Natural Gas Efficiency and Decarbonization

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Presentation to Northeast Gas Association

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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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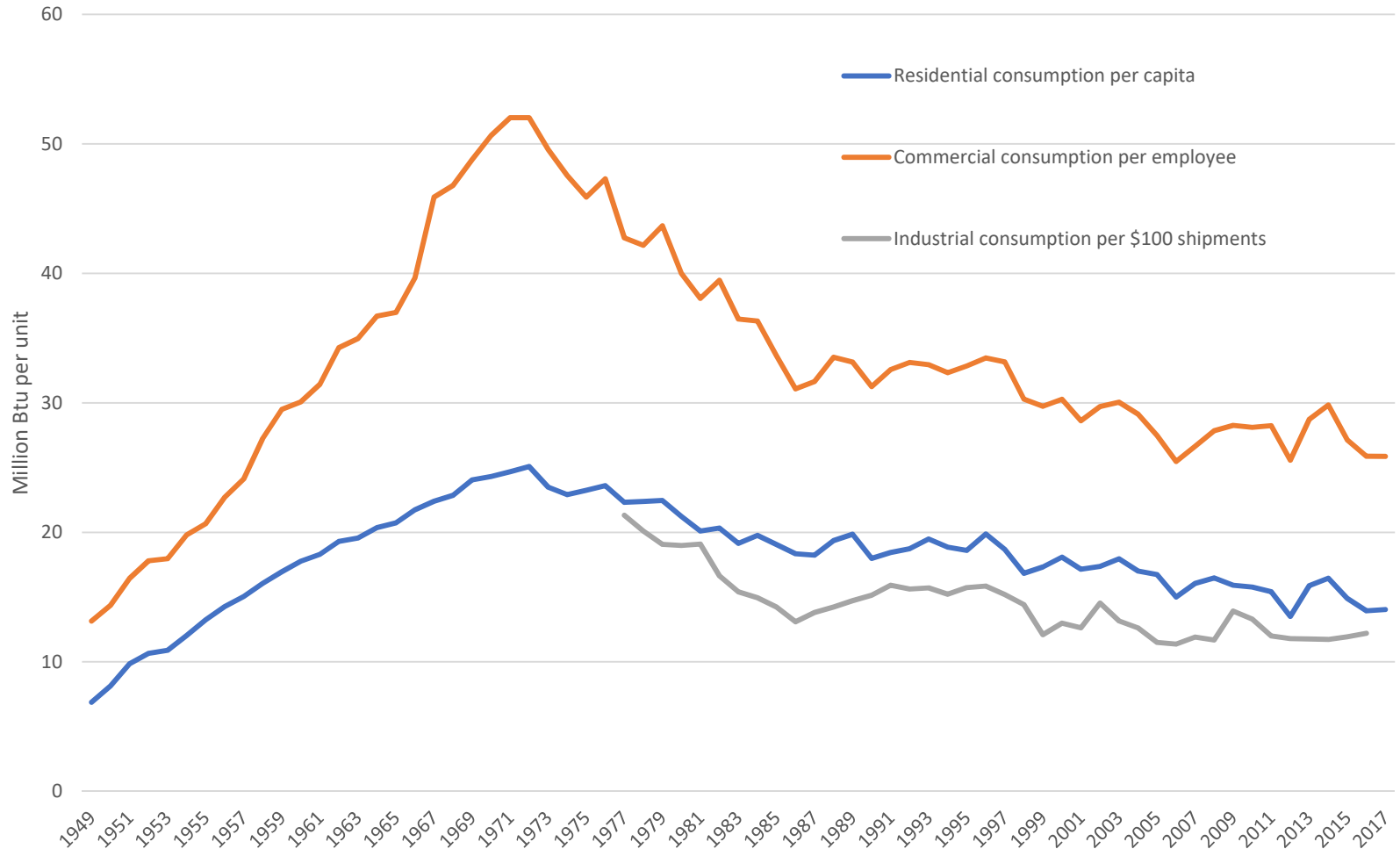
Normalized Natural Gas Consumption



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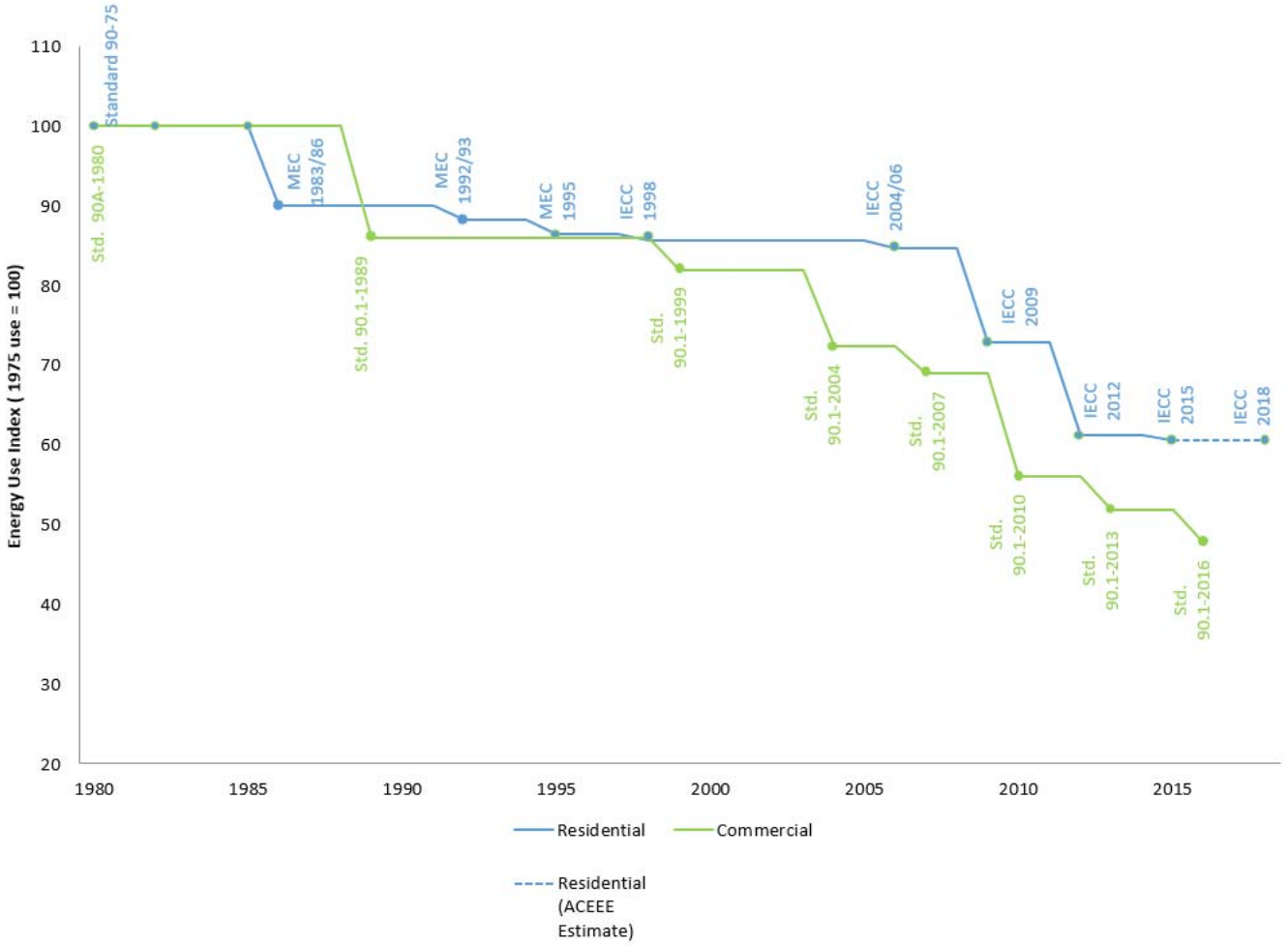
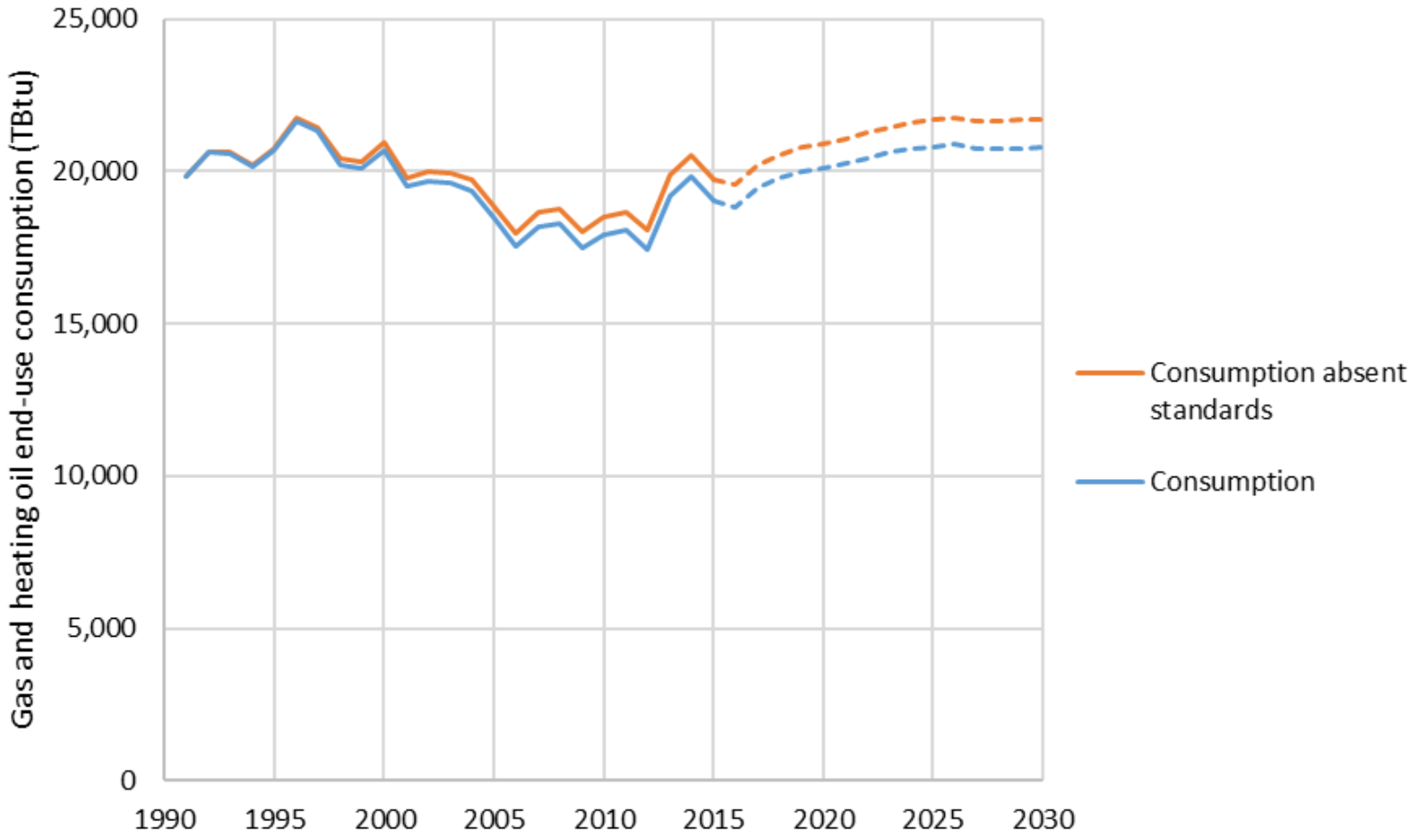
Source: ACEEE, Nadel 2017 with updates (based on EIA, BLS and FRED data)

