

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DO NOT QUOTE OR CITE AS RESULTS ARE SUBJECT TO CHANGE**

AEO2016 Electricity Working Group



*Office of Electricity, Coal, Nuclear, and Renewables Analysis
December 8, 2015 | Washington, DC*

What to look for: Electricity sector in AEO2016

- Inclusion of EPA final Clean Power Plan in Reference Case
- Updated cost estimates for new generating technologies
- Major data update on existing coal plant status: MATS-compliant technology or retirement schedules for all units
- Further expansion of EPA rules in Reference Case: coal ash, cooling water intake, effluent limits (under consideration)
- Additional side cases on nuclear, renewables tax subsidies, and on flexibility under Clean Power Plan

Key issues in AEO2016 Electricity Outlook

Supply-side

- Address improving macro fundamentals: lower interest rates create more favorable environment to invest in capital intensive technologies
- Shifting paths to lower-emitting generation- economic vs. policy basis for growth in:
 - renewables capacity additions: Clean Power Plan treatment, additional state RPS revision, lower interest rates.
 - natural gas capacity: Clean Power Plan treatment, lower natural gas prices.

Key issues in AEO2016 Electricity Outlook

Supply-side (cont'.)

- Re-setting the baseline: disposition of existing coal-fired generation under evolving environmental regulations
- Adjusting the risk of future CO2 regulation capital cost adder
- Re-evaluation of potential for nuclear uprates/retirements

Demand-side

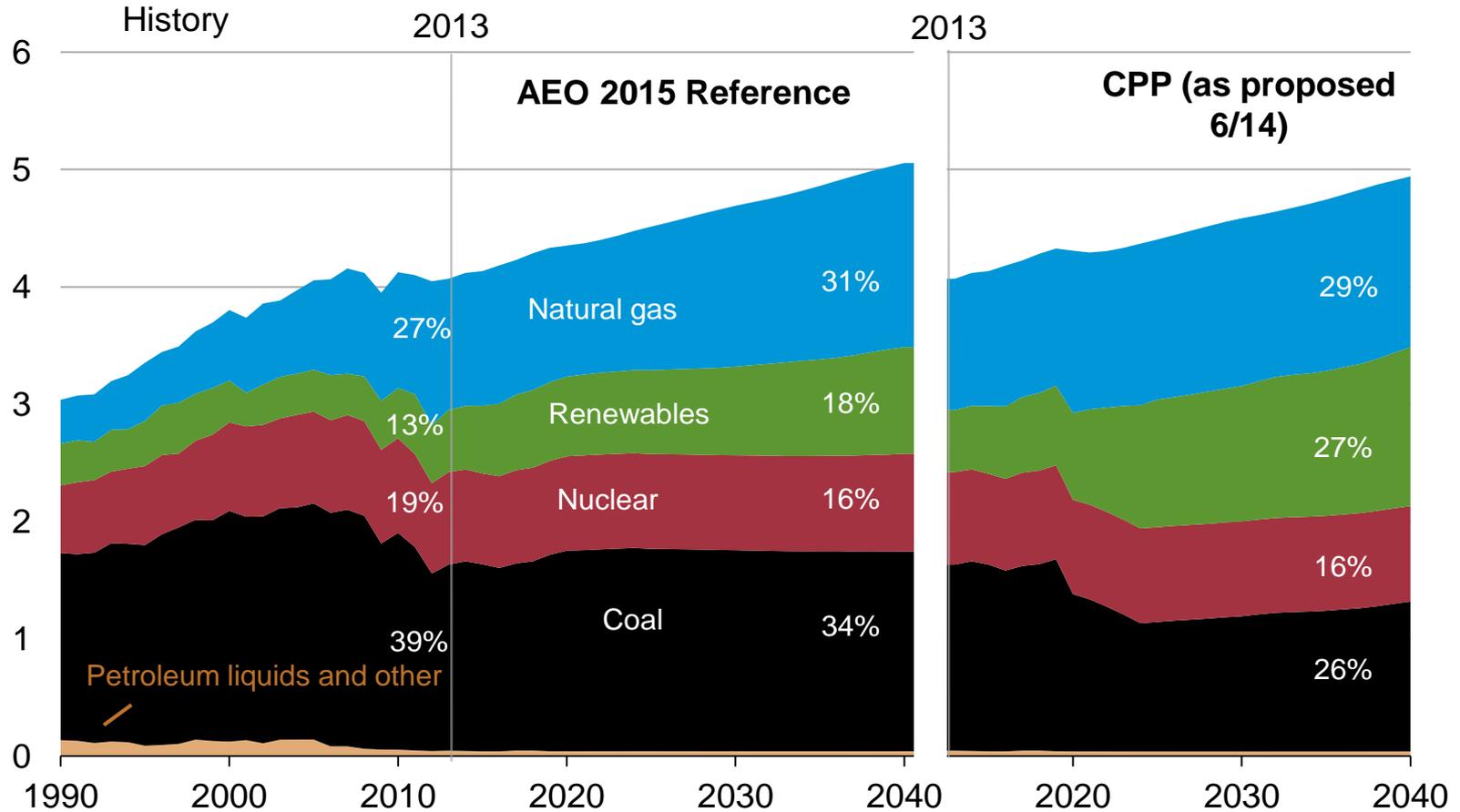
- Role of energy efficiency under Clean Power Plan.

