

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DO NOT QUOTE OR CITE AS RESULTS ARE SUBJECT TO CHANGE**

Annual Energy Outlook 2016

Renewables Working Group

Preliminary Results



Renewables AEO2016 Working Group

February 9, 2016/ Washington, DC

By

EIA, Renewable Electricity Analysis Team

Overview

- Key policy provisions
- Update on CPP model representation
- Update on status of Leidos capital cost study
- Preliminary results

Assumptions

AEO 2016 reflects new RPS policies and the ITC/PTC extension

- RPS updates:
 - Vermont 75% RPS, Hawaii 100% RPS, California 50% RPS
 - We do not directly model HI, but evaluated an exogenous representation of their targets to include in results accounting
 - Kansas has ended their RPS requirement
- ITC/PTC were extended in December 2015:
 - ITC for utility-scale solar will remain at 30% through the end of 2019, then decrease to 10% by 2022.
 - PTC for wind is extended at full value through 2016, then phase down to zero for projects under construction by 2020.

AEO2016 Reference case final Clean Power Plan must assume some policy choices

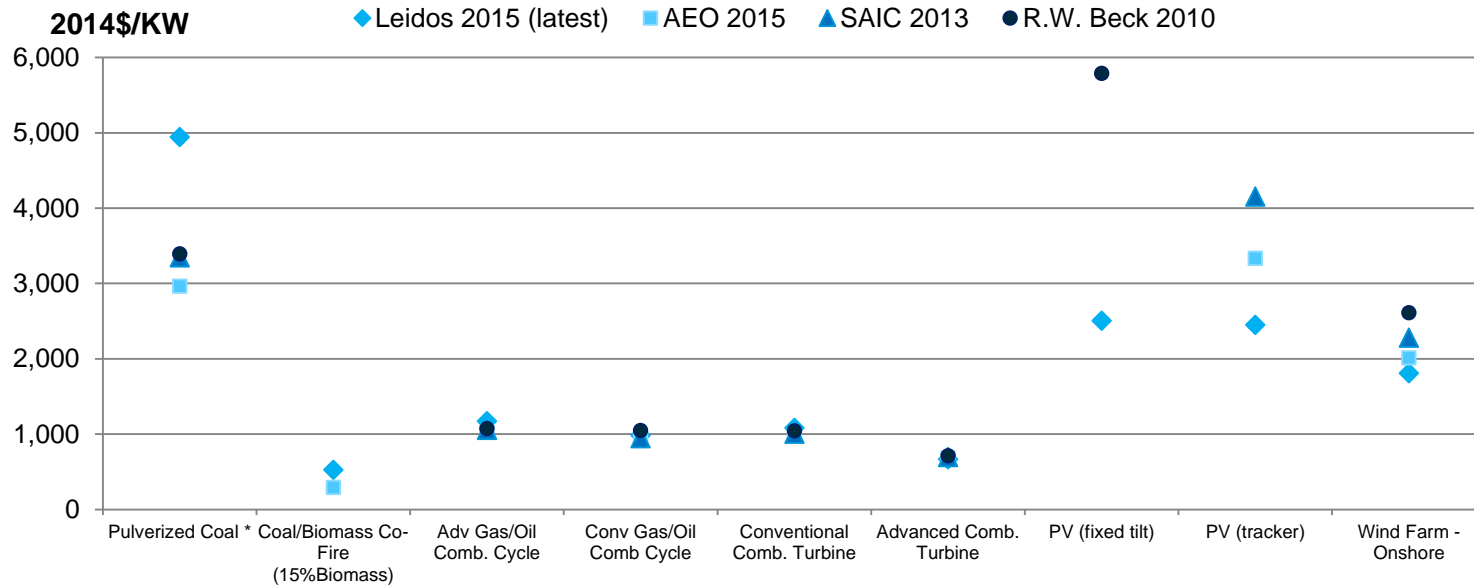
- The Reference case will assume that states select a mass-based approach that covers both new and existing sources
- Credit trading will be represented at the EMM region level
- Allowances will be allocated to load serving entities
- Side cases will explore alternative approaches
 - Rate-based regulation
 - Credit trading at the interconnect level
 - Allocation of allowances to generators
 - No CPP case

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
- The initial cost estimates are complete
- Stakeholder outreach identified several key questions/issues
 - Need for a 111b compliant coal technology
 - Lack of differentiation between fixed tilt and tracking PV costs
 - Large discrepancy for wind costs with other public sources

Costs have seen the most change for coal, solar, and wind

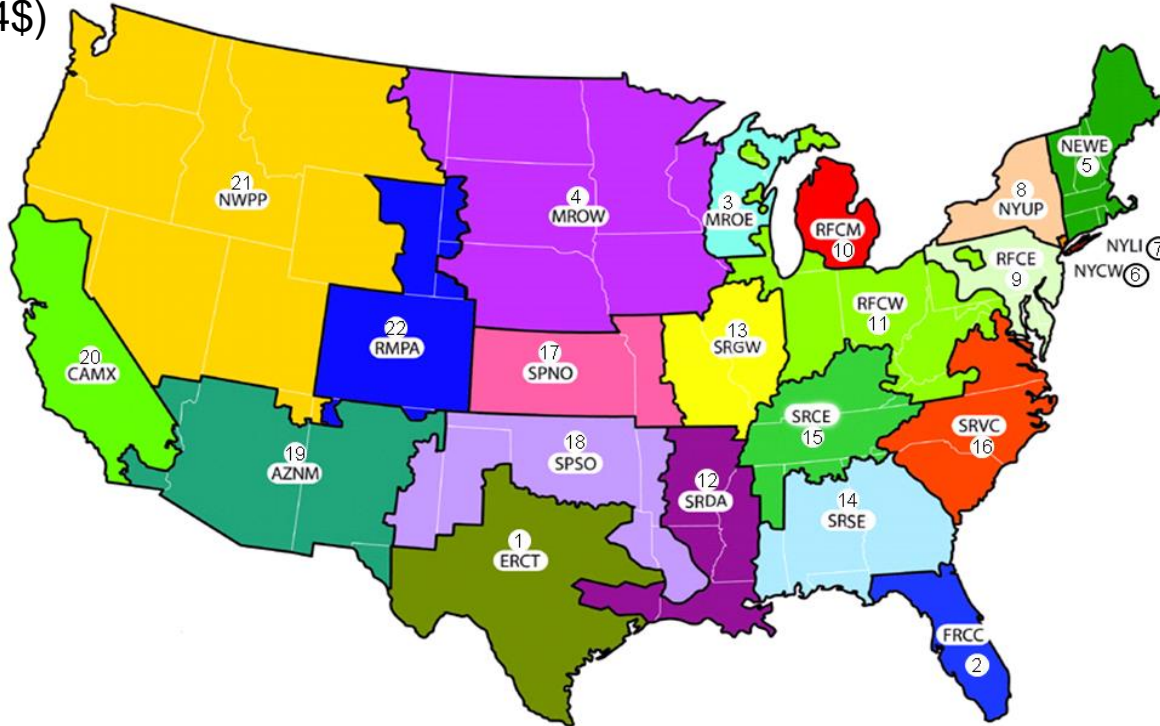
Total Overnight Capital Costs (2014\$/KW)



* Technology specification on some items may have changed from report to report. Pulverized coal has changed from super-critical to ultra-supercritical with 30% CCS.

