December 1, 2014

United States Environmental Protection Agency
Clean Power Plan, Proposed Rule
Docket ID: EPA-HQ-OAR-2013-0602

Re: Potential Modeling Bias in the EPA's Approach to Crediting Energy Efficiency and Establishing Equivalent Mass-Based Targets for New and Existing Sources Under Section 111(d) of the Clean Air Act

1. Introduction and Summary

Thank you for the opportunity to comment on the proposed Clean Power Plan. We support the EPA's goal of developing a legally and economically sound approach to regulating greenhouse gas emissions from existing power plants under Section 111(d) of the Clean Air Act, and commend the Agency for its efforts. If the EPA's preferred regulations are fully implemented and achieve their expected emissions reductions, they will contribute meaningfully towards the evolution of federal climate mitigation policy.

Nevertheless, we write to highlight an important potential weakness in the methodologies by which the EPA has calculated key aspects of the Clean Power Plan. Specifically, we urge the Agency to consider the extent to which current methodologies could credit states for reductions in electricity consumption that would have happened in the absence of the proposed rule. If the EPA adopts baseline electricity consumption forecasts that are biased upwards, as the current methodologies are poised to do, the Clean Power Plan could generate false credit for energy efficiency. In turn, states could use these false credits to avoid reducing greenhouse gas emissions at existing power plants. If these risks are not addressed proactively, the Clean Power Plan could fall well short of the Agency's goals.

Our concerns center on the use of electricity consumption forecasts from the reference scenario in the Annual Energy Outlook 2013 ("AEO2013") from the U.S. Energy Information Administration ("EIA"). [1] This report is based on output from the National Energy Modeling System ("NEMS"), the EIA's primary national forecasting and policy analysis model. As a general matter, energy models are powerful tools that can support informed decision-making. In this case, however, relying on a single forecast to drive critical methodologies used in the Clean Power Plan creates significant risks.

For over a decade, NEMS has significantly overestimated national electricity sales (see Figure 1). While no model can perfectly predict future energy markets, the track record with NEMS suggests that further Agency analysis is warranted before finalizing its methodologies. Indeed, most prominent energy models have done a relatively poor job antici-

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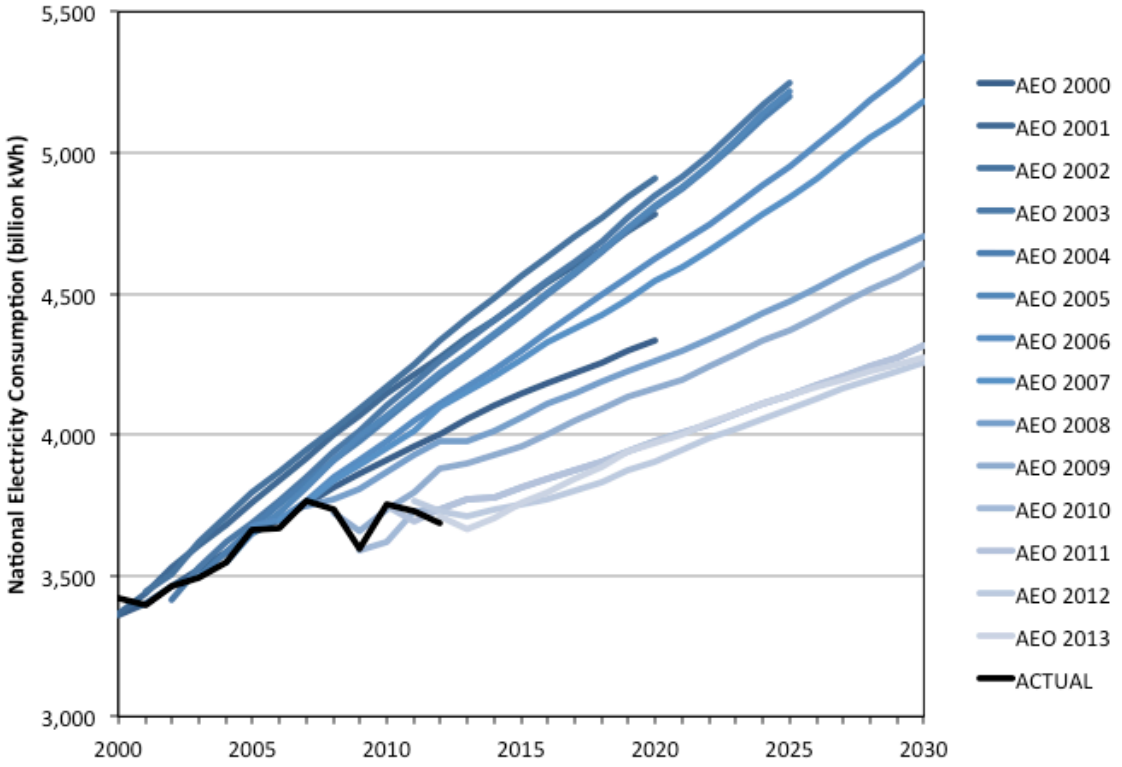
[1] U.S. Energy Information Administration, Annual Energy Outlook 2013, Report # DOE/EIA-0383(2013).

