

Working Group Meeting on Handling Renewable Electricity and Key Model Updates in AEO2016



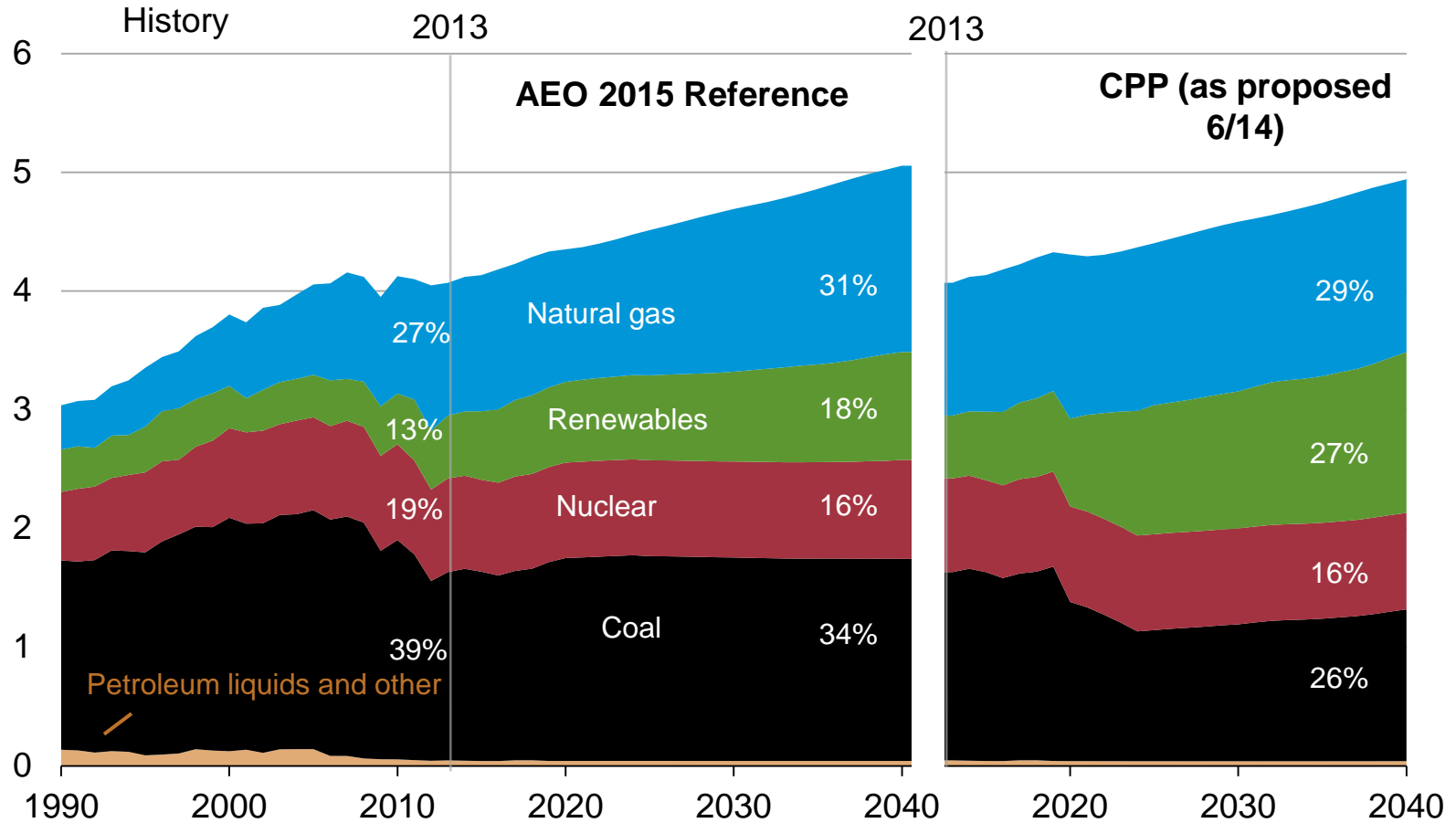
Office of Electricity, Coal, Nuclear, and Renewables Analysis
December 7, 2015 | Washington, DC