New wind costs yield a capacity-weighted average of approximately \$1770/kW (in 2015\$), when compared to 2014 capacity additions

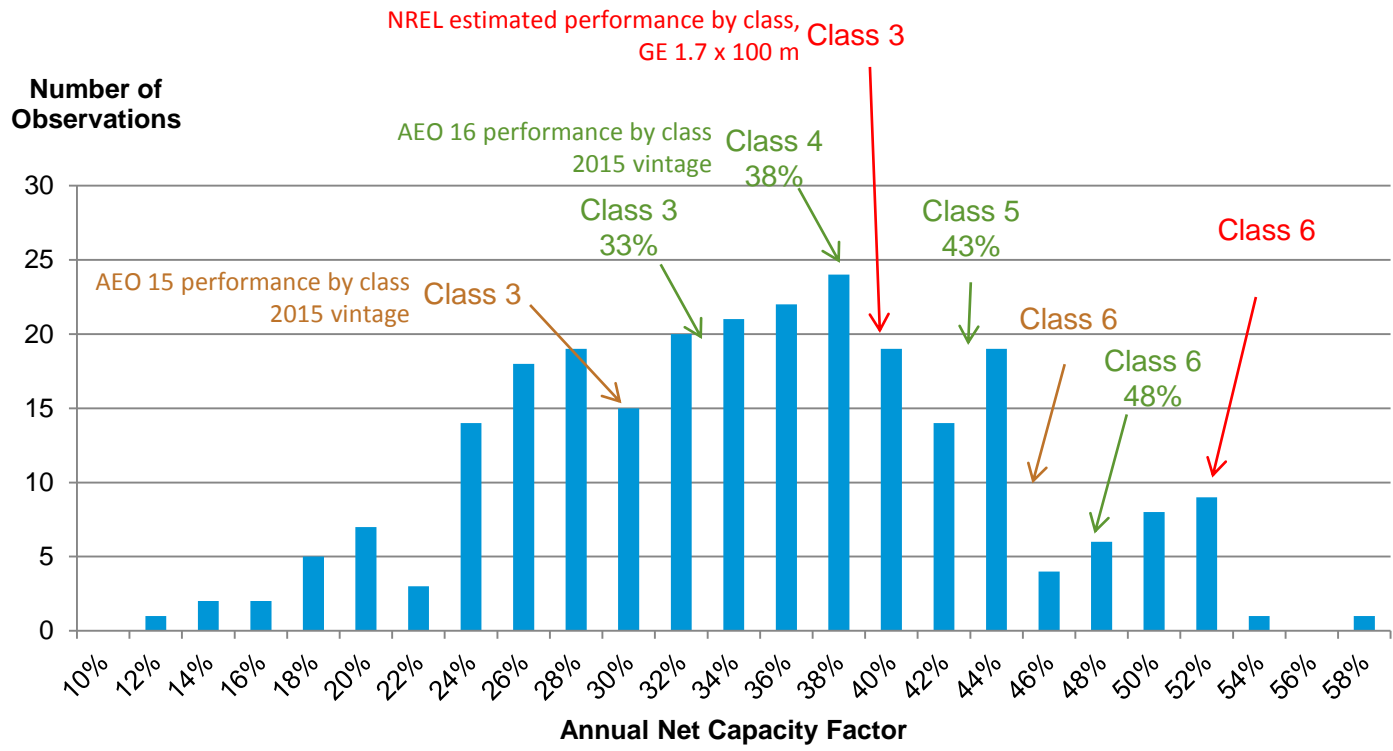
- LBNL reports \$1743/kW cap-wt average for 2014 (2015\$, reported as \$1710/KW in 2014\$)



	Region																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Net Reg. Cost (2015\$/KW)	1,654	2,444	2,256	1,861	2,301	2,301	2,301	2,301	2,301	2,256	2,256	2,444	2,256	2,444	2,444	2,444	1,555	1,555	2,021	2,021	2,021	1,555
2014 New Cap. (MW)	577	0	0	1,259	0	0	0	37	0	317	240	0	0	0	0	0	0	1781	0	331	20	235

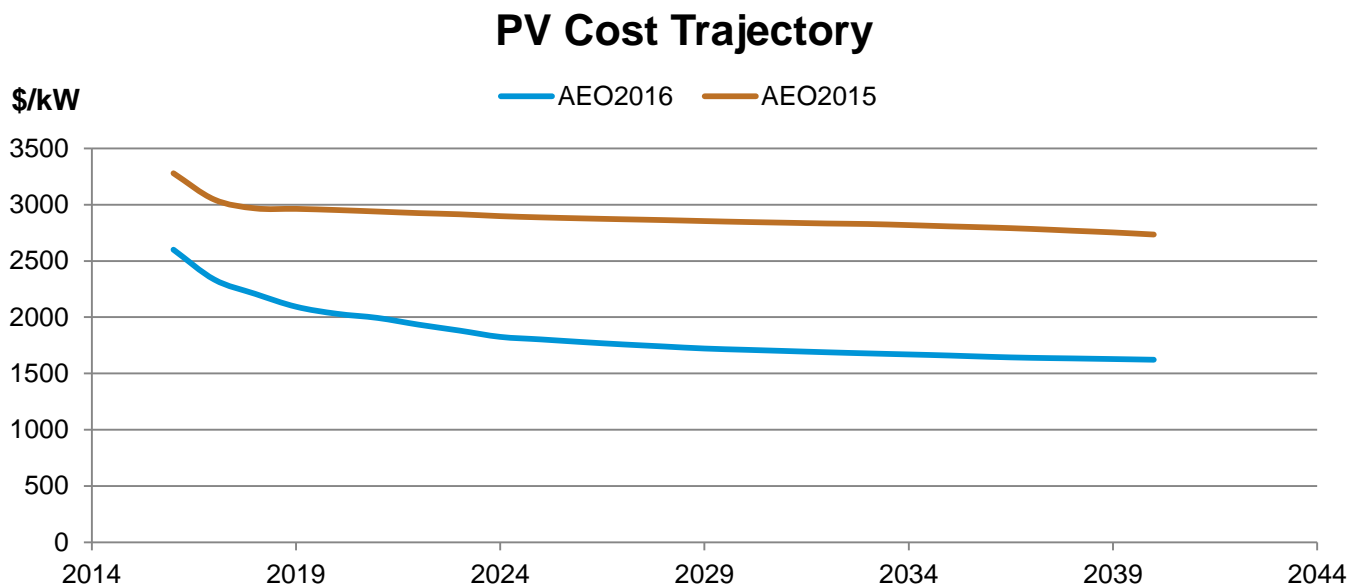
EIA has adjusted capacity factor assumptions up by 3 pts to reflect recent turbine models

