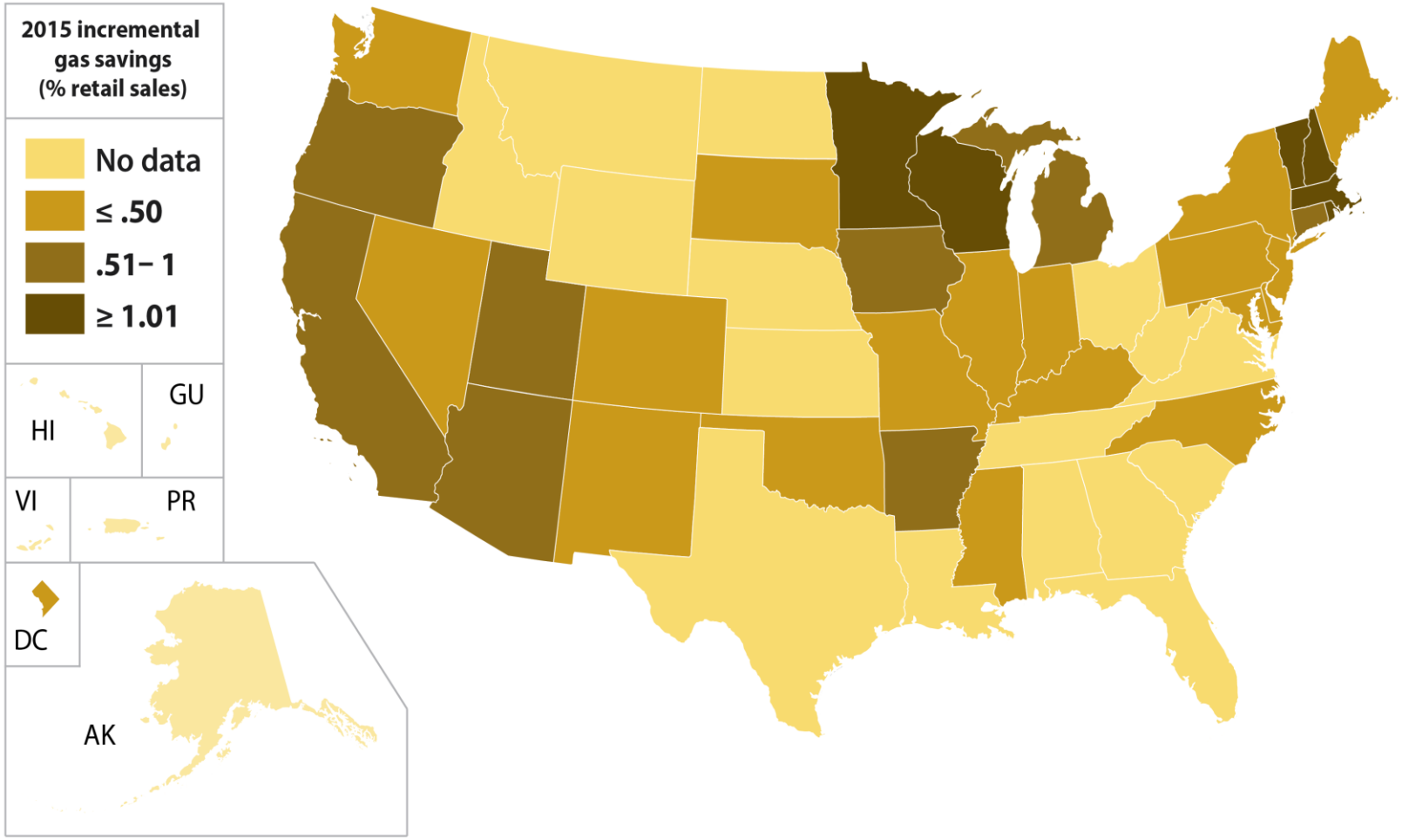
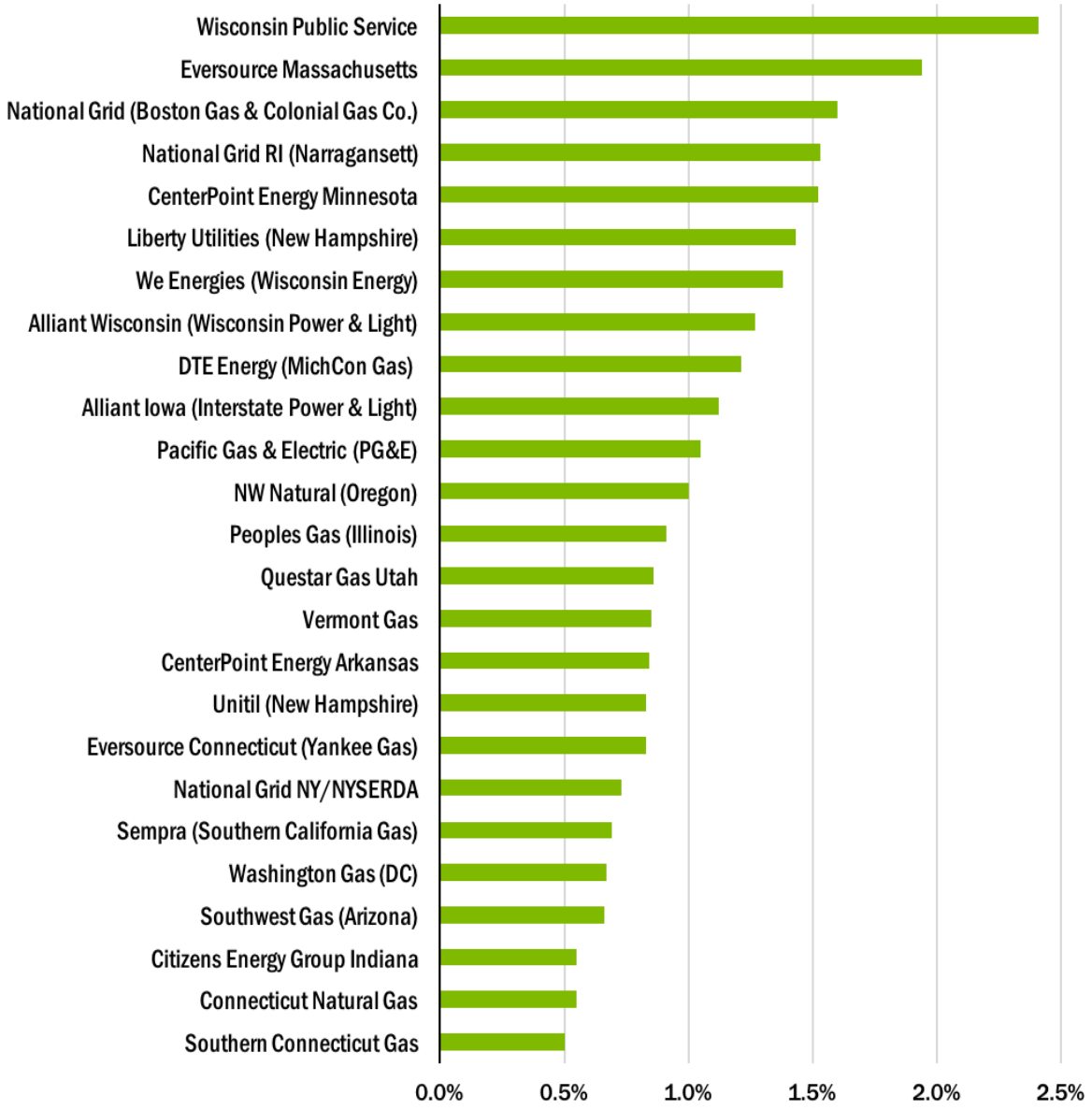
Source: ACEEE, Nadel 2017 and Berg et al. 2017