Energy Consumption of New Homes and Buildings Meeting National Model Codes



Source: ACEEE analysis using DOE data

Savings from Appliance Efficiency Standards



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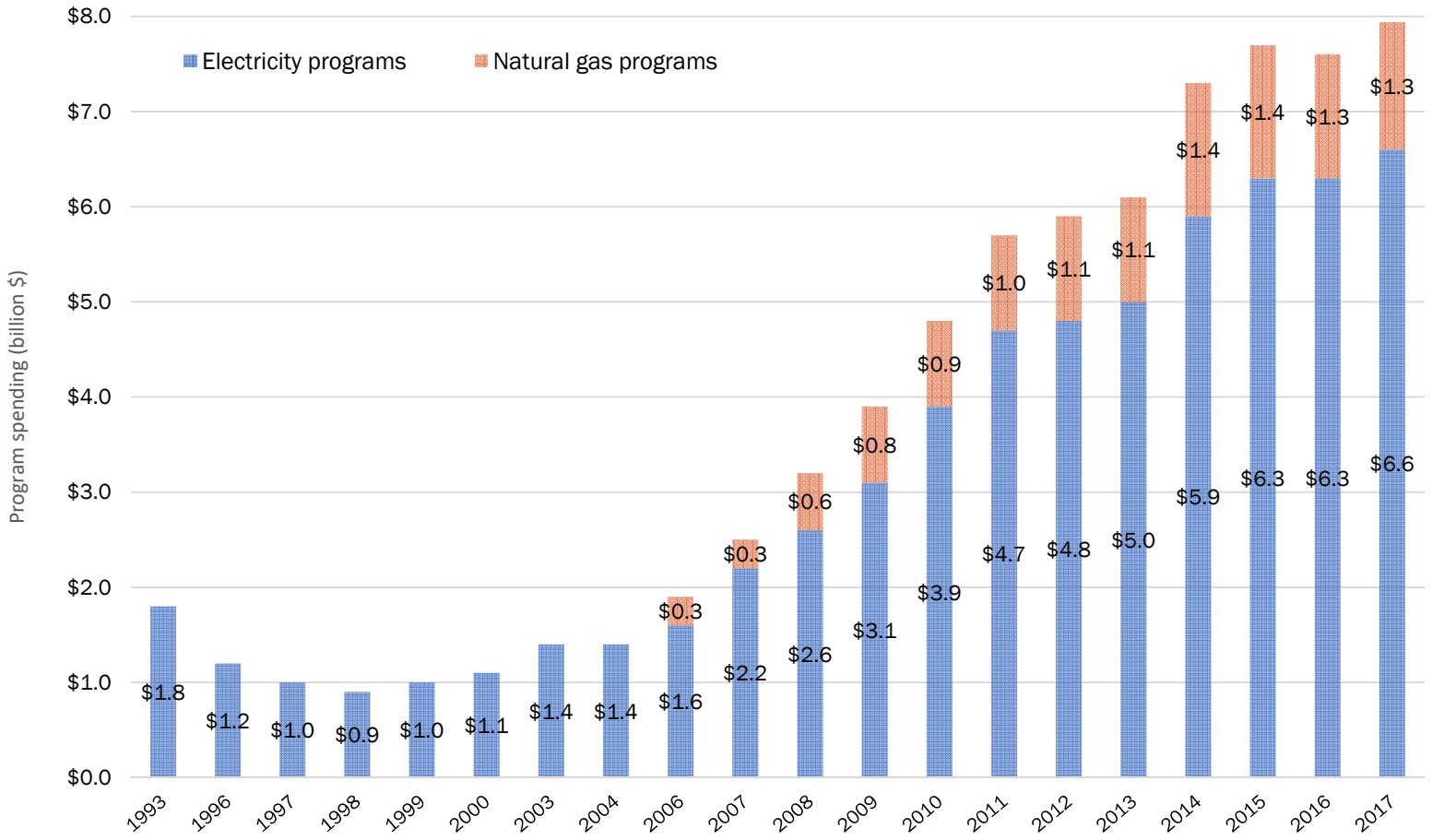
Source: ACEEE, Nadel 2017 (based on ASAP data)

Utility Energy Efficiency Spending



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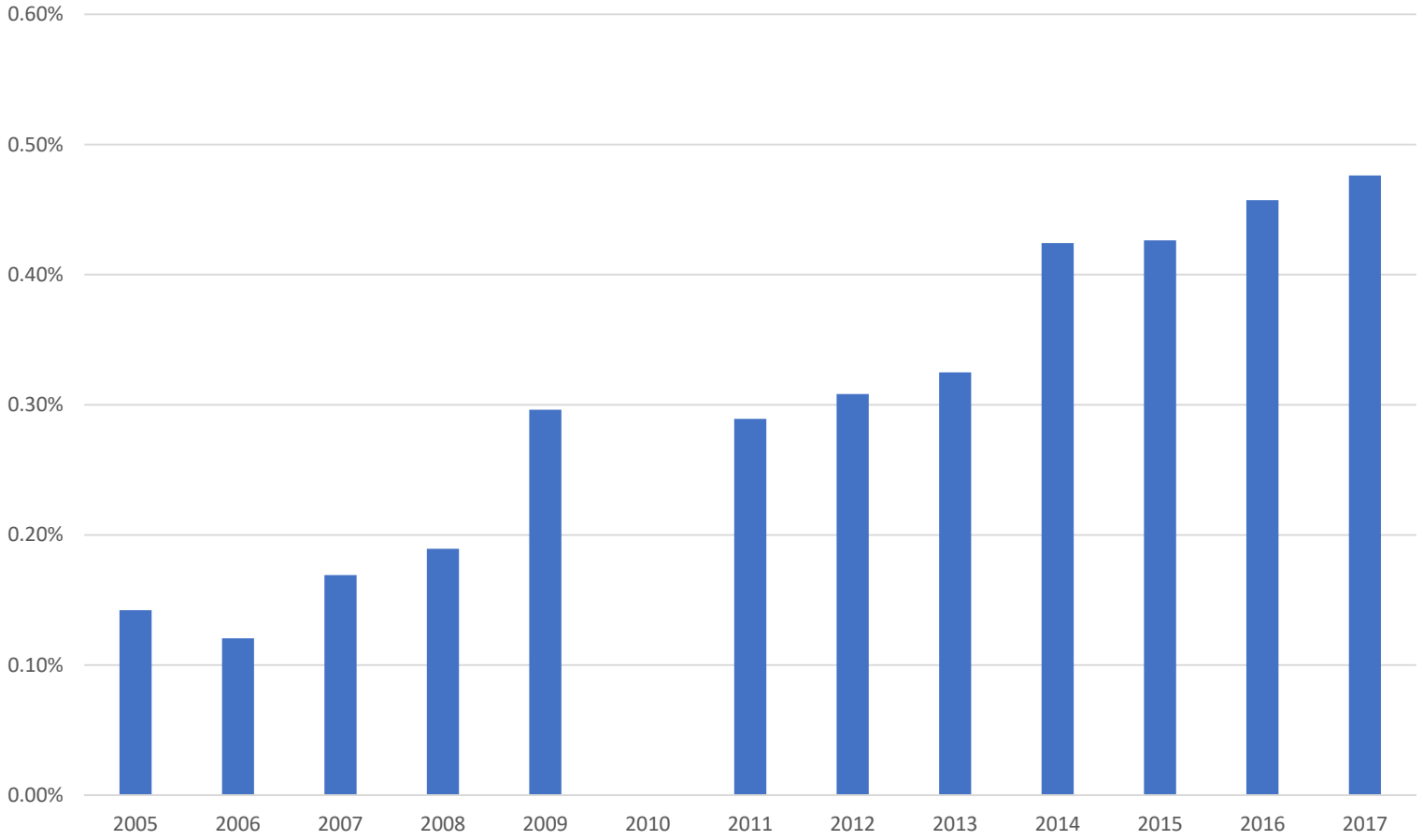
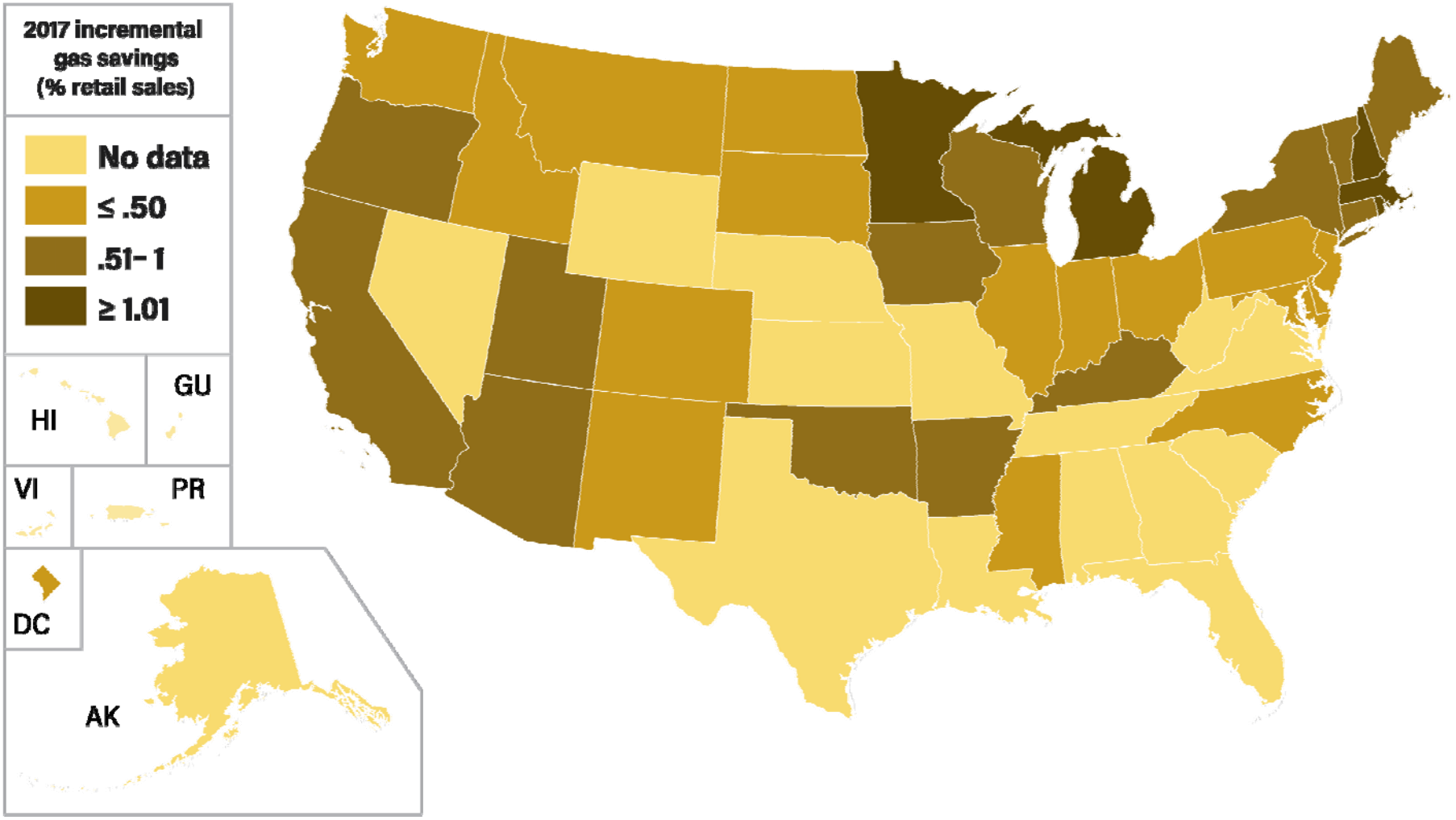
Source: ACEEE, Berg et al. 2018