[2] Paul Craig, Ashok Gadgil, and Jonathan G. Koomey (2002). What Can History Teach Us? A Retrospective Examination of Long-Term Energy Forecasts for the United States. *Annual Re-*

pating future levels of consumption;[2] this observation counsels adopting a conservative approach to mitigating the risk of forecast error—especially when developing guidance on appropriate methods for constructing their state plans.

Figure 1: Actual and Forecasted National Electricity Consumption.[3]



[2] Paul Craig, Ashok Gadgil, and Jonathan G. Koomey (2002). What Can History Teach Us? A Retrospective Examination of Long-Term Energy Forecasts for the United States. *Annual Review of Energy and the Environment* 37: 83-118; Jonathan G. Koomey, Paul Craig, Ashok Gadgil, and David Lorenzetti (2003). Improving Long-Rage Energy Modeling: A Plea for Historical Retrospectives. *The Energy Journal* 24(4): 75-92; Vaclav Smil (2005), Energy at the Crossroads: Global Perspectives and Uncertainties. Cambridge, MA: The MIT Press (see Chapter 5 on energy forecasting).

[3] U.S. Energy Information Administration, Annual Energy Outlook Retrospective Review, Report # DOE/EIA-0640(2013), Table 15: Total Electricity Sales, Projected vs. Actual. To extend forecasted data to 2030, we also relied on the supplemental tables for the Annual Energy Review, available at http://www.eia.gov/forecasts/aeo/archive.cfm.

- **Recommendation #1:** In developing guidance for the evaluation, monitoring, and verification ("EM&V") of demand-side energy efficiency programs in state plans,[4] the EPA should explicitly prohibit use of the methods the Agency used to calculate energy efficiency potential in the context of the Best System of Emission Reductions ("BSER"). While these methods may be defensible as an approach to evaluating the potential for energy efficiency in the context of the BSER, they are insufficient as a means of establishing the contribution of energy efficiency towards an individual state target.

- **Recommendation #2:** In the context of establishing equivalent mass-based targets for new and existing units, the EPA should evaluate the extent to which relying on the AEO2013 reference scenario to project future electricity sales risks establishing baseline consumption levels that are artificially high, and therefore would allow states to take credit for energy efficiency improvements that would have happened in the absence of the Clean Power Plan. The Agency should consider alternative methods for use in state plans, such as (1) using the actual energy consumption trends observed between 2012 and 2020 in place of forecasts made today, or (2) using forecasts made just prior to implementation of the Clean Power Plan in 2020, which are likely to have smaller errors. We elaborate on each approach later in this letter.

2. The EPA's methodologies for evaluating energy efficiency in the BSER and establishing equivalent mass-based standards for new and existing electricity generating units rely on NEMS forecasts.

Two key aspects of the Clean Power Plan rely on methodologies based on the AEO2013 reference scenario for future electricity consumption.

