Beneficial Building Electrification in Maryland

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ACEEE

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Agenda

- Synergies of building electrification and energy efficiency
- Policy trends
- Economics of building electrification
- Recommendations

Synergies of building electrification and energy efficiency

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Beneficial electrification can be a form of energy efficiency

We consider electrification beneficial and a form of EE when it:

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

ACEEE support strategies to promote beneficial electrification when it complements but does not undermine traditional energy efficiency policies and programs

Synergies of Efficiency and Electrification

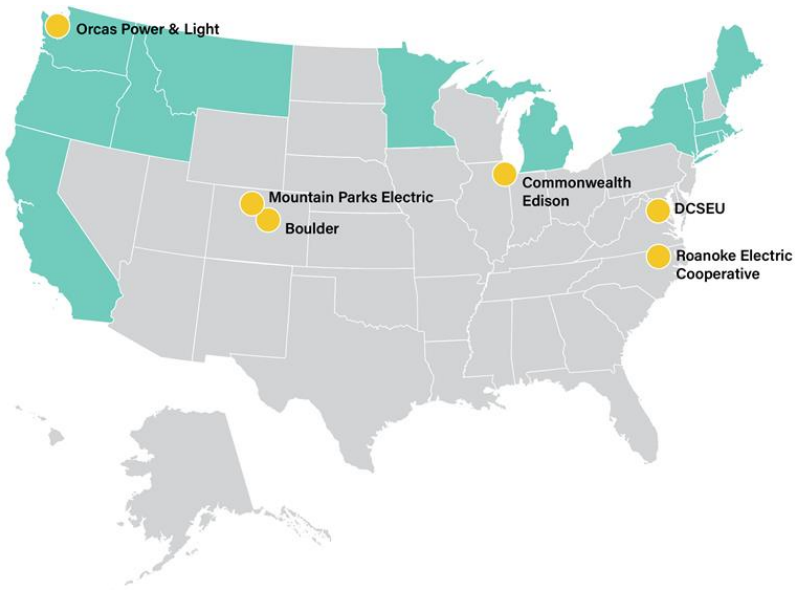
Building shell and other efficiency measures reduce loads, e.g. space heating, which can reduce equipment sizing and therefore costs

At the system level, aggressive EE can keep electricity demand in check, and can lower overall costs to meet new demand from electrification

EE and DR programs also provide opportunities for important value as load flexibility, which becomes increasingly important under electrification

Program & Policy Trends

Program trends



- ACEEE profiled 23 heat pump programs – current annual budgets are $110 million, up 70% from the prior year.
- Programs are most extensive on West Coast and in Northeast but beginning in other regions too
- Most programs encourage weatherization to reduce loads; about one-third require it.
- In areas with high use of delivered fuels, many programs target customers using these fuels because economics are better.
- A few programs are encouraging all-electric new construction.
- Existing programs emphasize residential sector; some small commercial buildings.

Nadel 2020. https://www.aceee.org/topic-brief/2020/06/programs-electrify-space-heating-homes-and-buildings

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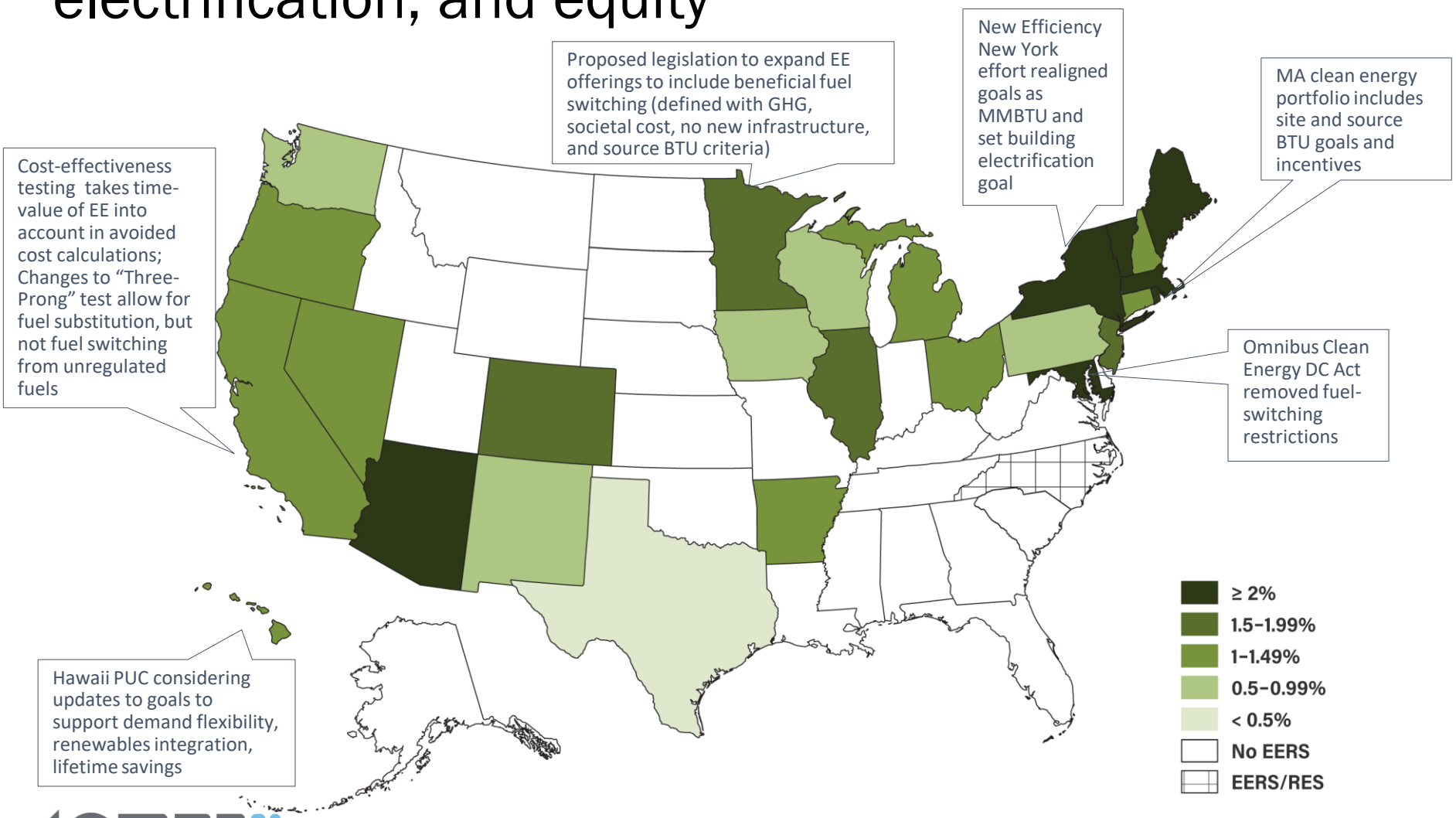
EERS have begun to evolve to better align with climate and grid needs, including beneficial electrification, and equity