Incorporating Clean Power Plan in Reference Case

Regulation	AEO2015 Assumption	AEO2016 Assumption
Existing Source Performance Standards limiting CO2 emissions <i>(Clean Air Act S. 111d)</i>	Not modeled	Will be included in Reference case
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

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

total electricity generation
trillion kilowatthours

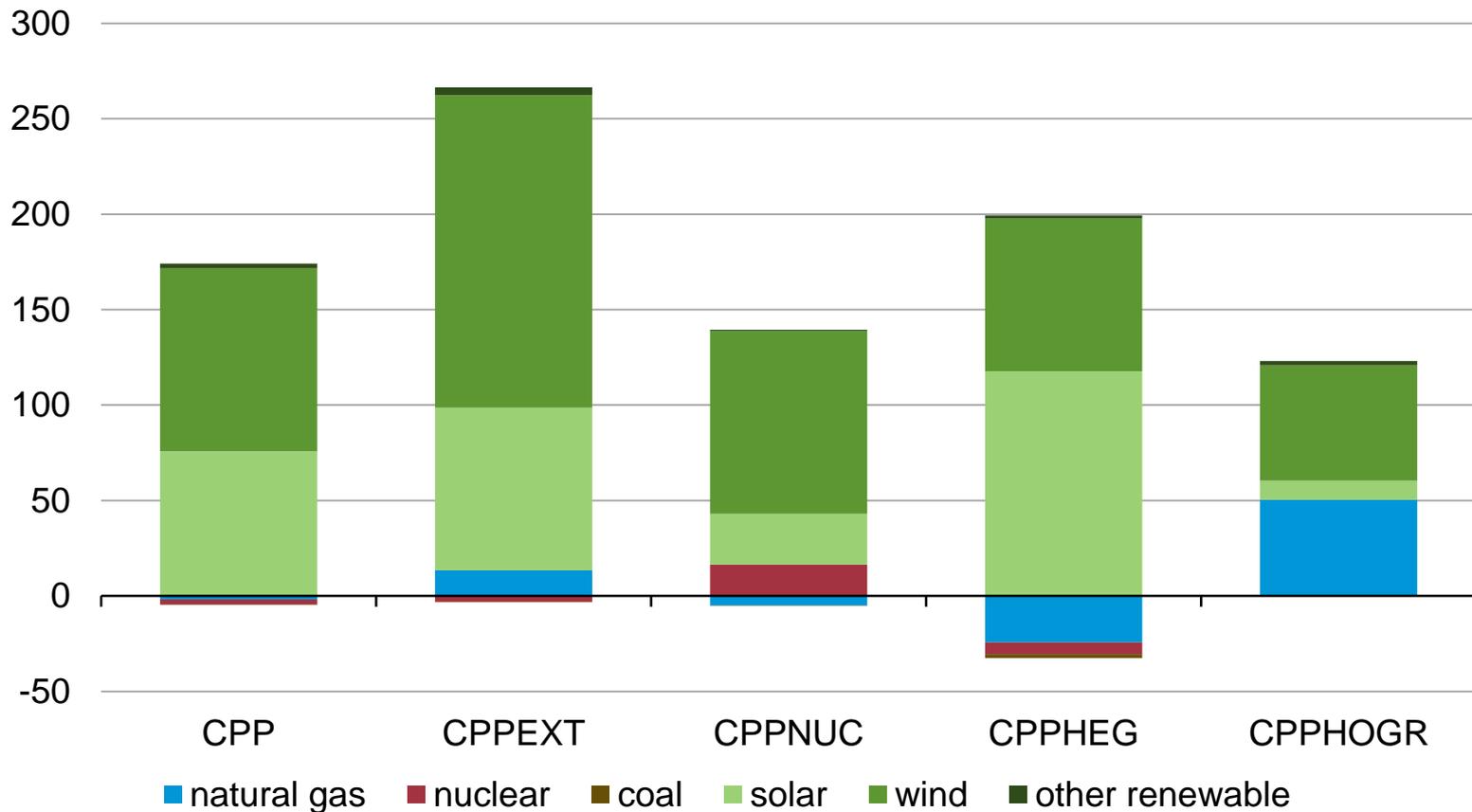


Source: EIA, Annual Energy Outlook 2015

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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

Specifics of CPP rule changes

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

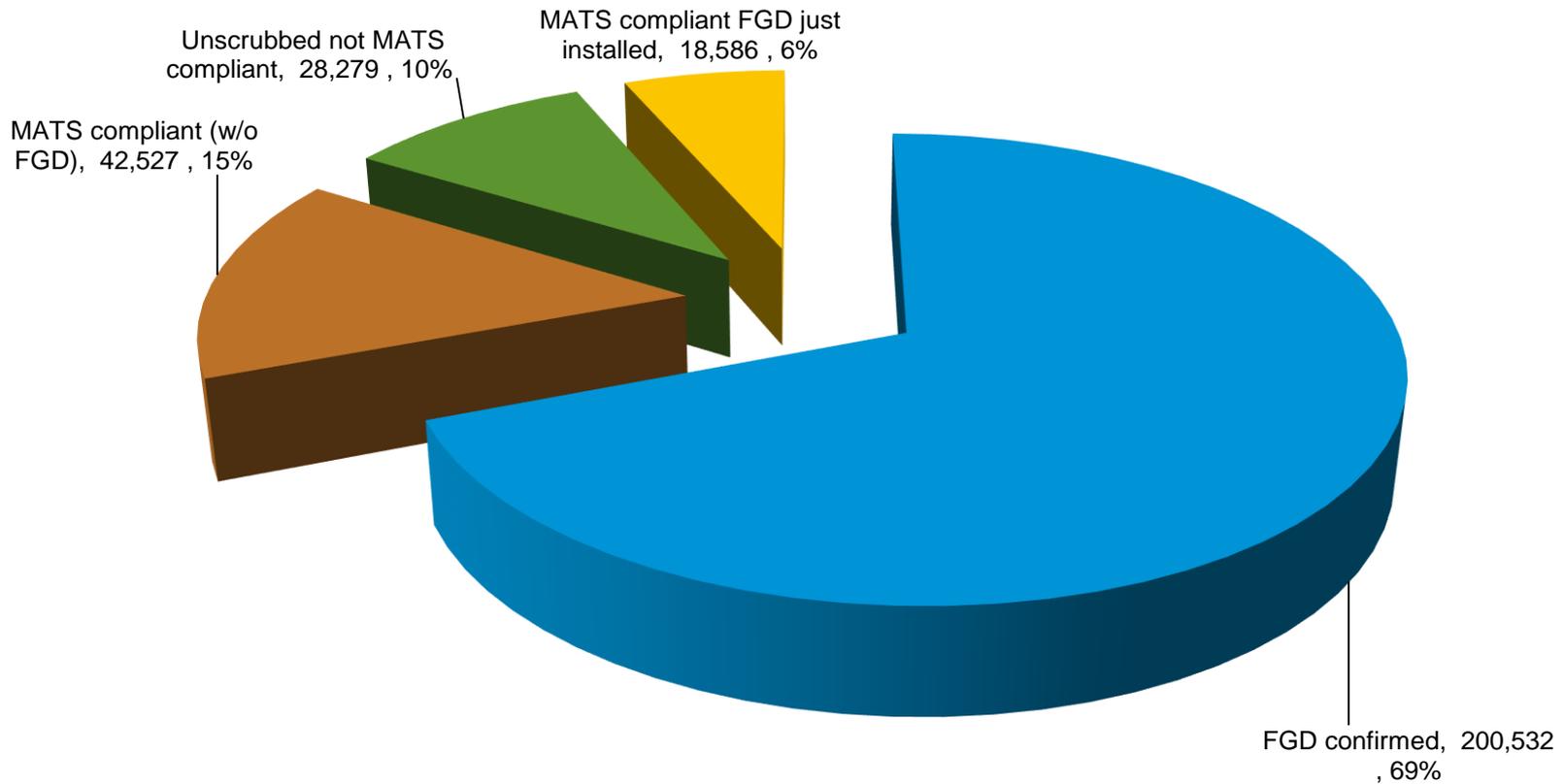
Increased emphasis on trading as flexibility mechanism: proposed federal plan/model rules

