

RESIDENTIAL STRATEGIC ELECTRIFICATION AND HEAT PUMPS

**Presentation to the Massachusetts Energy
Efficiency Advisory Council**

► **April 26, 2017**

PRESENTATION OVERVIEW



- ▶ **Defining strategic electrification**
- ▶ **Effects of strategic electrification**
- ▶ **Massachusetts policy framework that supports strategic electrification**
- ▶ **The role of efficient heat pump technologies in strategic electrification**
- ▶ **Efforts by other New England states to promote heat pumps for fuel switching**
- ▶ **Opportunities for Massachusetts PAs**

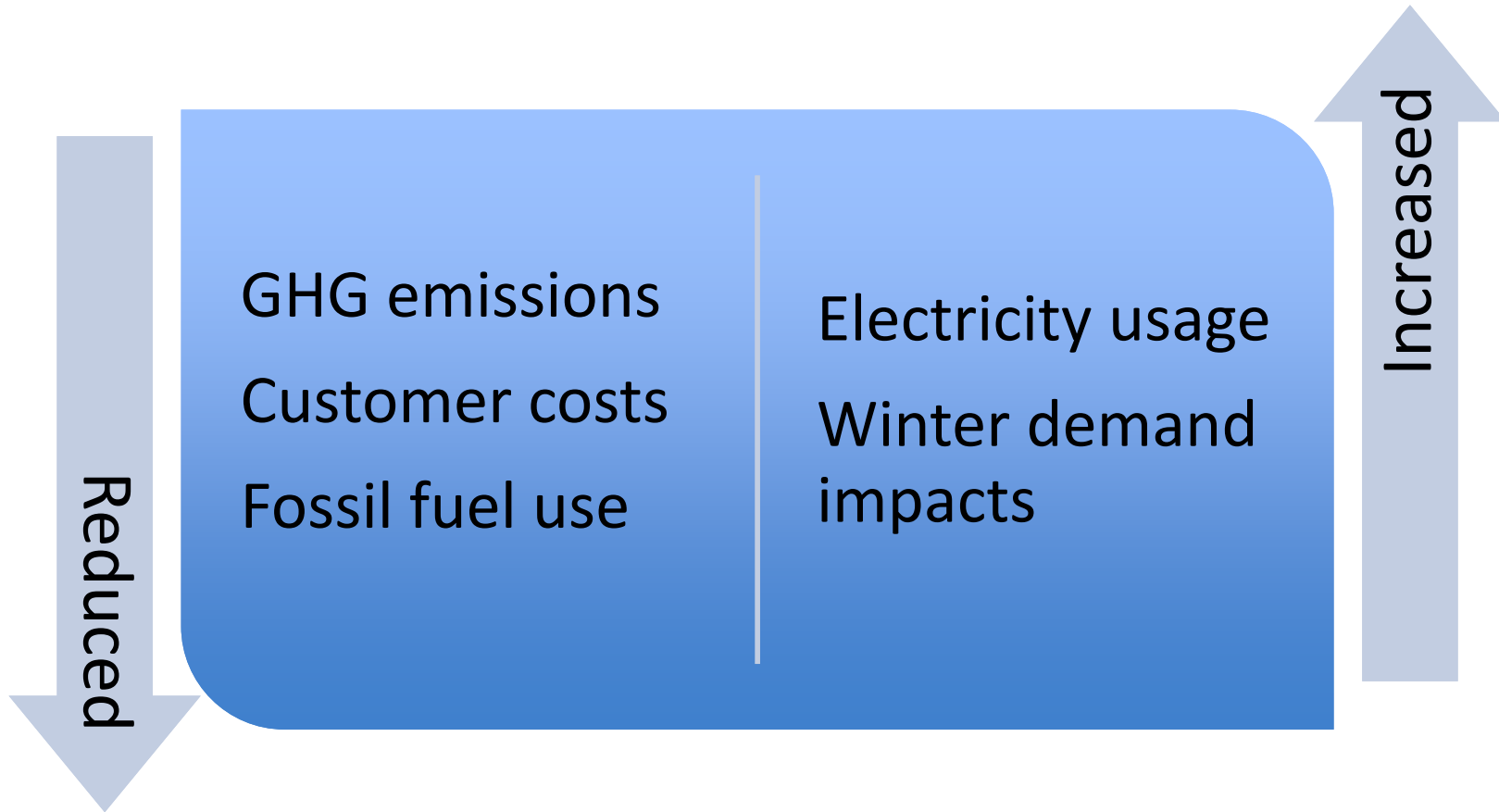
STRATEGIC ELECTRIFICATION DEFINED

Strategic electrification is a form of fuel switching that promotes the replacement or partial displacement of fossil fuel use with clean and efficient electric technologies.