Net Incremental Savings from Gas-Utility Funded Programs



Source: ACEEE, Nadel 2017 and Berg et al. 2018

Utility Program Savings by State



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Source: ACEEE, Nadel 2017 (data from Berg et al. 2018)

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

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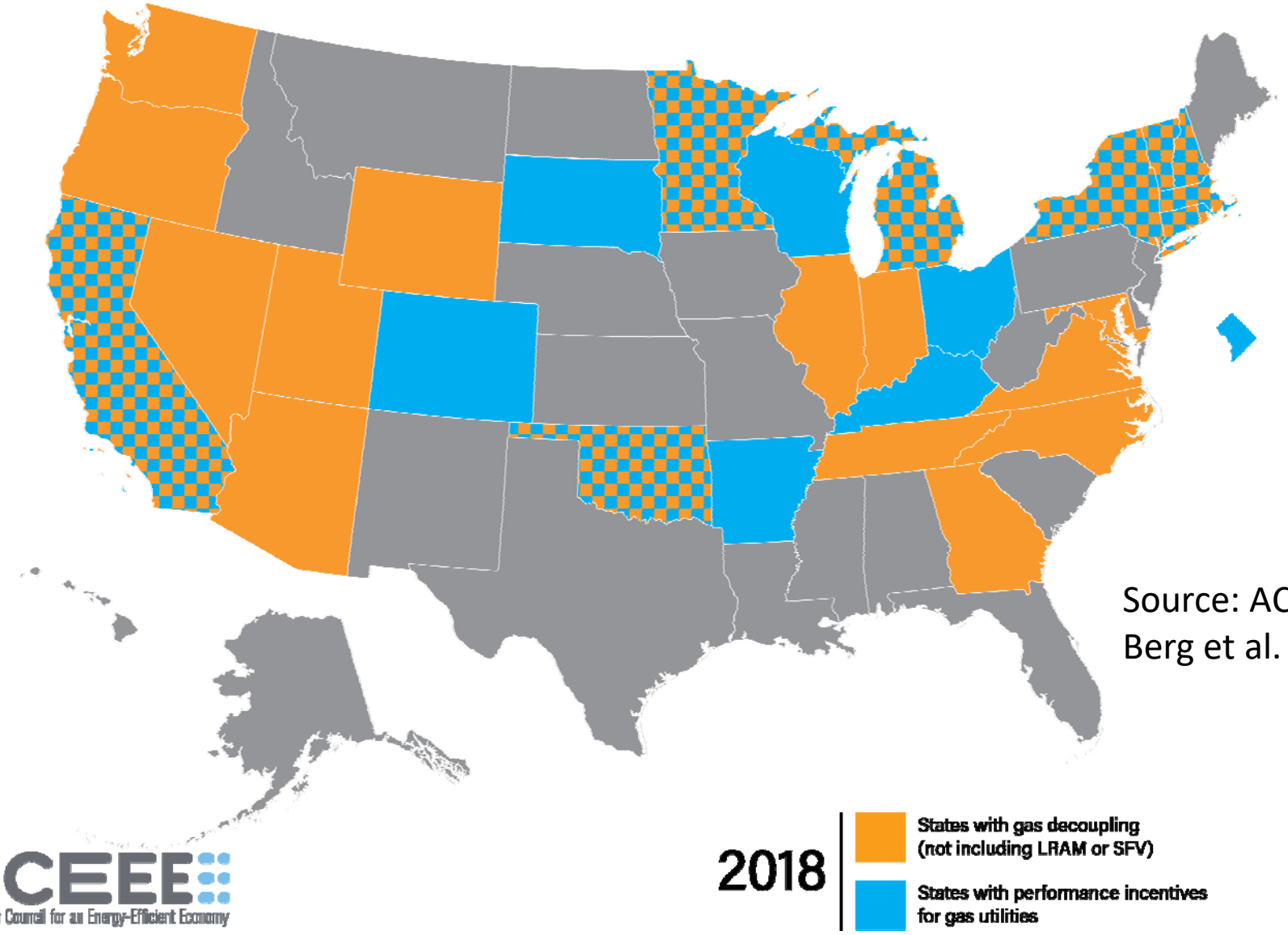
Source: ACEEE, Nadel 2017

State with Gas Decoupling and Performance Incentives



Source: ACEEE, Berg et al. 2018

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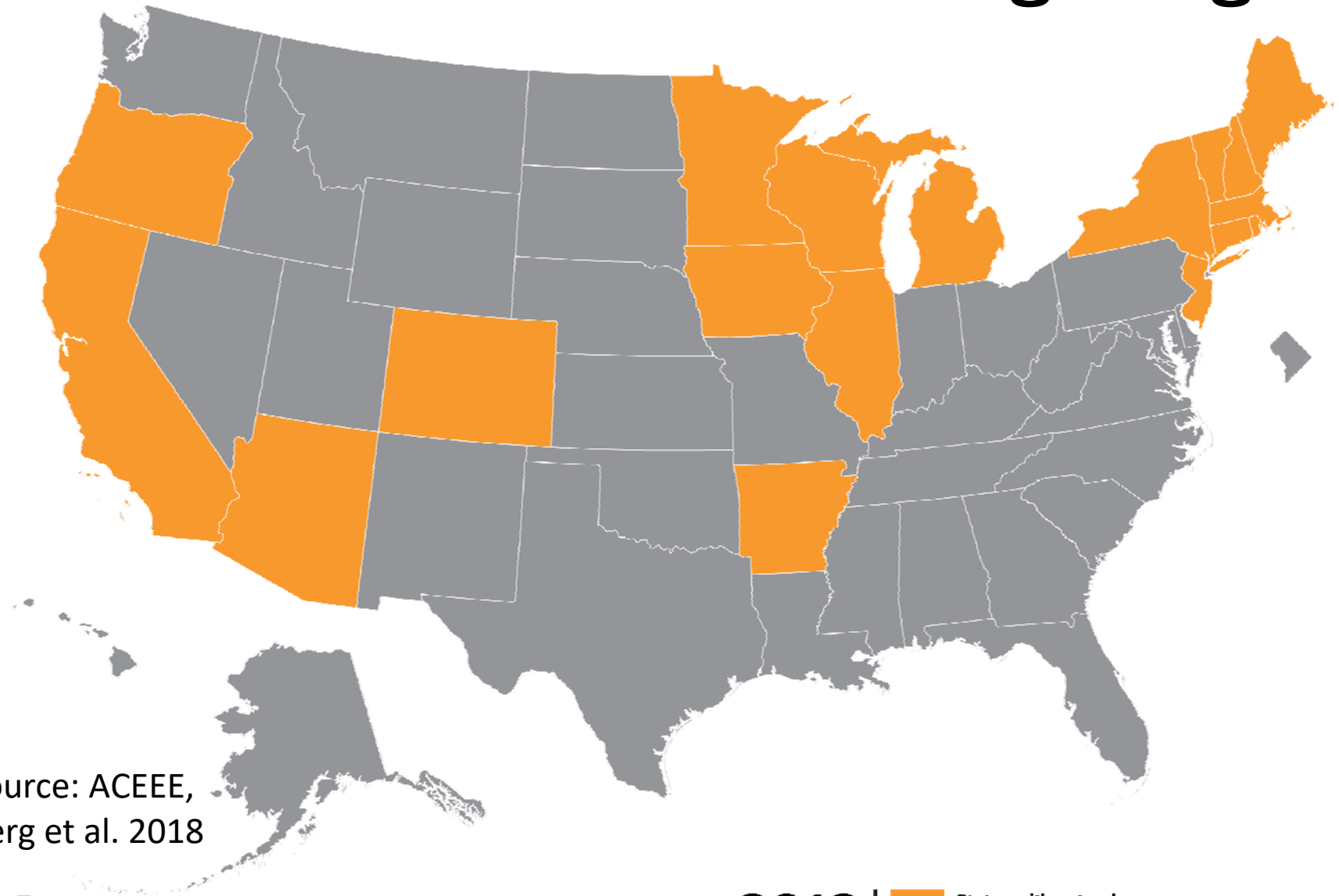
States with Natural Gas Savings Targets