- 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.
 - EPA requires states to address concerns about “leakage” under mass-based plans covering only existing sources due to construction of new NGCC.

Other EPA rules definitely in AEO2016 Reference Case

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

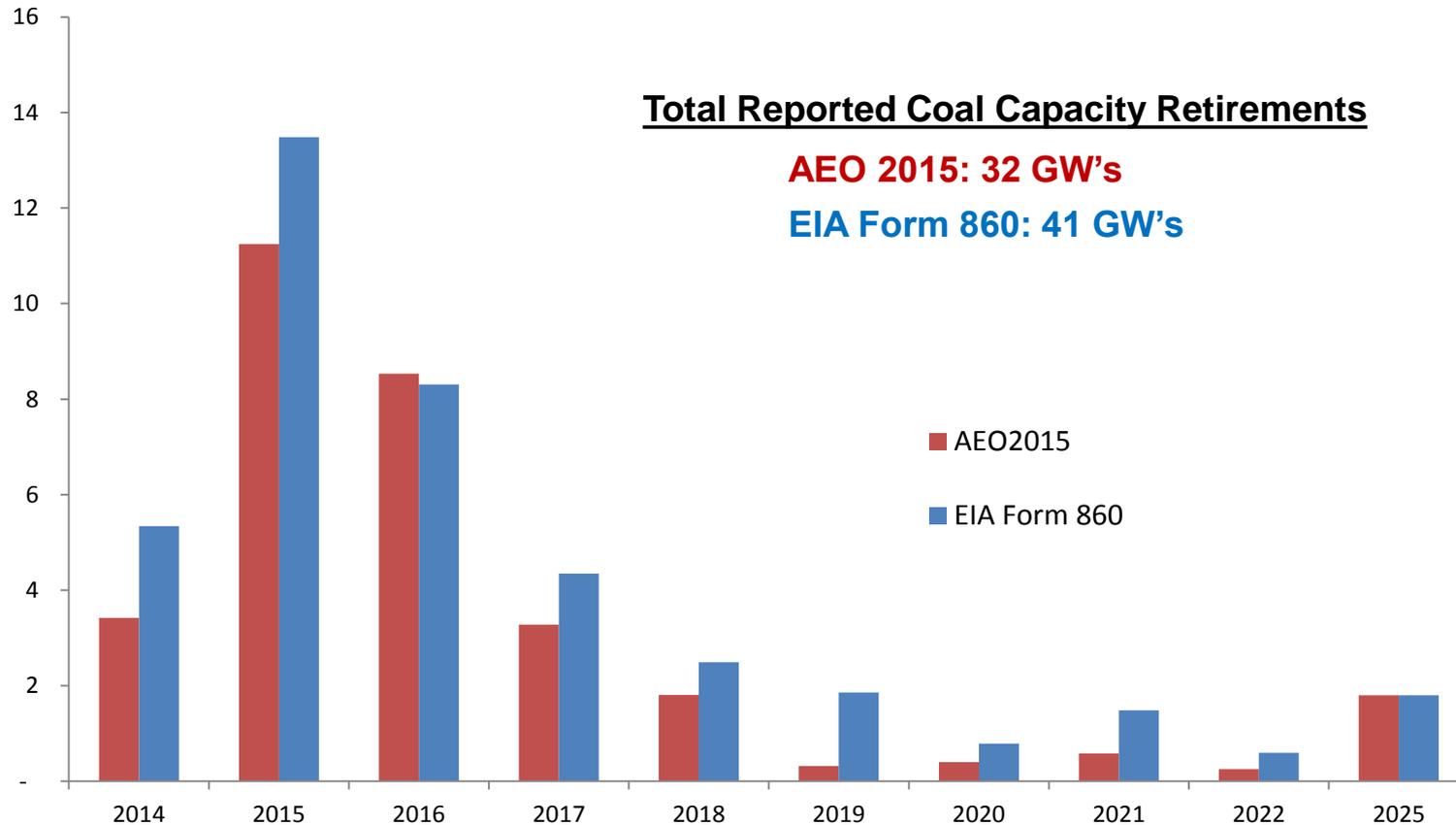
Status of Coal Capacity Retrofits- MATS Compliance