Highlights for AEO 2016

- EPA's Clean Power Plan rule is final
 - Representing this final rule will be a significant model development effort
- Updating capital costs
 - We will conduct follow-up meetings as necessary
- Several significant state RPS developments
- Monitoring federal tax policies
- The current schedule for AEO development is shorter than in the past
 - We will likely not be able to get to as much as we would like

EIA's analysis of the *proposed* Clean Power Plan hints at significant impact on renewable capacity growth

total electricity generation
trillion kilowatthours



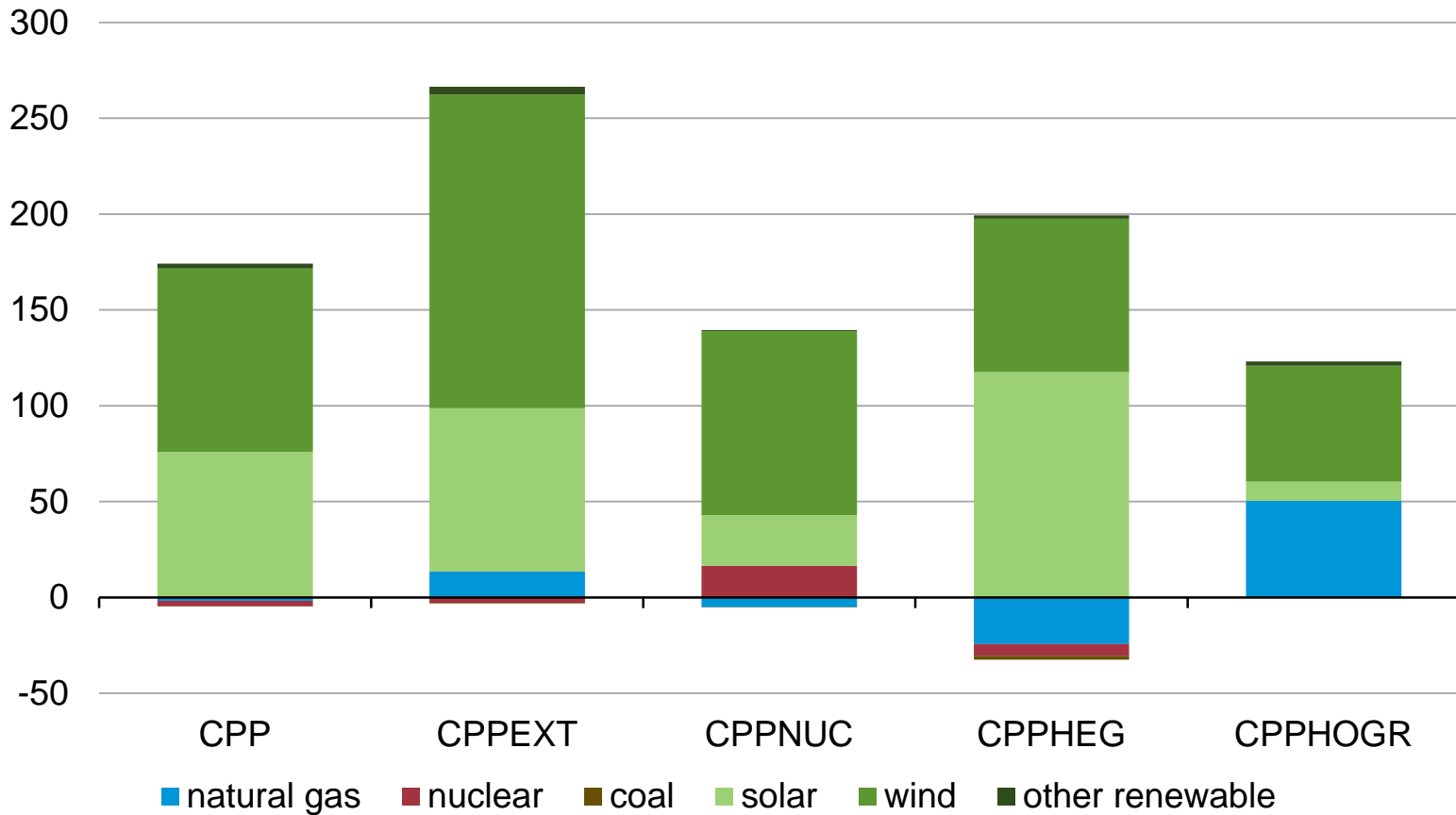
Source: EIA, Annual Energy Outlook 2015

Working Group Meeting on Renewable Electricity in AEO2016 Policy and Assumptions December 7, 2015

**WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES
DO NOT QUOTE OR CITE AS RESULTS ARE SUBJECT TO CHANGE**

From 2014-2040, 174 GW of renewable capacity is added relative to the AEO 2015 Reference in the proposed CPP case

change in capacity additions relative to baseline
gigawatts



U.S. Energy Information Administration

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CPP final rule delays start, improves phase-in, changes coverage, and increases flexibility

| Proposed Rule | Final Rule |
|---|--|
| Compliance begins in 2020 with one interim period from 2020 – 2029; Final targets in 2030 | Compliance start delayed to 2022 with three interim periods (2022–2024, 2025-2027, 2028-2029); Final targets in 2030 |
| Four building blocks (heat rate improvement, switching to NG, zero-carbon technologies, EE) | Three building blocks (heat rate improvement, switching to NG, zero-carbon technologies); EE counts for compliance but is not included in target calculation |
| Existing nonhydro renewables and incremental (new) renewables are included; end-use renewables excluded | Existing renewables excluded; incremental (post-2012) additions only; end-use renewables (incremental) included |
| Existing “at-risk” and incremental (post-2012) nuclear included | Existing (“at-risk”) nuclear excluded; incremental (post-2012) additions only |
| Fossil emission rates based on each State’s existing capacity resulting in considerable variation | Source specific (fossil steam, NGCC) rates determined at interconnect level reducing variation |
| Existing fossil steam, NGCC, and “large” or “higher-utilization” combustion turbines included | Existing fossil steam, NGCC; all combustion turbines excluded |
| Mass-based targets described but not specified | Two mass-based targets specified for fossil (existing, all) |
| Credit trading described but not sufficiently specified | Credit trading of zero-carbon MWh (rate-based) and carbon allowances (mass-based) included |

EPA and the courts have also been busy issuing or confirming other regulations affecting the power sector