CF Distribution, Wind Plants Built in 2011-2013



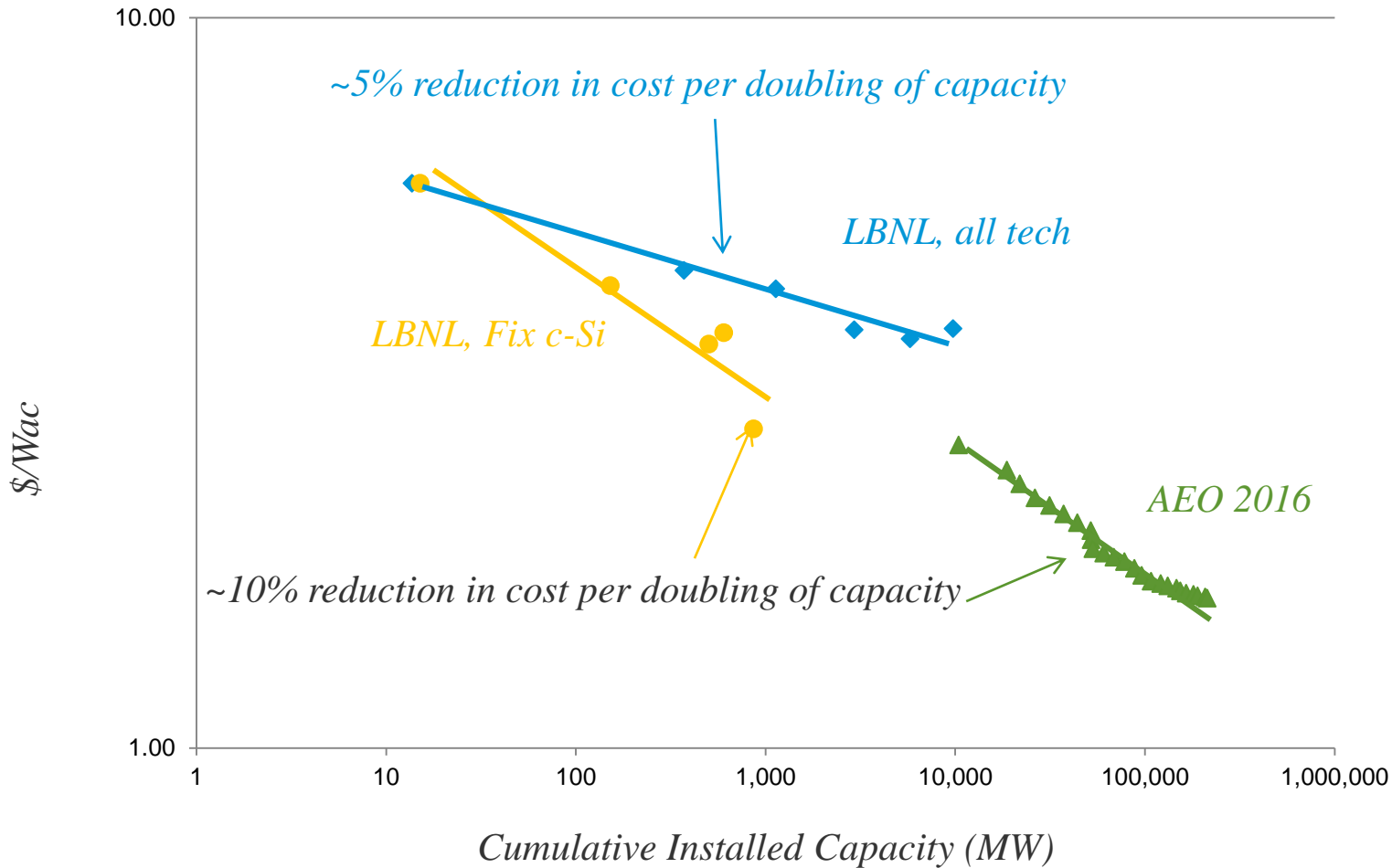
- However, cap-wt avg. capital costs approx. match recent installations
 - Performance also reflects performance of the fleet, not just an individual model

Solar PV costs decline sharply in the short-term, and continue to decrease slowly in the long-term



- Initial PV costs are ~20% lower; increased PV uptake results in faster, deeper cost reductions over time
- For 2014, LBNL reports \$3,800/kW cap-wt average (all tech), with \$2,800/kW median for fixed-tilt c-Si

EIA PV learning is more optimistic than fleet average, similar to fixed tilt average