- ▶ Historically, efficiency funds have *not* been used to provide fuel-neutral choice
- ▶ Considerable interest was expressed during 2016-2018 Plan development in promoting heat pumps for fuel switching

EFFECTS OF STRATEGIC ELECTRIFICATION



POLICY FRAMEWORK FOR STRATEGIC ELECTRIFICATION

Residential Conservation Services

Can expand PAs' ability to address fuel switching and strategic electrification

- Consideration of measures regardless of current fuel use
- "Fuel neutral rewards"

*Promulgated April 7;
details will be spelled out in
to-be-developed guidelines*

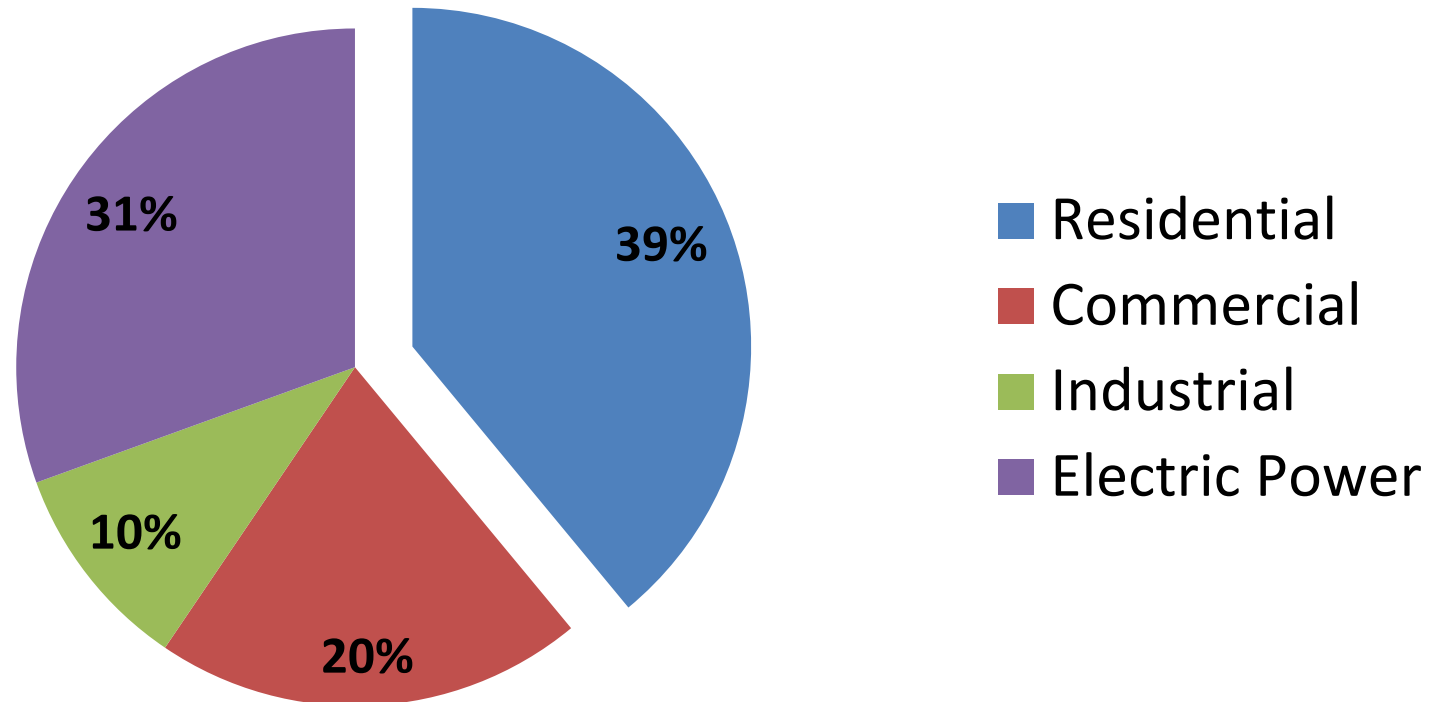
Alternative Portfolio Standard

Requires a certain percentage of the state's electric load to be met by eligible alternative energy systems technologies