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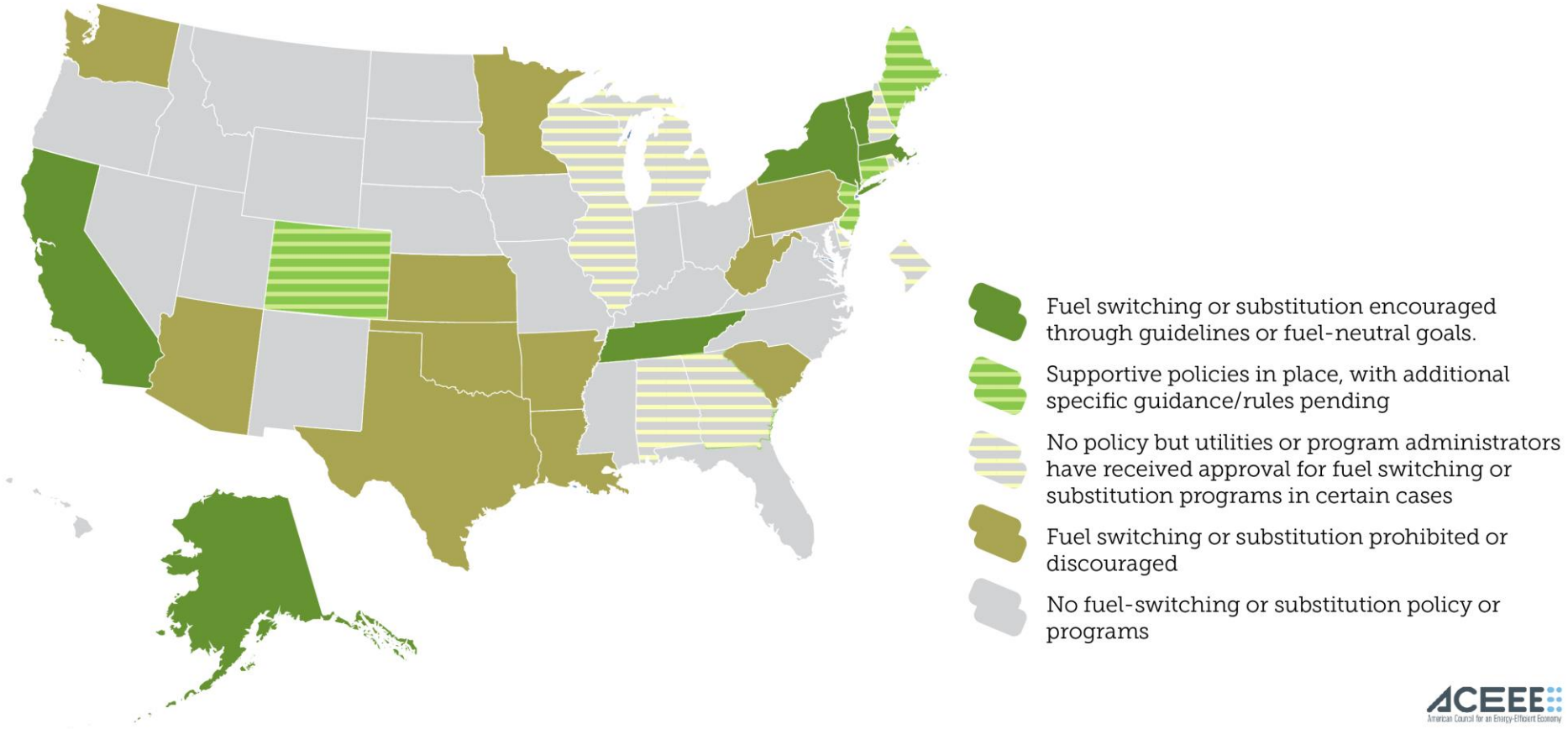
Source: Next-Generation EERS, ACEEE 2019

Fuel switching rules also have begun to evolve



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ACEEE Analysis on Consumer Economics for Residential Heat Pumps

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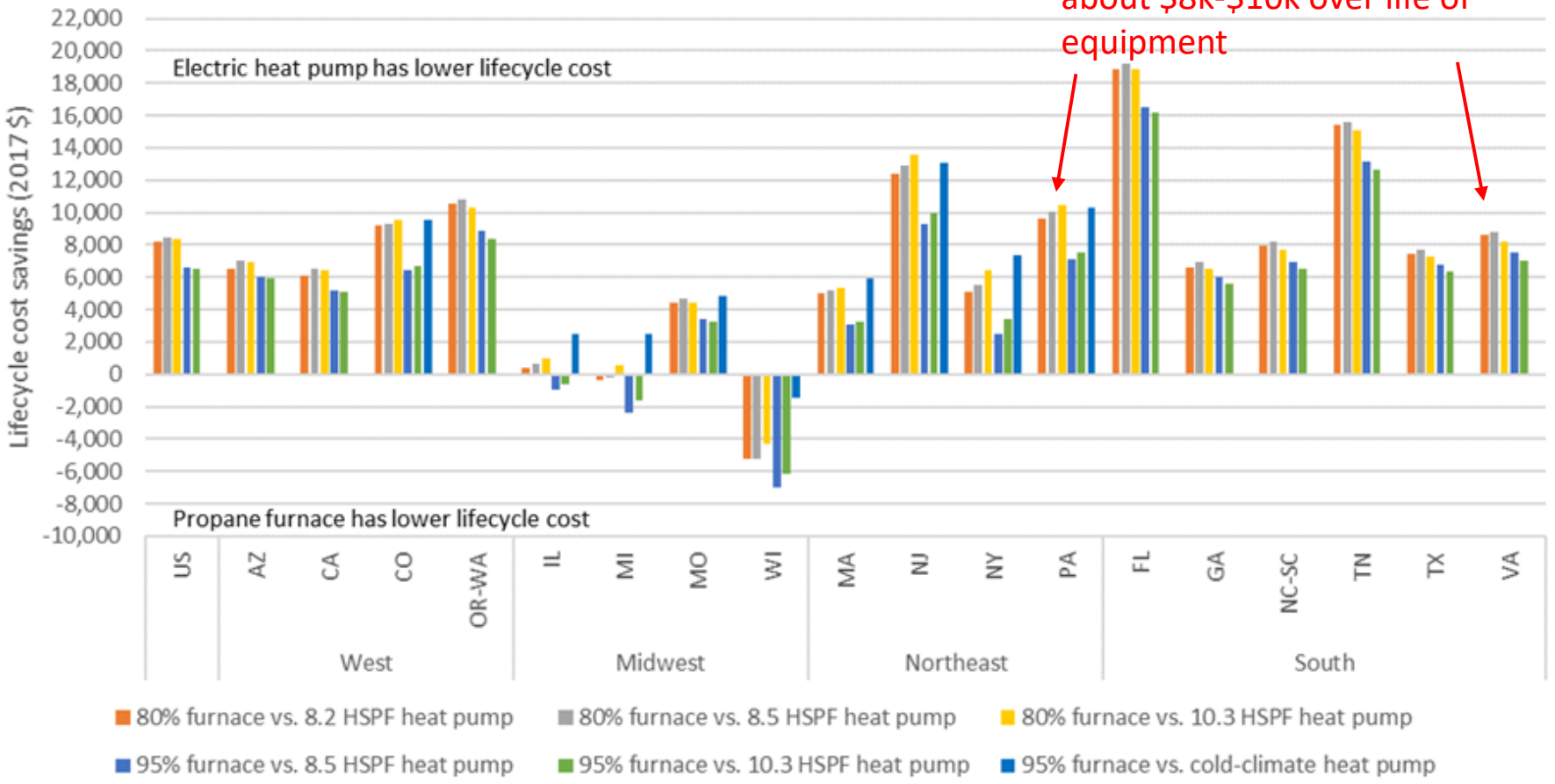
Key assumptions and caveats