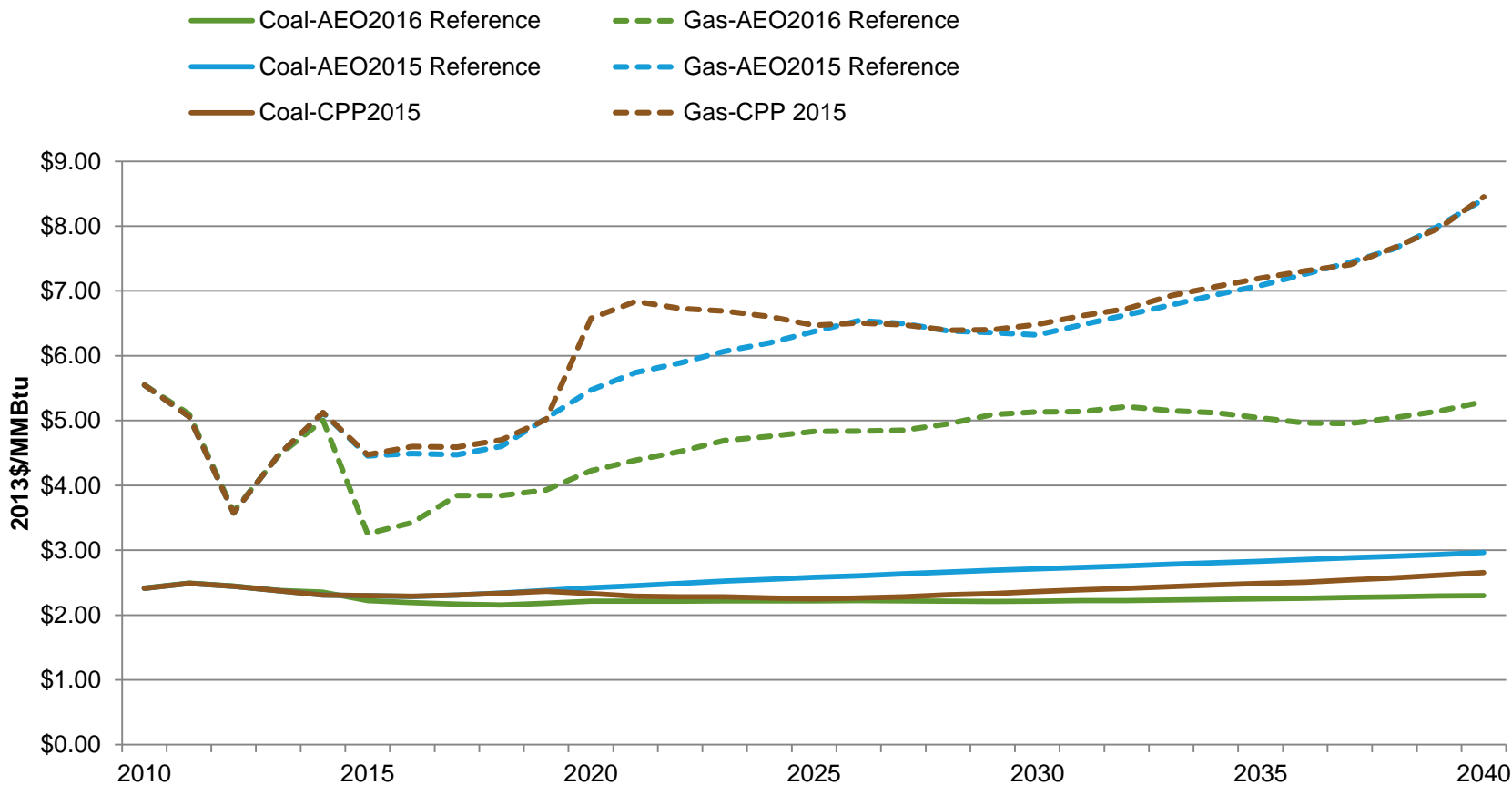
- Note: AEO shows gross cost reduction from learning and macro cost adjustments

Results

Summary results changes in renewables

- More renewable capacity additions through 2025 and 2030-2040. Renewable capacity is over 30% higher by 2040 in the AEO2016 than AEO2015, primarily from solar PV and wind.
- Growth results from 3 major changes to AEO
 - Extension and phase-out of federal tax credits
 - Implementation of the Clean Power Plan
 - Lower initial cost assumptions
- Natural gas prices still play a big role in renewable electricity markets
- Mass-based CPP implementation is less favorable to renewables than rate-based

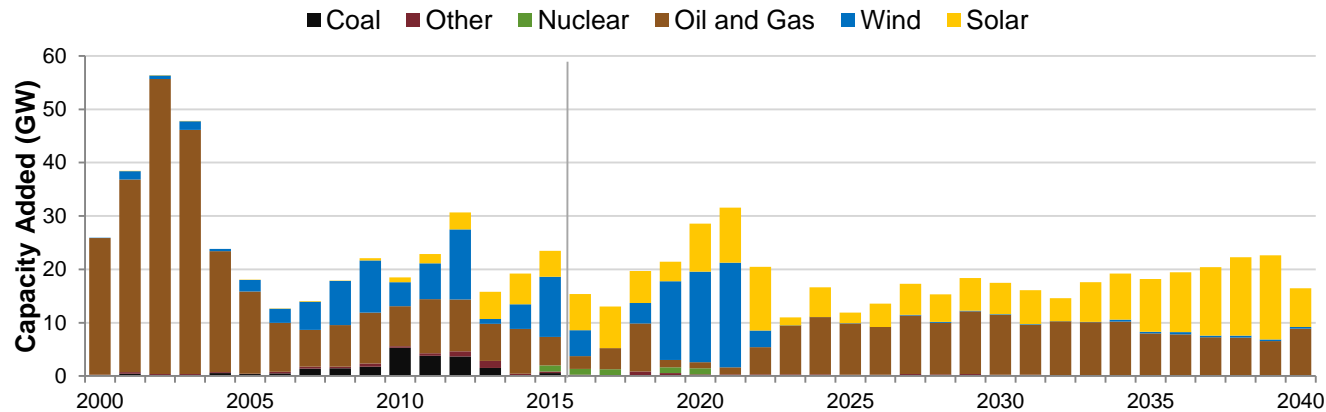
Natural Gas prices are significantly lower than AEO 2015



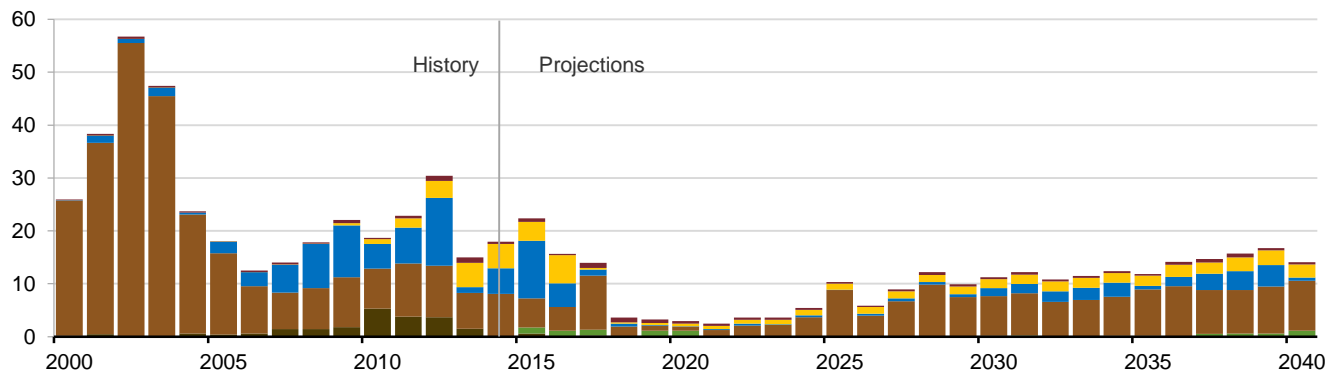
Source: Ref2016.0206a, Ref2015.0209a, rf15_111_all.0306a

Additions to electricity generating capacity in the AEO2015 Reference case, 2000-2040