Source: ACEEE, Berg et al. 2018

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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

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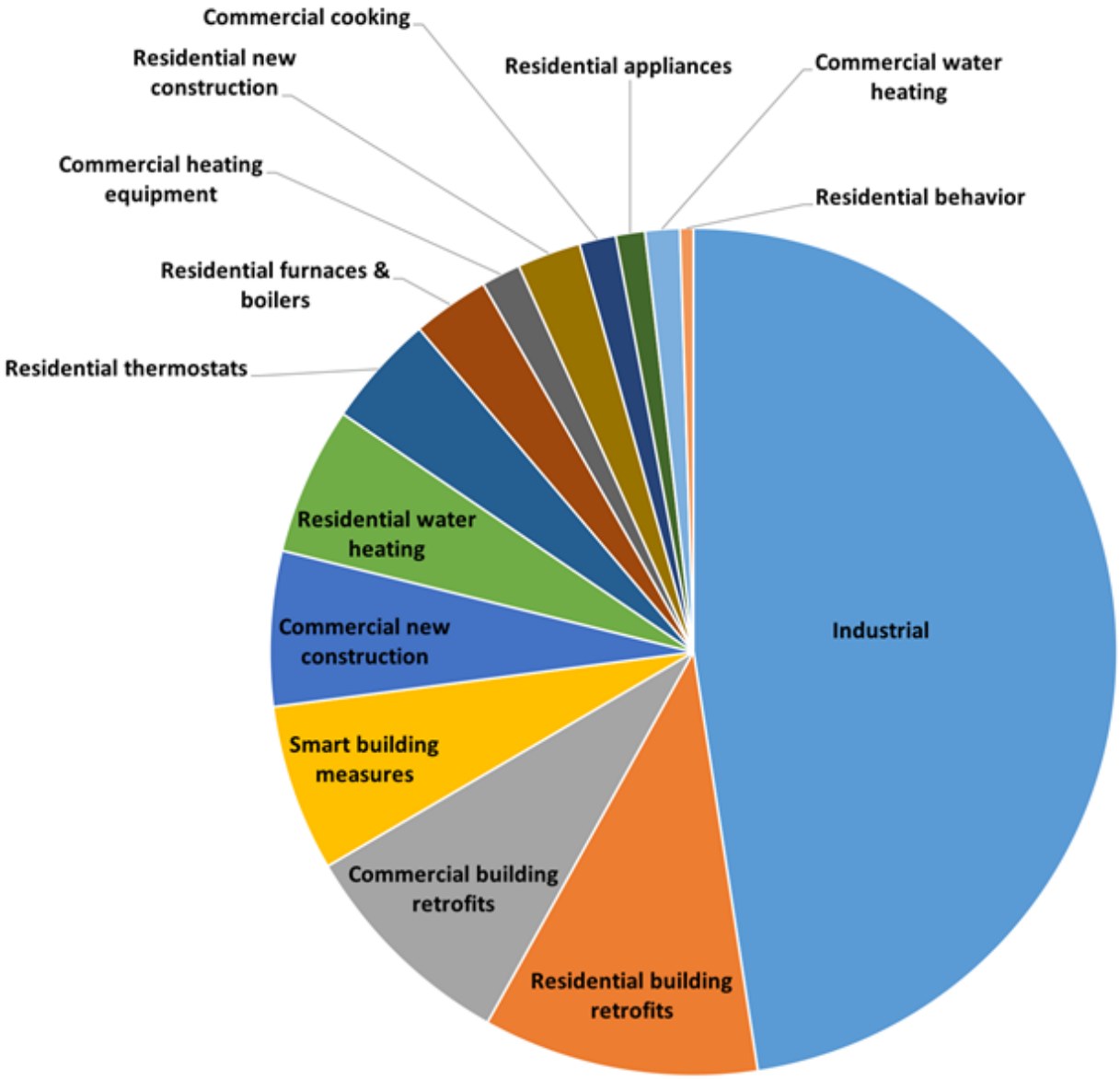
ACEEE Estimate of 2030 Savings Potential

26% potential

Perhaps half achievable



Source: ACEEE, Nadel 2017

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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

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Combined Heat and Power

Texas Medical Center, Houston

Rainier Advanced Materials, Florida

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Natural Gas for Transportation

(CNG)

(Long haul; primarily LNG)

EV's may be eclipsing NG for:

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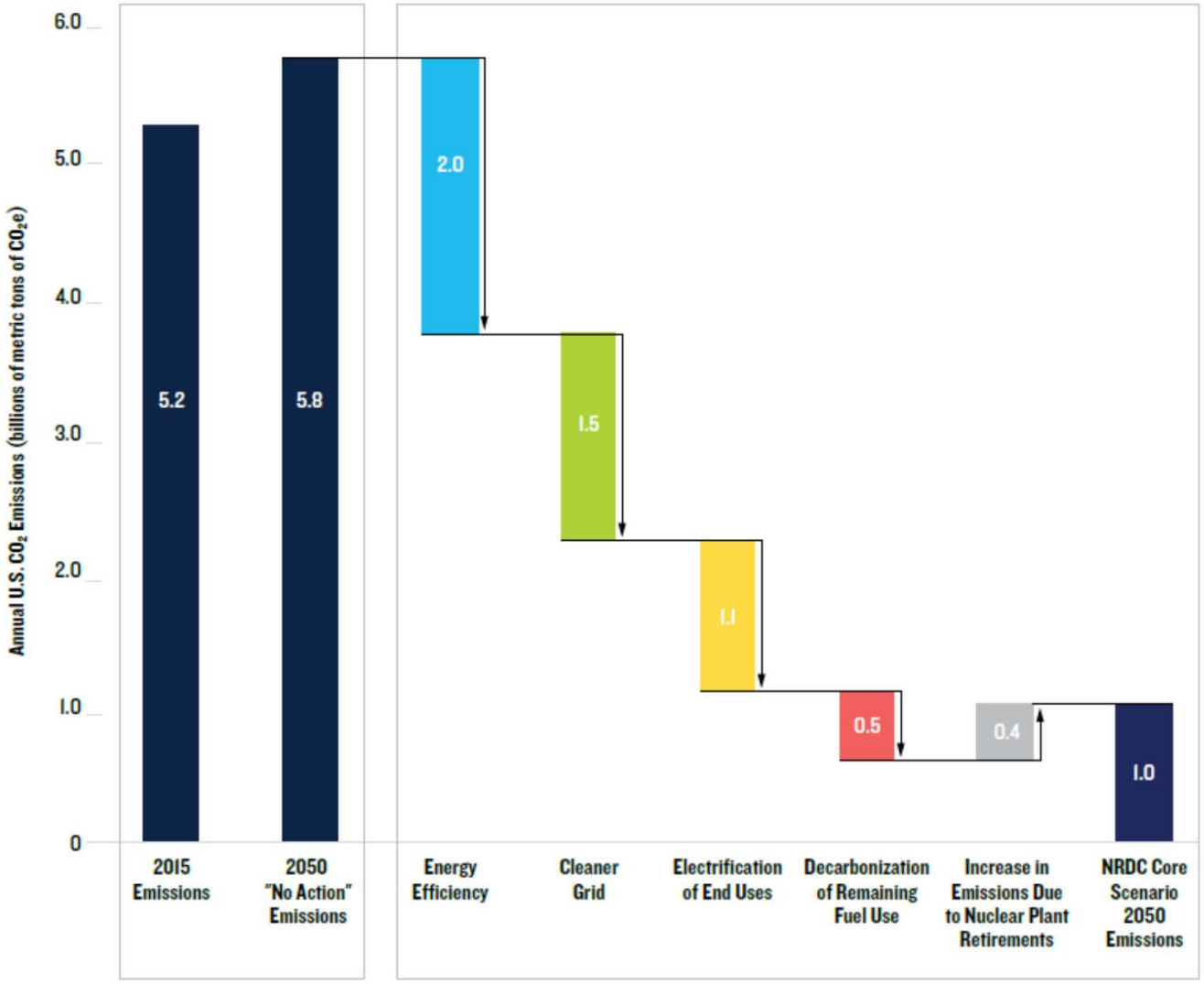
America's Clean Energy Frontier



Source: NRDC, 2017

ACEEE Reports on Electrification

- *Comparative Energy Use of Residential Furnaces and Heat Pumps*, May 2016
- *Opportunities for Energy and Economic Savings by Replacing Electric Resistance Heat with Higher Efficiency Heat Pumps*, May 2016
- *Energy Savings, Consumer Economics, and Greenhouse Gas Emissions Reductions from Replacing Oil and Propane Furnaces, Boilers, and Water Heaters with Air-Source Heat Pumps*, July 2018