Utility Program Savings by State



Source: ACEEE, Nadel 2017 (data from Berg et al. 2016)

Incremental Net 2015 Natural Gas Savings by Utility as a % of Sales



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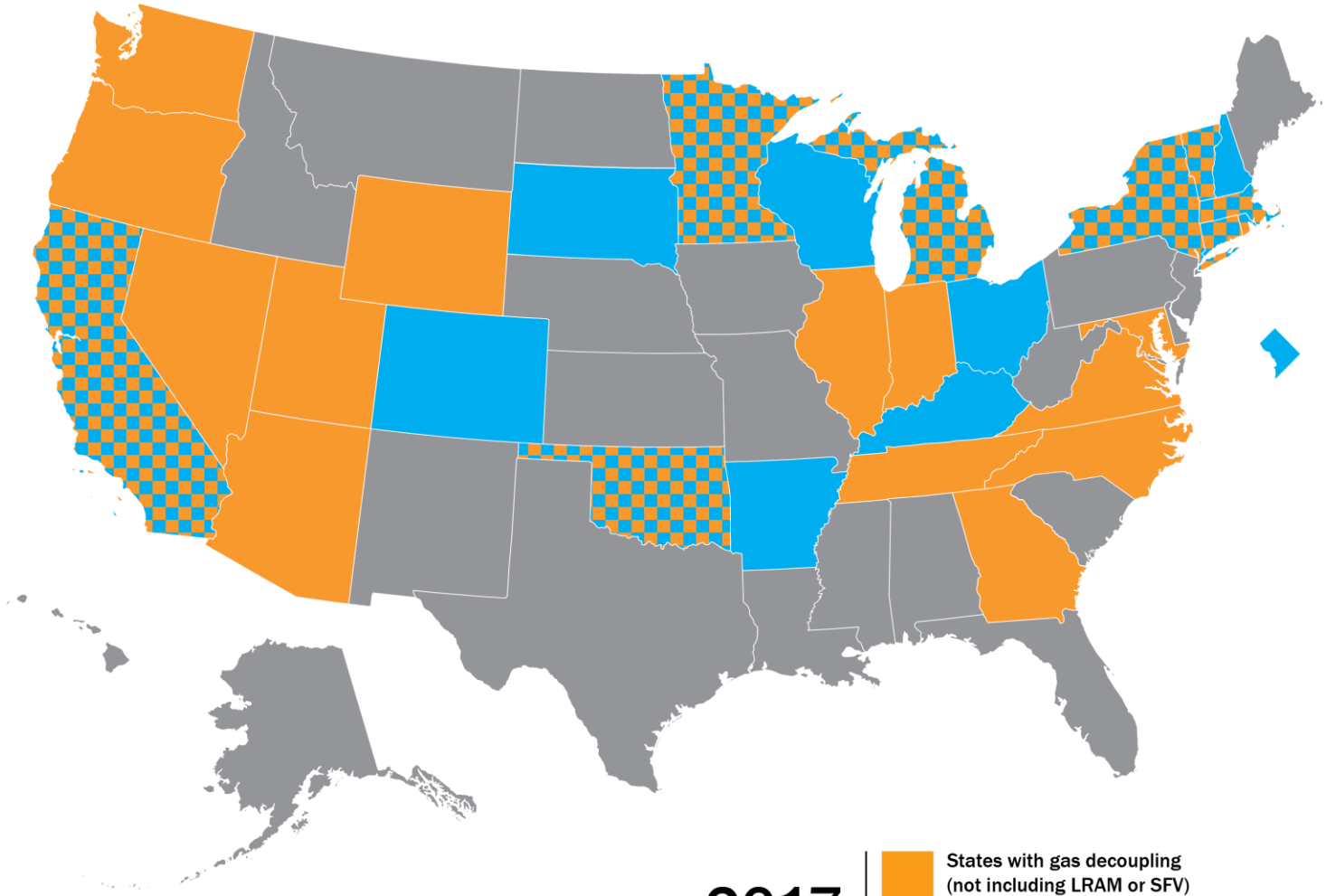
Source: ACEEE, Nadel 2017

Total 2015 Savings from Utility-Funded Programs as a % of Sales

State	Savings as % of R+C sales
Vermont	6.4
Minnesota	5.7
Massachusetts	5.2
New Hampshire	5.0
Rhode Island	4.9
Michigan	4.4
Wisconsin	4.0
Oregon	3.6
Iowa	3.5
Arizona	2.8
California	2.7
Utah	2.6

Source: ACEEE, Nadel 2017

State with Gas Decoupling and Performance Incentives



Source: ACEEE, Nadel 2017 (using data from Berg et al. 2017)