AEO2016 Reference

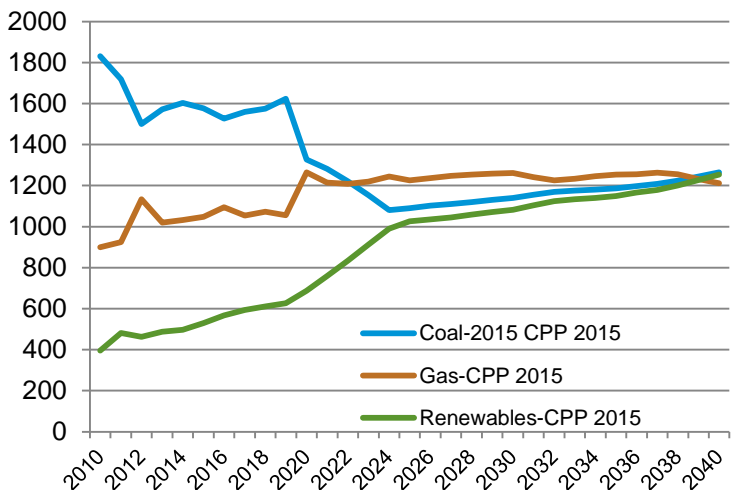
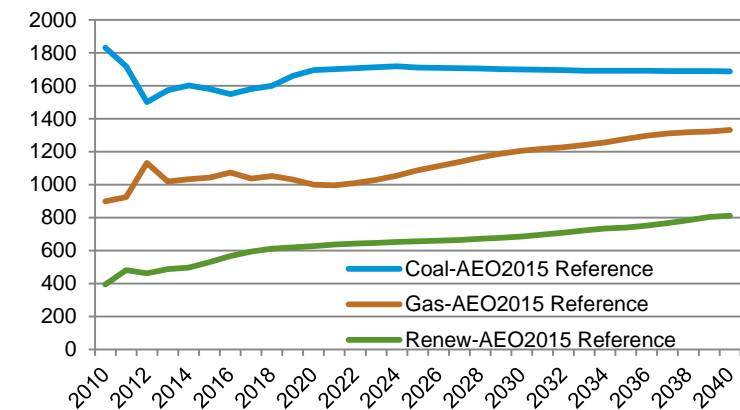


AEO2015 Reference

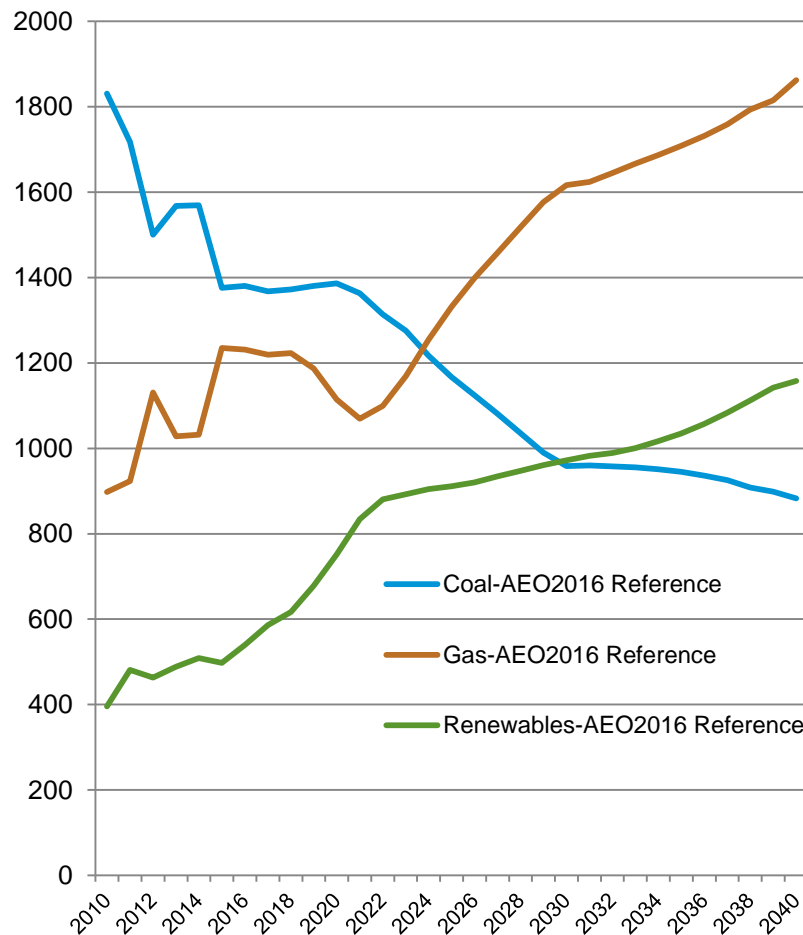


Natural gas and coal-fired generation, EIA CPP Study 2015 vs. preliminary AEO2016

Billion kilowatthours



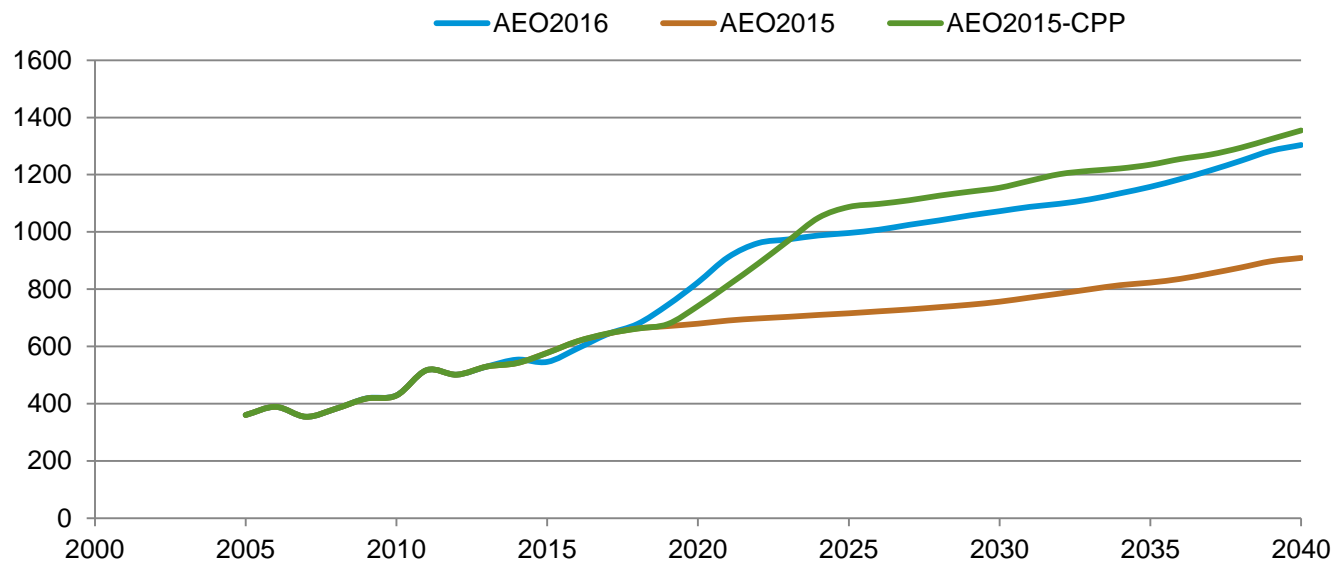
Billion kilowatthours



Source: Ref2016.0206a, Ref2015.0209a, rf15_111_all.0306a

Renewable generation in AEO2016 is 43% higher by 2040 than in AEO 2015, but lower than proposed CPP rule analysis