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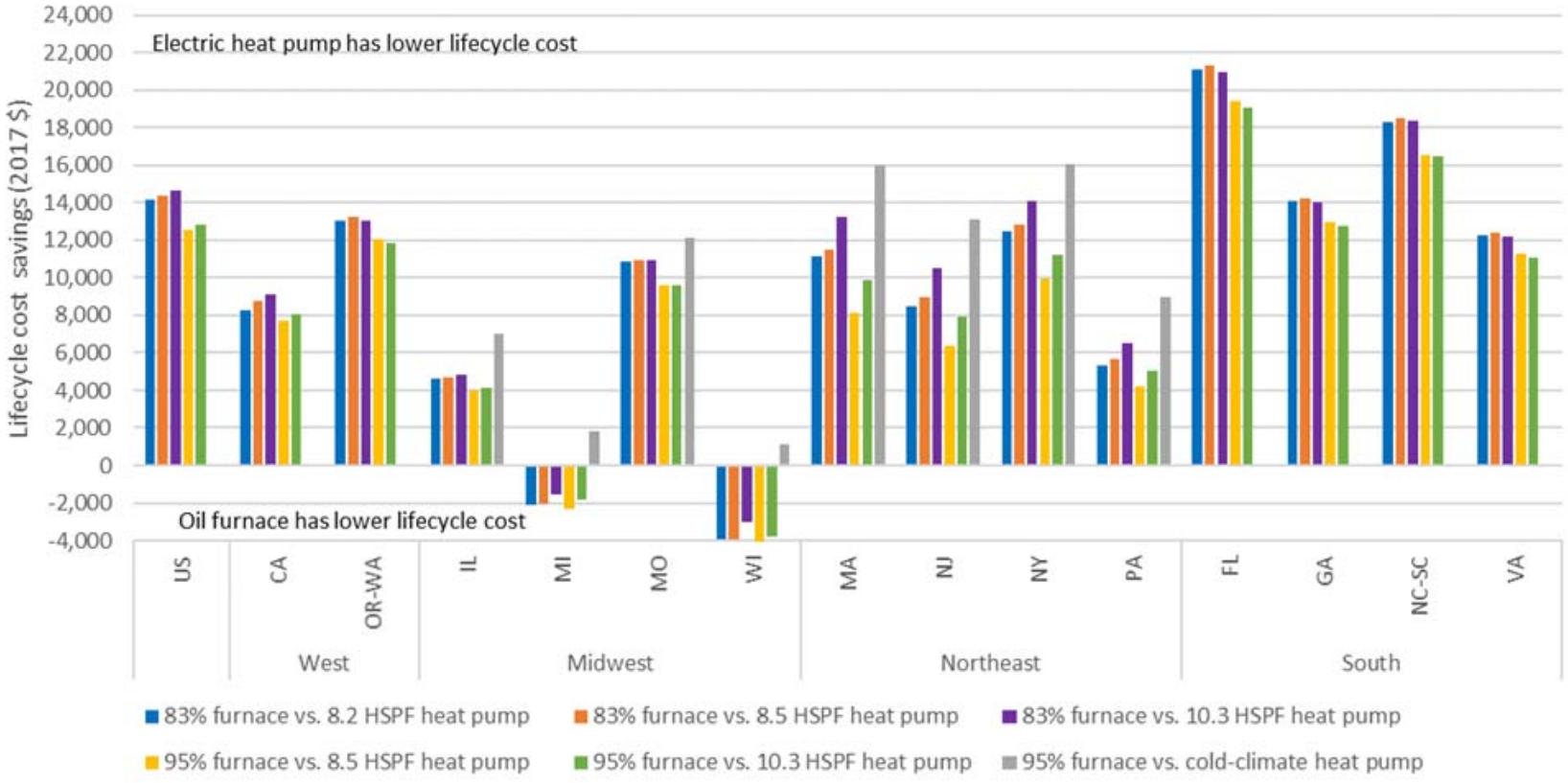
Lifecycle Cost Savings from Converting an Oil Furnace to a Heat Pump at Time of Replacement



Source: Nadel 2018, *Savings from Replacing Oil and Propane Heating with Heat Pumps*, ACEEE

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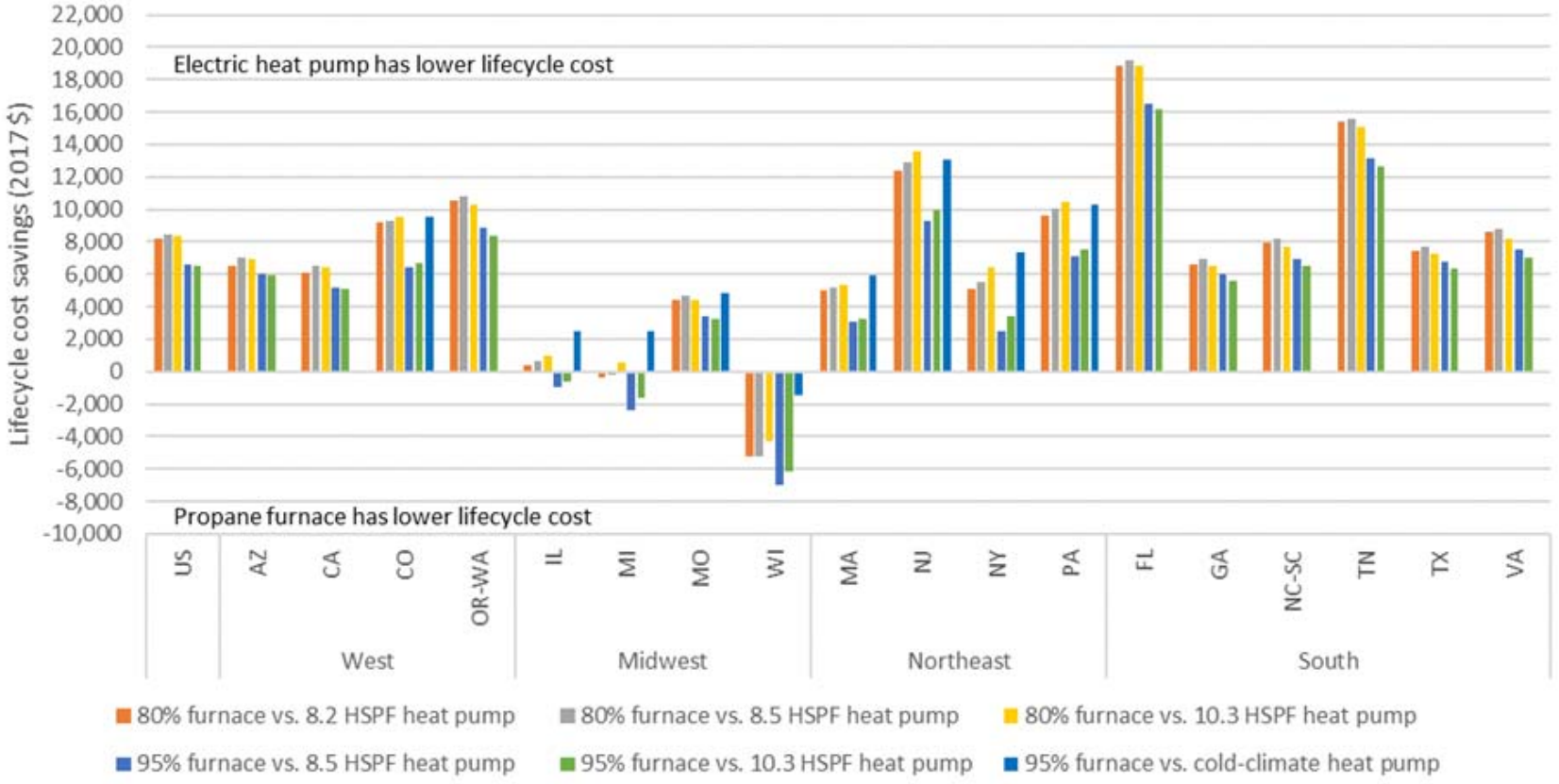
Lifecycle Cost Savings from Converting a Propane Furnace to a Heat Pump at Time of Replacement



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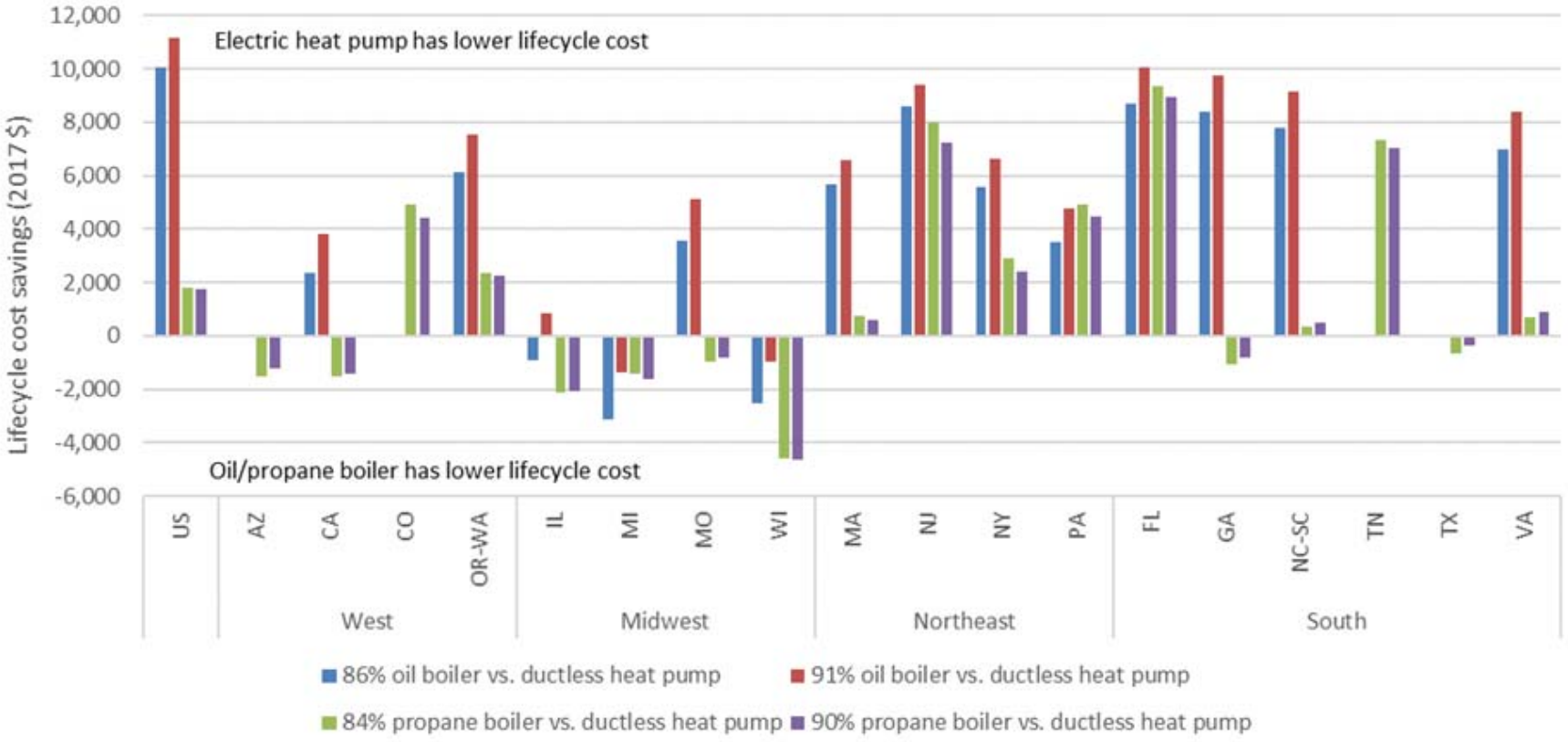
Lifecycle Cost Savings from Installing Ductless Heat Pumps in Homes with Oil or Propane Boilers at Time of Replacement



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Consumer Paybacks – Oil & Propane at Time of Equipment Replacement

Comparison	Average simple payback period (years) US	West	Midwest	Northeast	Southeast
Oil furnace (83% AFUE) vs. HP (8.5 HSPF), includes AC savings	0.9	1.4	1.3 in MO; no savings in Upper MW	1.9	0.8
Propane furnace (80% AFUE) vs. HP (8.5 HSPF), includes AC savings	1.5	1.7	3.4 in MO; no savings in Upper MW	2.0	1.3
Oil boiler (86% AFUE) vs. ductless HP, without AC	4.4	7.3	18.8	6.2	5.1
Propane boiler (84% AFUE) vs. ductless HP, without AC	16.1	12.1	19.8	8.5	9.1
Std. oil water heater to HPWH (2.0 rated EF)	Immediate	Examined only at a national level			
Std. propane water heater to HPWH (2.0 rated EF)	3.9				

Note: Payback periods are typically longer relative to natural gas systems.