- **Energy efficiency in the BSER.** First, the method by which the EPA quantifies energy efficiency contributions in the BSER—and by which state plans could potentially claim credit for energy efficiency—is based on the AEO2013 reference scenario.[5] In its process for determining the BSER, the EPA matches each state to one of the NEMS Electricity Market Module ("EMM") regions. Next, the EPA calculates the baseline future electricity sales for each state by taking its 2012 actual sales and compounding them by the average annual growth rate over the period 2012 to 2040 from the matched EMM region, as projected in the AEO2013 reference scenario. Thus, in the BSER, energy efficiency potential is measured against baseline projections from the AEO2013 reference scenario.

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[4] U.S. Environmental Protection Agency, Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Generating Units; Proposed Rule, 79 Fed. Reg. 34830, 34913 (hereinafter "Clean Power Plan") (indicating the EPA's intention to develop guidance for EM&V standards in state plans).

[5] U.S. Environmental Protection Agency, GHG Abatement Measures, Technical Support Document (TSD) for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, Docket ID No. EPA-HQ-OAR-2013-0602, at 5-40 (hereinafter "GHG Abatement Measures TSD").

- **Mass-based standards for new and existing sources.** Second, the AEO2013 reference scenario also drives the EPA's determination of equivalent mass-based standards for new and existing sources.[6] For states that elect a mass-based target that includes both new and existing power plants, the EPA provides an "illustrative approach" to demonstrating equivalence with the default rate-based targets.[7] Exactly as it did in the BSER calculations described above, the EPA selected the corresponding regions in the EMM module of NEMS and applies the average regional electricity consumption growth rate from the AEO2013 reference case over the period 2012 to 2029 to each state.[8] The EPA then calculates incremental demand for new generation by subtracting historical 2012 sales from these NEMS-derived projections for the year 2029, adjusted for transmission losses and natural gas-fired power plants already under construction.[9] The Agency then adds this incremental demand to existing sources, building block 3 contributions (new renewable energy and avoided nuclear retirements), and building block 4 contributions (energy efficiency), generating a total called the "Final Mass Equivalent Generation."[10] Finally, the EPA calculates the equivalent mass-based target by multiplying the Final Mass Equivalent Generation (MWh) by the default rate-based targets (lbs CO_2/MWh) to generate an equivalent mass-based target (lbs CO_2). Thus, the EPA's treatment of incremental new generation is based on the AEO2013 reference scenario projections.

3. NEMS has consistently overestimated national electricity consumption.

The EIA has been using NEMS to generate its Annual Energy Outlook report series since the mid-1990s. As Figure 1 illustrates, Annual Energy Outlook reports over the past decade have projected that electricity consumption would grow significantly; however, actu-

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6 U.S. Environmental Protection Agency, Translation of the Clean Power Plan Emission Rate-Based CO_2 Goals to Mass-Based Equivalents, Technical Support Document (TSD) for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, Docket ID No. EPA-HQ-OAR-2013-0602, at 6 (hereinafter "Mass-Based Equivalents TSD").

7 *Id*. (describing EPA's NEMS-based methodology as an "illustrative approach"); Clean Power Plan at 34951 (proposing language to require state plans demonstrate that they are "equivalent to or stricter than" the default rate-based targets) (to be codified at 40 C.F.R. § 60.5740(a)(3)(ii)).

8 Mass-Based Equivalents TSD, *supra* note 6 at 6; *see also id.* at 6, footnote 21 (clarifying that the period over which average annual growth rates are determined for this purpose is 2012 to 2029). Note that this period is different than the period used to determine the contribution of energy efficiency as building block 4 in the BSER, where the relevant period of analysis is 2012 to 2040. *See* GHG Abatement Measures TSD, *supra* note 5 at 5-40.