- Currently combined heat and power, flywheel storage, coal gasification, and efficient steam
- Revised regulations (likely in fall) could support residential clean heating and cooling

IMPORTANCE OF RESIDENTIAL STRATEGIC ELECTRIFICATION

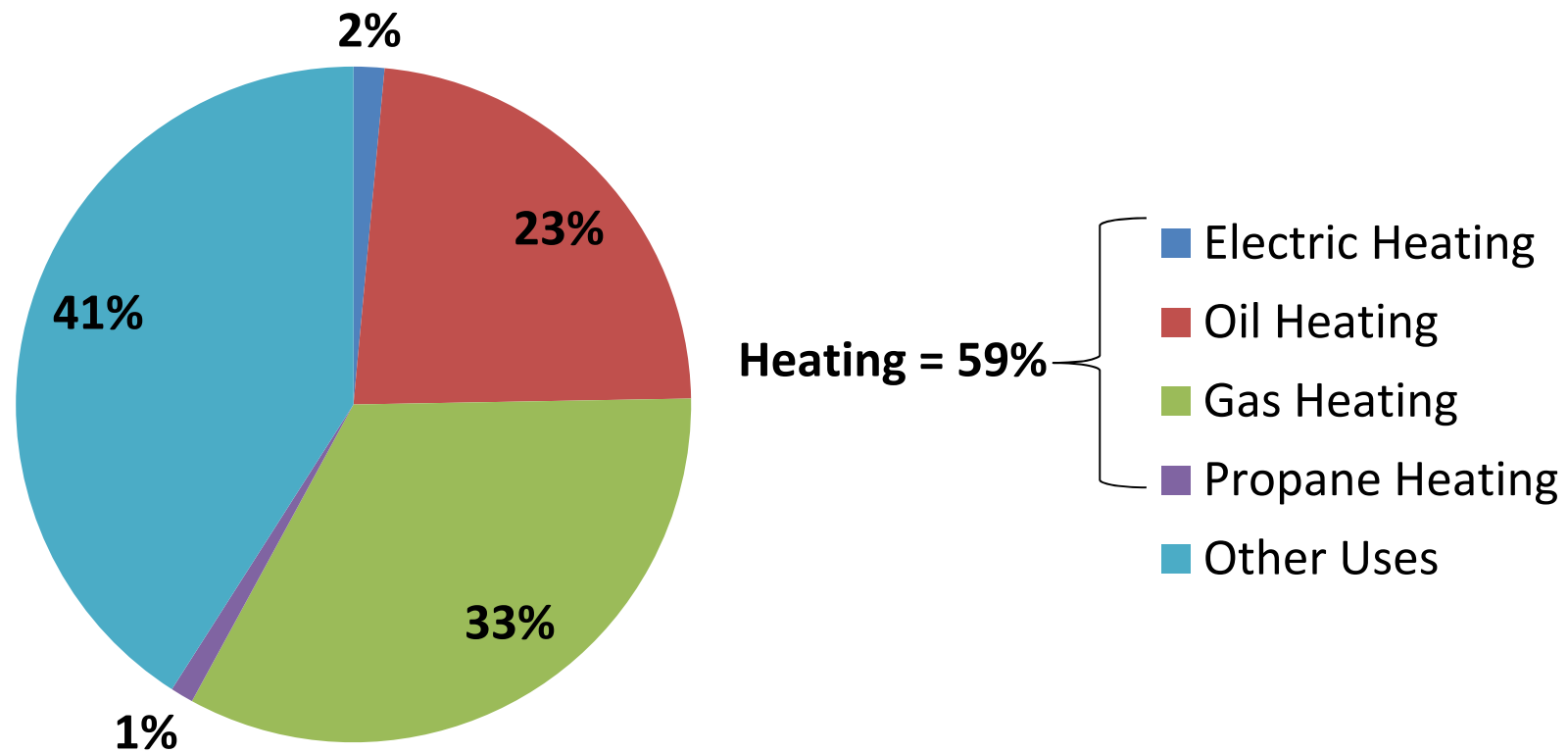
GHG Emissions Sources (MMTCO₂e) (Exclusive of Transportation)