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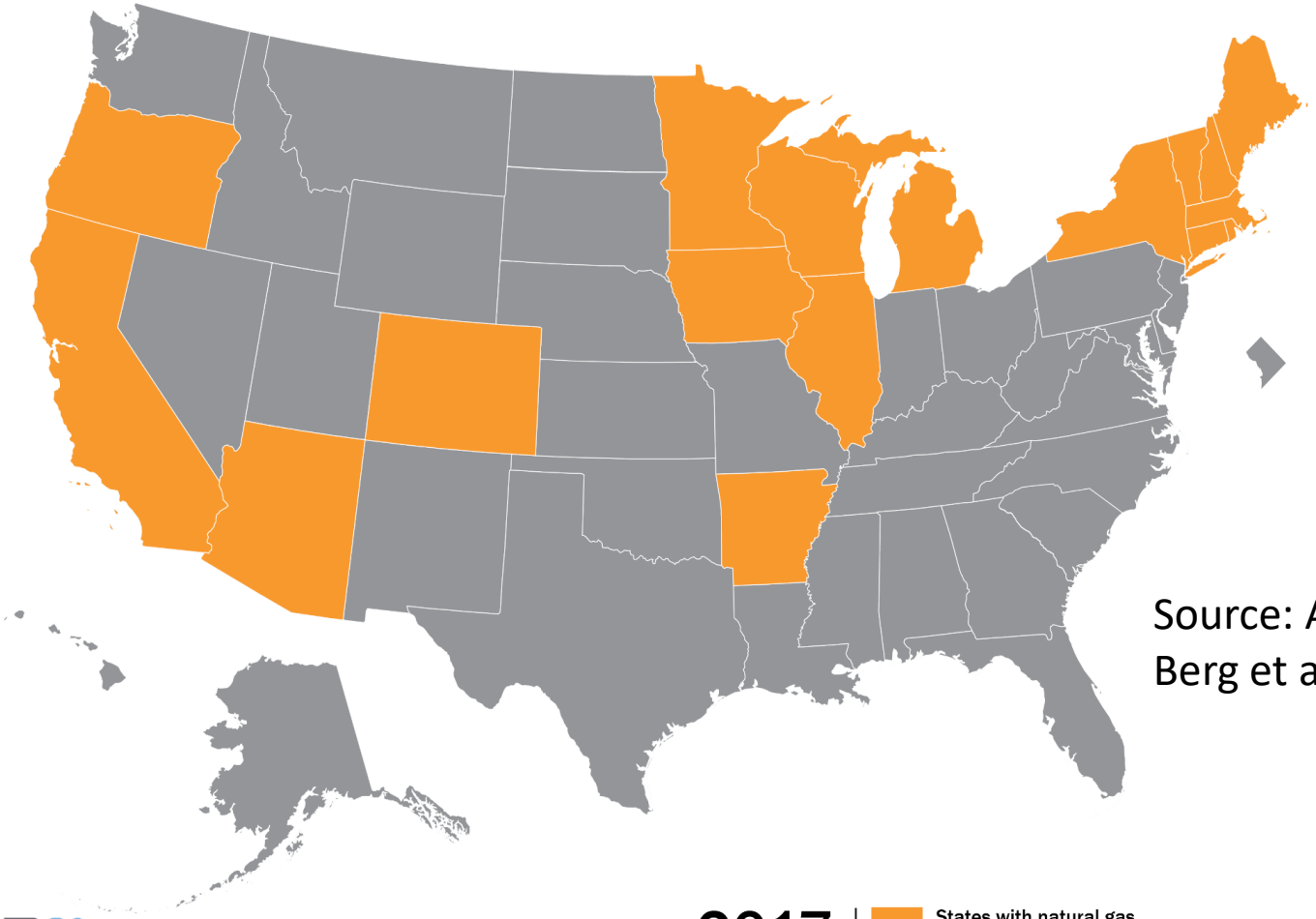
States with Natural Gas Savings Targets