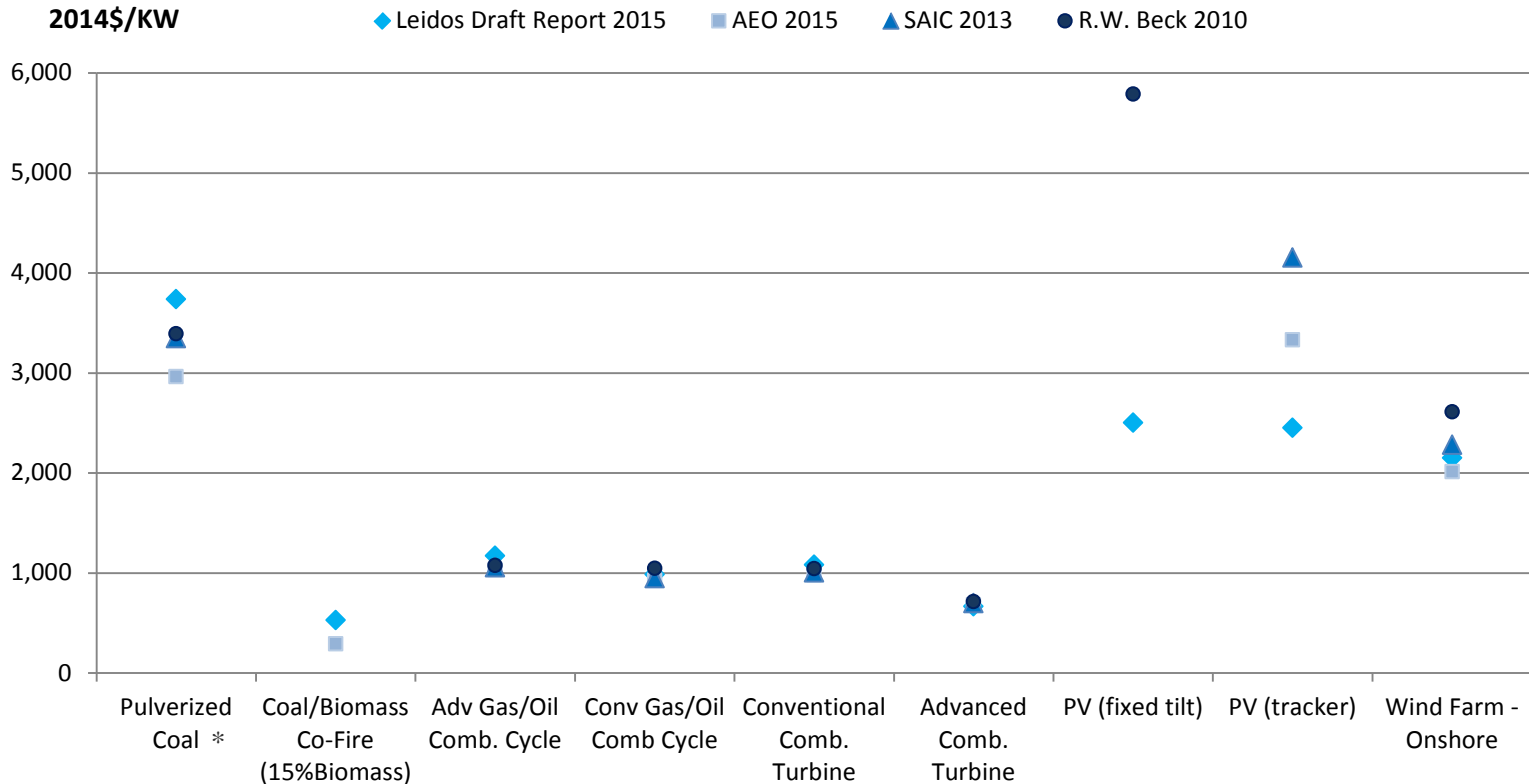
| Regulation | AEO2015 Assumption | AEO2016 Assumption | Comment |
|--|--|---|---|
| Cross State Air Pollution Rule- CSAPR <i>(SO₂/NO_x)</i> | Clean Air Interstate Rule | Will model CSAPR | |
| Mercury and Air Toxics Program <i>(Hg/SO₃)</i> | Models compliance with MATS requirements | Update retirements to match announced plans | Could have impact on CPP results |
| New Source Performance Standards limiting CO2 emissions from new plants <i>(Clean Air Act S. 111b)</i> | Not modeled | Will be included in Reference case | Part of CPP package |
| Regional Haze <i>(Best Available Retrofit Technology)</i> | Assumes compliance is reflected in EIA-860 filings on plants | Will re-assess for inclusion in AEO | Not expecting significant impact |
| Cooling Water Intakes <i>(Clean Water Act S. 316b)</i> | Not modeled | Will evaluate for inclusion in AEO | Not expecting significant impact (approx. 1 GW) |
| Coal Combustion Residuals <i>(Coal ash)</i> | Not modeled | Will be included in Reference case | Not expecting significant impact (approx. 0.8 GW) |
| Effluent Limitation Guidelines | Not modeled | Will evaluate for inclusion in AEO | Not expecting significant impact (approx. 1 GW) |

We have commissioned a new study to update power-sector capital costs

- We have limited the scope of the update to technologies we think may have changed substantially and technologies that are likely to be built in the model
 - If time and funding allow, we may get data on technologies that we are considering adding to the model
- The initial cost estimates are complete
 - We have asked a number of external experts to review the draft costs
 - We will have follow-up meetings with Leidos and/or peer reviewers to clarify any discrepancies identified

Comparison of Overnight Capital Costs

Total Overnight Capital Costs (2014\$/KW)



* - Technology specification on some items may have changed from report to report. Pulverized coal has changed from super-critical to ultra-supercritical