Source: Nadel 2018, *Savings from Replacing Oil and Propane Heating with Heat Pumps*, ACEEE

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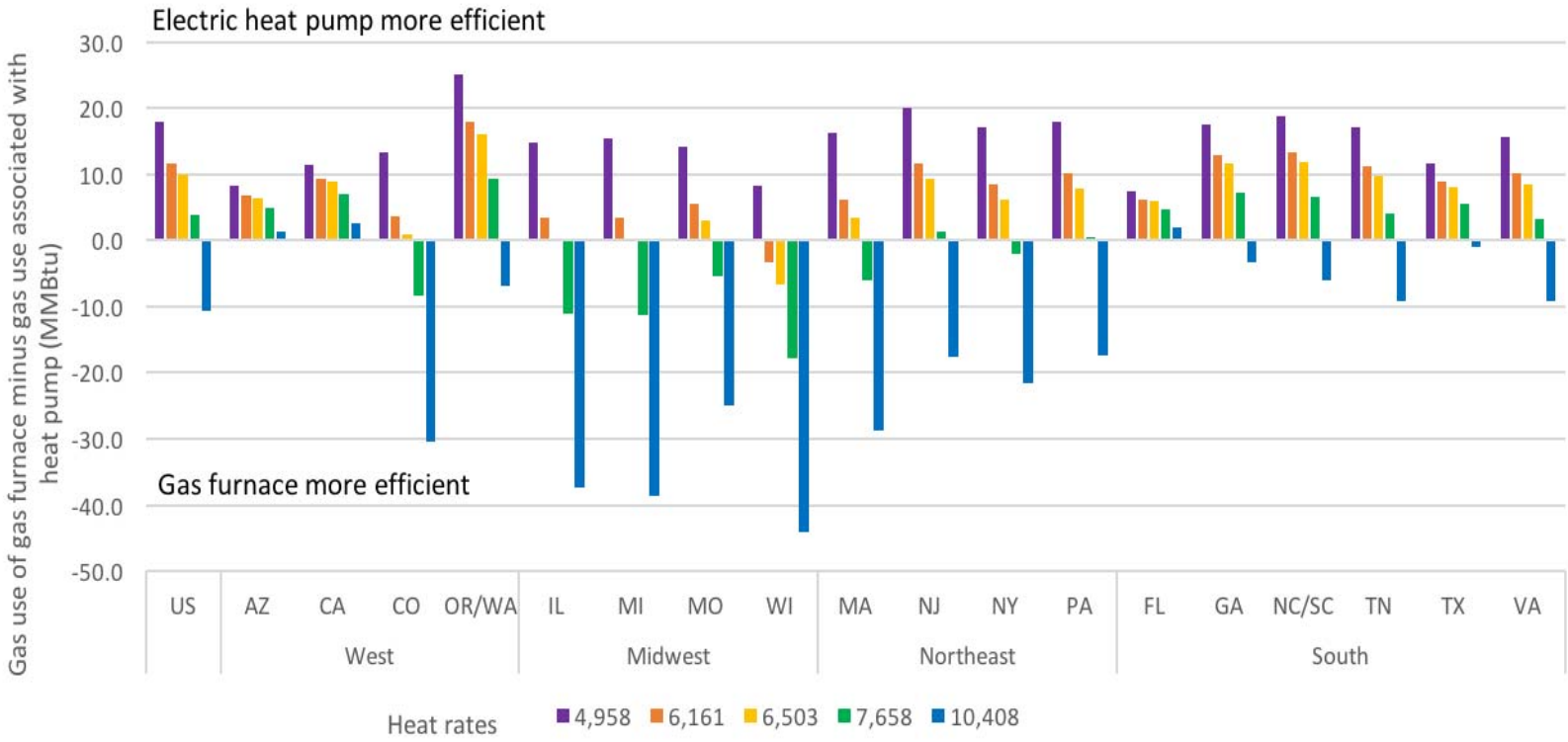
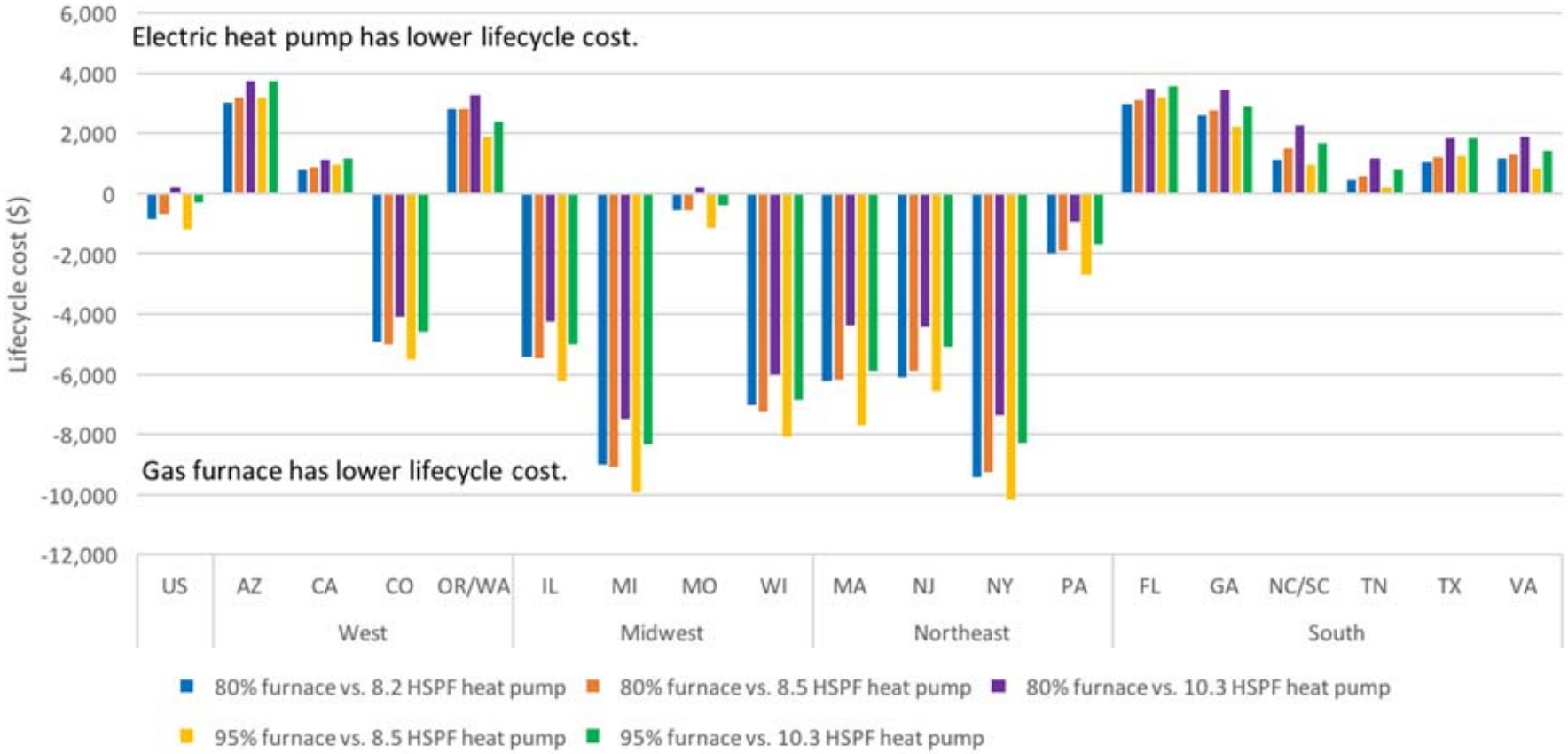
Electrification – Gas to Heat Pumps



Comparison of source energy use: 95% AFUE furnace vs. 10.3 HSPF Heat Pump

Source: Nadel 2016, *Comparative Energy Use of Residential Gas Furnaces and Electric Heat Pumps*, ACEEE

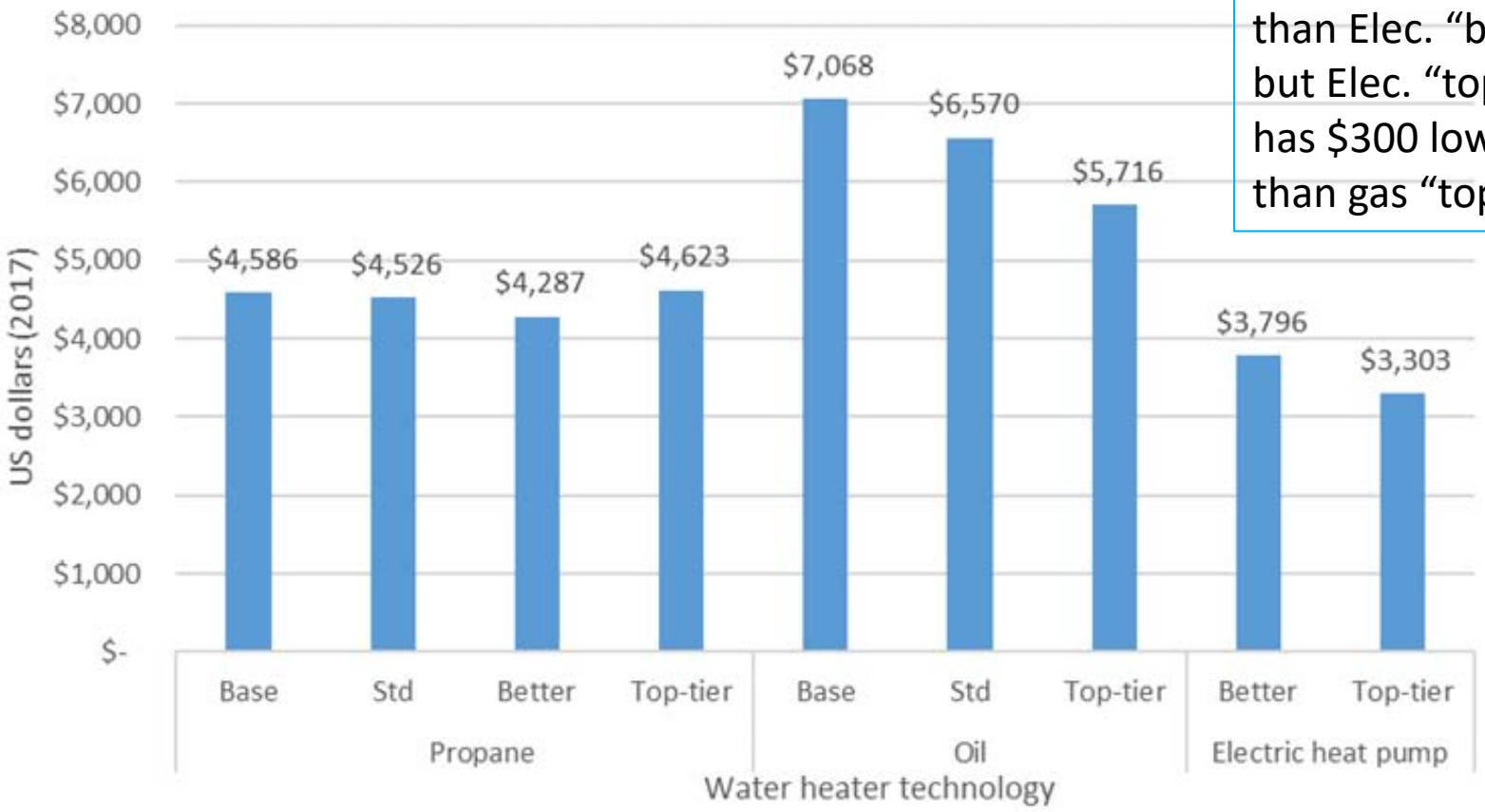
Lifecycle Cost Economics – Natural Gas Furnaces vs. Heat Pumps



