

Annual Energy Outlook 2018: Preliminary Results for Electricity, Coal, Nuclear, and Renewables



For

*Joint Session- AEO2018 Working Groups
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By

EIA, Office of Electricity, Coal, Nuclear & Renewables Analysis

Summary

- Significant developments for AEO2018 cycle
- Present preliminary AEO2018 outlook results
- Open discussion

Significant electric sector model development for AEO2018

Electricity/Nuclear

- Addressing review/revision of existing federal air regulations for generators
- Explicit modeling of generation at economic risk
- Electric generating capacity updates
- Initiation/modeling of state programs to support nuclear generation
- Analysis of local market conditions to evaluate economic risk factors at individual nuclear plants

Renewables

- Improved representation of renewable generation resources
- More detailed representation of state RPS programs
- Changed capital cost structure of generating technologies to better account for renewable tax credits

Coal

- Addressing revision of existing rules affecting cost of coal mining

Status of the Clean Power Plan remains highly uncertain, although the nature of the uncertainty has shifted since AEO2017

- EPA review of the Clean Power Plan (CPP)
 - No final decision to date, but publicly stated preference for repealing the ruling “as-is”
 - Not clear from available information what, if anything, will replace it
 - EPA vs. Massachusetts still presumably requires carbon regulation
 - The longer the rule is stayed, the more specific CPP deadlines become untenable
- EPA review of Standards of Performance for Greenhouse Gases (NSPS)
 - From New, Modified, or Reconstructed Stationary Sources: Electric Generating Units
- EPA withdrawal of Proposed Rules intended to support implementation of CPP
 - including Model Trading Rule, Clean Energy Incentive Program, etc.
- EIA will continue to publish cases including and excluding the CPP
 - Core side cases will be developed under both scenarios

AEO2018 Cases

- Case with the Clean Power Plan
- Case without the Clean Power Plan
- Core side cases
 - High/low oil price
 - High/low economic growth
 - High/low oil and gas resource and technology
- CPP/No CPP alternative cases for particular side cases
- Additional side cases currently under consideration
 - Extended Policies
 - Energy Storage
- Unless otherwise noted, preliminary “AEO2018” results shown in this presentation include the CPP to facilitate comparisons with AEO2017

Electricity/Nuclear Updates

Modeling the economic risk for nuclear units in AEO2018

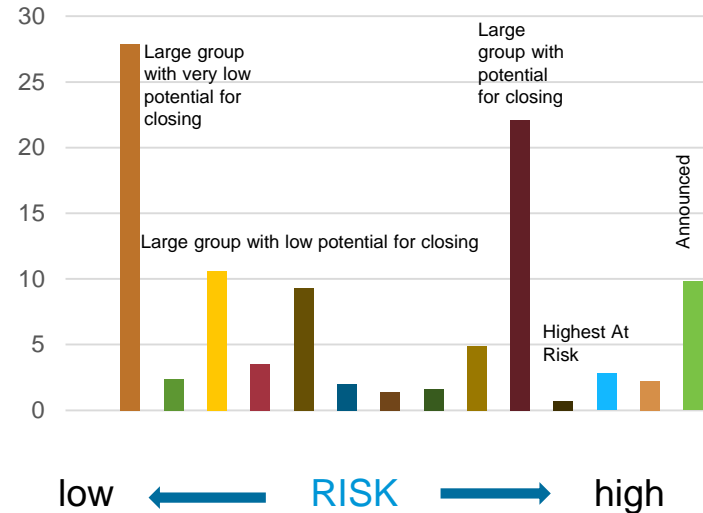
- Define nuclear units at economic risk as those with 3+ years of “negative net revenues” (projected revenues insufficient to cover projected costs)
- Currently analyzing scenarios to evaluate higher levels of fixed O&M prior to developing final inputs
 - Minimum= 110% of plant-level O&M
 - Maximum= 150% of plant-level O&M
- Still analyzing the price variability experienced by nuclear units (zonal prices vs. region-wide pricing)

Variety of economic risk issues for the nuclear power fleet

Cost and Revenue Risk Issues

- Local market prices (actual)
- FOM costs (\$/MWh)
- Market structure (reg/dereg)
- Demand trend (near flat)
- Technical (aging cost)
- State RPS (renewable wedge)
- State Price Support (life line)
- Grid Congestion (temporary ?)
- Growth in natural gas use