2014 MA GHG Inventory

NEARLY 60% OF RESIDENTIAL GHG EMISSIONS ARE FROM SPACE HEATING

2014 Residential GHG Emissions Sources (MMTCO2e)



Calculated using data from 2009 RECS Survey and 2014 MA GHG Inventory

MA CURRENTLY PROMOTES SEVERAL TECHNOLOGIES THAT DISPLACE RESIDENTIAL FOSSIL FUEL USE

► Massachusetts Clean Energy Center (MassCEC) provides incentives for:

- Air source heat pumps
 - Central ducted and ductless heat pumps
- Ground source heat pumps
- Solar hot water
- Wood stoves
- Biomass heating (central pellet heating technologies)



MASSCEC AND MASS SAVE HEAT PUMP SPECIFICATIONS

MA Heat Pump Rebates	HSPF	COP @ 5°F	SEER	EER	Percent of Rated Heating Capacity Delivered at 5°F	Rebate
MassCEC Single Head (NEEP Spec)	≥10	≥1.75	20	12.5	100%	\$625-\$1500 per ton Varies by Income
MassCEC Multi-Head and Central HP (NEEP Spec)	≥10	≥1.75	20	12.5	100%	\$625-\$1500 per ton Varies by Income Max of \$2500-\$6000
PA DHP Tier 1	≥10	N/A	≥18	N/A	N/A	\$100/indoor unit
PA DHP Tier 2	≥12	N/A	≥20	N/A	N/A	\$300/indoor unit
PA Central HP Tier 1	≥8.5	N/A	≥16	N/A	N/A	\$250
PA Central HP Tier 2	≥9.6	N/A	≥18	N/A	N/A	\$500

HEAT PUMPS ARE THE PRINCIPAL CLEAN ELECTRIC HEATING TECHNOLOGY

- ▶ **Heat pumps can be installed in most single- and multi-family dwellings**
- ▶ **Can be a lower cost heating option for customers heating with:**
 - Electric resistance – an efficiency, not electrification, measure
 - Propane; and
 - Oil depending on fuel and equipment costs and operating assumptions
- ▶ **Gas-to-heat pump consumer economics are generally not favorable in Massachusetts**
- ▶ **Significant growth in heat pump market, particularly ductless heat pumps**
 - Growing number of multi-head (indoor unit) systems

MOST DUCTLESS HEAT PUMP INSTALLATIONS ACHIEVE PARTIAL DISPLACEMENT

- ▶ **Not all fossil fuel use is displaced – Not a complete “fuel switch”**
- ▶ **Existing heating system has to be kept and maintained**
 - Needs to be considered in consumer and PA BCR calculations
 - Good cold temperature DHP performance minimizes existing system use
- ▶ **Control integration between DHP(s) and existing equipment and proper customer operation are critical**
 - Good controls are still an industry work-in-progress
- ▶ **Typically treat largest spaces first**
- ▶ **Economics become less favorable when conditioning smaller spaces**
 - Transfer fans and mini-duct systems may help address

DUCTED HEAT PUMP INSTALLATIONS CAN PROVIDE A WHOLE HOUSE SOLUTION

- ▶ Typically installed in homes to displace furnaces
- ▶ Can maintain existing heating system or install supplementary resistance back-up heat to address heating loads at very low temperatures
- ▶ Addition of resistance back-up may effect winter generation and/or T&D peaks