- Heat pump generally installed when existing equipment needs to be replaced including AC (separate analyses on early retirement and partial replacement; not new construction)
- Unit of analysis = Average lifecycle cost savings for full conversion to heat pump; by region/ state
- Includes both capital and operating costs.
- Based on statewide average values (RECS data on energy usage), not range of household values
- Does not assume any financial incentives to convert to heat pumps, which would improve economics for participants
- Does not include any price on GHG emissions/ social cost of carbon

Lifecycle Cost Savings from Converting a Propane Furnace to a Heat Pump

MD likely in between these average values. ASHPs save about $8k-$10k over life of equipment



Source: Nadel 2018. https://www.aceee.org/research-report/a1803

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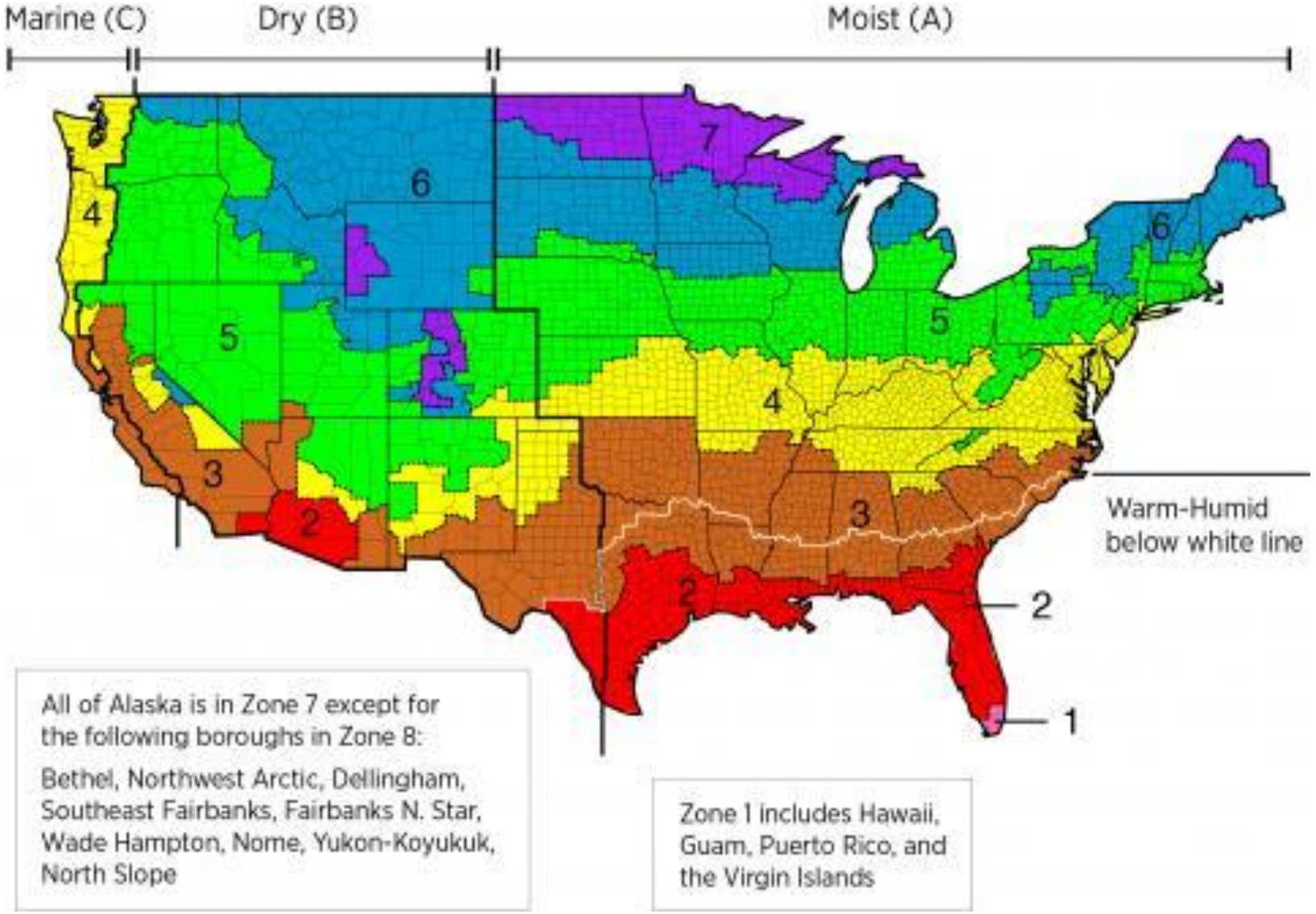
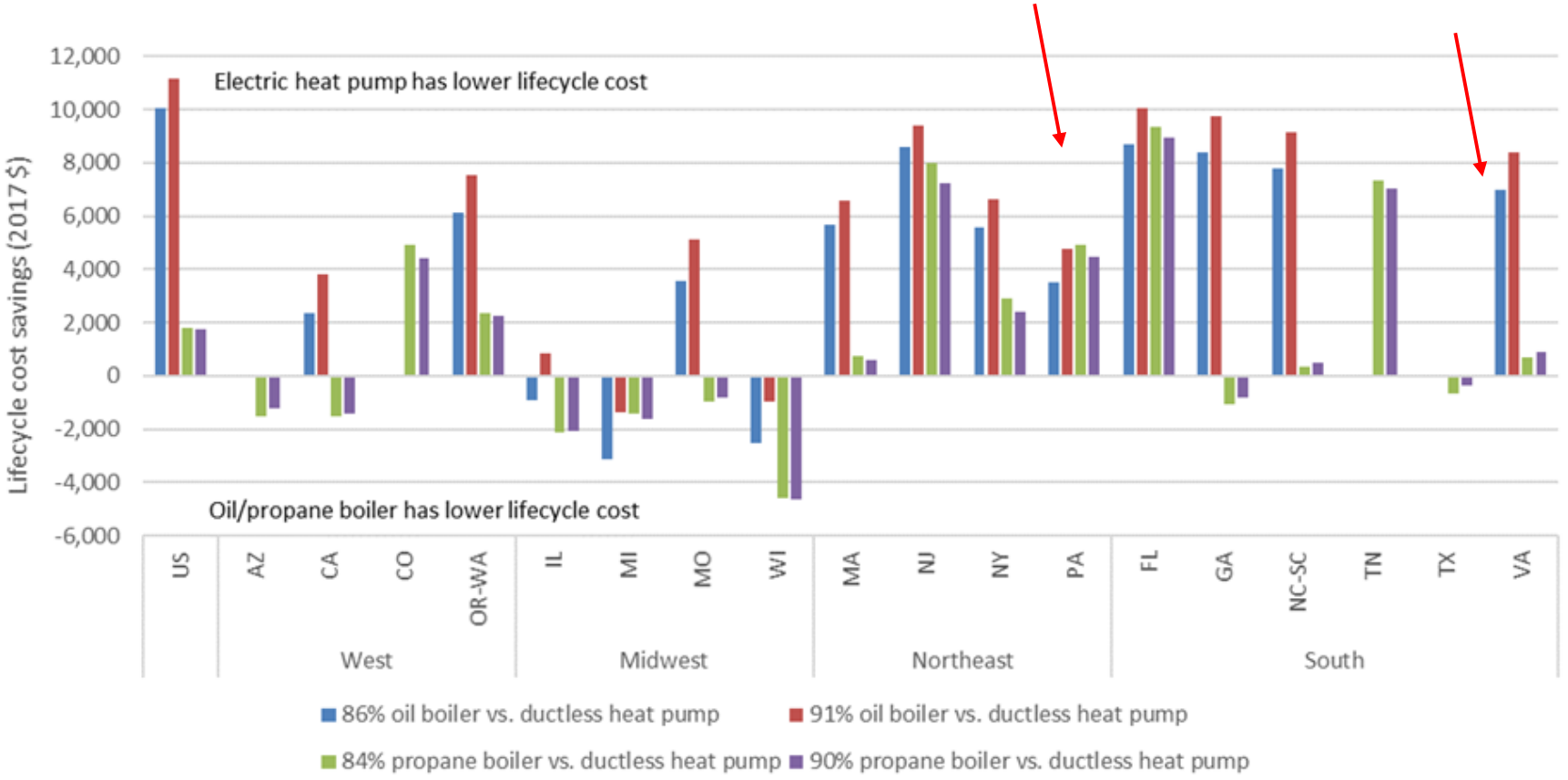