Potential nuclear generating capacity retirements
gigawatts

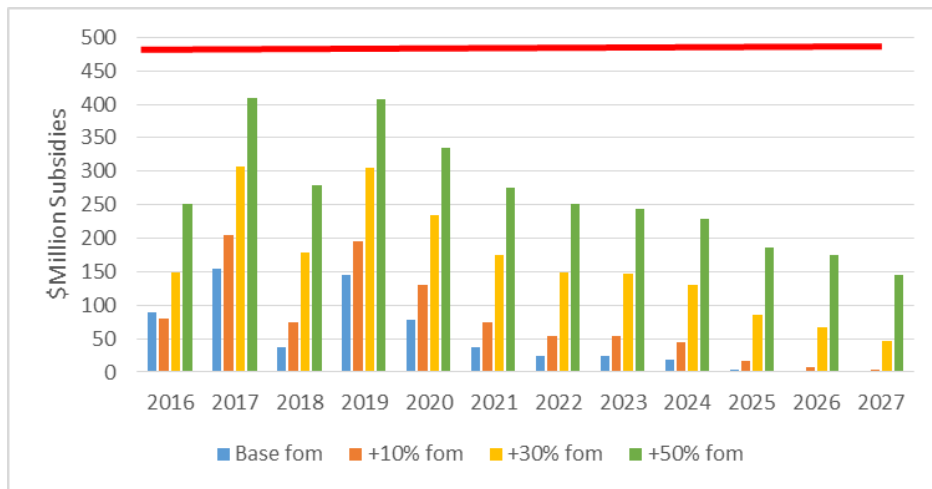


Methodology for inclusion of Zero Emission Credit programs

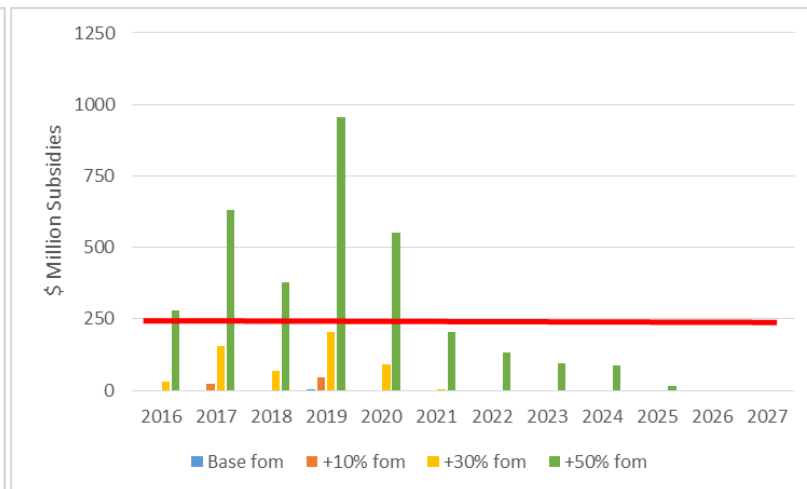
- Require units at economic risk to remain operational over specified period of ZECs programs in NY(12 years) /IL (10 years)
- Determine subsidy representing additional revenues required to overcome net revenue loss and to continue economical operation
 - Adjust subsidy accordingly if specified annual limits are exceeded
- Pass subsidy costs to retail prices as an adder to the distribution component to represent the purchase of ZECs by load-serving entities

Projected ZECs subsidy paid vs. NY/IL program maximum: *Alternative Fixed O&M Cost Cases*

New York (Upstate- EMM Region 8)



Illinois (EMM Regions 11-13)



Renewables Updates

Renewable Electric Power Sector Updates for AEO2018

- **Renewable generation:** Include improved representation of renewable generation resources.
- **Variable renewable integration:** Assess parameters that are impacted by increased generation of non-dispatchable (i.e., variable) generation, such as wind and solar.
- **Curtailement and energy storage:** Integrate energy storage as a capacity expansion option.
- **Potential hydro builds:** Reassess data sources of potential hydro builds.
- **State-level renewable policy:** Enhance representation of Renewable Portfolio Standards (RPS).
- **Utility rate structure:** Reconsider representation of electric power price with increasing deployment of distributed generation to adequately address the ability to recover system costs
- **Project Financing :** Reevaluate cost of capital to finance new generating capacity by owner type.
- **Additional data updates:** Update standard input assumptions as needed.

Progress to date: Renewables

- **Renewable Generation:** Added technology slots for wind turbines with higher hub heights and tracking for solar PV; refining parameters
- **Variable RE integration:** Testing new parameters for maximum regional penetration for wind and solar
- **Curtailement and energy storage:** Refining parameters for a 4 hour storage technology
- **Hydro builds:** Adding data from ORNL on non-powered dams to replace NPD data currently in model
- **State RPS policies:** More detailed RPS model in-place along with revised RPS parameters
- **Utility rate structure:** Developing sensitivity case to highlight policy uncertainty
- **Project financing:** Revised capital structure for wind, solar, and deregulated builds, reverted to regulated financing in regulated regions
- **Additional data updates:** Reviewing regional cost factors for wind and solar; reviewed capacity factor assumptions for wind

EIA is finalizing cost and performance assumptions for new energy storage, solar (tracking), and wind (tall tower) technologies

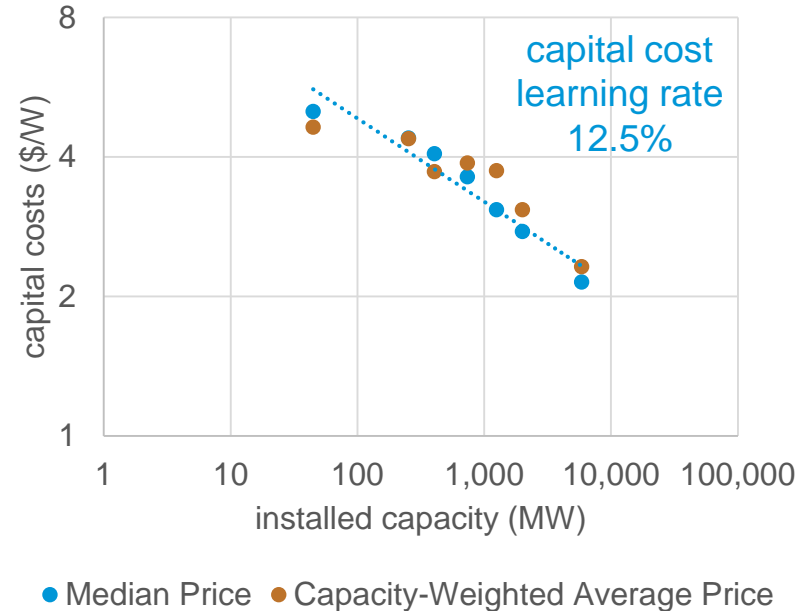
- Utility-scale storage assumptions:

- Size: 30 MW / 120 MWh, Efficiency = 85%
- System costs:
 - Pack costs = \$425/kWh
 - BOS costs = \$670/kW
 - Project contingency cost = 5%
 - Variable O&M = \$8/MWh
 - Fixed O&M = \$40/kW-year

- Solar PV capital cost assumptions:

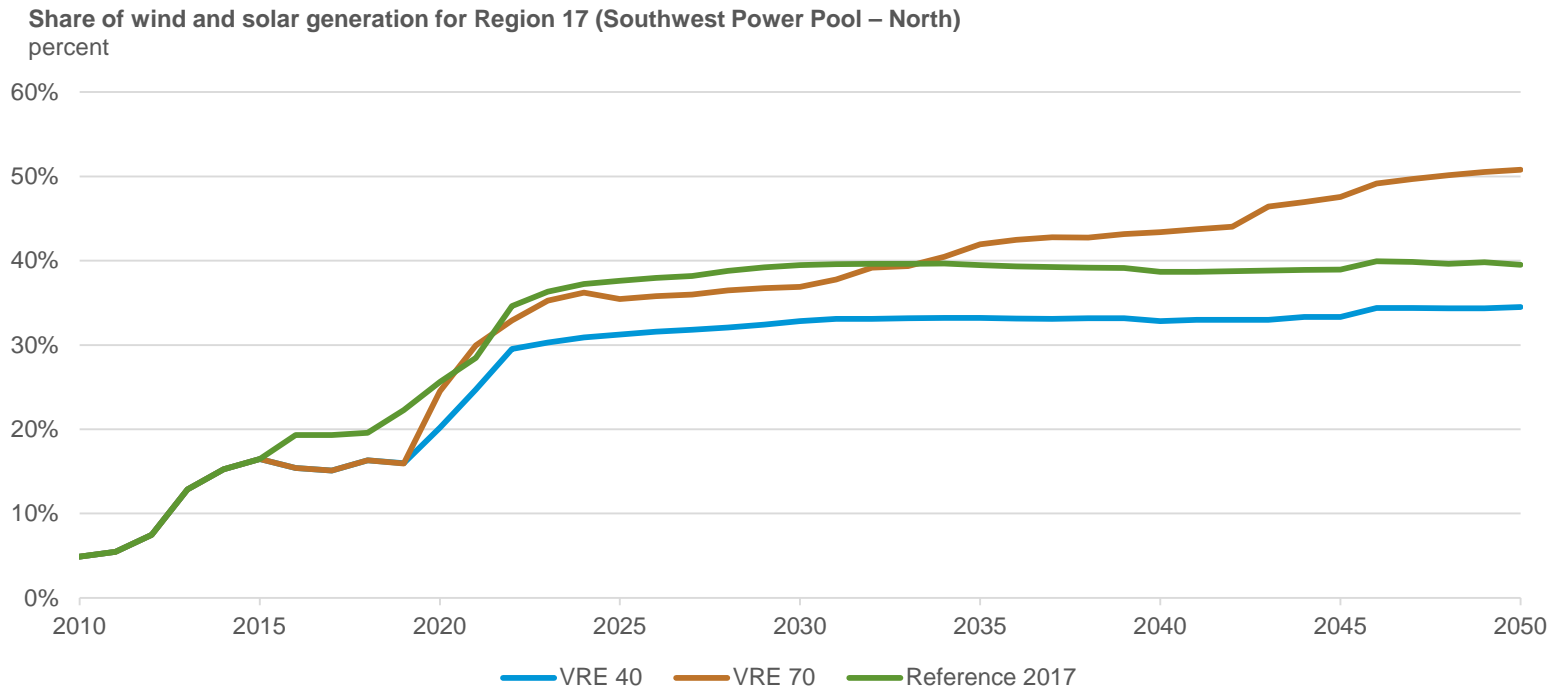
- Capital cost learning for solar PV tracking
- Tracking cost of \$0.15/watt will be used to estimate the fixed axis tracking costs

Utility-Scale solar PV-tracking capital cost learning



Source: EIA, based on LBNL Utility-Scale Solar 2016, <https://emp.lbl.gov/publications/utility-scale-solar-2016-empirical>

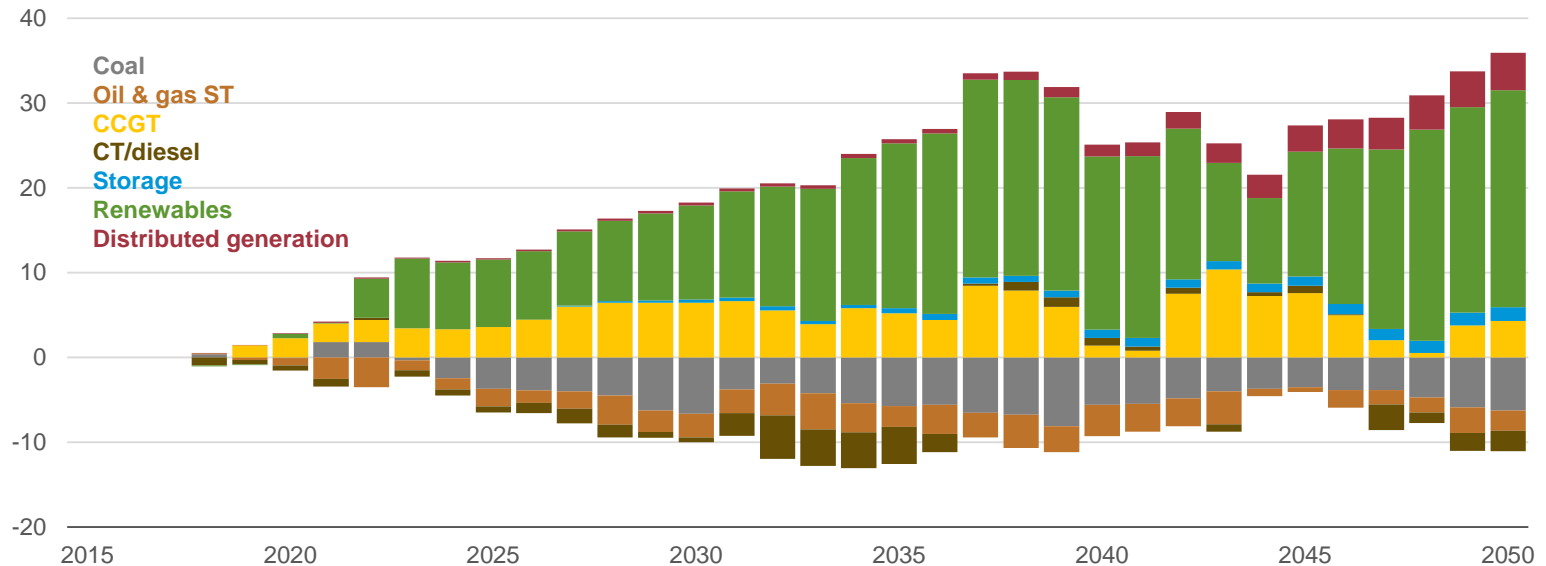
Increasing max intermittent share allows some regions to extend growth beyond 2017 levels



