
Innovations in Energy Efficiency Modeling at the National and Regional Scale



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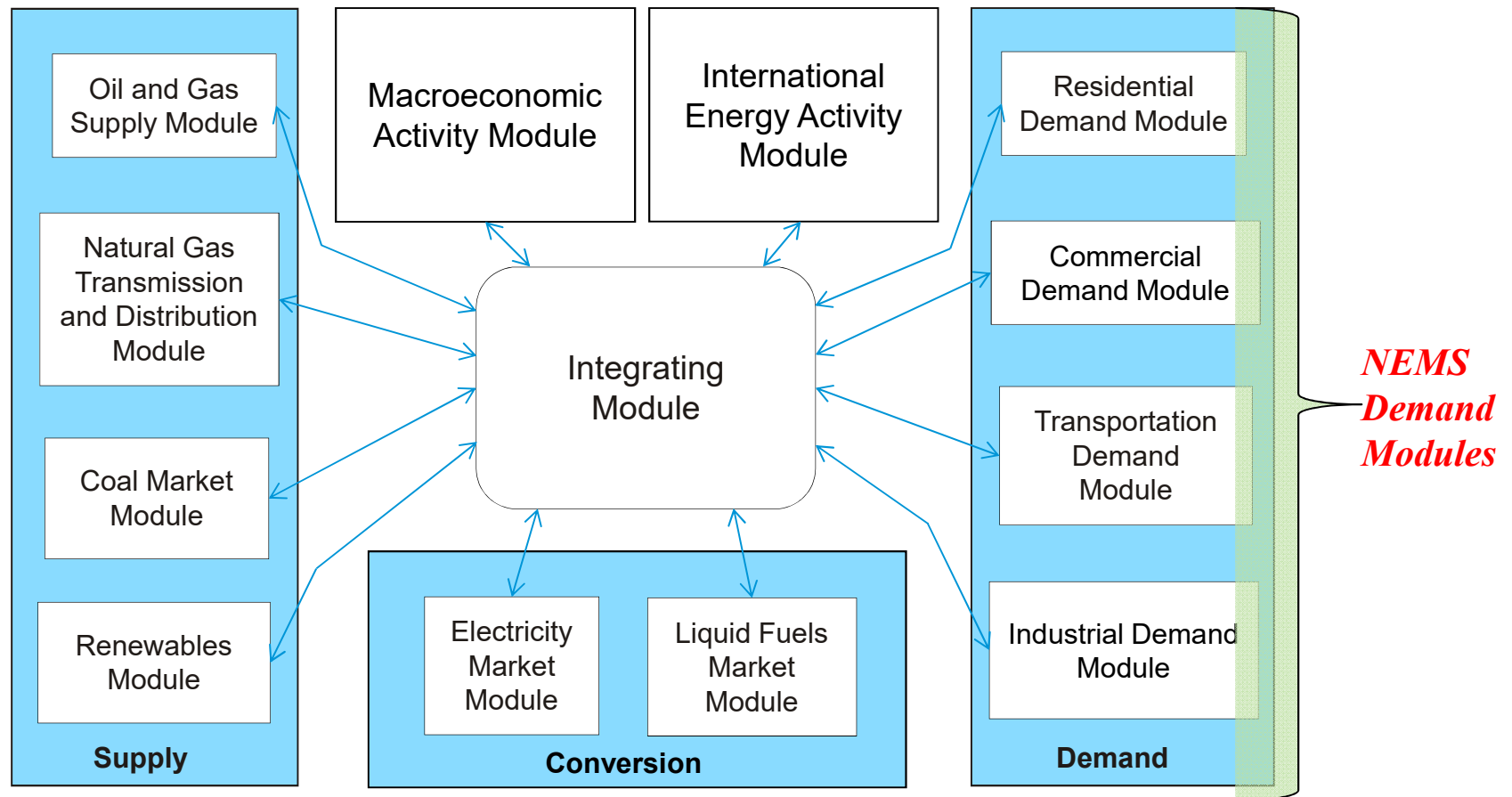
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Overview