Several states have enacted substantial increases in RPS targets

- Vermont 75% RPS
- Hawaii 100% RPS
 - We do not directly model HI, but evaluating an exogenous representation of their targets to include in results accounting
- California 50% RPS
- Monitoring other states
 - NY has indicated they will move toward a 50% target, but rules will not likely be available for this AEO
- Kansas has ended their RPS requirement

Status of federal tax credits for renewables

- PTC for wind (and other) expired at the beginning of 2015
 - Projects currently under construction (as of 12/31/14) may still get the tax credit
 - Congress has not yet passed an extension
 - Previous extension was almost entirely “retroactive”, and simply “grandfathered” projects already in the works
- ITC for utility-scale solar will revert from 30% to 10% at the end of 2016
 - For residentially-owned solar, the 30% credit goes away completely
- We will publish an “Issues in Focus” article in the AEO looking at different extension scenarios

Model changes in other areas may have significant impact on the electric power sector

- Preliminary macro-economic updates suggest lower interest rates, lower construction-cost escalation factors
 - This is making the more capital intensive technologies (nuclear and renewables) more attractive
- Near-term natural gas costs are lower than last year
 - Longer-term price path remains to be seen
- With the CPP in place, slowing demand growth may have less of an impact than in previous years
 - Substantial coal retirements/redispach will create opportunities for new capacity not seen in several years

Distributed generation in buildings

- Policy-related capabilities/assumptions for distributed generation
 - adding capability to represent regional incentives for renewable distributed generation and combined heat and power technologies for AEO2016
 - interconnection limitations based on Database of State Incentives for Renewables & Efficiency
 - 2016 expiration of investment tax credit for solar PV, small wind, fuel cells, geothermal heat pumps, solar water heaters
 - EPACT 2005, EIEA: 30% of cost with no upper limit (except fuel cells)
 - commercial solar tax credit reverts to 10% after 2016
 - 2016 expiration of investment tax credit for microturbines, CHP
 - EPACT 2005 (microturbines only), EIEA : 10% of installed cost

Distributed generation in buildings (continued)

- Cost/performance updates
 - PV costs align with Tracking the Sun VIII for 2015 installations
 - draft report from Leidos for projected cost and performance – still a work in progress, but PV cost declines do not “level off” as much/as soon as in past AEOs
- Alternate modeling option for residential solar PV capacity penetration
 - econometric penetration model with logit function coefficients and ZIP code-level data instead of niche/ payback model oriented more toward customer-owned systems
 - currently investigating benefits/issues for both options
- Usual annual updates
 - distributed generation capacity
 - historical CHP generation

For more information

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Supplemental Slides

Phase-in of CPP requirements

- Implementation start shifts to 2022 from 2020, but still reaches mandated final targets in 2030
- Interim period is split into three steps (2022-2024, 2025-2027, and 2028-2029) with separate performance rates
 - Earlier targets are less stringent than in proposal – imposing a ‘glide path’ that will lessen the near-term cliff seen originally
 - Final rule includes a new early incentive program to certain renewable and EE projects that provide/reduce generation in 2020 and 2021
- State plans due September 2016, grace period until September 2018

Increased emphasis on trading as flexibility mechanism: proposed federal plan/model rules

- Role of EPA model rules: both rate and mass-based programs can implement trading without formal interstate agreements
 - EPA's proposed model rules/federal plan to be finalized Summer 2016
- Rate-based plans: emission rate credits (ERCs)– represent MWh of zero-emitting generation or avoided generation through EE – can be traded, and used as MWh in the denominator of the rate calculation for state holding the ERC
- Mass-based plans: allowances representing carbon emissions are traded directly, as long as each state holds enough allowances to meet its own emission cap.