Source: int40_r18.0807a, int70_r18.0807a, ref2017.1208a

The revised cost of capital assumptions result in more renewables & CCGT; less coal & CT

Difference in net summer capacity, revised vs. previous assumptions, by fuel type
gigawatts change

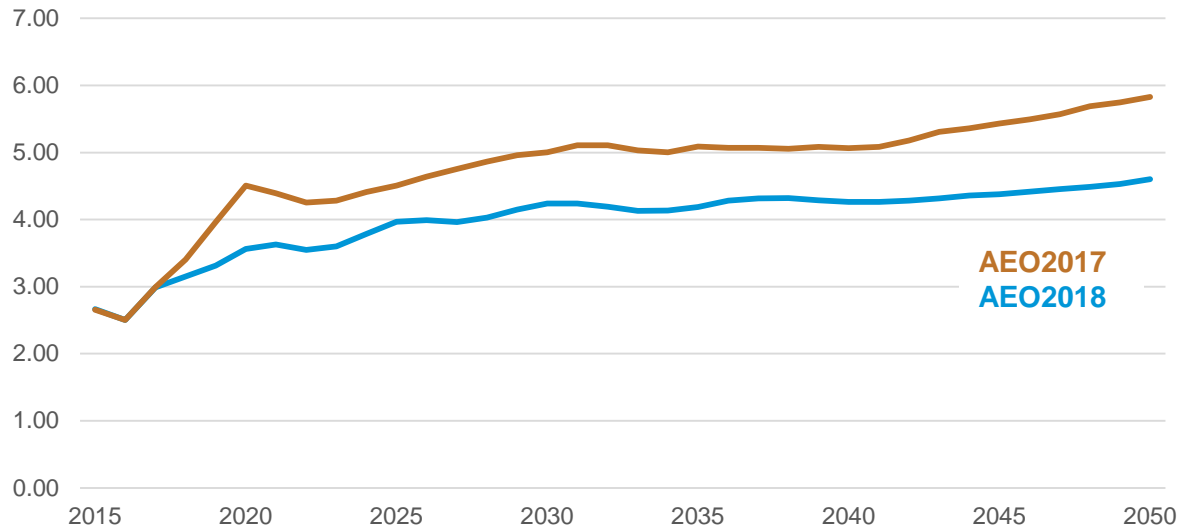


Source: ref2018.0916a, wg2.0918b

Preliminary Results

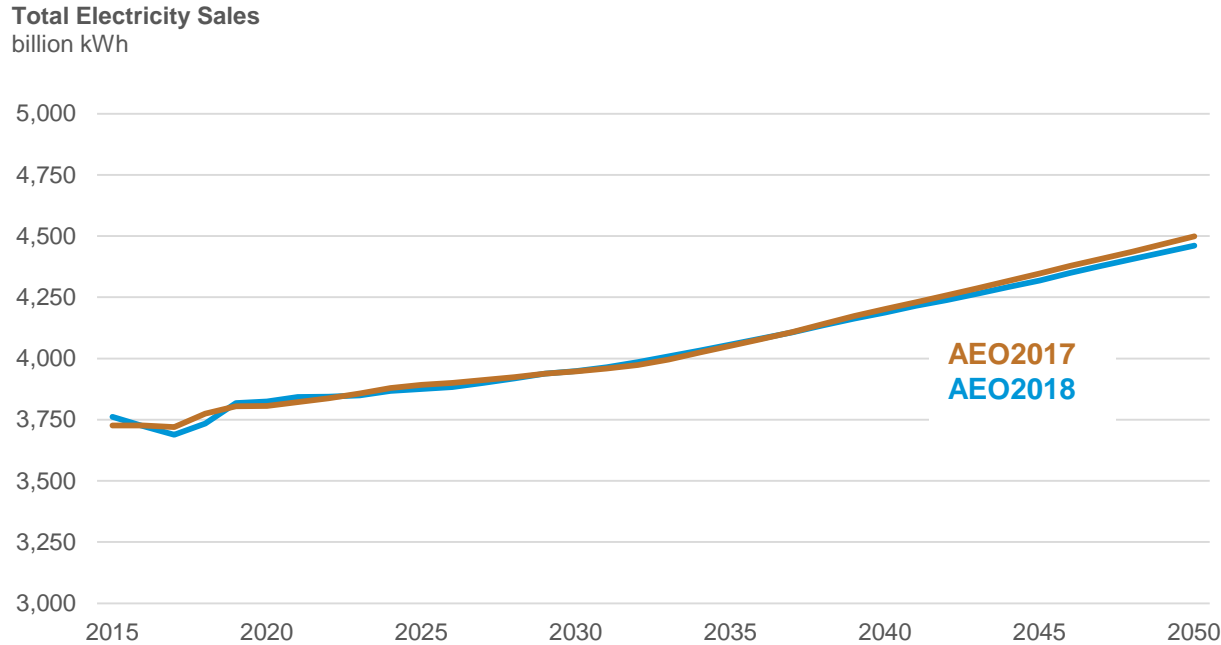
Lower short term natural gas price path in AEO2018, stabilizing at 20-25% lower than AEO2017