Marine (C)
Dry (B)
Moist (A)
Warm-Humid
below white line
All of Alaska is in Zone 7 except for the following boroughs in Zone 8:
Bethel, Northwest Arctic, Dellingham, Southeast Fairbanks, Fairbanks N. Star, Wade Hampton, Nome, Yukon-Koyukuk, North Slope
Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands

Lifecycle Cost Savings from Installing Ductless Heat Pumps in Homes with Oil or Propane Boilers



High-efficiency heat pumps: cost-effective now relative to propane and oil equipment (Consumer paybacks)

Table ES1. Representative average simple payback period for installing a heat pump at the time an existing oil or propane system needs to be replaced

	Average simple payback period (years)				
Comparison	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				

Simple paybacks are typically just a few years, except for the Upper Midwest, due to high electricity prices and low oil/propane prices. Note: Payback periods are typically longer relative to natural gas systems.

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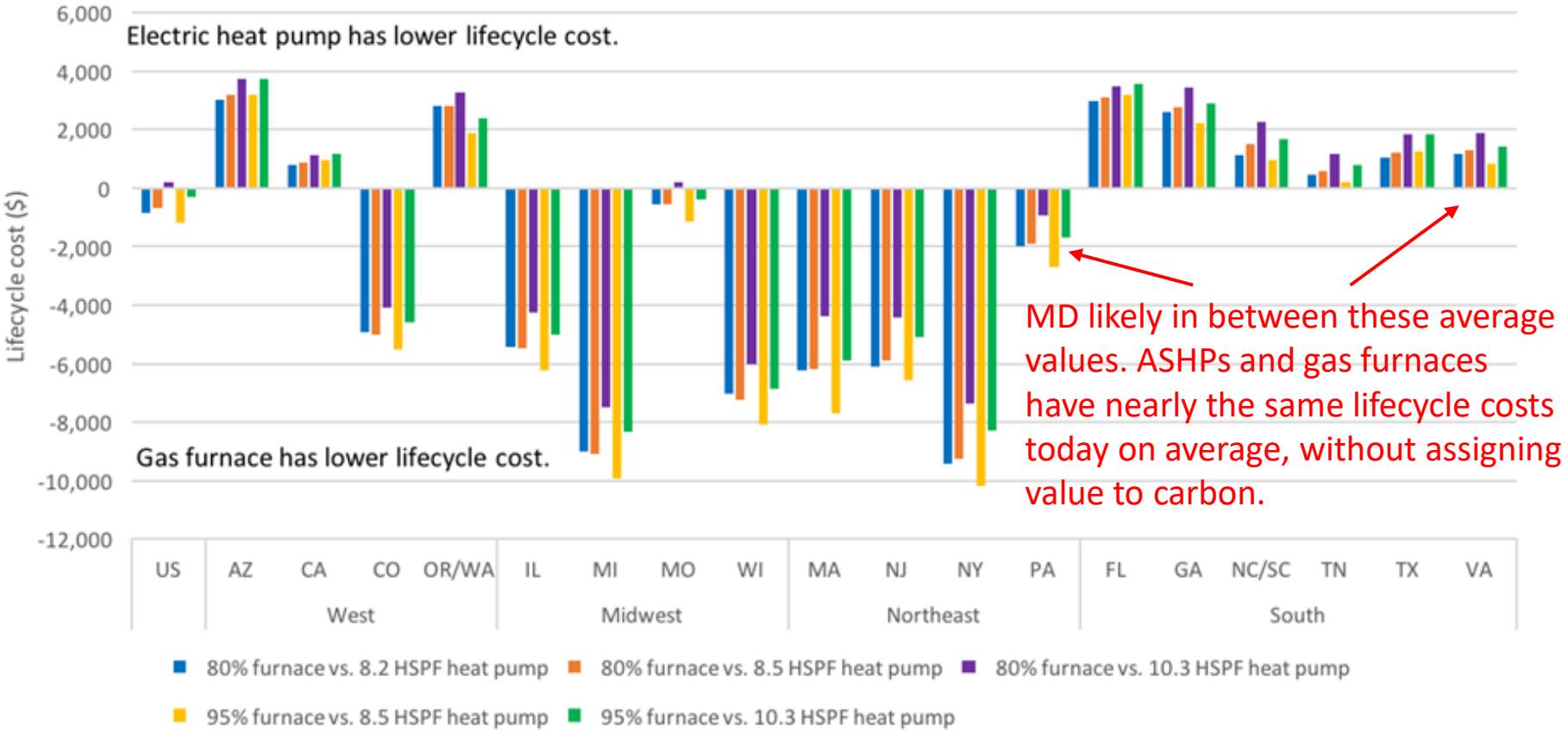
Source: Nadel 2018, Savings from Replacing Oil and Propane Heating with Heat Pumps, ACEEE