9 Mass-Based Equivalents TSD, *supra* note 6 at 7 (see the equation describing "Incremental Demand for New Generation").

10 *Id*. (see the equation describing "Final Mass Equivalent Generation").

al electricity consumption has remained consistently below the forecasted levels.[11]

To be fair, one reason for the discrepancy is that earlier NEMS projections did not account for the national recession that began in 2008-09. Nevertheless, the recession only explains some of the reduced electricity demand observed over the last few years, especially when considered in the context of past model projections. Other factors include the structure of and assumptions in NEMS itself. For example, in the residential and commercial sectors of the model, adoption of energy-efficient technologies is driven primarily by user-specified input parameters describing consumers' discount rates.[12] If consumer preferences change, or if new energy efficiency technologies emerge in the coming two decades, those developments will not be reflected in the AEO2013 reference scenario.

Perhaps most importantly, if the structure and business model of the U.S. electricity industry changes in the coming twenty years—as many analysts expect it will, due to the improvements in distributed and renewable energy technologies—then the AEO2013 reference scenario would serve as a poor proxy. After all, EIA intends its Annual Energy Outlook series not as a prediction of future conditions, but as a projection of the status quo policy and discernable economic trends into the future.[13] The reference scenarios are, by definition, not intended to project significant changes in the energy industry or macro economy.

Whatever one's view of the future of the electricity industry, it is worth considering the history of NEMS projections and state-level electricity sales patterns in greater detail. To this end, we provide an appendix with additional context. The appendix compares historical data on state-level electricity sales growth patterns with their corresponding AEO2013 reference scenario projections. As the figures in this appendix illustrate, changes in electricity sales vary widely by state and time period of analysis. The last couple of years have witnessed a fairly rapid increase in electricity sales, but extending one's perspective back only five or ten years results in negative growth rates in many states.

For example, Figure 2 shows that the growth rate in electricity sales has been negative for many states (such as DE, HI, MD, ME, MI, NJ, and TN) since the year 2005 (the baseline year against which greenhouse gas emissions reductions under the Clean Power Plan are measured); for others, the actual growth rate has been close to zero, yet the projected growth from AEO2013 is modestly positive (such as AR, CA, and MT); and for a handful of states (such as ND, NE, SD, UT, and WY), actual growth has been strongly posi-

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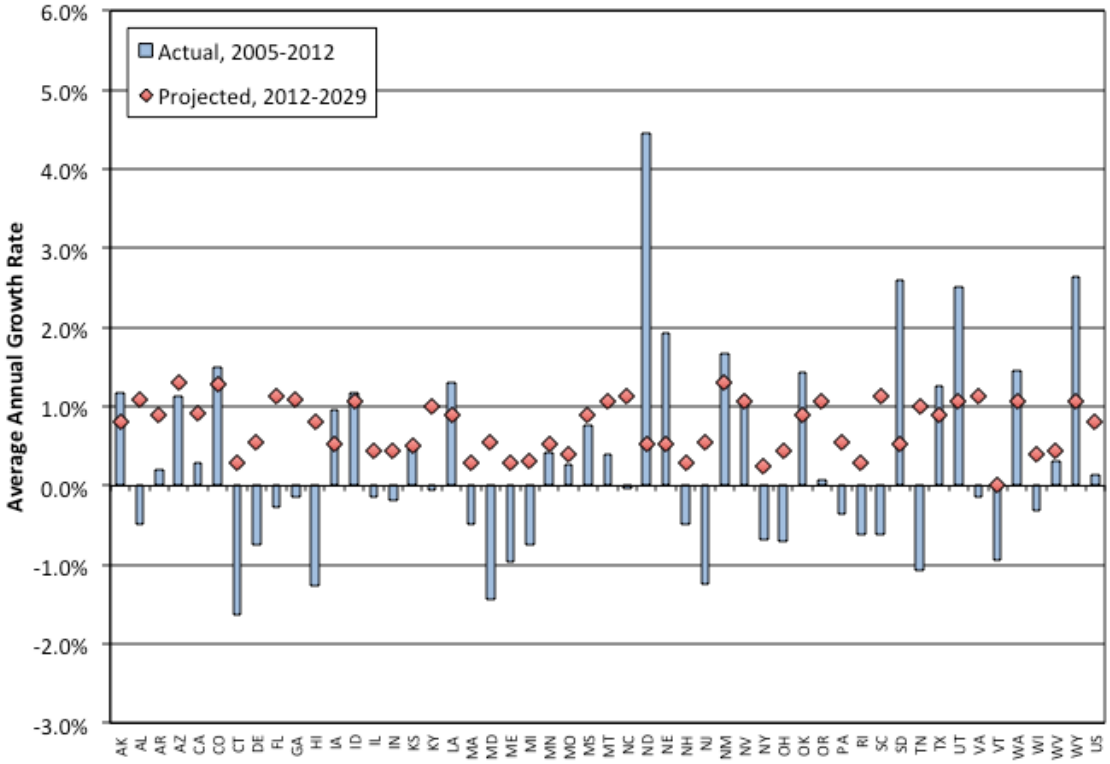
[11] Some of the earliest projections from the mid-1990s underestimated actual consumption in the 2000s. *See* Annual Energy Outlook Retrospective Review, *supra* note 3.