Natural Gas: Henry Hub Spot Price
2016\$ per MMBtu



Source: ref2017.1208a, ref2018.0916a

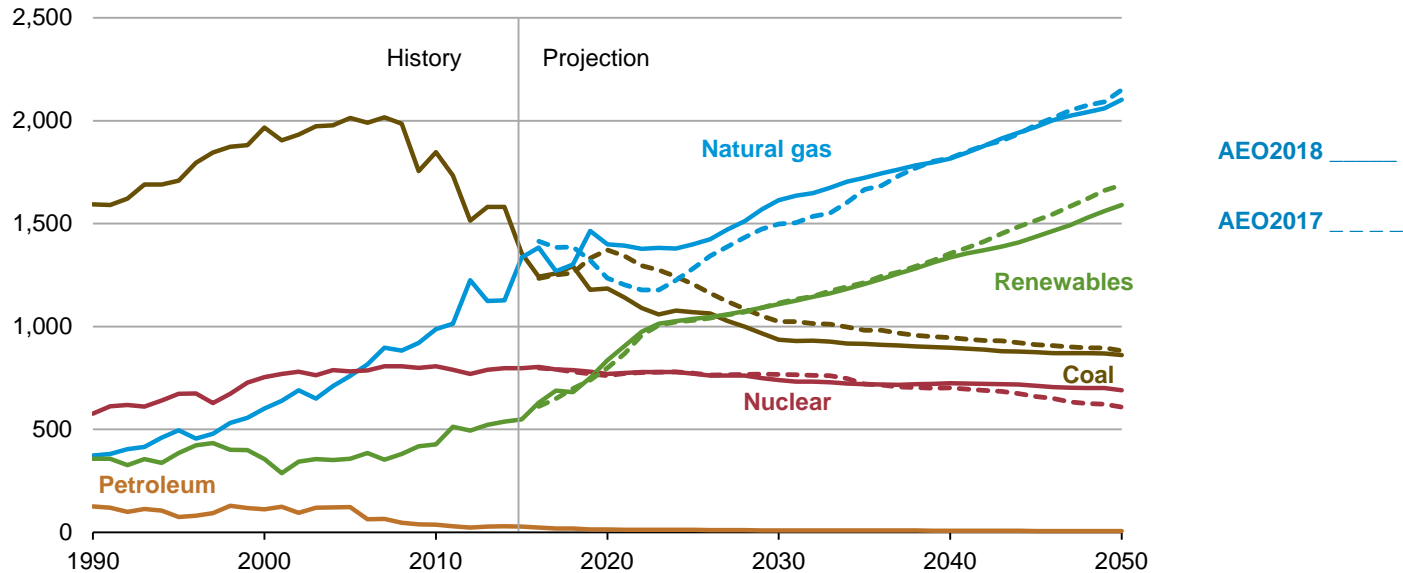
Electricity sales largely unchanged from AEO2017



Source: ref2017.1208a, ref2018.0916a

Generation mix is similar to AEO2017, with slightly less coal and higher mid-term natural gas use due to lower projected natural gas prices

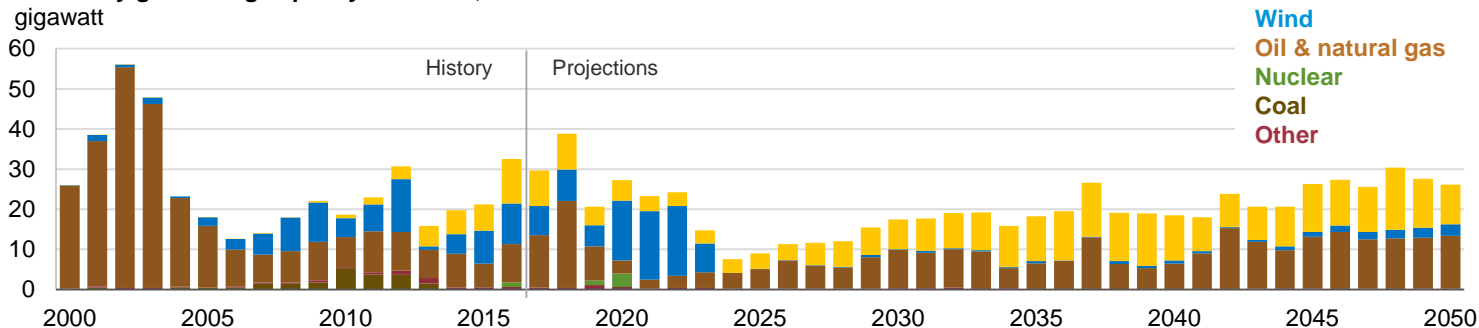
Net U.S. electricity generation
billion kilowatthour