- EIA, as the independent provider of energy data and analysis for the U.S. government, uses a national scale integrated model of the energy system called NEMS; four system modules represent end use sectors (transportation, industrial, commercial and residential)
- EIA has been working to build representation of energy efficiency program investment into the NEMS buildings demand modules
- Two stages of this effort:
 - Incremental changes to EE spending as a Clean Power Plan compliance option
 - Full historic and future representation of regionalized EE investment, embedding rebate structure into Annual Energy Outlook Reference case and enabling new EE analysis
- Sneak peek at current modeling and discussion of no-EE model runs ('counterfactual case')

The National Energy Modeling System uses a modular structure that builds demand up from end uses and capital equipment



Behavioral representation in the NEMS framework

- Mathematical construct that treats demand as occurring only via specified end use services, as mediated by specified installed equipment
- Cost and performance characteristics of equipment specified independently of behavioral parameters; behavior influences both *purchase decisions for new capital* and the *level of end use demand* as determined by fuel prices, weather, etc.
- In practice, this equates to *hurdle rates* (implicit discount rates) and *short-term elasticity parameters*
- *New rebate structure connects EE program investment to specific end uses and equipment, at a regional level*

Commercial consumer risk-adjusted time preference premium distribution, 2014-2040

Commercial Consumers' Time Preference Premium to the Risk-Free Interest Rate	Shares of Specific Energy End Uses Subject to Each Premium Level						
	Heating	Cooling	Ventilation	Lighting	Water Heating	Cooking	Refrigeration
∞ (represented by 1000%)	26.5%	26.4%	26.5%	26.4%	26.3%	26.1%	26.2%
100%	22.6%	22.5%	22.6%	22.5%	24.9%	24.8%	24.8%
45%	19.6%	19.3%	19.6%	19.3%	21.2%	21.4%	21.3%
25%	19.2%	19.2%	19.2%	19.3%	16.9%	17.1%	17.0%
15%	10.5%	10.6%	10.5%	8.5%	9.7%	9.7%	9.7%
6.5%	1.3%	1.6%	1.3%	1.3%	0.6%	0.5%	0.6%
0.0%	0.3%	0.4%	0.3%	2.7%	0.4%	0.4%	0.4%