Lifecycle Cost Economics – Natural Gas Furnaces vs. Heat Pumps



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

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Commercial Electrification Example

- Vishay Tansitor, mixed-use light industrial facility in Bennington, Vermont with a 10-ton rooftop cooling and heating system.
- Existing equipment at end of life.
- Looked at a replacement electric resistance heat system, a propane system, or a high-efficiency heat pump, ultimately choosing the heat pump.
- Conversion cost ~$12,500 more than a replacement all-electric system; simple payback ~4 years.
- Cost and savings a little lower relative to propane, also ~4 year payback.

https://www.efficiencyvermont.com/Media/Default/bbd/2015/docs/presentations/efficiency-vermont-air-source-heat-pumps-in-the-commerical-market.pdf

Some concluding observations on consumer economics

- ACEEE analysis shows that residential heat pumps provide lifecycle cost *savings* for households in mid-Atlantic region on average at time of equipment replacement
  - **Economics are most favorable for customers currently heating with propane and fuel oil.**
  - **For gas customers, *average* household economics just on the margin; some customers will have lifecycle savings others won't.**
- Consumer economics data helpful, but customers do not generally make decisions based solely on payback thresholds and lifecycle cost analysis
- Need to **target programs** to customers appropriately, e.g.
  - **Where opportunities are most cost-effective and reduce carbon**
  - **To those who have participated in retrofit programs in the past**
  - **Underserved communities**

Recommendations

Recommendations

- Maryland can build on its track record of success in energy efficiency for building electrification programs– synergies of pursuing both strategies for societal benefits (GHG, jobs, etc.)
- Engage stakeholders early and often: Incorporate equity at the beginning of policy and program discussions
- Evolve the state's energy efficiency and decarbonization policies, e.g. EERS, fuel-switching rules, to encourage beneficial building electrification
- Given the many technology options and customer applications, target programs to meet needs of customers. Use market transformation principles.
- Align electrification equipment programs with building upgrades and new construction where possible to reduce energy demands, e.g. staged and combined programs

Contact Information

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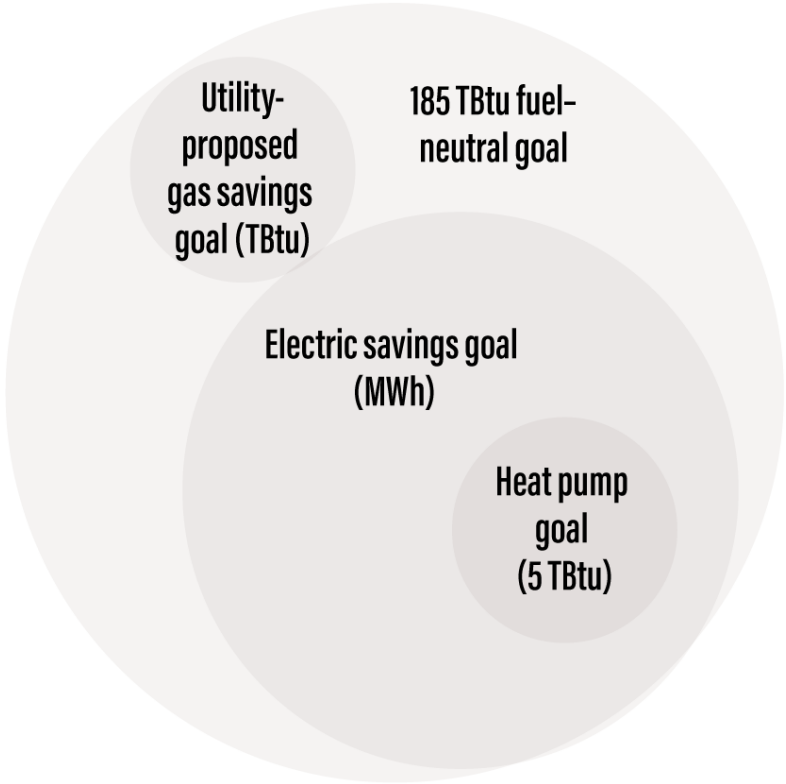
Appendix

ACEEE Reports on Electrification

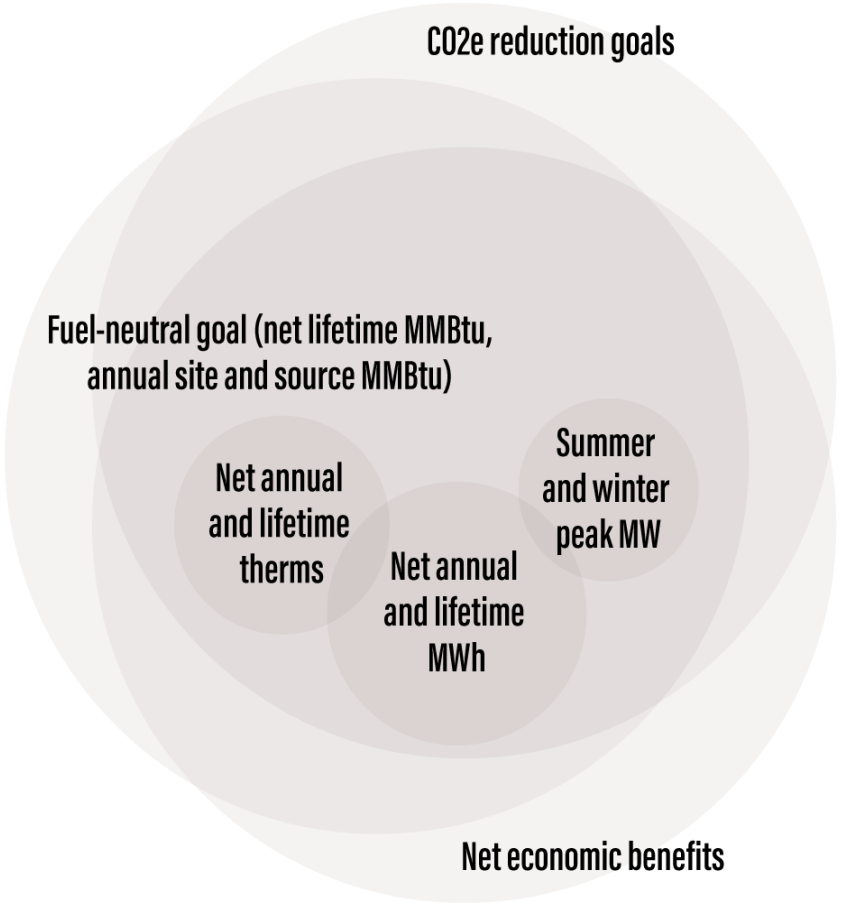
- *Comparative Energy Use of Residential Furnaces and Heat Pumps*, May 2016
- *Opportunities for Energy and Economic Savings by Replacing Electric Resistance Heat with Higher Efficiency Heat Pumps*, May 2016
- *Energy Savings, Consumer Economics, and Greenhouse Gas Emissions Reductions from Replacing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