Source: EIA Form 860

Data updates from Form EIA-860: announced coal retirements and existing generator status

Gigawatts



EPA rules considered for AEO2016 Reference Case

Regulation	AEO2015 Assumption	AEO2016 Assumption	Comment
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 evaluate for inclusion in AEO	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)

Several states have enacted substantial increases in RPS targets

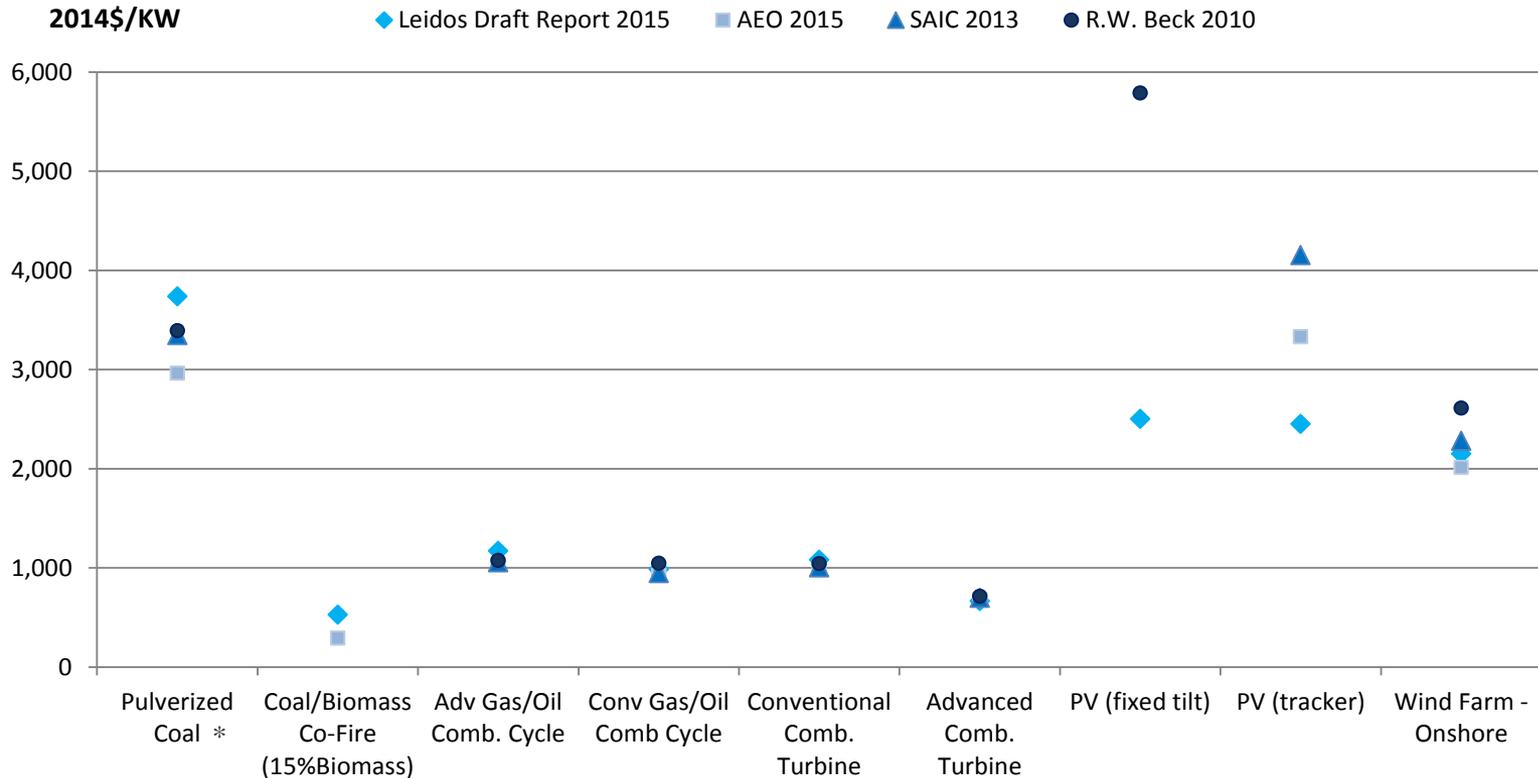
- Vermont 75% RPS
- Hawaii 100% RPS
 - We do not directly model HI, but evaluating an exogenous representation of their targets to include in results accounting
- California 50% RPS
- Monitoring other states
 - NY has indicated they will move toward a 50% target, but rules will not likely be available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

Other data updates for AEO2016: new generator technology 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
 - Including ultra-supercritical coal, coal/biomass co-firing, and advanced CC, solar tracking;
 - 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, currently under review by a number of external experts.

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

We are re-examining nuclear uprate and retirement assumptions

- We have identified 2,139 MW of announced or planned retirements (in addition to plants recently retired)
 - 2016 FitzPatrick (New York), 852 MW
 - 2019 Pilgrim (Massachusetts); 678 MW
 - 2019 Oyster Creek (New Jersey); 610 MW
- Unplanned/un-modeled retirements will require a more thorough examination of the latest information for both economic and non-economic factors that may be influencing current retirement discussions in the literature
- AEO 2015 did not model uprate potential in the Reference case

Potential Side Cases- AEO2016 Electricity

- Variations in Clean Power Plan implementation choices
- Issues in Focus: tax treatment of renewables

Key changes in other areas may have significant impact on the electric power sector in AEO2016

- Preliminary macro-economic updates suggest lower interest rates, lower construction-cost escalation factors
 - Causes more capital intensive technologies (nuclear and renewables) to appear more attractive, even without the CPP in place
- 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

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AEO2016 Electricity Working Group: Supplemental Slides