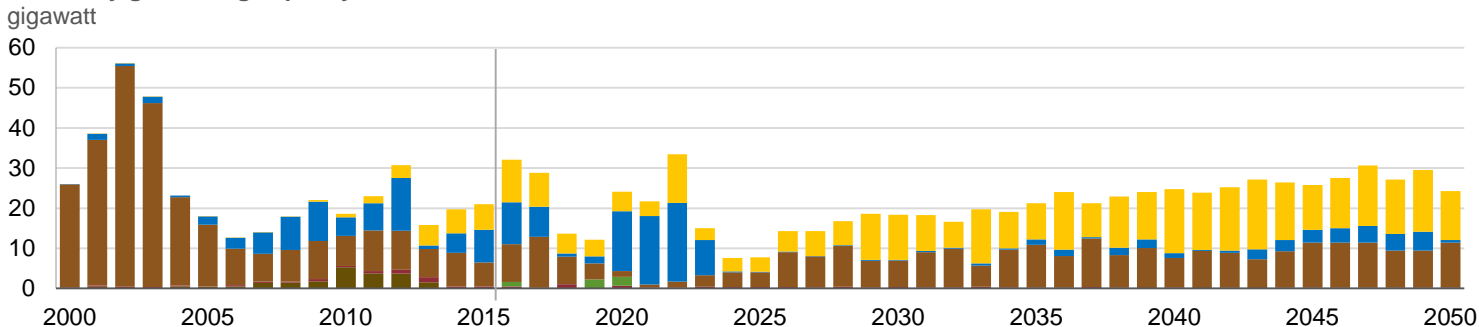
Source: ref2018.d091617a, ref2017.d120816a

Similar to AEO2017, primarily solar and natural gas-fired capacity is added after 2025, with slightly more near-term wind

Electricity generating capacity additions, AEO2018



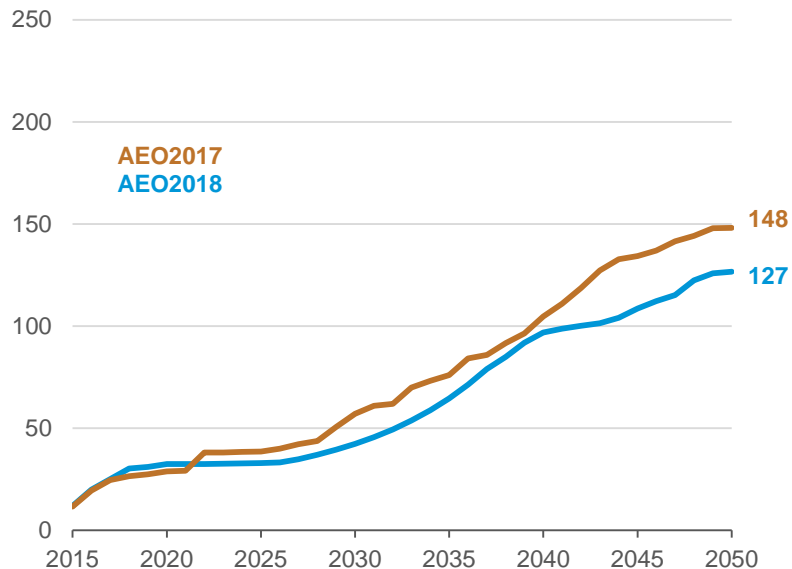
Electricity generating capacity additions, AEO2017



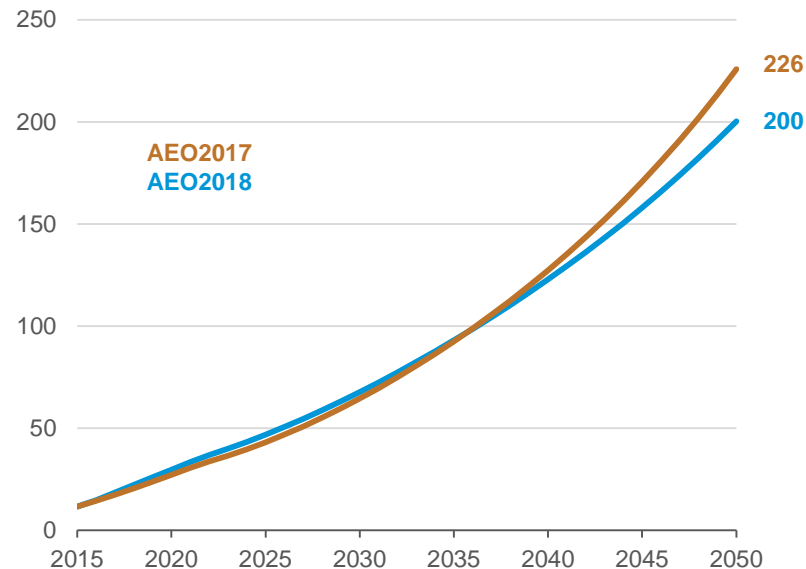
Source: ref2018.d091617a, ref2017.d120816a

Utility and end-use PV capacity is lower due to lower natural gas & electricity prices and a re-specification of the end-use PV model

Utility-scale solar PV generating capacity
gigawatts



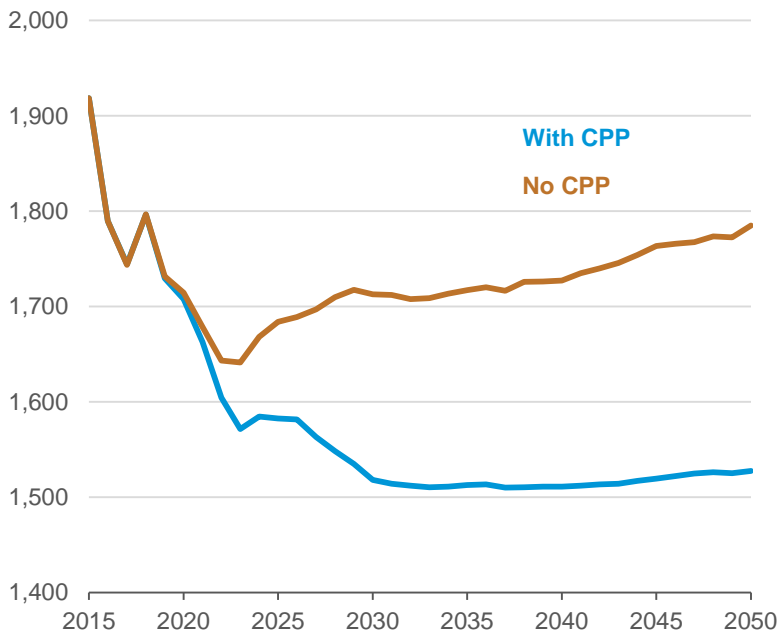
End-use solar PV generating capacity
gigawatt