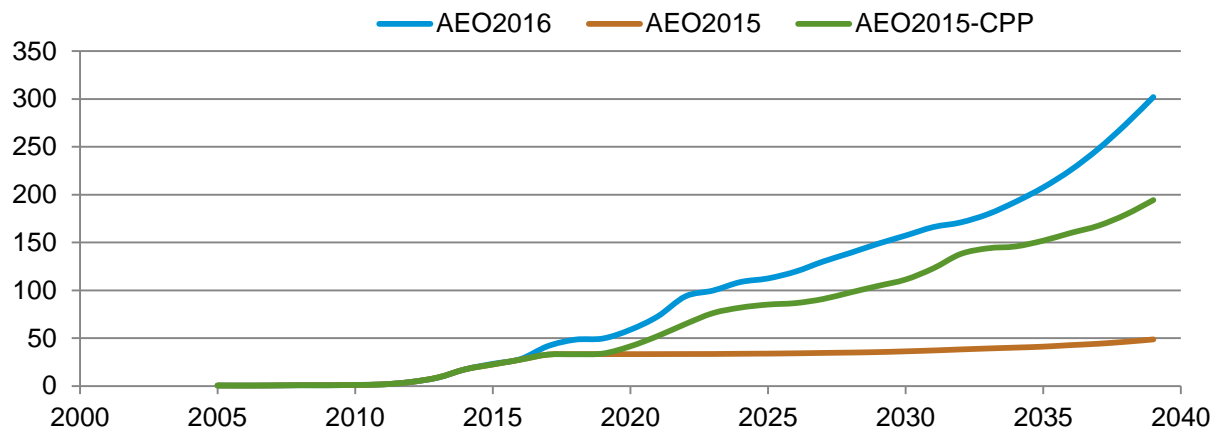
Renewable Generation (bill KWh)



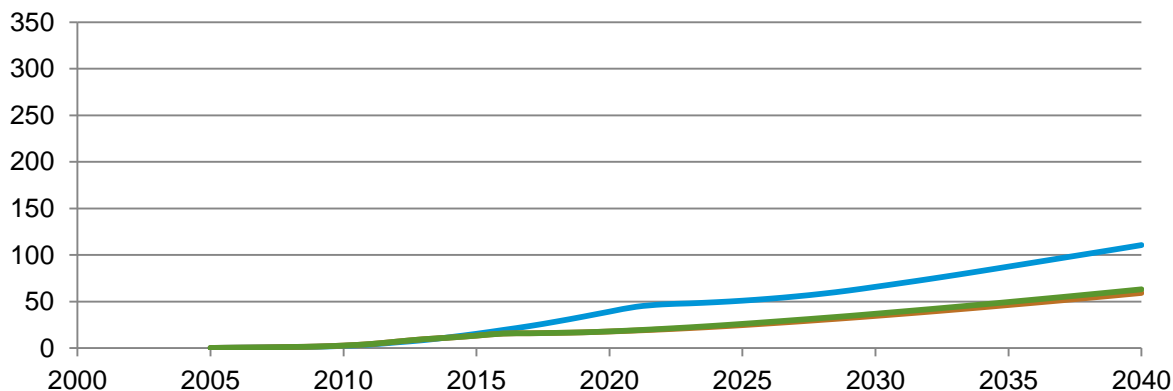
Source: Ref2016.0206a, Ref2015.0209a, rf15_111_all.0306a

Solar grows to over 200 GW by 2040, with growth in both utility and distributed sectors

Utility Solar (bill KWh)

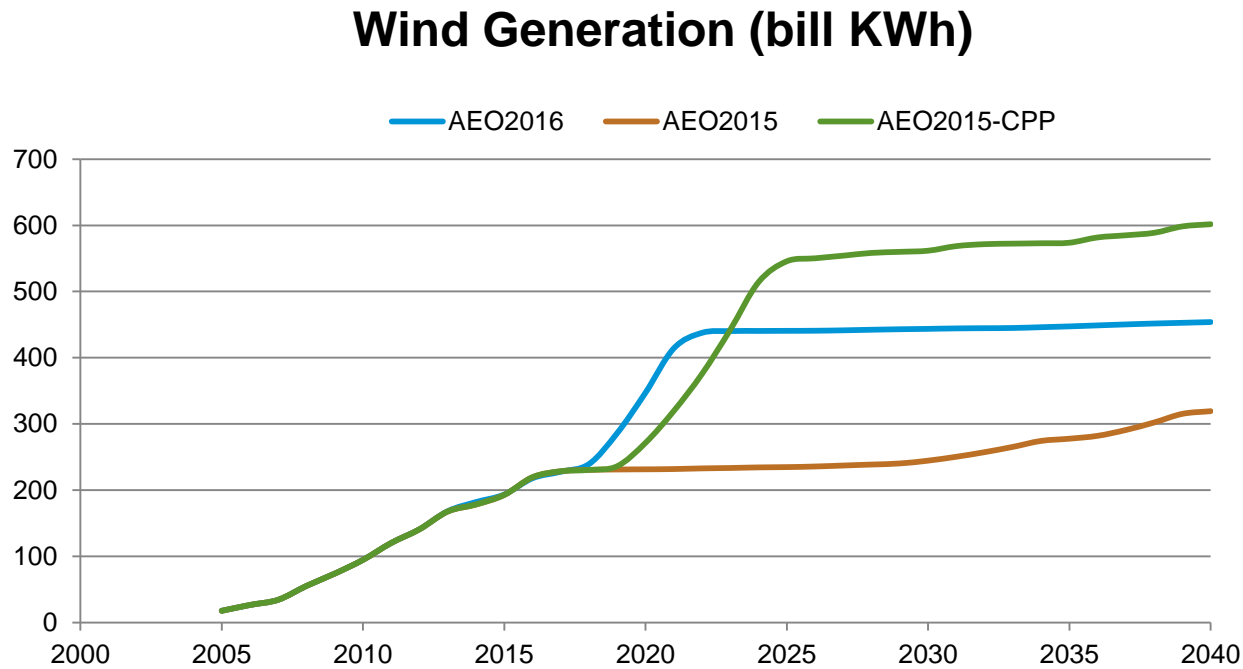


Solar PV--End Use (bill KWh)