Sources used for compliance are revised

- Emissions from existing (online by Jan. 8, 2014) fossil steam and gas combined cycle plants are included
 - Greater than 25 MW
 - Simple cycle combustion turbines excluded, regardless of output
- Compliance with a state rate-based target can include new, non-emitting sources or EE
 - New nuclear or renewable generation online after 2012 (not all existing), including uprates
 - End-use renewable generation can be counted
 - Energy efficiency can be counted (beyond 'baseline' amounts)

Changes from proposed CPP rule

- “Phasing-in” requirements to ease implementation: changes to schedule to facilitate more gradual compliance
- Reduced variability in required reductions: EPA expects more of states that have made slower progress reducing CO2
 - final rule revises calculation of targets and definition of building blocks
- Increased emphasis on trading as flexibility mechanism: EPA proposes model rules to speed creation of interstate cooperative programs for rate- and mass-based programs
- Redefinition of available compliance options

Reduced variability in required reductions in final rule; 2012 rate changes based on new definition of affected sources (lbs. CO₂ / MWh)

| State | Decline in rate under proposal | 2012 affected rate | Final goal | Decline in rate under final rule | State | Decline in rate under proposal | 2012 affected rate | Final goal | Decline in rate under final rule |
|---------------|--------------------------------|--------------------|------------|----------------------------------|----------------|--------------------------------|--------------------|------------|----------------------------------|
| Alabama | -27% | 1,518 | 1,018 | -33% | Montana | -21% | 2,481 | 1,305 | -47% |
| Alaska | -26% | | | | Nebraska | -27% | 2,161 | 1,296 | |
| Arizona | -52% | 1,552 | 1,031 | -34% | Nevada | -35% | 1,102 | 854 | -23% |
| Arkansas | -44% | 1,816 | 1,130 | -38% | New Hampshire | -47% | 1,119 | 858 | -23% |
| California | -23% | 954 | 828 | -13% | New Jersey | -42% | 1,058 | 811 | -23% |
| Colorado | -35% | 1,905 | 1,174 | -38% | New Mexico | -34% | 1,798 | 1,146 | -36% |
| Connecticut | -29% | 846 | 786 | -7% | New York | -44% | 1,140 | 918 | -19% |
| Delaware | -32% | 1,209 | 916 | -24% | North Carolina | -40% | 1,673 | 1,135 | -32% |
| Florida | -39% | 1,221 | 919 | -25% | North Dakota | -11% | 2,368 | 1,305 | -45% |
| Georgia | -44% | 1,597 | 1,049 | -34% | Ohio | -28% | 1,855 | 1,190 | -36% |
| Hawaii | -15% | | | | Oklahoma | -35% | 1,565 | 1,068 | |
| Idaho | -33% | 834 | 771 | -8% | Oregon | -48% | 1,089 | 871 | -20% |
| Illinois | -33% | 2,149 | 1,245 | -42% | Pennsylvania | -31% | 1,642 | 1,095 | -33% |
| Indiana | -20% | 2,025 | 1,242 | -39% | Rhode Island | -14% | 918 | 771 | -16% |
| Iowa | -16% | 2,195 | 1,283 | -42% | South Carolina | -52% | 1,791 | 1,156 | -35% |
| Kansas | -23% | 2,288 | 1,293 | -43% | South Dakota | -35% | 1,894 | 1,166 | -38% |
| Kentucky | -18% | 2,122 | 1,286 | -39% | Tennessee | -39% | 1,985 | 1,211 | -39% |
| Louisiana | -39% | 1,577 | 1,121 | -29% | Texas | -38% | 1,553 | 1,041 | -33% |
| Maine | -14% | 873 | 778 | -11% | Utah | -27% | 1,790 | 1,179 | -34% |
| Maryland | -37% | 2,031 | 1,287 | -37% | Virginia | -38% | 1,366 | 934 | -32% |
| Massachusetts | -38% | 1,003 | 824 | -18% | Washington | -71% | 1,566 | 983 | -37% |
| Michigan | -31% | 1,928 | 1,169 | -39% | West Virginia | -20% | 2,064 | 1,305 | -37% |
| Minnesota | -41% | 2,082 | 1,213 | -42% | Wisconsin | -34% | 1,996 | 1,176 | -41% |
| Mississippi | -31% | 1,151 | 945 | -18% | Wyoming | -19% | 2,315 | 1,299 | -44% |
| Missouri | -21% | 2,008 | 1,272 | -37% | | | | | |

Source: U.S. Environmental Protection Agency, Office of Air and Radiation, Goal Computation Technical Support Document