New models are not one-size fits all

New York



Massachusetts



Update: NY heat pump goal reduced to 3.6 TBtu in January 2020 order

Source: Next-Generation EERS, ACEEE 2019

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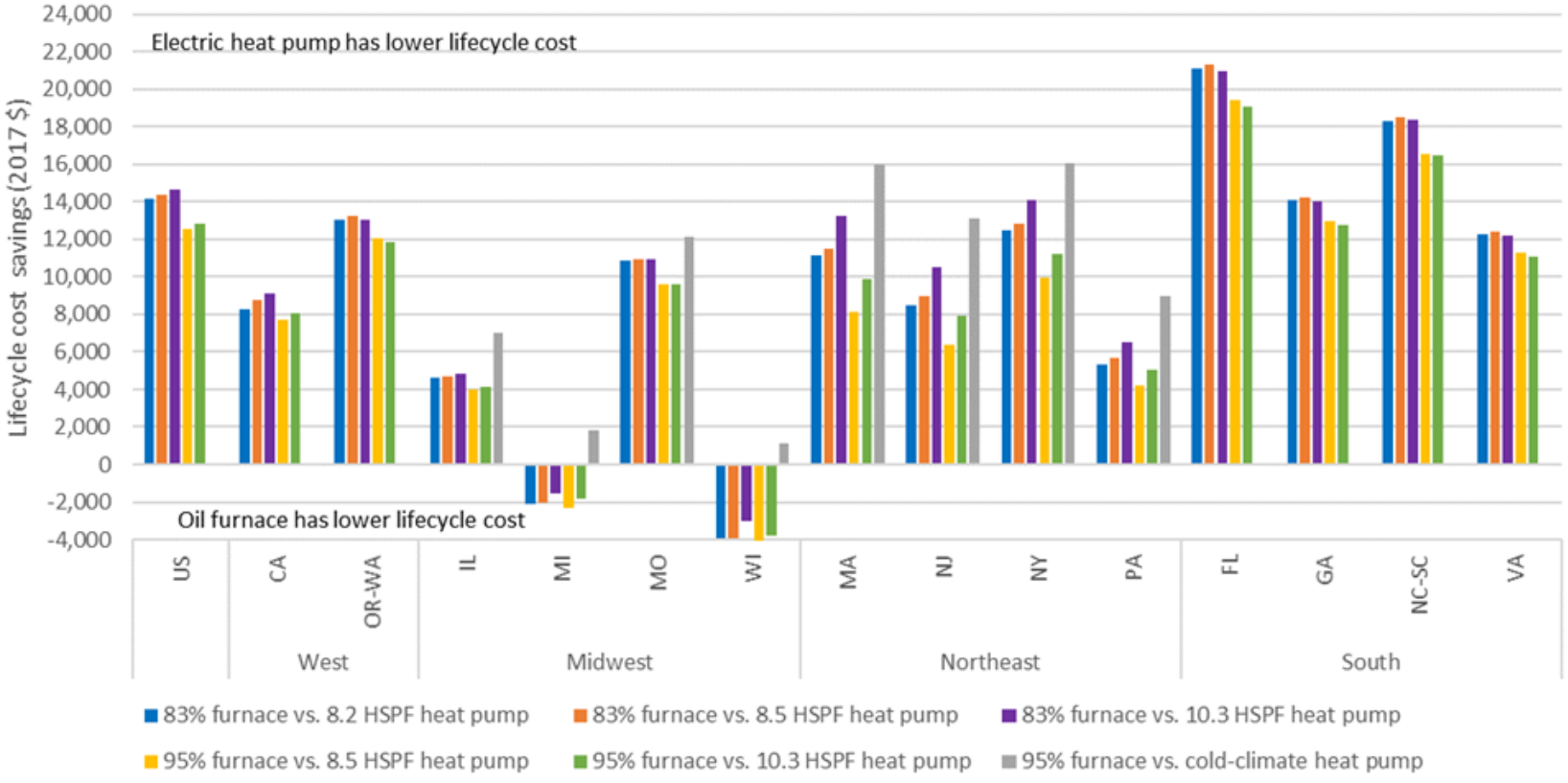
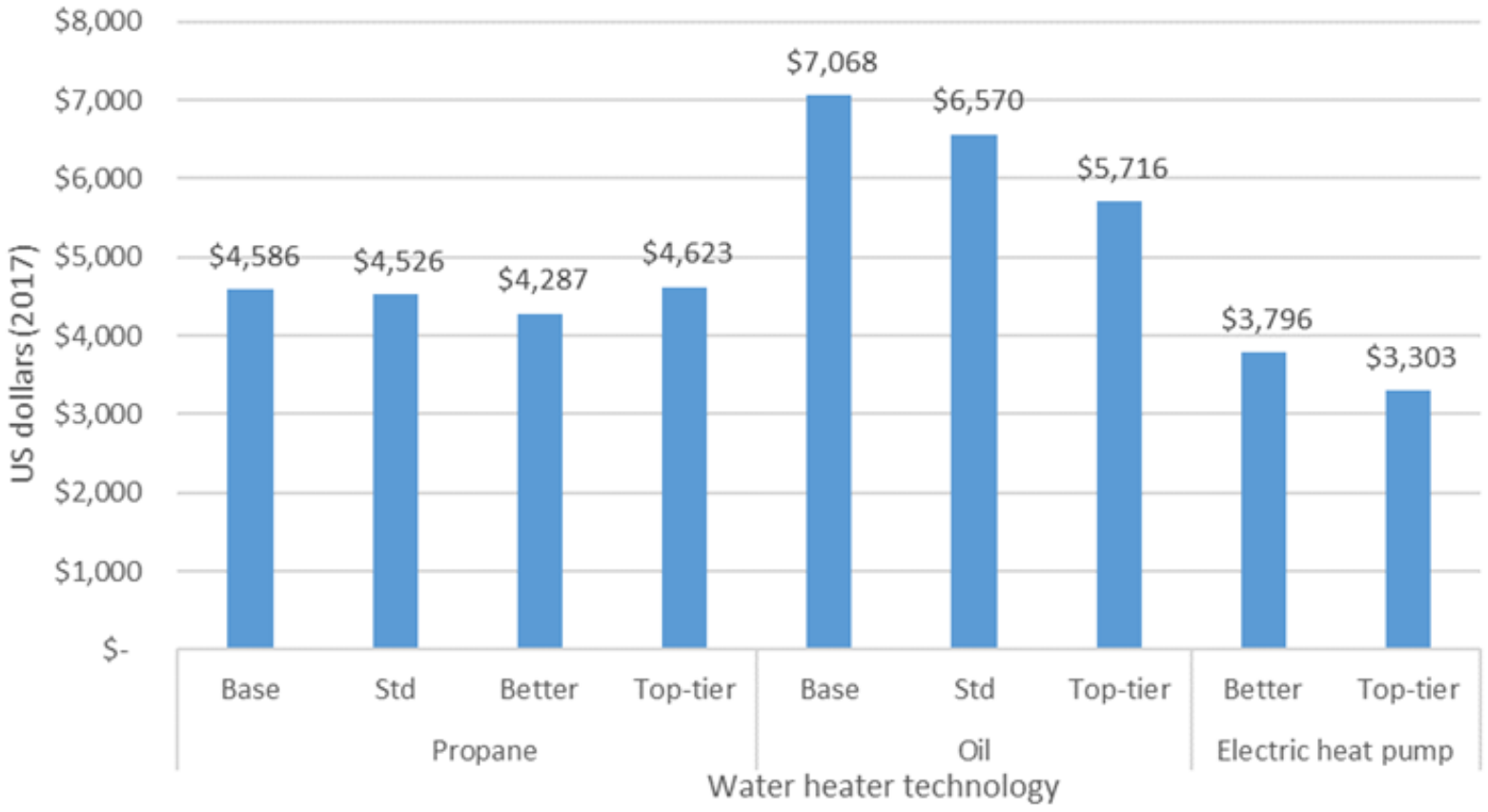
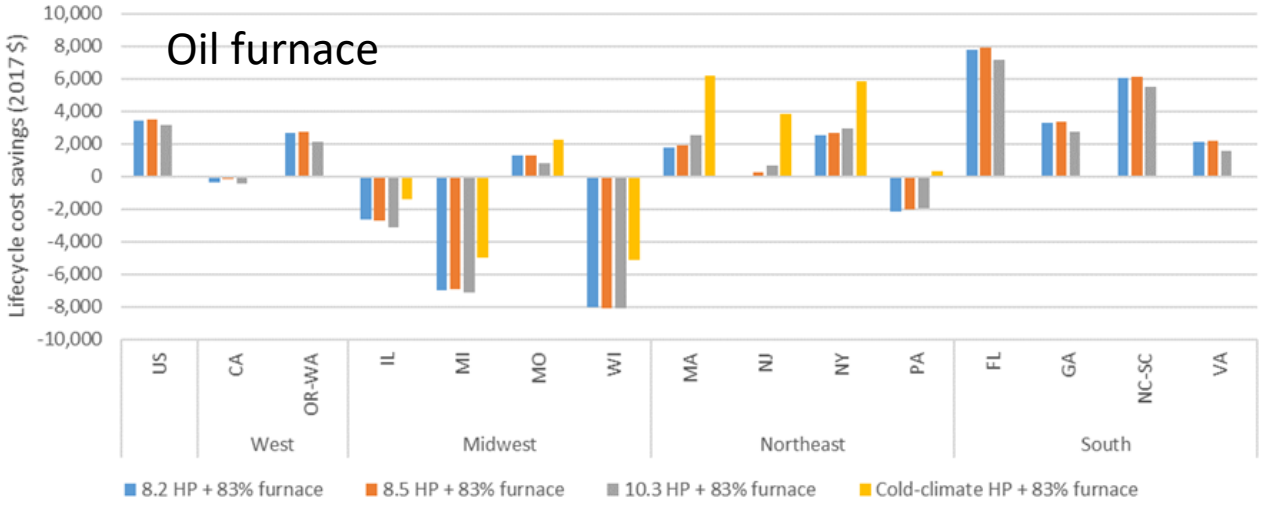
Lifecycle Cost Savings from Converting an Oil Furnace to a Heat Pump