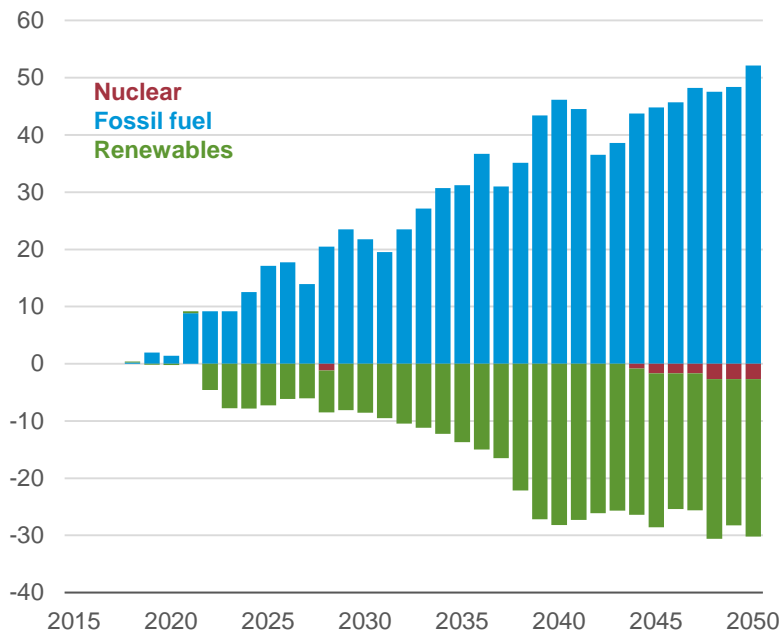
Source: ref2017.1208a, ref2018.0916a

CO2 emissions are higher in the No CPP case as renewables and nuclear generating capacity are lower than in the case with the CPP