[12] Jordan T. Wilkerson, Danny Cullenward, Danielle Davidian, and John P. Weyant (2013). End use technology choice in the National Energy Modeling System (NEMS): An Analysis of the Residential and Commercial Sectors. *Energy Economics* 40: 773-84.

[13] U.S. Energy Information Administration, The National Energy Modeling System: An Overview 2009, Report # DOE/EIA-0581(2009), at 1 (stating that NEMS projections "are not considered to be statements of what will happen but of what might happen …. The projections are business-as-usual trend estimates, given known technological and demographic trends.")

tive and in excess of future predicted growth. Thus, if future trends match those observed in the period 2005 to 2012, the AEO2013 reference scenario would set an artificially high baseline for most states if used in the Clean Power Plan.

Figure 2: Comparing AEO2013 projections and state electricity sales, 2005-2012



4. Artificially high electricity consumption baselines will generate false credit for emission reductions under the Clean Power Plan.

As described above, the EPA's Clean Power Plan relies on the AEO2013 reference case forecast in two key places. Here, we discuss what the impacts would be if the AEO2013 is biased in the direction of projecting more electricity consumption than is likely to occur in the future.

If states are allowed to use the EPA's basic approach to calculating energy efficiency in state plans, then they will measure actual electricity sales against an artificially high baseline. Thus, they would receive credit for efficiency improvements that would have occurred in the absence of the Clean Power Plan, in addition to those caused by the state plan.

For the same reasons, a state that adopts an equivalent mass-based standard for new and existing sources that is based on the AEO2013 reference case will face an artificially lenient target. Because the projected electricity sales are biased upwards, such a state will face an overly generous target. As a result, theses states would receive credit for efficiency improvements that would have occurred in the absence of the Clean Power Plan, in

addition to those required by the state plan.

5. Alternative methods for setting equivalent mass-based standards for new and existing sources.

Given the risk of forecast error, we believe that the EPA should revisit its determination of equivalent mass-based targets for new and existing sources. The Agency should evaluate whether the AEO2013 reference scenario is the best approach to generating an equivalent target. To contribute to this discussion, we suggest two potential alternatives here:

- **Alternative #1: Use observed trends in electricity consumption.** One option to reduce forecasting error is to use some period of current and/or future trends in electricity consumption to establish the equivalent mass-based standard. Examples include the trends in electricity observed from 2005 to 2012, 2012 to 2020, or some other combination of current and/or historical periods.

- **Alternative #2: Wait to forecast future trends.** The EPA could also choose to use a different forecast generated closer to the time of regulation. The Agency could, for example, adopt the reference scenario from a future Annual Energy Outlook issued just before 2020; or it could generate its own scenario, if none is available.

Both approaches reduce the risk of forecasting error by basing the quantification of an equivalent mass-based target on data observed, or forecasts made, closer to the time of regulation. While both approaches introduce a new kind of uncertainty—the precise quantification of an equivalent target—these uncertainties may be tractable in those states with an interest in pursuing a mass-based target, who presumably have studied their expected future electricity sales and emissions trends in greater detail. On the other hand, these alternatives could produce an undesirable incentive for states to increase consumption in the coming years in order to produce high baseline scenarios.