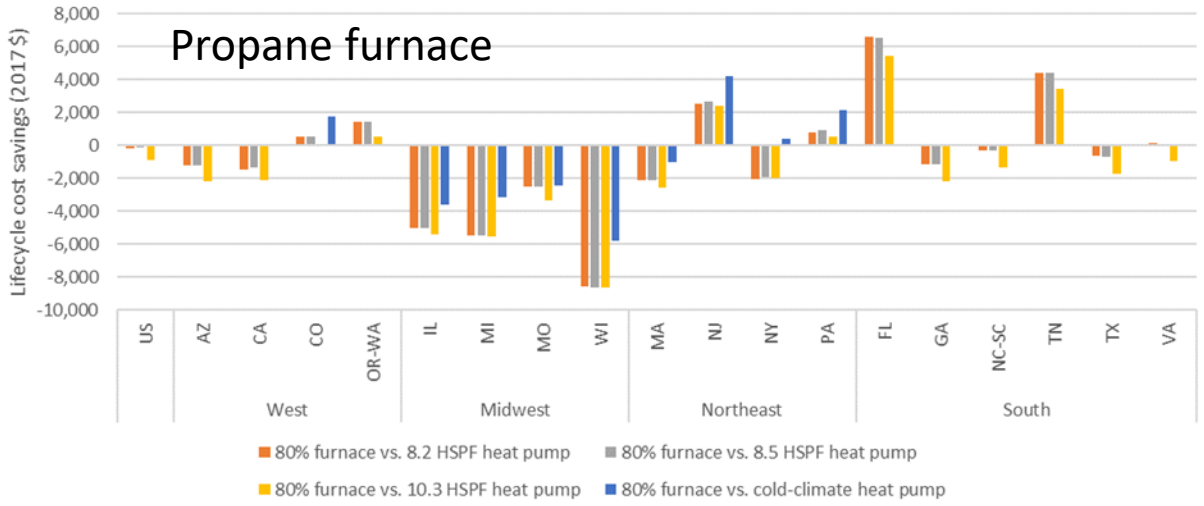


Lifecycle Cost Comparison for Water Heaters



Lifecycle Cost Savings from Partial Replacement Often Modest





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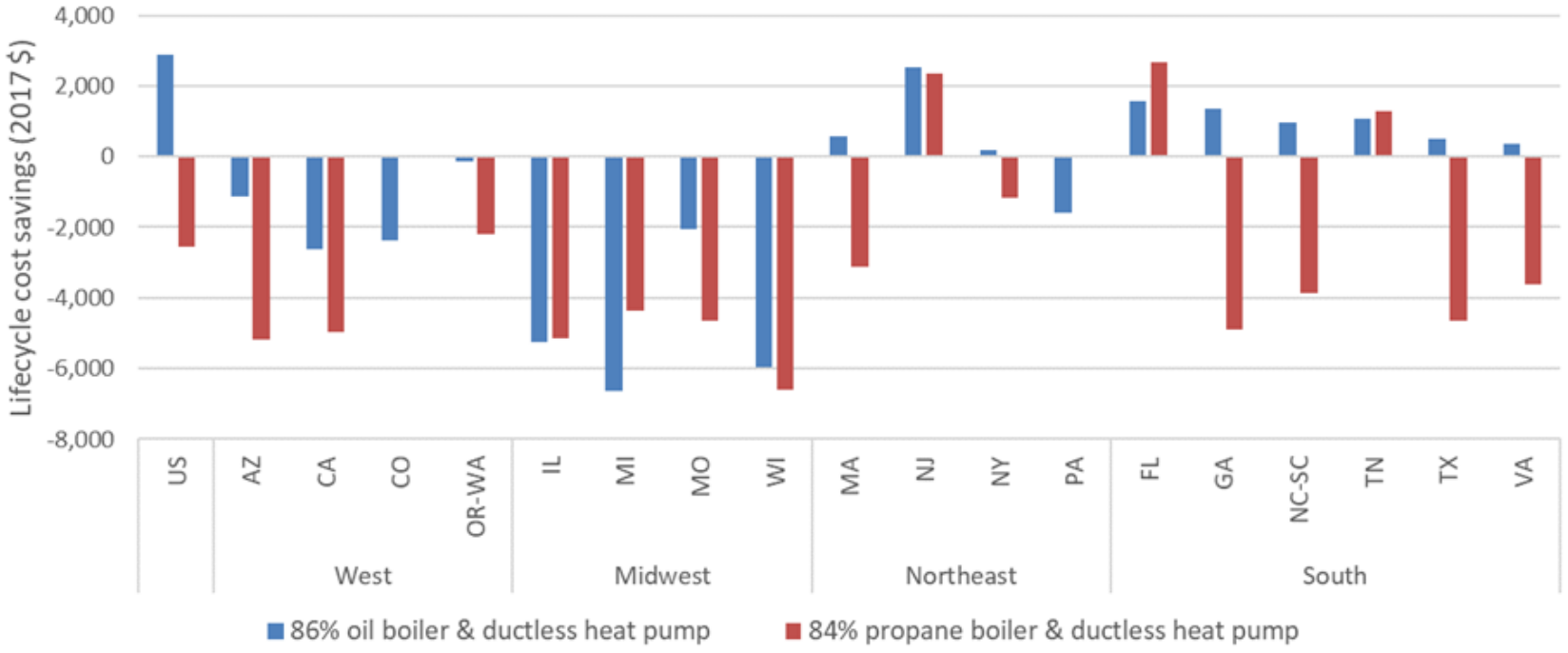
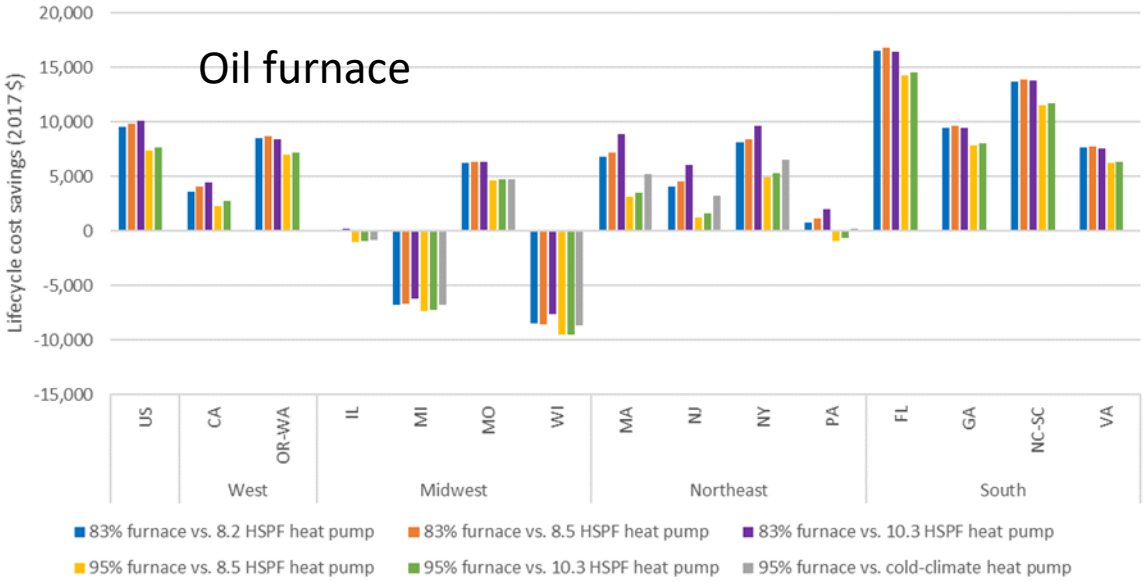
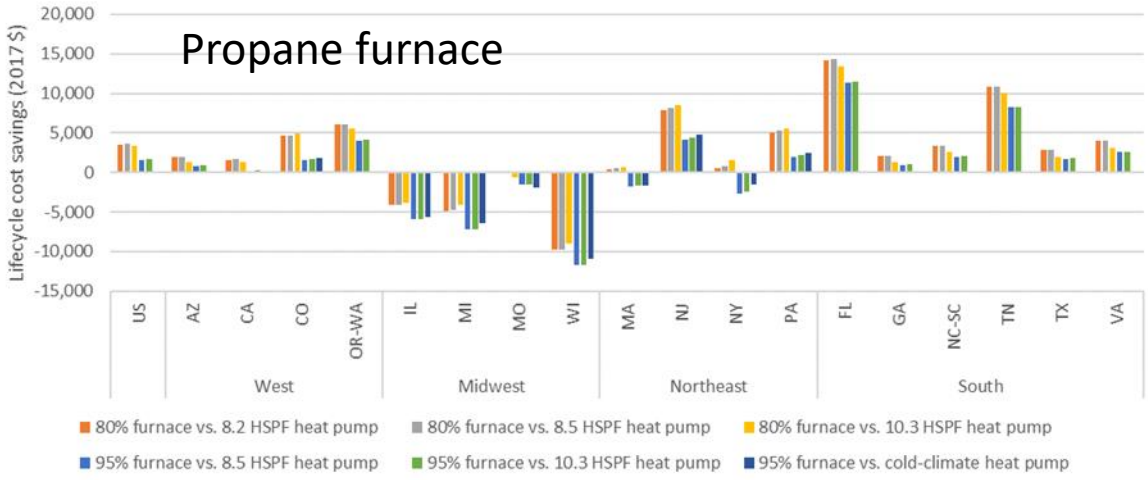
LCC of Partial Replacement of Boilers



Lifecycle Cost Savings from Early Replacement (5 years early)





LCC of Early Replacement of Boilers