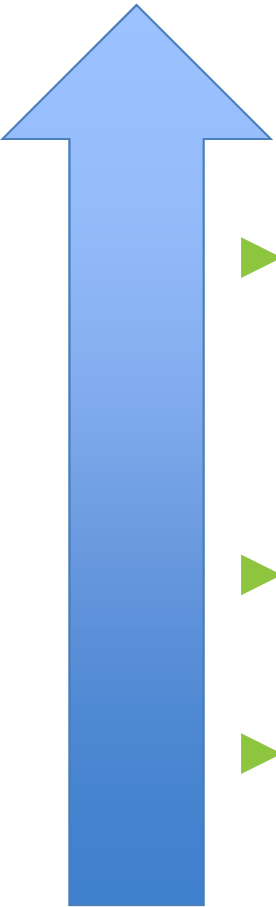


OTHER NEW ENGLAND STATES PROMOTE HEAT PUMPS FOR FUEL SWITCHING

- ▶ **Vermont and Maine support fuel displacement/switching**
 - Use NEEP cold climate heat pump specification
 - Green Mountain Power HP leasing program
 - Vermont Tier 3 standards (similar to MA APS)
 - Specifically focused on reduced fossil fuel use
- ▶ **Vermont Zero Energy Now (ZEN) program combines ductless heat pumps, PV and weatherization**
 - Similar Connecticut pilot under development



OPPORTUNITIES TO ACHIEVE GREATER PENETRATION OF HEAT PUMPS IN EXISTING HOMES

- 
- ▶ **PAs can address electric resistance (ER) heat opportunities under current program and policy frameworks**
 - May require higher incentives to address full installed cost
 - ▶ **~8% of MA dwellings have electric resistance as primary space heat based on 2009 study**
 - Very low in single family: 4%
 - But much higher in 5+ dwelling multi-family: 45%
 - ▶ **Large per home savings when replacing ER**
 - 2,798 to 3,948/kWh for a single-head DHP in a SF home
 - ▶ **Marginal cost effectiveness in TRC screening, but includes some “old” assumptions**
 - Old free-ridership and NEI assumptions

CONSIDER DEVELOPMENT OF ALL-ELECTRIC NEW CONSTRUCTION PACKAGE

- ▶ **Consider use of some components of [DOE Zero Energy Ready Home](#)**
 - Low load home and PV-ready requirements
- ▶ **High efficiency ductless heat pumps**
 - HSPF of 12.0 or greater and meeting MassCEC cold climate spec
 - Eliminates cost and inefficiencies of ductwork
- ▶ **Heat pump water heater**
 - Energy Factor of 3.0 or higher
- ▶ **Initial target: Areas without easy access to natural gas**



CONSIDERATIONS FOR INCREASED PA SUPPORT OF HEAT PUMPS

- ▶ **Anticipate RCS guidelines and revised APS regulations that will allow fuel switching measures**
 - Which measures to promote?
 - Begin to develop appropriate measure costs, NTG assumptions, savings estimates, and NEIs
 - Screen fuel switching measures
 - Consider inclusion in both Residential and Low Income Programs
- ▶ **Determine how EE efforts to support fuel switching could align with gas utility fuel conversion efforts**

HEAT PUMPS ARE ONLY PART OF THE STRATEGIC ELECTRIFICATION PUZZLE

- ▶ **Other end uses (e.g., hot water) can be electrified: Heat pump water heaters**
- ▶ **Other clean heating and cooling technologies**
 - Biomass, ground source heat pumps, and solar hot water
- ▶ **How do we track “savings” for measures that increase electricity use?**
 - CHP treatment of increased gas use as a model
- ▶ **Integration or co-delivery of renewables, e.g., PVs, into efficiency efforts (given proper policy support)**
- ▶ **Electric vehicle charging**

SUMMARY/TAKEAWAYS



- ▶ **Fuel switching is an important strategy to achieve the Commonwealth's goals, especially for the reduction of greenhouse gas emissions**
 - Changes in the policy environment are underway to make this increasingly possible
- ▶ **Strategic electrification is a type of fuel switching and heat pumps are the most promising residential measure to advance it**
- ▶ **Heat pumps are already promoted through the PAs' energy efficiency programs**
 - Opportunity to do more in existing policy context
 - There may be opportunities to boost penetration even further
- ▶ **Economics will inform appropriate applications**