Source: Nadel 2016, *Comparative Energy Use of Residential Gas Furnaces and Electric Heat Pumps*, ACEEE

Lifecycle Cost Comparison for Water Heaters

Gas "better" has ~$400 lower cost than Elec. "better" but Elec. "top-tier" has $300 lower cost than gas "top-tier"



Source: Nadel 2018, *Savings from Replacing Oil and Propane Heating with Heat Pumps*, ACEEE

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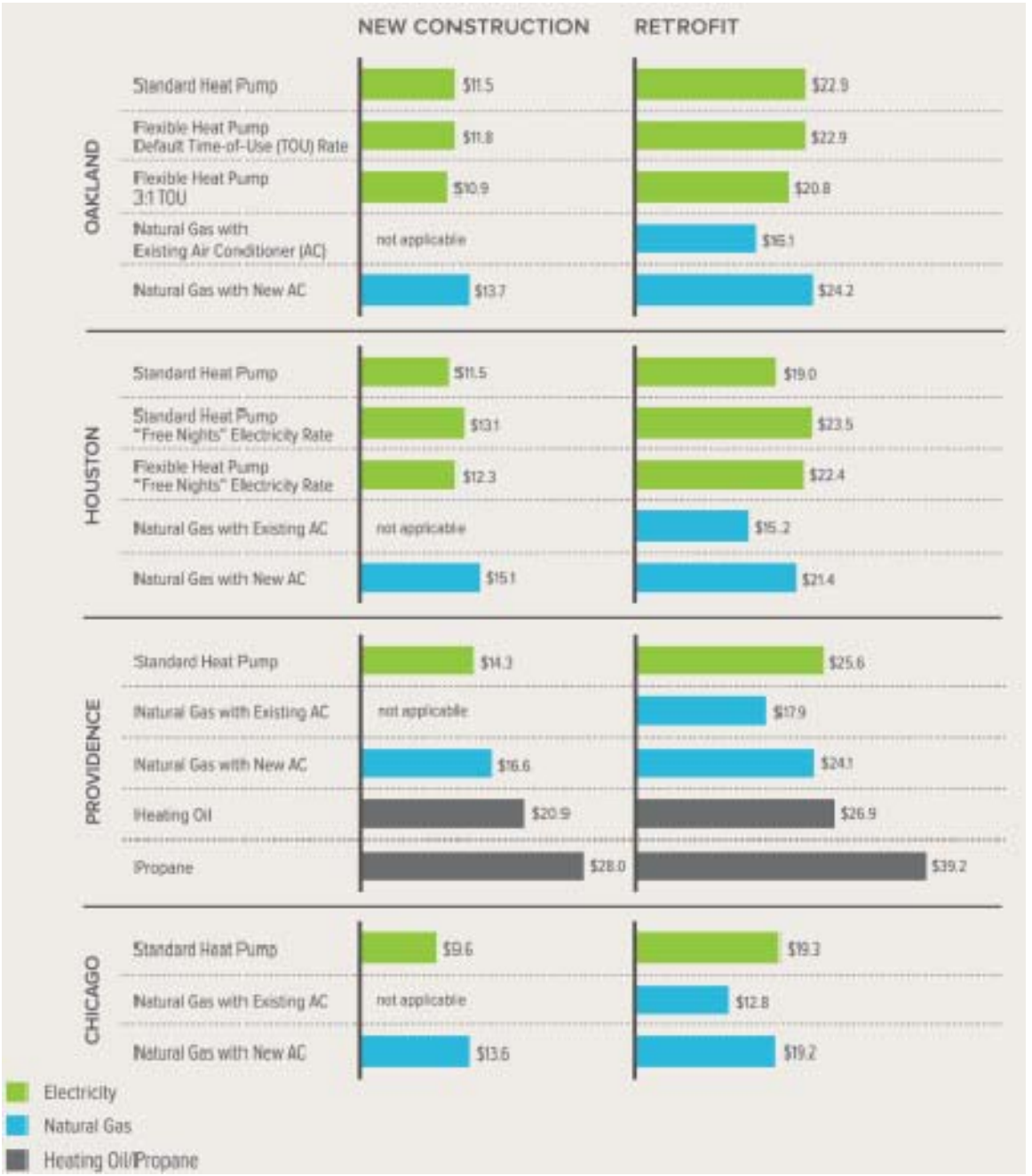
RMI Study on Heat Pumps

- Figures are 15 year NPV costs (1000$)
- https://rmi.org/report-release-electrifying-buildings-for-decarbonization/



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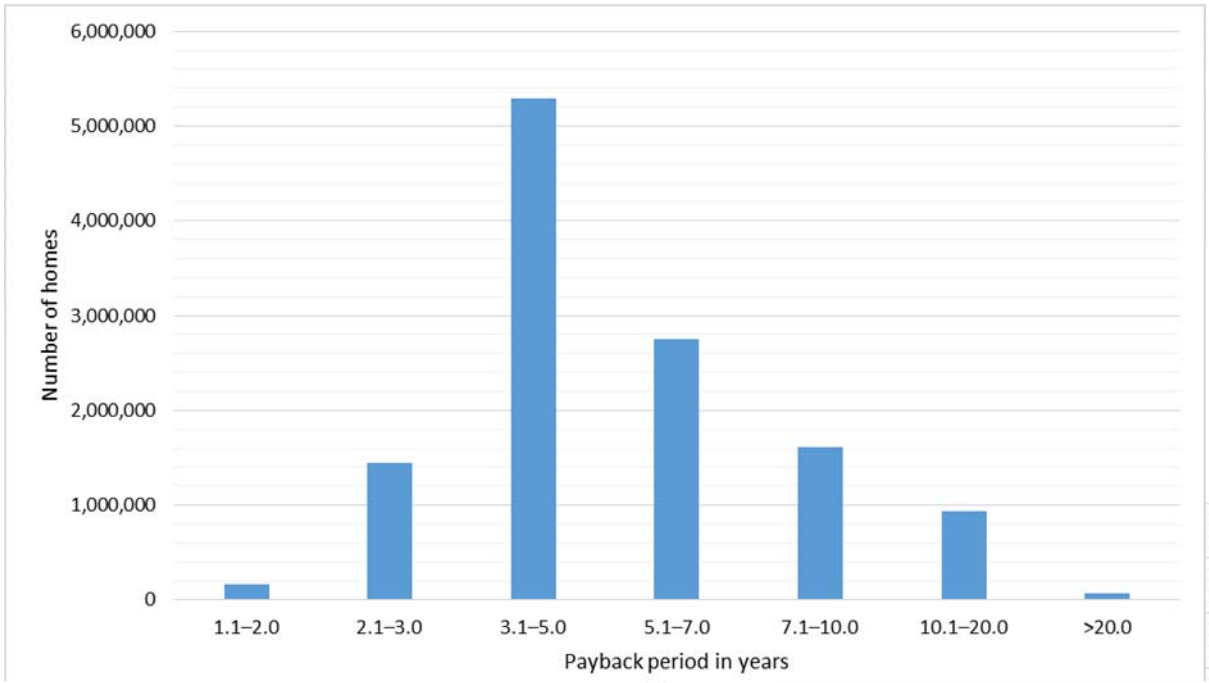
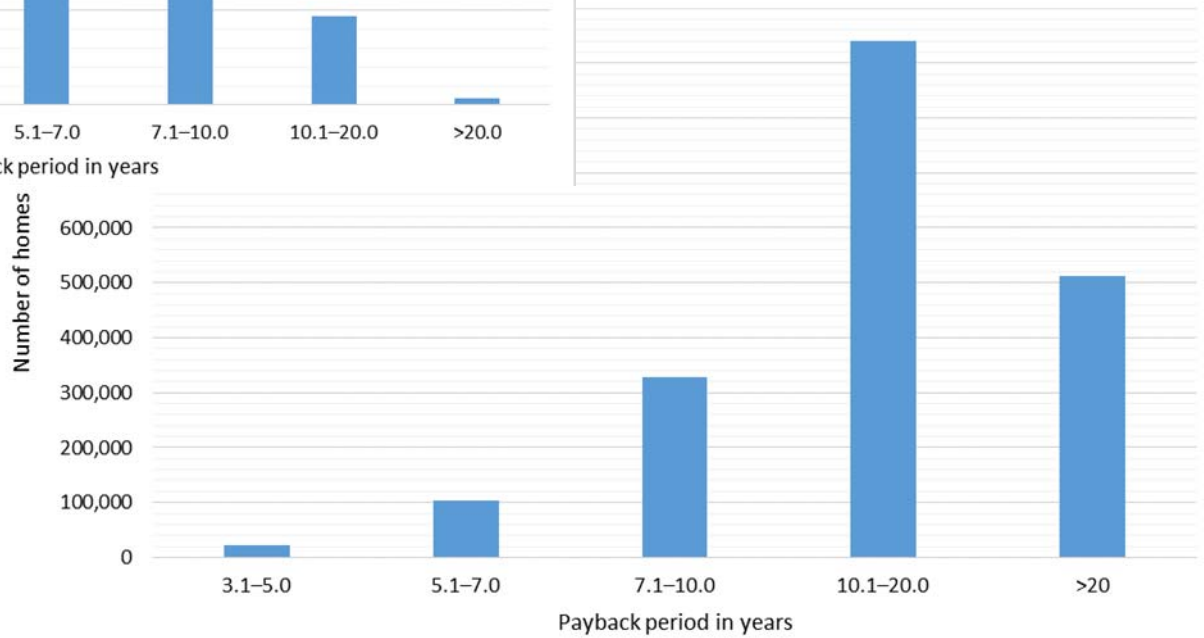
Replace Electric Resistance with Heat Pumps