Note: risk-free interest rate is represented by the 10-year Treasury note

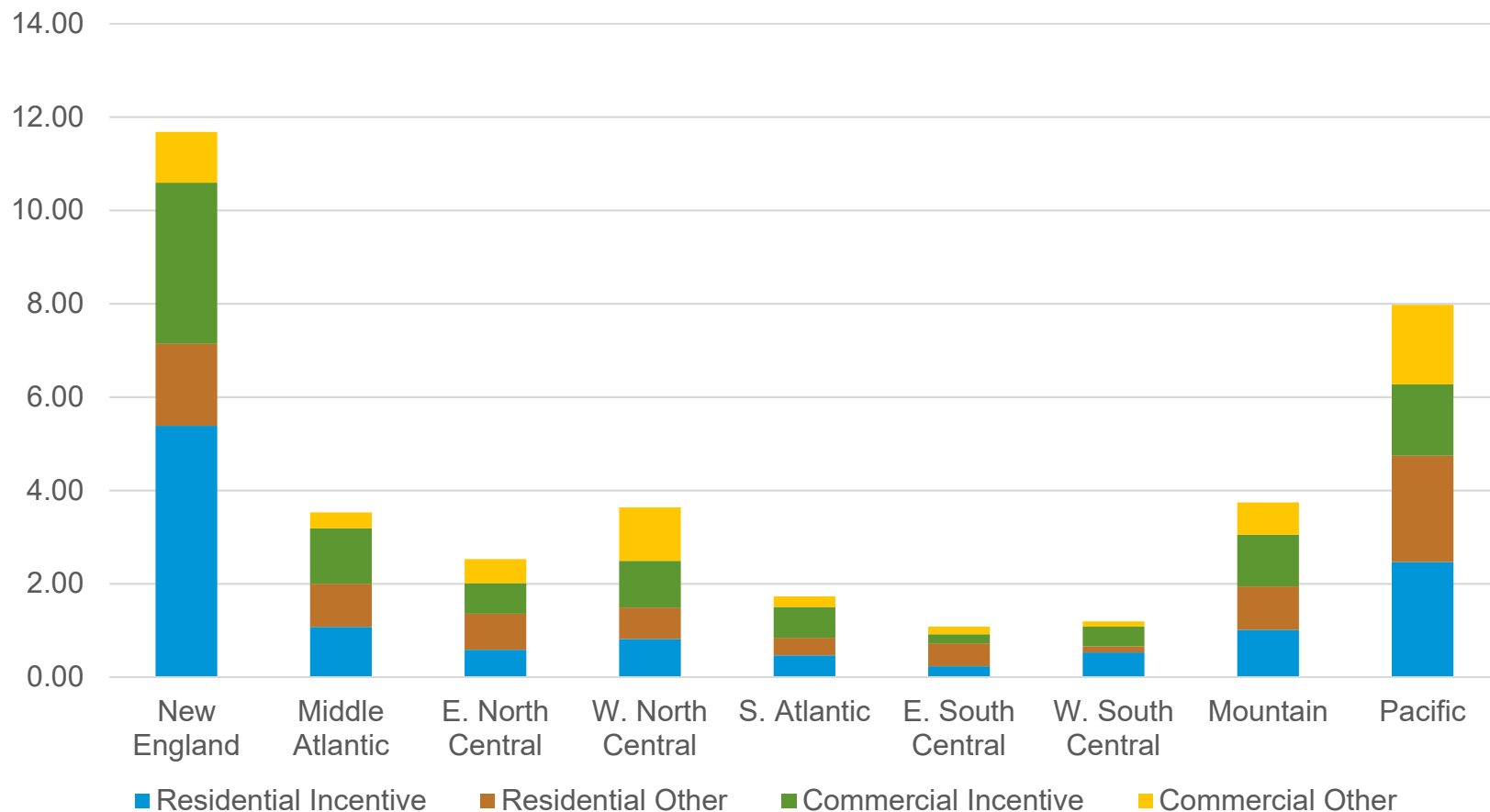
Current EIA work on demand specifications

- New regional energy efficiency ‘investment portfolios’ that allow NEMS to represent changing levels of activity
- Associates energy efficiency spending with specific sets of end uses and technologies over time; portfolios can broaden and deepen as investment increases
- Based on extensive studies of program activity intended to support regional aggregate representation
- To be used in analysis of regulatory actions, energy market trends, and policies such as state energy efficiency resource standards (new inclusion in Annual Energy Outlook text)

Inputs for new EE rebate modeling: EE spending as a fraction of sales is highest in New England and the Pacific