CO2 emissions by electric power sector
million metric tons



Generating capacity by fuel type under No CPP case
gigawatt change from CPP case

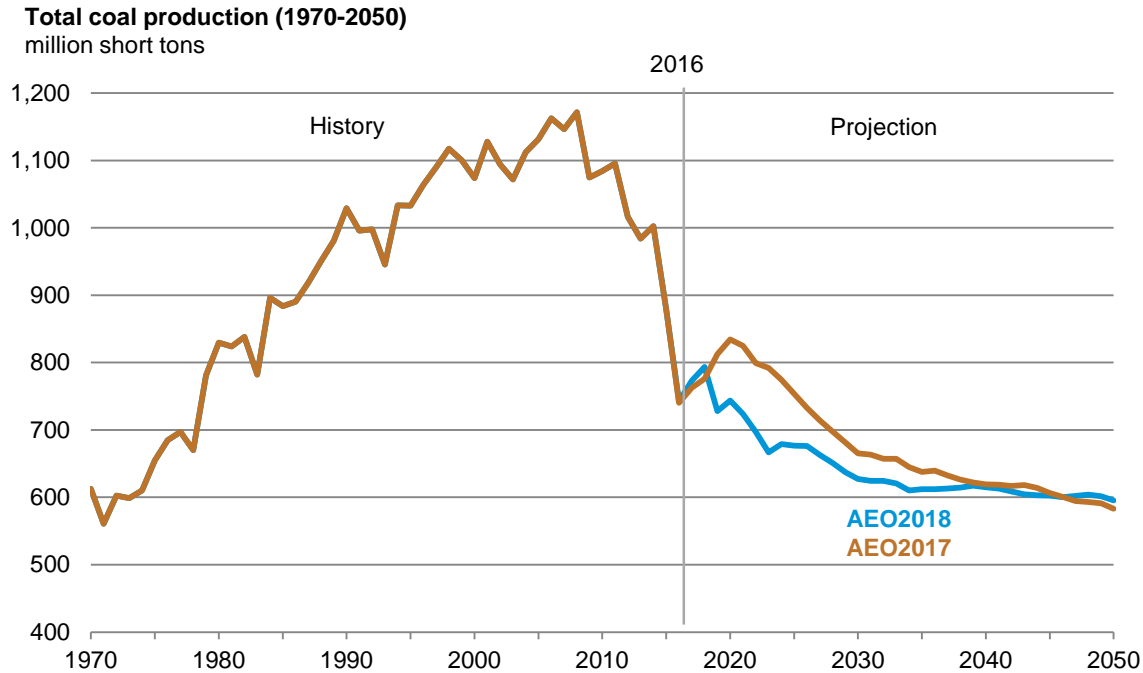


Source: ref2018.0916a, ref_no_cpp.0916a



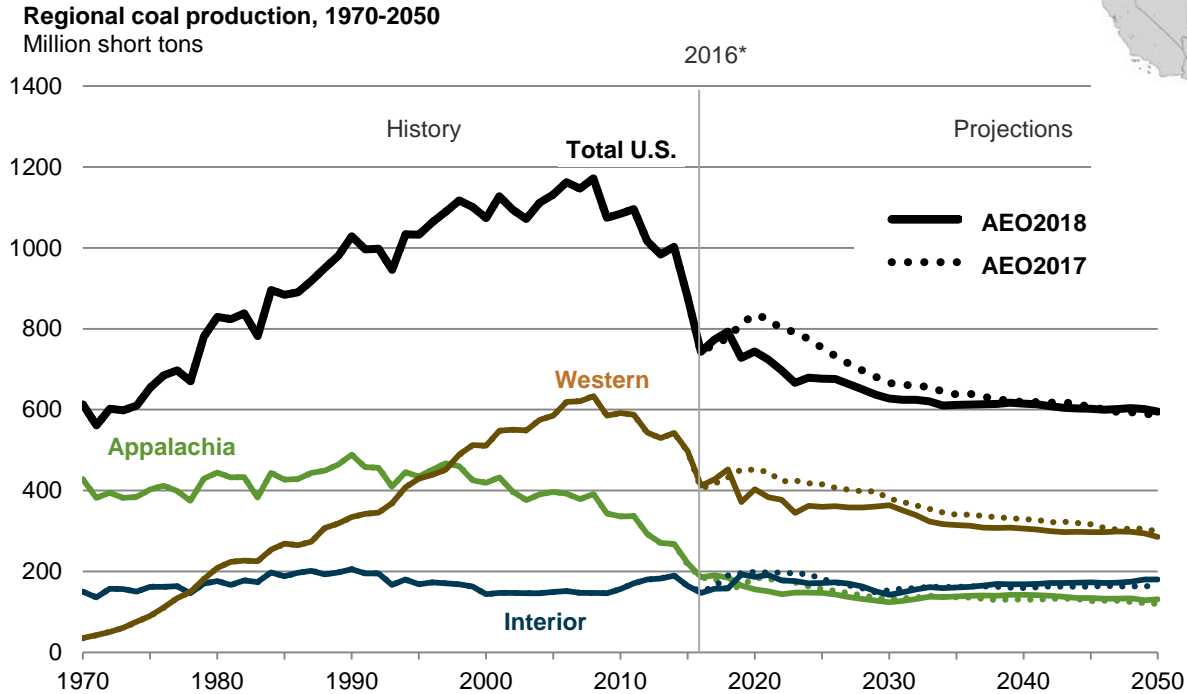
Coal Production and Exports

Total coal production down slightly in short-term, but increases slightly in later year



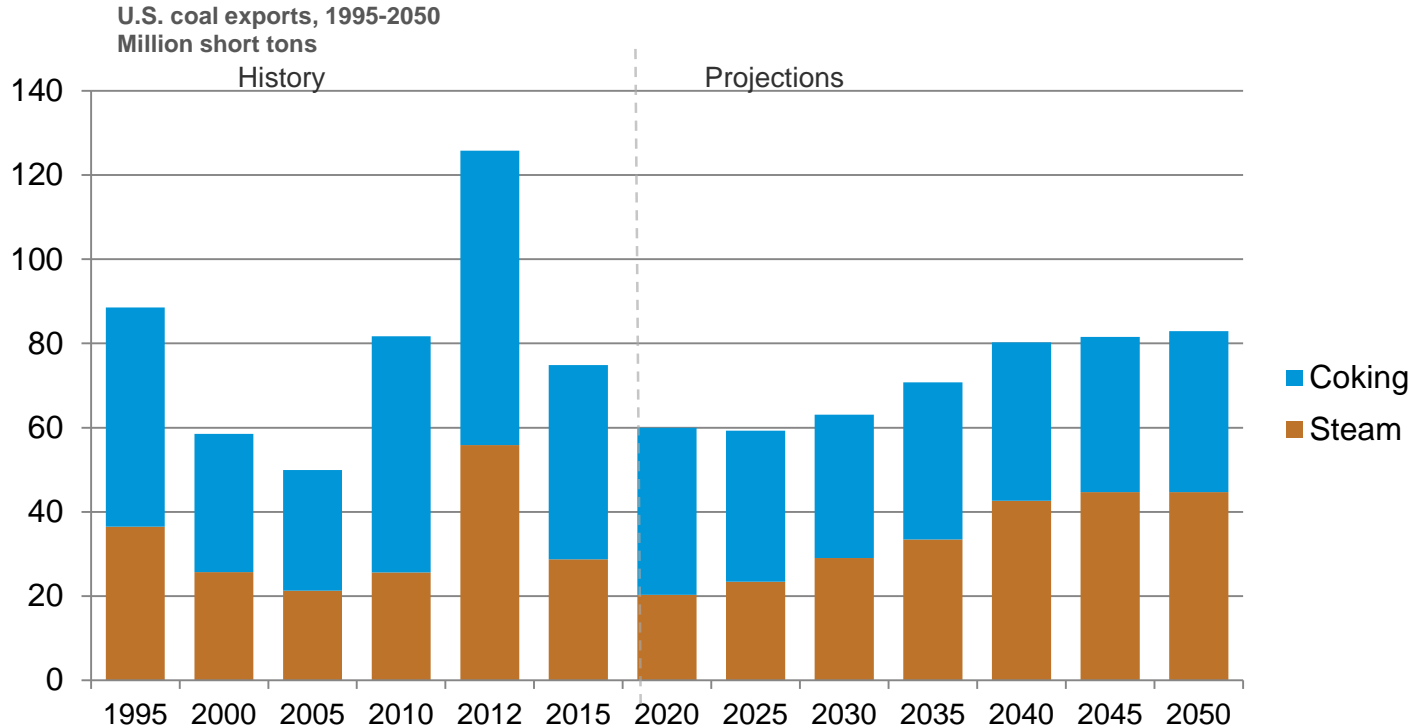
Source: ref2017.1208a, ref2018.0916a *2014 - 2016 data is estimated per the STEO projections

Coal production by region, 1970-2050



Source: ref2017.1208a, ref2018.0916a *2014 - 2016 data is estimated per the STEO projections

U.S. coal exports are expected to recover only gradually through 2050



Source History: U.S. Energy Information Administration, Quarterly Coal Report

Projections: IEO2017 Reference case (Released 9/14/2017)

For more information

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

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

Annual Energy Outlook | www.eia.gov/aeo

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

Today in Energy | www.eia.gov/todayinenergy

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