<=With ducts

Without ducts=>



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Source: Nadel & Kalakari 2016

Meeting All Heating Needs with Heat Pumps

- Possible with regular heat pumps down to ~20 F
- With cold climate heat pumps down to ~ 5 F
  - **Need to size heat pump for design loads**
  - **Pay attention to air circulation**
  - **Weatherizing helps**
  - **More work needed to develop cold climate ducted HP**
- In areas where temperatures get below zero, weatherizing essential
  - **Very efficient homes can get by with a simple electric coil in the air intake**
  - **Less efficient homes may continue to need an oil/ propane/natural gas backup for very cold days**

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Niches for Home Heat Pumps

- New construction
- Homes with electric resistance heat
- Homes with oil and propane heat
  - **But likely to be hybrid systems for existing homes in very cold climates**
- Gas heated homes in warm climates at the time the AC needs to be replaced

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Beneficial Electrification

We consider electrification“beneficial” when:

- Reduces energy consumption (total source BTUs)
- Lowers customer costs
- Reduces greenhouse gas emissions (GHG)

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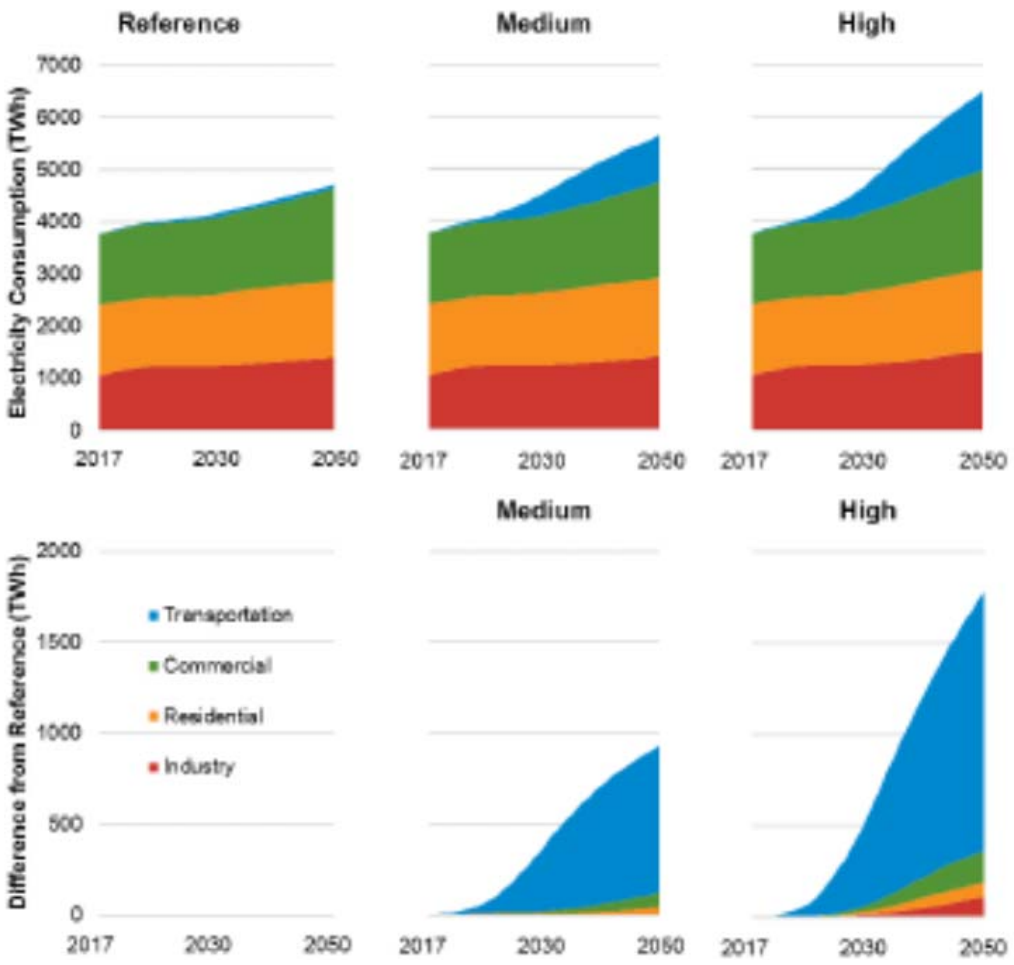
Electricity Consumption Under Several Electrification Scenarios



Source: NREL 2018

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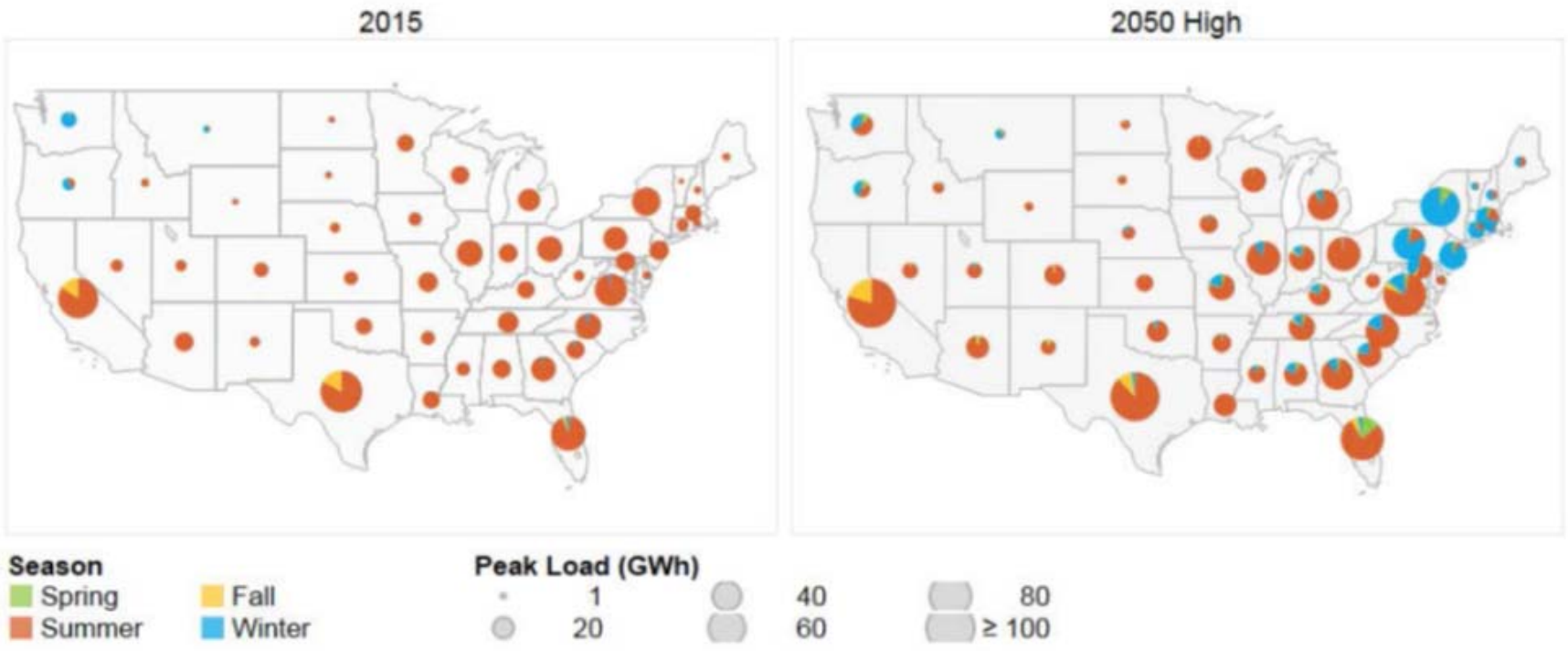
Peak Loads in 2050 in a High Electrification Scenario



Source: NREL 2018

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Electrification and the Grid, Pipes

The Grid

- Northeast could eventually become winter peaking
- Need to do more to explore winter demand response
  - **Applies to both electricity and natural gas**
- Gas generation plants to help balance load
- Some long-term interest in using extra renewable energy to generate hydrogen

Pipes

- Extensions of distribution system becomes questionable – will there be 30+ years of demand?
- For existing distribution, if electrification takes off, need to figure out fair ways to recoup gas distribution costs

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2019/2020 ACEEE Conferences

FORUM ON CONNECTED AND AUTOMATED VEHICLES: ENERGY IMPACTS	MAY 6, 2019	WASHINGTON, DC
SUMMER STUDY ON ENERGY EFFICIENCY IN INDUSTRY	AUGUST 12-15, 2019	PORTLAND, OR
NATIONAL CONFERENCE ON ENERGY EFFICIENCY AS A RESOURCE	OCTOBER 15-17, 2019	MINNEAPOLIS, MN
BEHAVIOR, ENERGY, AND CLIMATE CHANGE CONFERENCE	NOVEMBER 17-20, 2019	SACRAMENTO, CA
CONFERENCE ON HEALTH, ENVIRONMENT, AND ENERGY	JANUARY 21-23, 2020	NEW ORLEANS, LA
RURAL ENERGY CONFERENCE	FEBRUARY 25, 2020	CHICAGO, IL
HOT WATER FORUM	MARCH 23 – 25, 2020	ATLANTA, GA
FINANCE FORUM	DATE TBD, 2020	NYC AREA
SUMMER STUDY ON ENERGY EFFICIENCY IN BUILDINGS	AUGUST 15-21, 2020	PACIFIC GROVE, CA

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