Energy efficiency spending (USD) per MWh of sales

Source: EIA-861 Survey, 2015



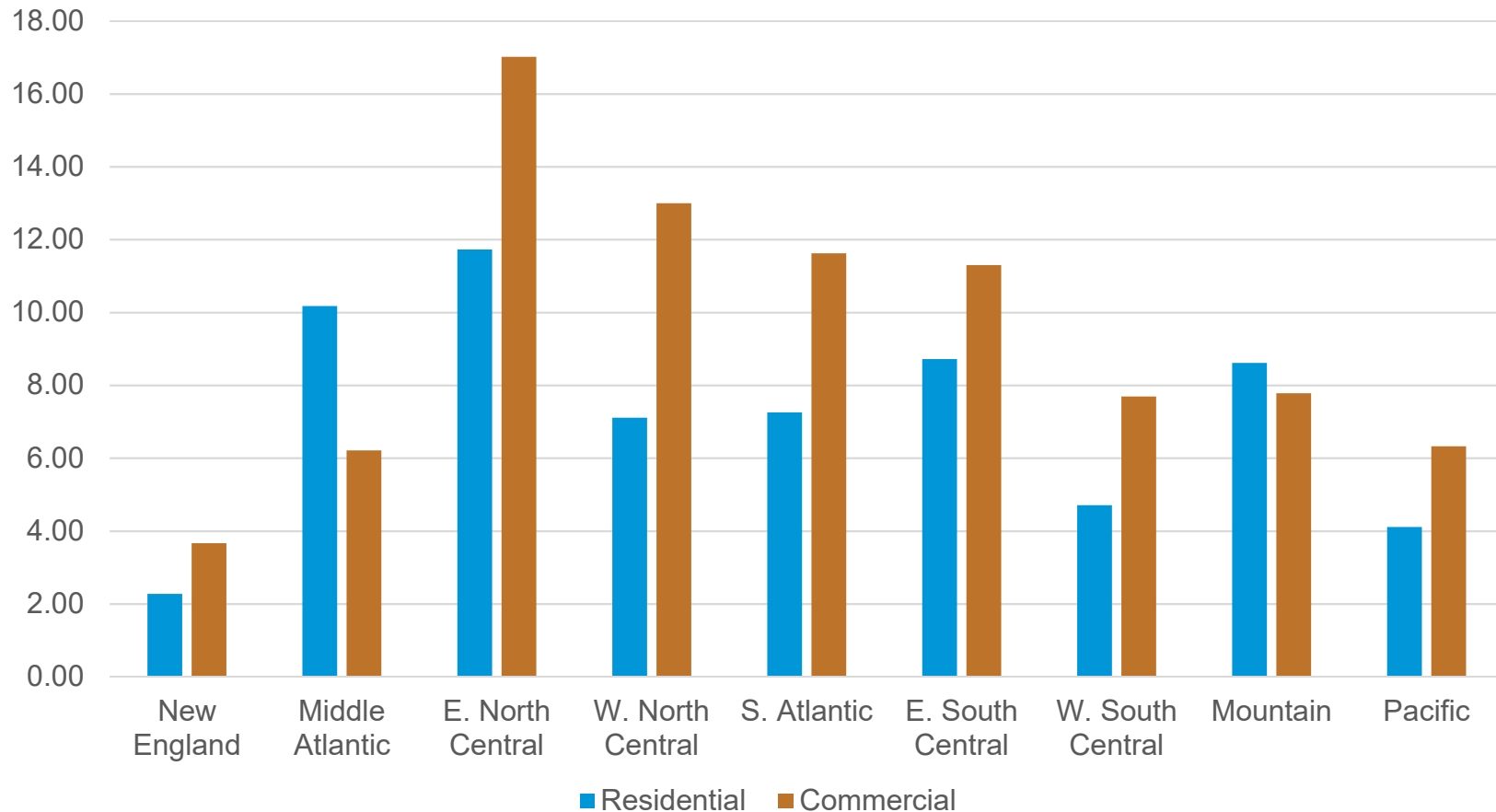
Assessing existing energy efficiency program activity

- In 2016, EIA contracted an assessment of existing energy efficiency program activity, defined as kWh of energy savings per dollar spent on customer energy efficiency incentives (ICF, 2016)
- Measure-level data on incentives were collected from a sample of 30 utilities representing the nine Census Divisions. Utilities were selected from each Census Division from approximately the 90th and 50th percentiles according to the energy savings reported
- These data were used to determine the number of end-use technologies supported in each Census Division
- Bottom-up estimates of program activity were obtained for each measure by using technical reference manuals to approximate savings from various technology choices

Top-down estimates using EIA-861 survey data show that the East North Central U.S. has the highest savings per dollar of EE

*Median estimates of energy efficiency program activity
kWh saved per dollar of customer incentive*