Source: Ref2016.0206a, Ref2015.0209a, rf15_111_all.0306a

Wind generation by 2040 is 42% higher in AEO2016 than in AEO2015, but lower than rate-based proposed CPP rule analysis

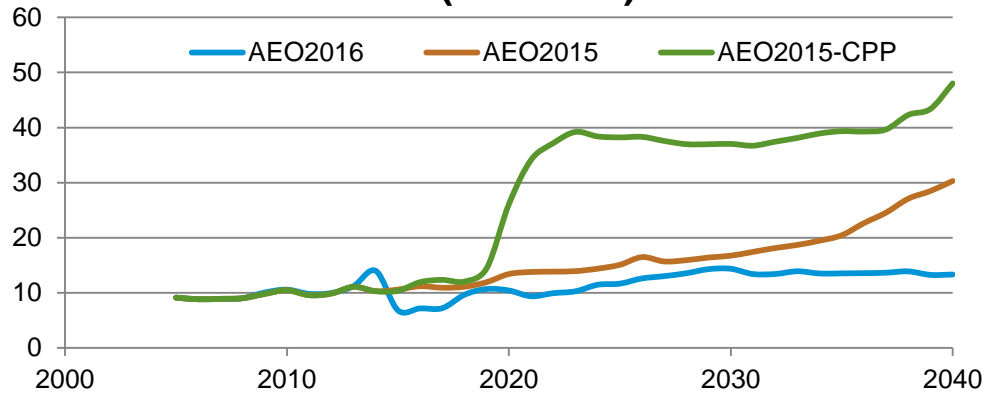


Source: Ref2016.0206a, Ref2015.0209a, rf15_111_all.0306a

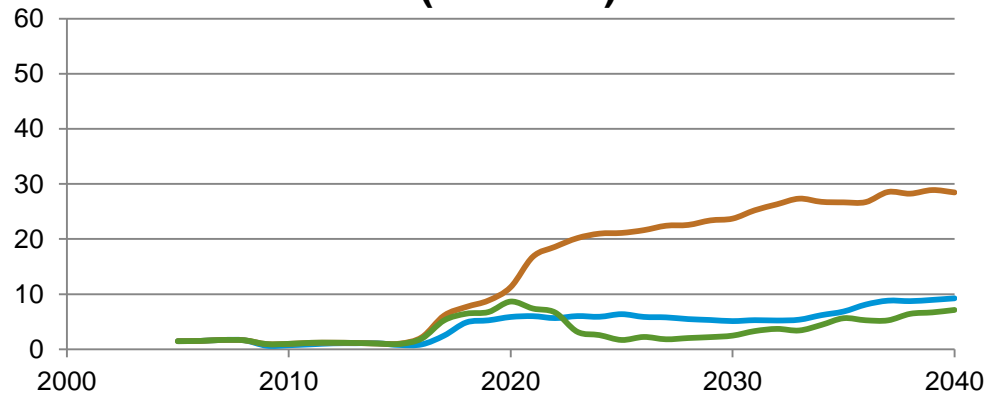
- Near-term growth is accelerated by PTC extension
 - In longer-term, PV and low NG prices constrain growth

Biomass generation is down at both dedicated and co-fired facilities relative to AEO 2015

Generation at dedicated biomass plants (bill KWh)



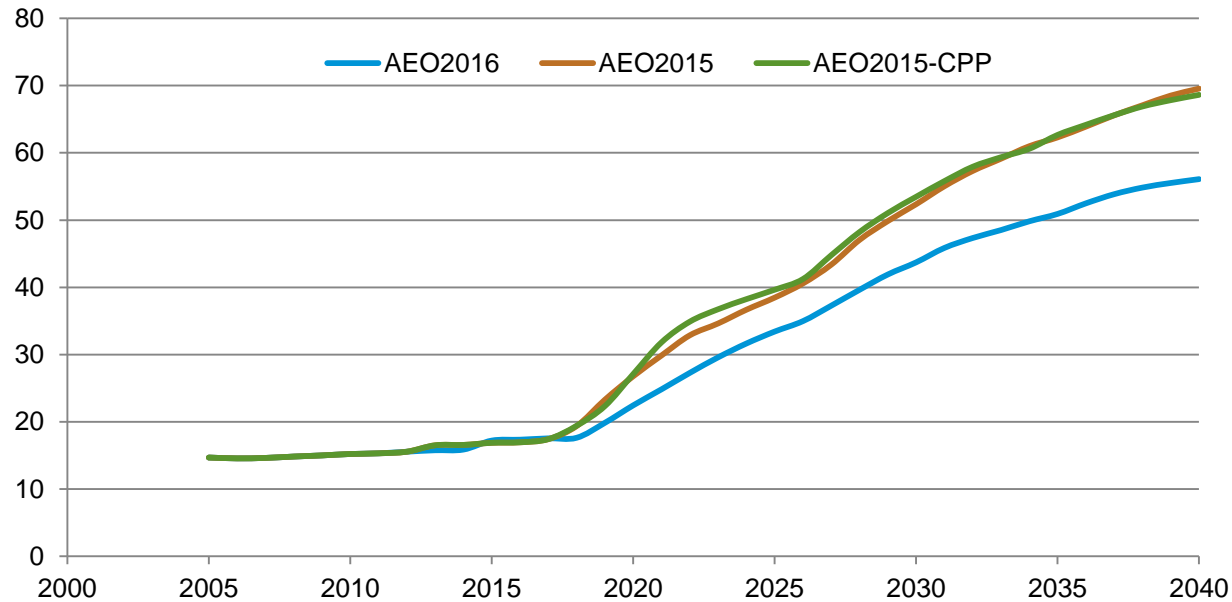
Generation at cofiring biomass plants (bill KWh)