Whether these alternatives or others are preferable from the EPA's perspective, we suggest that additional analysis is needed in order to be certain that mass-based targets under the Clean Power Plan will generate real emission reductions.

Thank you for your consideration. If we can provide additional assistance, or any of the data behind the figures and analysis presented here, please do not hesitate to contact us.

Sincerely,

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Affiliations are listed for identification purposes only; we are commenting in our individual capacities, and not on behalf of the University of California.

Appendix I

Comparing State Electricity Consumption Trends and AEO2013 Projections

Figure 3: Comparing AEO2013 projections and state electricity sales, 2009-2012

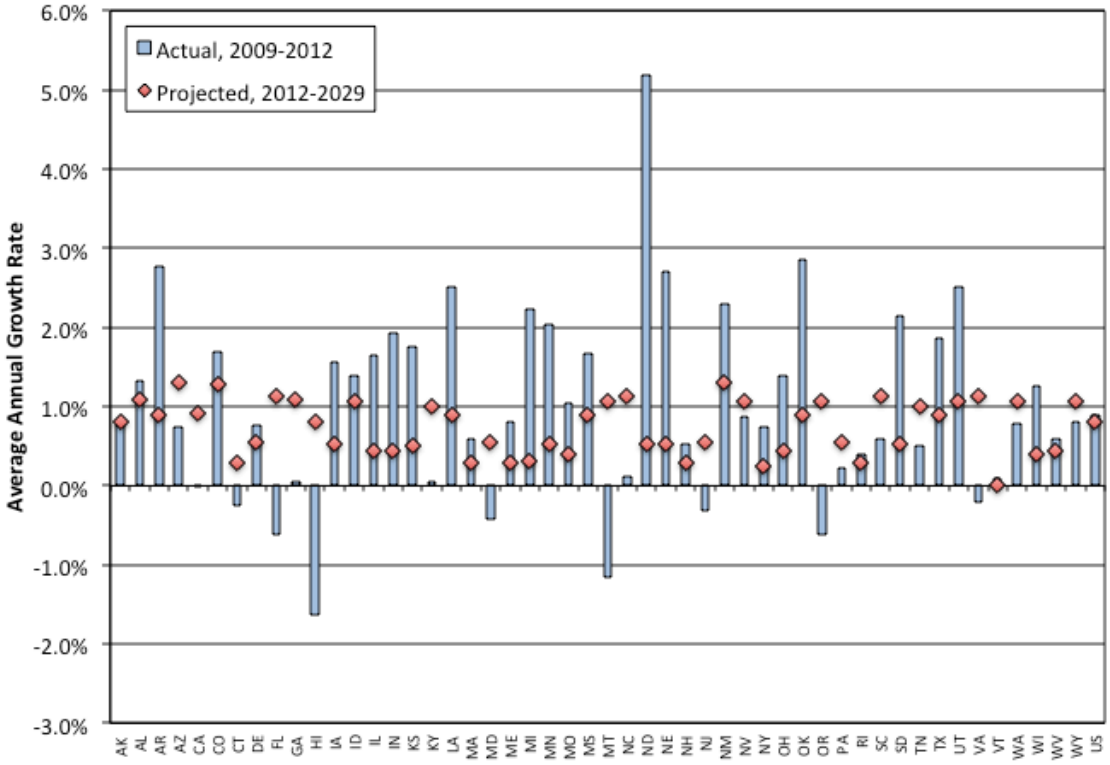