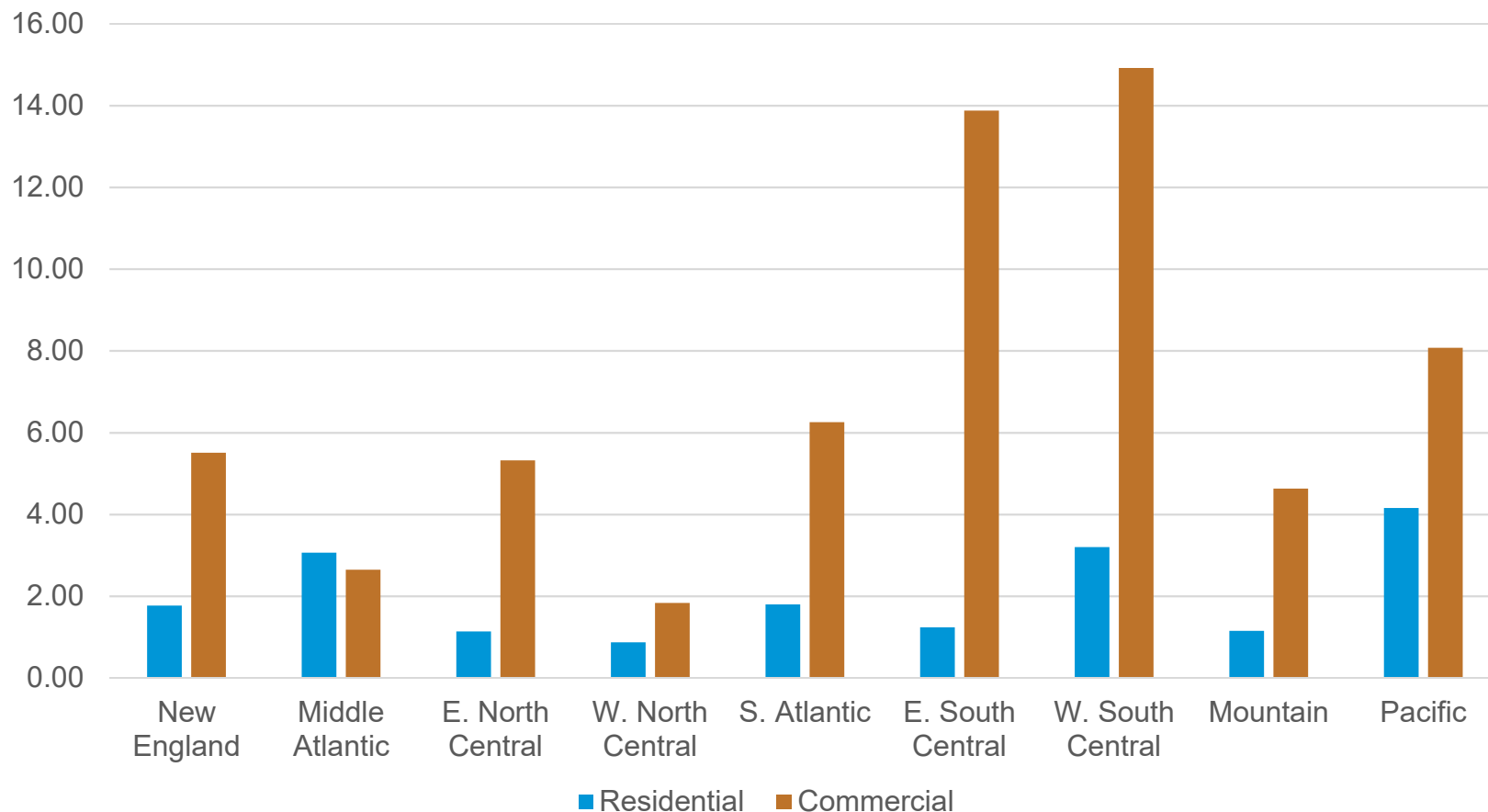
Source: EIA-861 Survey, 2015



However, bottom-up estimates of savings per unit invested favor the East South Central and West South Central regions

*Median estimates of energy efficiency program activity
kWh saved per dollar of customer incentive*