QUESTIONS

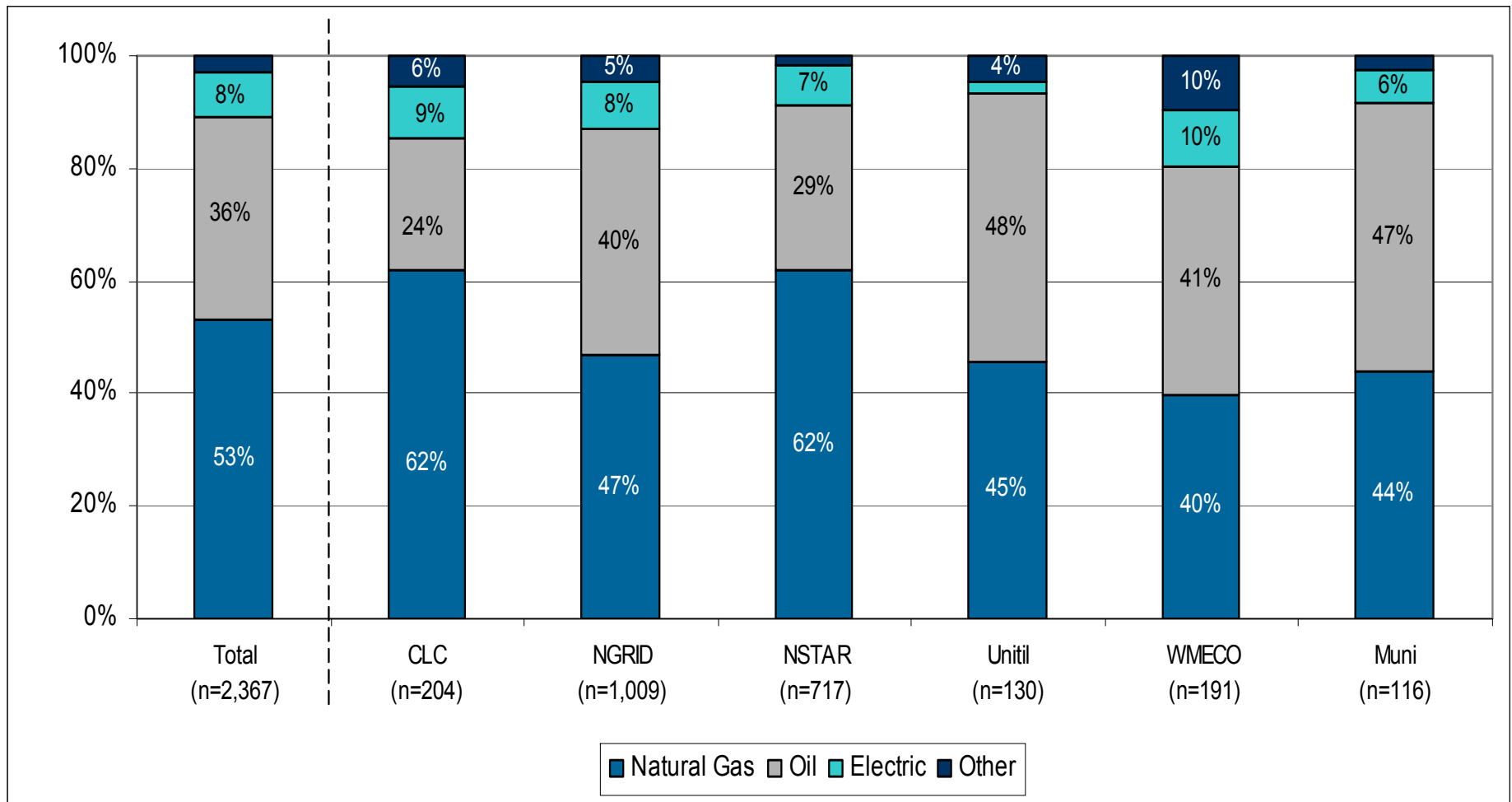
Glenn Reed

greed @energyfuturesgroup.com

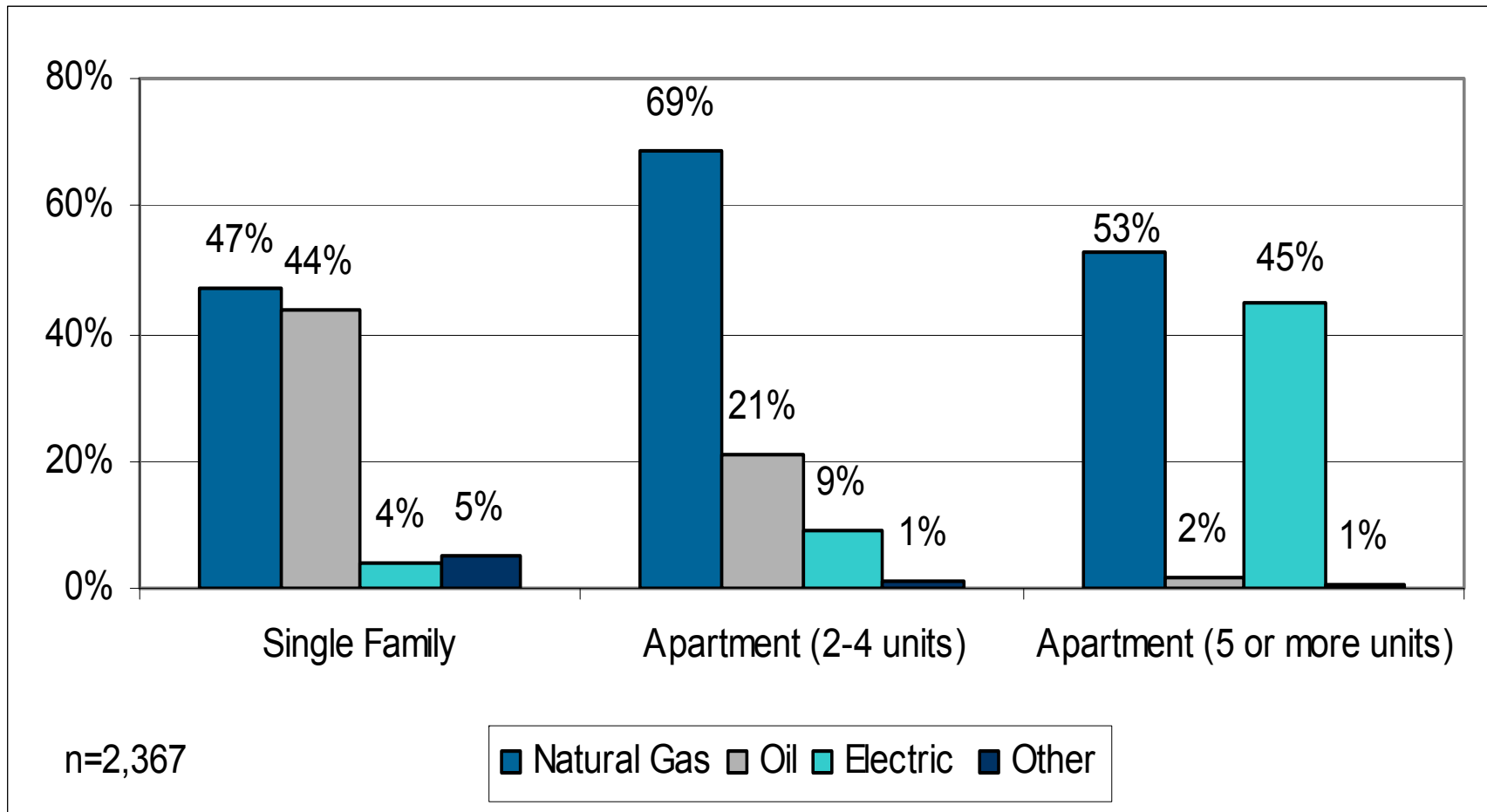
APPENDICES



NEARLY 90% OF RESIDENTIAL HEATING USE IS GAS OR OIL



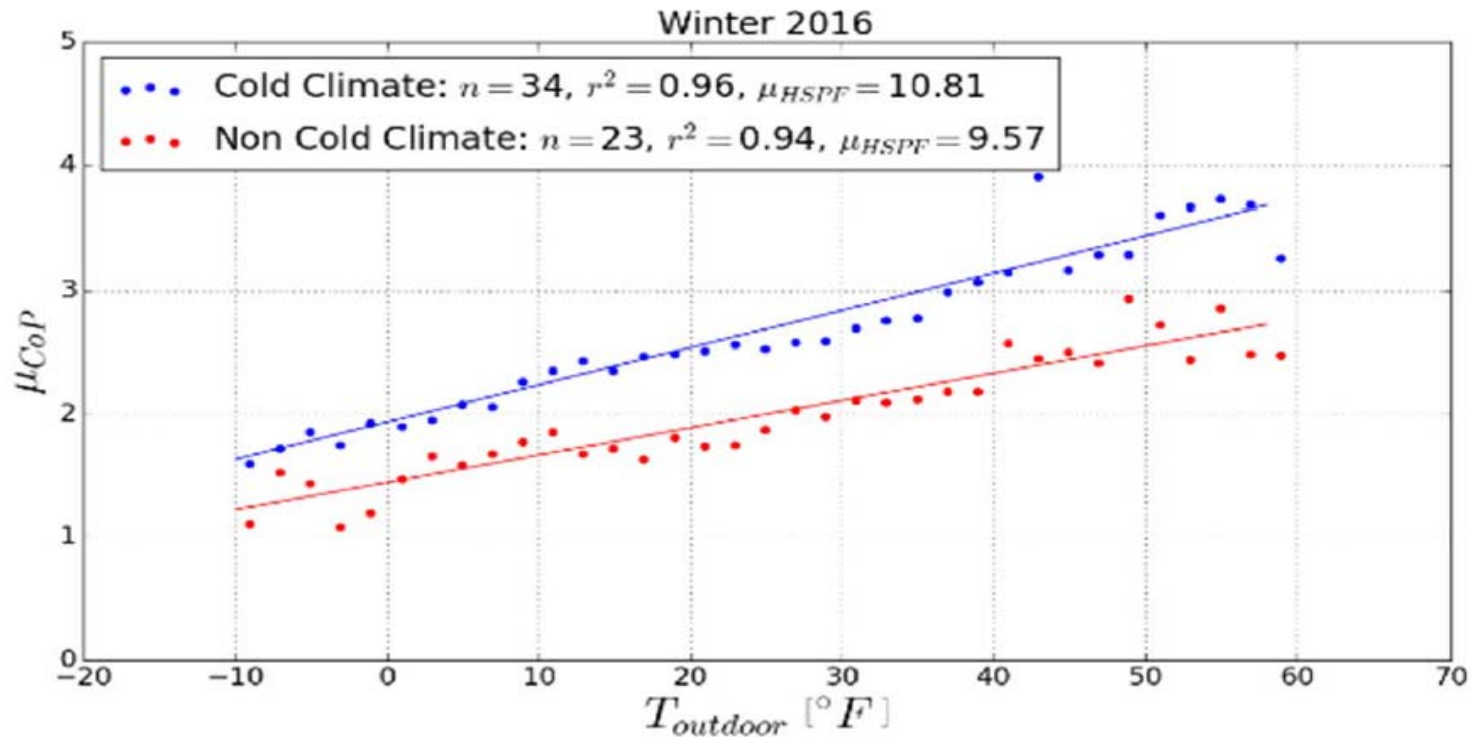
FOSSIL FUEL USE IS EVEN MORE DOMINANT IN SINGLE FAMILY HOMES



INCREASED FOCUS ON COLD CLIMATE PERFORMANCE

- ▶ Heat pump efficiency & output decline with outdoor temperature

Figure ES-5. Average Heating COP vs. Outdoor Air Temperature for Cold-Climate and Non-Cold-Climate Systems—Winter 2016



OTHER HEAT PUMP PROMOTIONAL EFFORTS IN NEW ENGLAND

- ▶ **CT targets electric resistance space heat displacement**
 - Higher incentives offered
 - Contractor training required
- ▶ **VT and CT engage upstream**
 - 50% sales increase in Vermont
- ▶ **RI developing electric resistance displacement offer for 2018**
- ▶ **Installation is a focus of heat pump programs in the region**
 - Efficiency Vermont checklist
 - [Efficiency Maine Trust installation checklist](#)
 - [Recently released NEEP Heat Pump Guides](#)
 - Equipment sizing and specification
 - Equipment installation