Source: ACEEE, Berg et al. 2017

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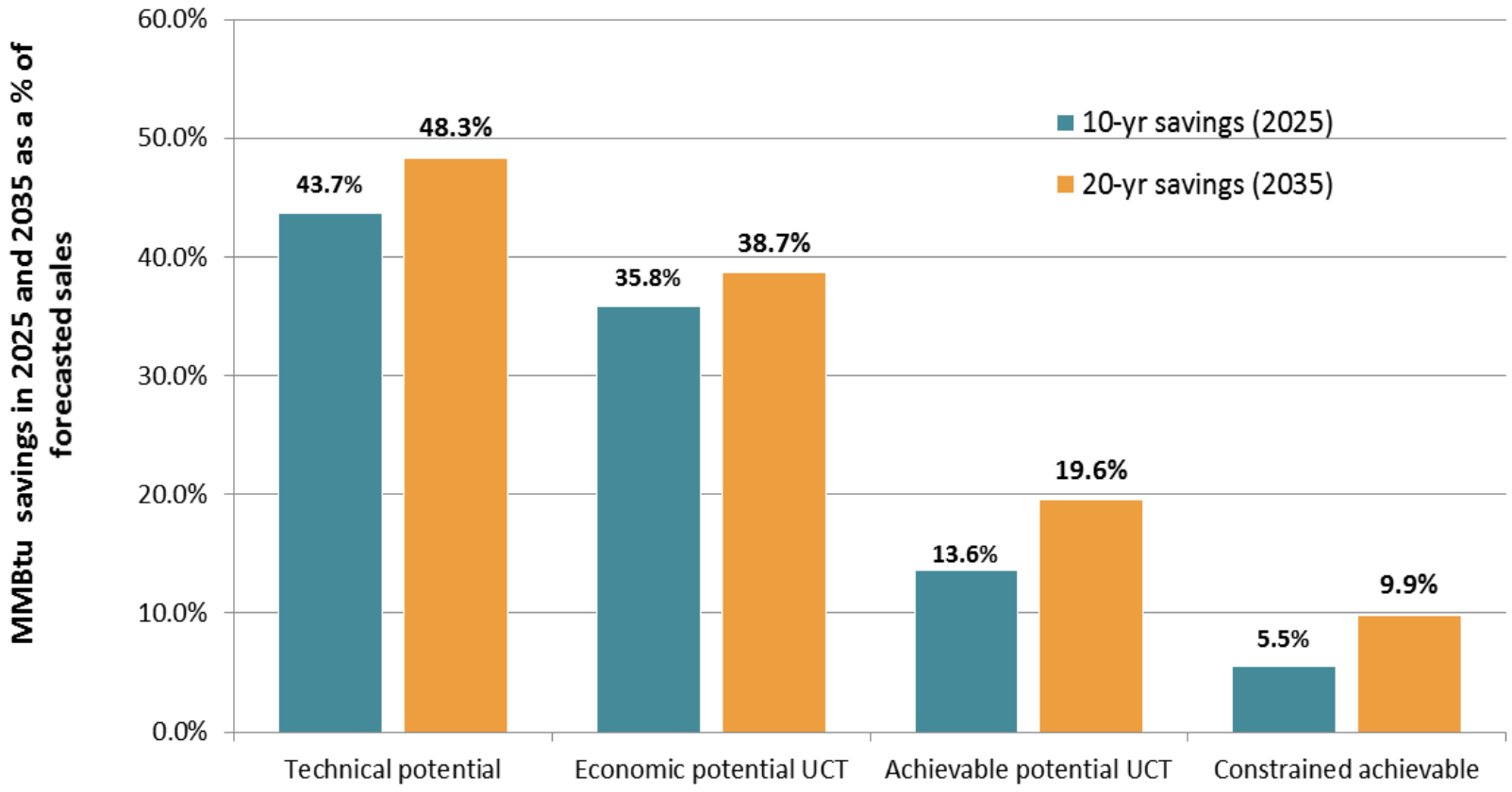
Comparison of States with and without Gas Savings Targets

Policy	No. of states	Average EE $/residential customer	Avg. EE savings as % of R+C sales
No target	33	$4	0.08%
Target	17	$33	0.82%