Cooling Water Intakes (316(b)) Final Rule

- Final rule effective as of October 2014
 - Sets impingement controls for new and existing electric generating and manufacturing facilities with design intake flow of at least 2 million gallons per day (MGD) and use at least 25% of the water withdrawals for cooling.
 - Requires facilities having >125 MGD design intake flow to conduct studies to help permitting authorities determine what, if any, entrainment controls are needed.
 - Establishes a best technology available (BTA) standard for both impingement mortality and entrainment at new and existing facilities.
 - Existing BTA technologies for impingement include a closed cycle system, reduction of intake flows to 0.5 feet per second, minimum 800-foot distance offshore intakes with use of bar screens, or use of modified travelling screens.
 - BTA for entrainment will be determined on a site-specific basis.
 - Requires that new units must have the equivalent of closed loop cooling.
- Implementation time frame
 - Based on expiration of National Pollutant Discharge Elimination System (NPDES) permits but no later than 2023; a plan must be submitted by July 14, 2018.
 - Early choice of evaporative thermal cooling can allow implementation delay to 2023.
- EPA's estimated electric power capacity retirements: ~1 gigawatt
- EPA's estimated incremental costs:
 - \$275-297 million per year (excludes entrainment costs)

Coal Combustion Residual (Coal Ash) Final Rule

- Final guidelines released April 2015
 - Rule sets national minimum criteria for the new and existing landfills and impoundments used for the disposal of coal ash.
 - All CCR units must monitor groundwater.
 - Impoundments and landfills that fail to meet location requirements or impoundments that fail to meet structural integrity requirements (i.e. those that pose the greatest risk) must close.
 - Some existing disposal sites may be required to retrofit or decide to close (avoiding all compliance costs) .
 - Unlined impoundments can continue to operate, but if unacceptable groundwater contamination occurs, they must retrofit or close. Similarly, unlined landfills can continue to operate but corrective action must occur to address any releases.
 - Coal ash will continue to be regulated as a non-hazardous waste under Subtitle D of the Resource Conservation Recovery Act.
 - Rule allows CCR products to remain unregulated if the CCR is encapsulated in a product having a beneficial use. This includes gypsum wallboard and concrete but specifically excludes the use of coal ash as ground fill.
 - Rule is unenforceable by EPA, but facilities that do not comply may be subject to litigation from other interested parties.
- Implementation timeline
 - Specific timelines vary depending on type of characteristics of CCR unit and compliance option chosen.
- EPA's estimate of electric power capacity retirements: ~ 0.8 gigawatts
- EPA's incremental cost estimate:
 - \$509-\$735 million annually (depending on discount rate)

Effluent Limitation Guidelines

- Final guidelines released September 2015
 - Addresses liquid waste streams from plants (primarily coal plants) discharged directly and indirectly to water bodies (e.g. lakes, rivers)
 - In response to the transfer of pollutants from air to water as a result of the Clean Air Act
 - Regulates wastewaters associated with flue gas desulfurization, fly ash, bottom ash, flue gas mercury control, and gasification of fuels such as coal and petroleum coke
 - Addresses discharge of mercury, arsenic, selenium, nitrites/nitrate wastes from flue gas desulfurization equipment
 - Includes zero discharge pollution limits for ash transport water and flue gas mercury control water
- Implementation timeline
 - Effective as of January 2016
 - Compliance deadlines vary according to the expiration of the plant's National Pollutant Discharge Elimination System (NPDES) permit but will occur between 2018 and 2023.
- EPA's estimate of electric power capacity retirements: ~ 1 gigawatt
- EPA's incremental cost estimate:
 - \$471-\$480 million annually (depending on the discount rate)

EPA is concerned about leakage with mass-based standards

- Rate-based standards encourage increasing zero-carbon generation by including in denominator of compliance rate
- Mass-based standards can only mandate emissions targets for existing sources creating potential for “leakage” of emissions by building new (e.g. NGCC) plants to displace generation from existing fossil capacity
- EPA addresses the concern about leakage by requiring states choosing mass-based plans to mitigate leakage potential
 - Include new sources using revised targets provided by EPA
 - Set aside allowances to shift generation from fossil to zero-carbon technologies
 - Demonstrate that state plan indicates leakage is unlikely to occur
- Leakage may also occur with combustion turbines (not regulated) but EPA does not address this possibility