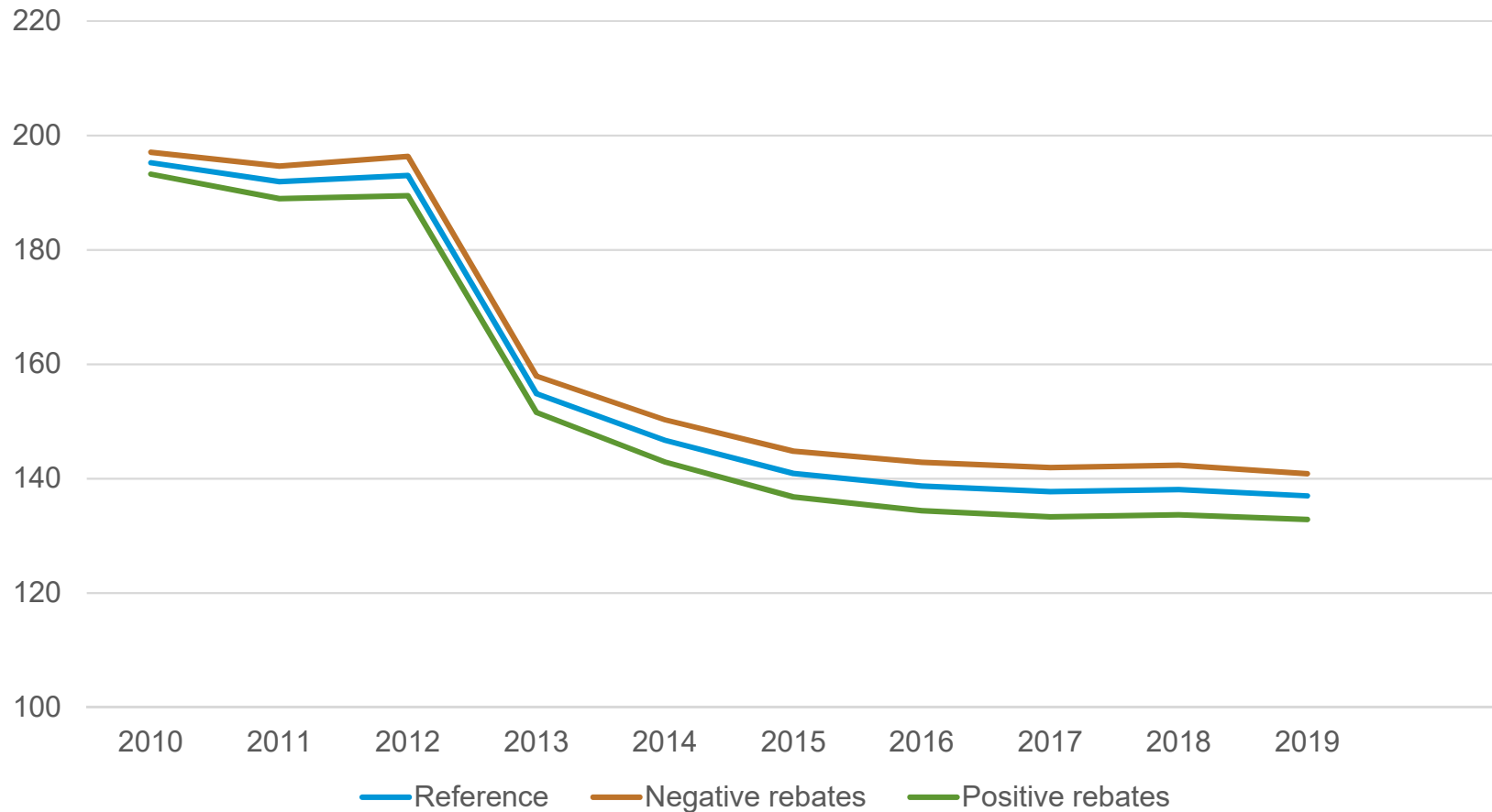
Source: ICF, 2016



Embedded effects of efficiency programs on electricity use for residential lighting: calibrating rebates and behavior in NEMS