Source: ACEEE, Nadel 2017 (using 2015 data from Berg et al. 2016

Detroit Edison Energy Savings Potential

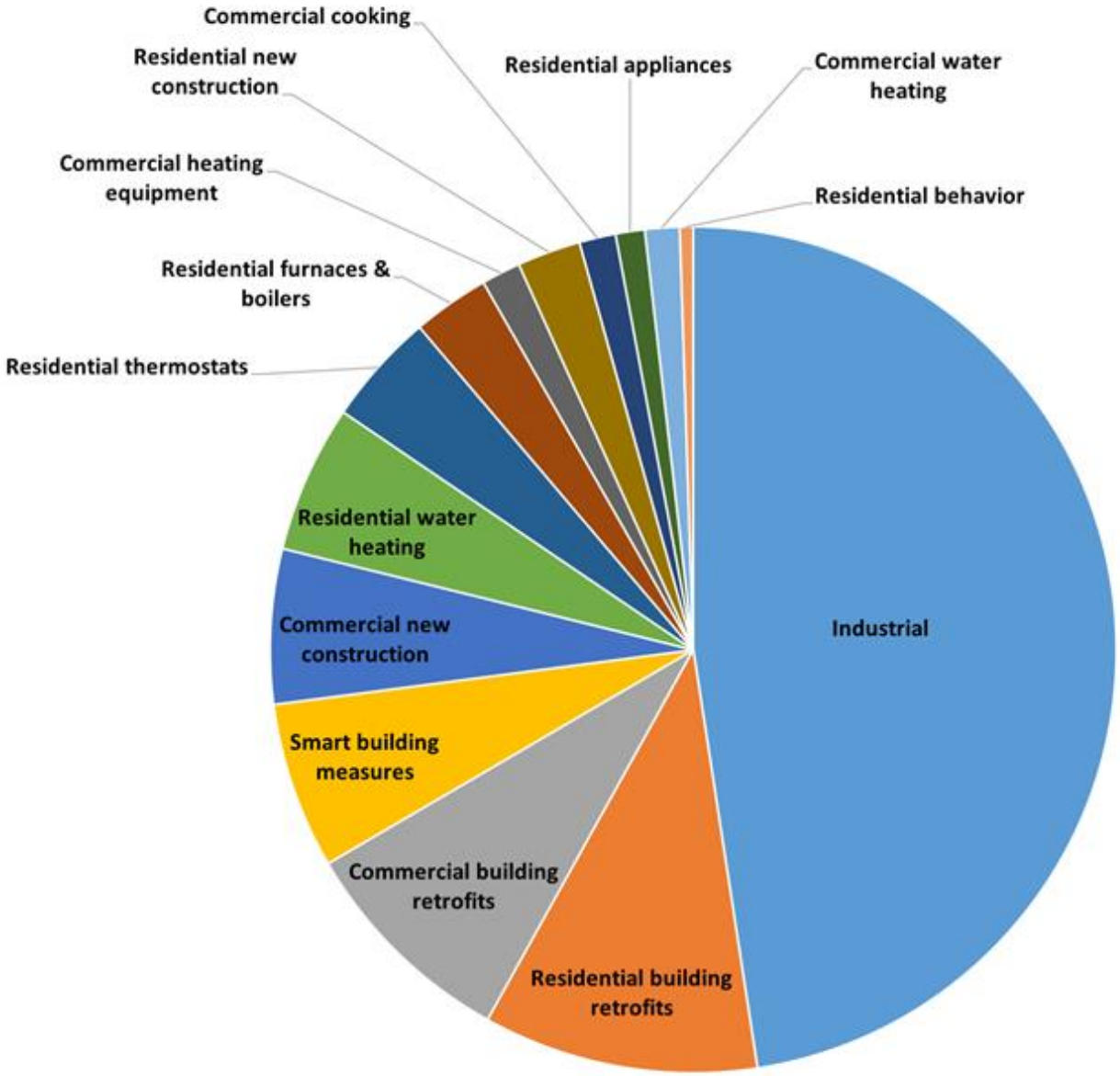


Source: DTE Energy 2016

ACEEE Estimate of 2030 Savings Potential

26% potential

Perhaps half achievable



Source: ACEEE, Nadel 2017

Emerging Areas

- Combined heat and power, particularly as a resiliency strategy for hospitals and other critical infrastructure
- Transportation, particularly heavy trucks
- Coordination between gas, electric and water utilities
- Electrification, particularly vehicles and space/water heating