Source: Ref2016.0206a, Ref2015.0209a, rf15_111_all.0306a

Geothermal growth is also constrained by more competitive PV and natural gas

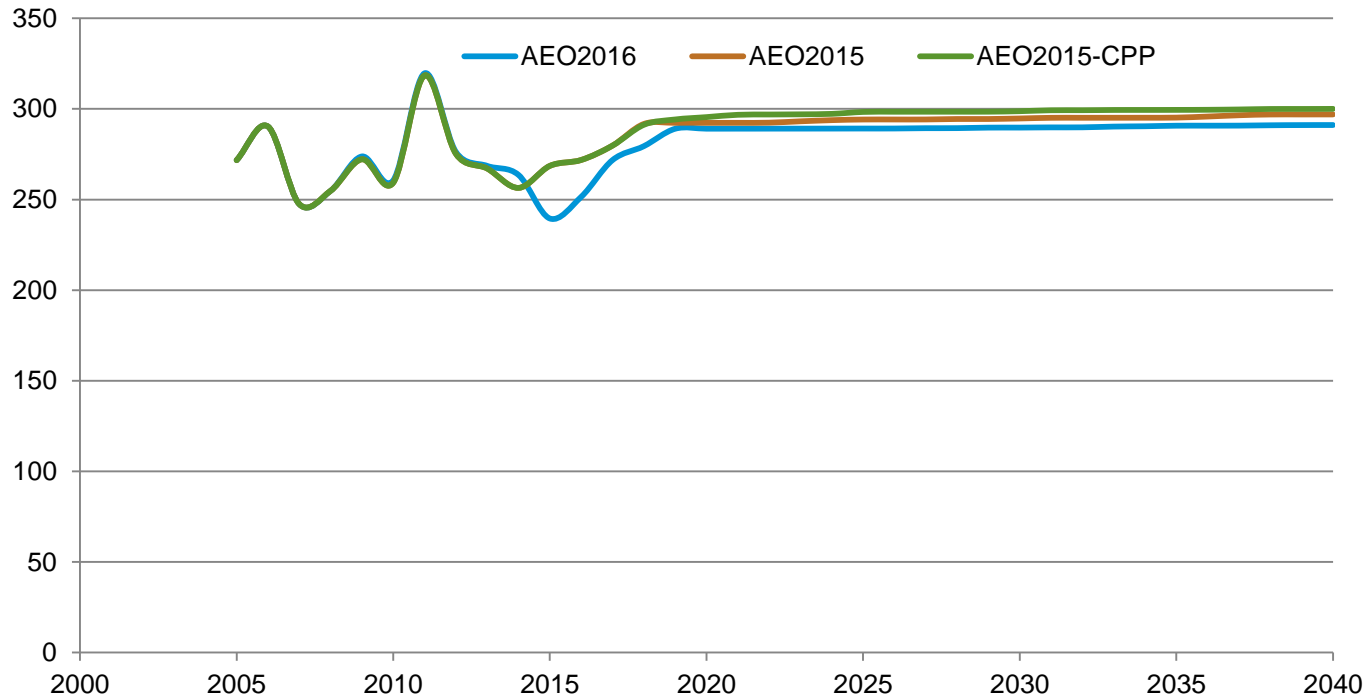
Geothermal Generation (bill KWh)



Source: Ref2016.0206a, Ref2015.0209a, rf15_111_all.0306a

Hydroelectric maintains historical generation levels

Hydroelectric Generation (bill KWh)



Source: Ref2016.0206a, Ref2015.0209a, rf15_111_all.0306a

For more information

U.S. Energy Information Administration home page / www.eia.gov

Annual Energy Outlook / www.eia.gov/aeo

Short-Term Energy Outlook / www.eia.gov/steo

International Energy Outlook / www.eia.gov/ieo

Monthly Energy Review / www.eia.gov/mer

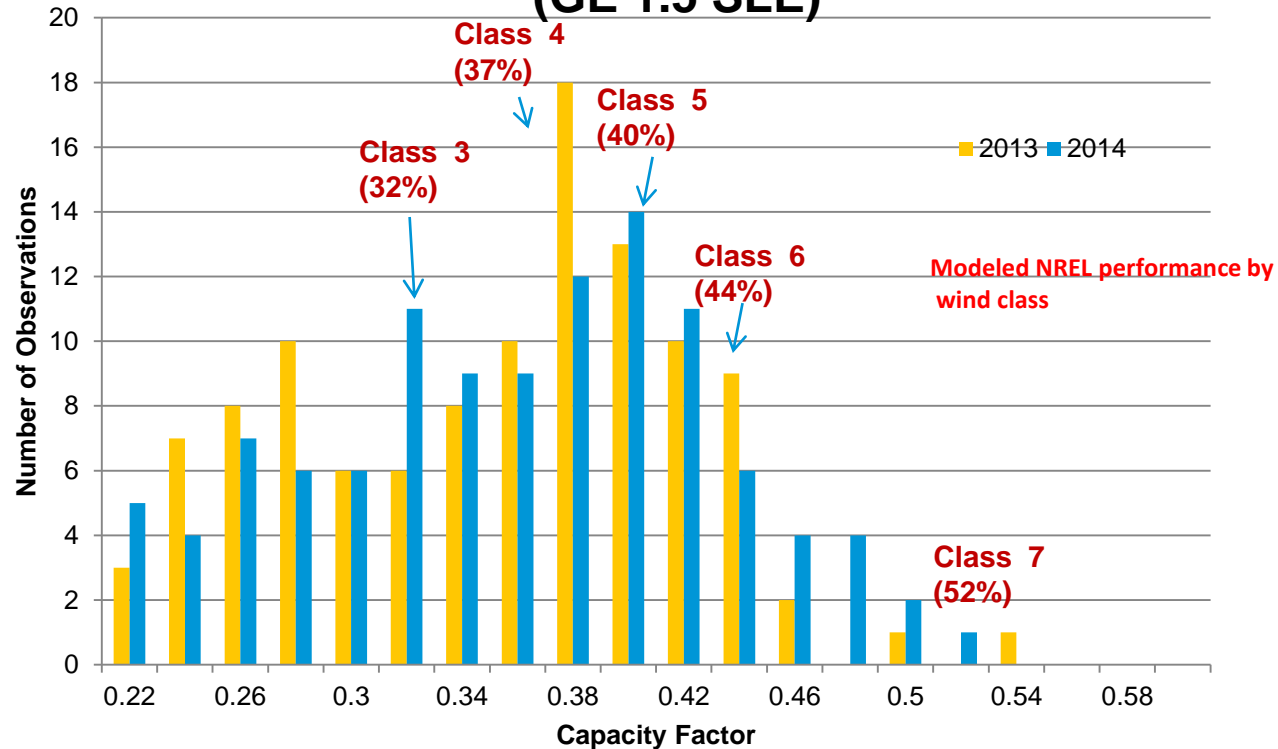
Today in Energy / www.eia.gov/todayinenergy

State Energy Portal / www.eia.gov/state

Supplemental Slides

NREL “modeled” turbine performance provides a reasonable bracket around observed performance for popular models

Frequency Distribution of Capacity Factors (GE 1.5 SLE)



- Newer model used by Leidos lacks sufficient data for calibration
- Modeled performance skews a bit high

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/re-dispatch will create opportunities for new capacity not seen in several years