*Residential lighting electricity consumption
billion kilowatthours*

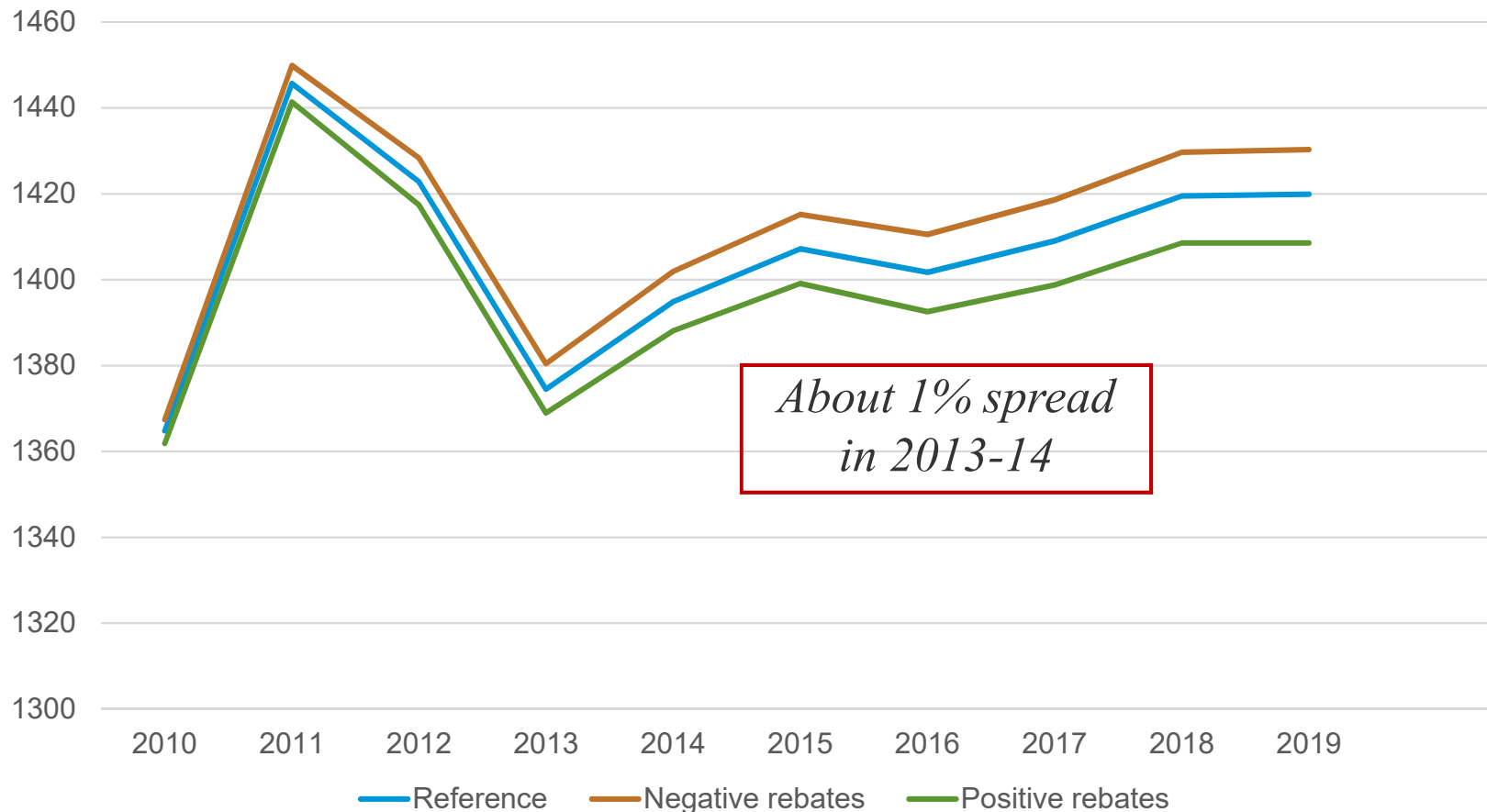
Source: EIA Office of Energy Analysis



Using negative rebates to create counterfactual with higher electricity demand than actually observed

*Residential electricity sales
billion kilowatthours*

Source: EIA Office of Energy Analysis



New EE representation going into production beginning with AEO2017

- Clean Power Plan service report for Congress published in 2015—incremental EE changes as a compliance strategy
- New ‘Legislation and Regulation’ text section on state energy efficiency resource standards (EERS) in AEO2016; placing treatment of EERS and RPS policy on equal footing
- Current modeling of EE in the NEMS history and Reference case to debut in AEO2017, enabling new EE scenario capability in future EIA analysis

Thanks for your time and interest!!!