Figure 4: Comparing AEO2013 projections and state electricity sales, 2007-2012

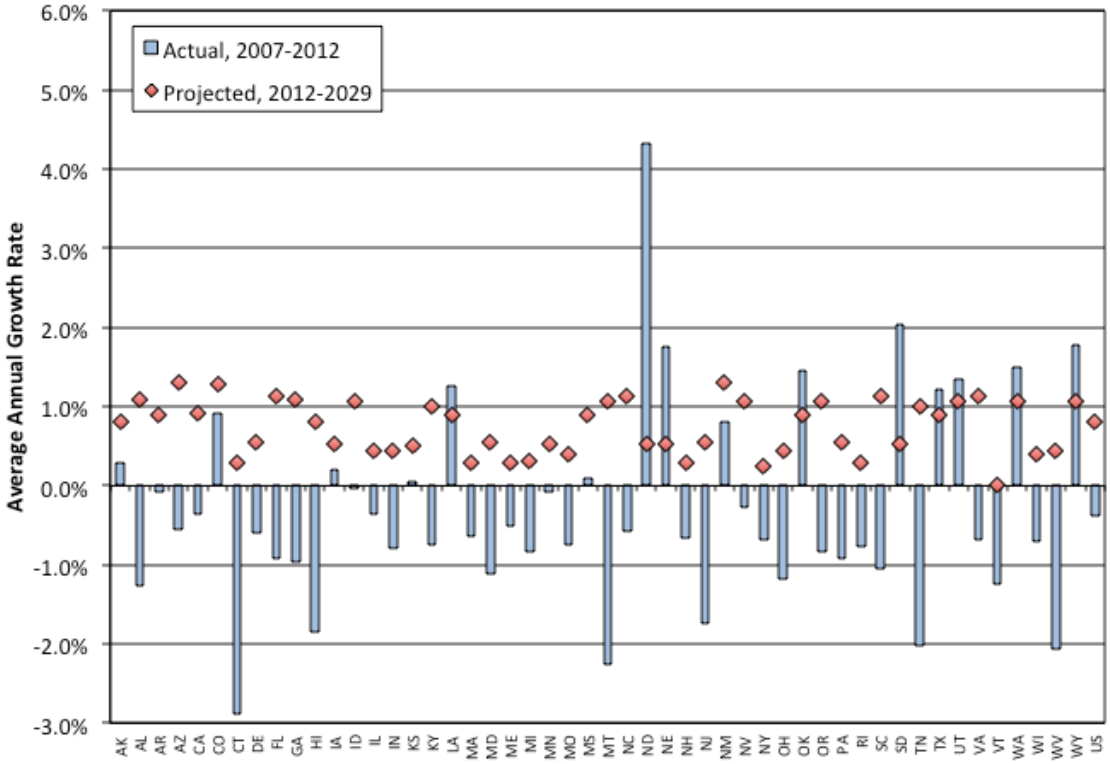

Figure 5: Comparing AEO2013 projections and state electricity sales, 2002-2012

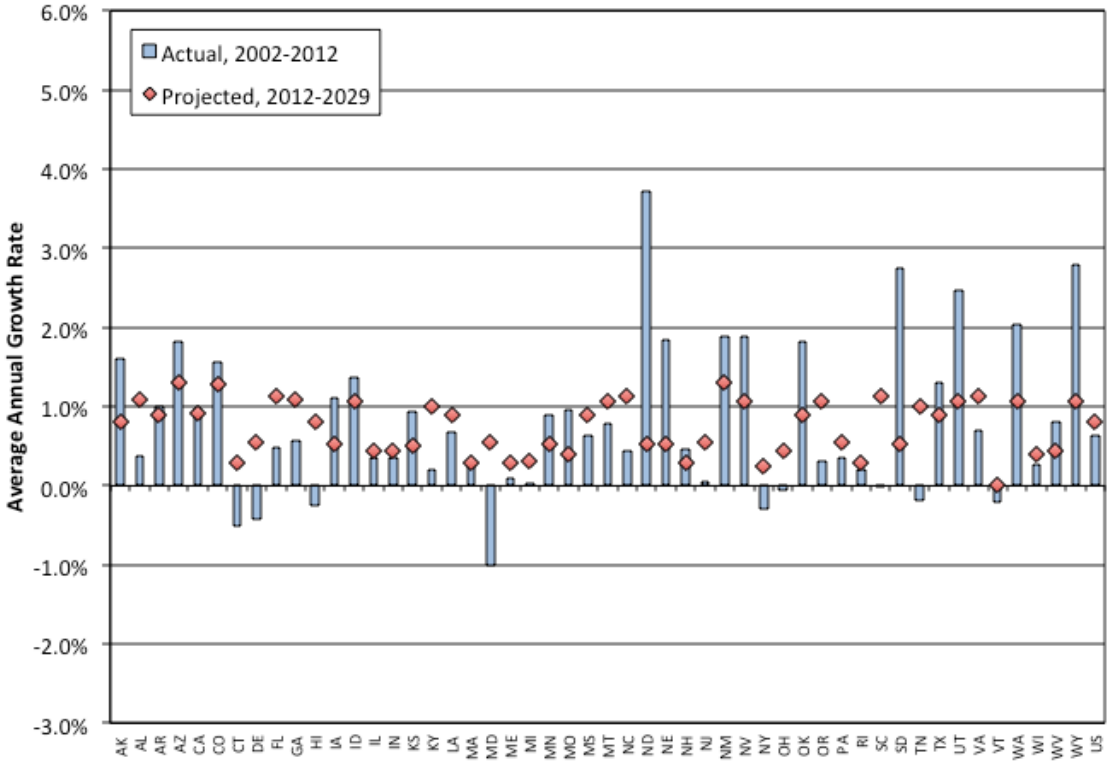

Figure 6: Comparing AEO2013 projections and state electricity sales, 2000-2012

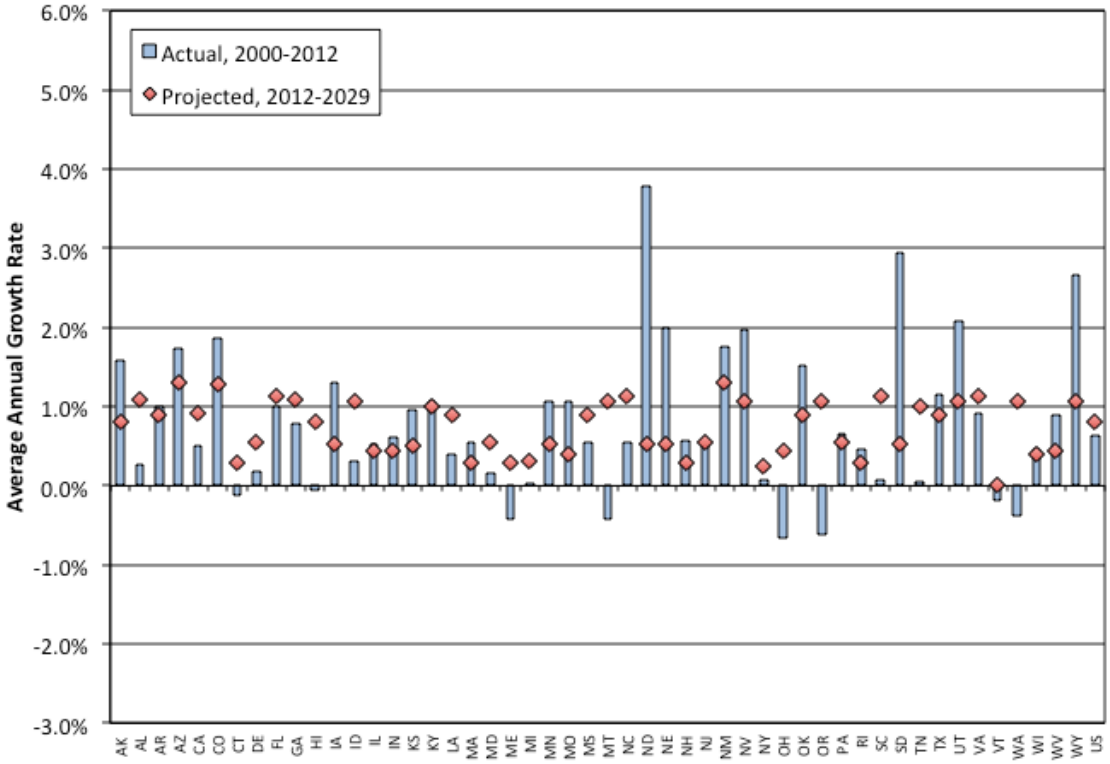

Figure 7: Comparing AEO2013 projections and state electricity sales, 1990-2012