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AEO2018 1st Coal Working Group Meeting

Coal and Uranium Analysis Team

August 10, 2017 | Washington, DC

Roll Call

Guests (in person)	Affiliation	EIA Staff
Jose' Benitez	Energy Ventures Analysis	David Fritsch, Greg Adams, Bonnie West,
Brian Fisher	U.S. EPA	Elias Johnson, Jim Diefenderfer, David Daniels,
Frances Wood	On Location	Mike Cole, Scott Jell, Rosalyn Berry, Lori Aniti,
		Nilay Manzagol, Laura Martin

Guests (WebEx/phone)	Affiliation	Guests (WebEx/phone)	Affiliation
Justin Wormmeester	BNSF Railway	Jamie Peters	Union Pacific
Gaven Pikenpaugh	NETL	Jennifer DiGiantommaso	U.S. Dept. of Labor
Delma Bratvold	Leidos	Jamie Heller	Hellerworx
Emily Hunter (+6 Others)	U.S. Dept. of Labor / OWCP	Gregory Marmon	Wood Makenzie
Stephen Gigliotti	MSHA	William Meroney	U.S. EPA
Gang He	Stony Brook University	Ron Oster	Peabody Energy
Jerry Eyster	GE Energy Financial Services	Whitney Herndon	Rhodium Group
Brian Shaffer	USGS	James Sutton	GE Power
Sean Nesselt	CSX Transportation	Samir Nandy	EIA Contractor
Russ Epting	CSX Transportation	Cynthia Simpson	U.S. Dept. of Labor
Shannon Angielski	Carbon Utilization Research Council	Song Zhao	Leidos
Thomas Wos	Tri-State Generation	Tesfaye Wyes	U.S. Dept. of Labor
Ayaka Jones	U.S. Dept. of Energy	Stephen Gardner	ECSI
Aaron Szabo	EOP/OMB	Erich Eschmann	U.S. EPA
Leslie Coleman	National Mining Association	Lee Gresham	Brattle Group
Ann Satsangi	U.S. Dept. of Energy	Mark Gehlhar	OSMRE U.S. DOI
Nicolaos Kydes	On Location	William Wolf	Boyd Company
Jonathan Sullivan	Norfolk Southern	Kevin Steinberger	NRDC
Carolyn Evans	Norfolk Southern	John Dean	JD Energy
Thomas Hewson	Energy Ventures Analysis		

Agenda

- Introduce new EIA staff working on AEO coal projections
- Review AEO2017 results
- Discuss EIA staff priorities during AEO2018 cycle
- Provide status update on coal research efforts by contractors and next steps
- Open floor to other issues affecting the outlook for U.S. coal production

EIA coal team in process of “rebooting”

- David Fritsch, who joined EIA in November 2016, will have oversight over Coal Market Module (CMM) operations and development, and coordinating AEO2018 projections and analysis

- Bonnie West, who joined EIA in January 2017, will oversee updates to econometric elements of the CMM, namely the Coal Production Submodule and assist with CMM updates and analysis of AEO2018 results

- Elias Johnson will coordinate with David on benchmarking AEO results to the Short-Term Energy Outlook (STEO) and provide coal market expertise based on his over 25 years of experience with EIA

- Looking to fill vacant coal position in FY2018

What to look for in the AEO2018

- AEO2017 extended results through 2050 in the AEO data browser to help solicit feedback from stakeholders
  - AEO2018 will be the first year time the 2040-2050 results will be highlighted in the presentation of AEO results
  - Please pay particular attention to the trends during that period and let us know if you have any feedback you would like us to consider

- AEO2018 will be presented in the same flip-book format as used for AEO2017
  - Regular cycle that will feature several Issues in Focus articles, an expanded set of side cases, and write ups of key legislation and regulations
  - Whether or not the EPA's Clean Power Plan (CPP) is included in the Reference case is still under consideration, but side cases with and without the CPP will be developed as for AEO2017

EPA policies with significant impacts on coal use included in AEO2017 Reference case

Regulation	AEO2017 Assumption	Comment
Clean Power Plan (CPP) *(Clean Air Act. S. 111(d))*	**Modeled following mass-based approach in all regions with emission budgets applied to both new and existing units**	**Side cases without the CPP (No CPP) are also available**
New Source Performance Standards limiting CO2 emissions from new plants *(Clean Air Act S. 111(b))*	**All new coal units must install USC with partial CCS to achieve max. rate of 1,400 lb CO2/MWh; technology option meeting this standard included, but subject to the 3% rate of return adder**	**Also assumed in side cases without the CPP (No CPP)**
Cross State Air Pollution Rule- CSAPR *(SO_2/NOx)*	**Includes required emissions limits**	
Mercury Air Toxics Standard (MATS)	**Detailed accounting of retirements and environmental retrofits completed by EIA staff**	**Deadline for compliance was April 2016**
Regional Haze *(Best Available Retrofit Technology)*	**Assumes compliance is reflected in EIA-860 filings on plants as settlement agreements reached between EPA and individual states and utilities**	**State Implementation Plans (SIP) due by July 31, 2021 with implementation by 2028**
Coal Combustion Residuals *(Coal ash)*	**Not specifically modeled in the Reference case; assumes compliance is reflected in EIA-860 filings as each plant takes specific actions to comply with the regulation**	**Not expecting significant impact (approx. 0.8 GW)**
Cooling Water Intakes *(Clean Water Act S. 316b)*	**Not specifically modeled in the Reference case; assumes compliance is reflected in EIA-860 filings as each plant takes specific actions to comply with the regulation**	**Not expecting significant impact (approx. 1 GW); compliance between 2018 – 2023 depending on CWA permit**
Effluent Limitation Guidelines	**Not specifically modeled in the Reference case; assumes compliance is reflected in EIA-860 filings as each plant takes specific actions to comply with the regulation**	**Not expecting significant impact (approx. 1 GW); compliance between 2018 – 2023 depending on CWA permit**

State-level CO2 initiatives included in AEO2017 Reference case

- California
  - Recently signed state law under AB 398 Global Warming Solutions Act requires statewide greenhouse gas emissions to return to the 1990 level by 2020 and be 40% below the 1990 level by 2030
  - Cap-and-trade program under AB 32
  - State law under SB-1368 that prohibits CA utilities from entering into long-term financial commitments for base load generation, unless in compliance with the CO2 emissions performance standard of 1,100 lbs/MWh
    - Reduce firm imports to represent expiration of contracts with the Four Corners, Navajo, Reid Gardner, San Juan, and Boardman plants and retire Intermountain in 2025
    - Adjust carbon emission rate for firm imports in accordance with the expiration of contracts
- The Northeast's Regional Greenhouse Gas Initiative (RGGI) program
- Renewable Portfolio Standard (RPS) programs

Uncertainty on CO2 policy addressed in the AEO2017 Reference case through cost of capital

- The 3% adder on the cost of capital for upgrades to coal units without maximum sequestration options (90% removal) included to account for risk of future tightening of CO2 emissions standards and other policies affecting coal
- Regulatory uncertainty associated with future policies
  - Clean Power Plan (CPP) under review; other EPA rules may also be reviewed further
  - Office of Surface Mining's Stream Protection Rule was nullified and formal programmatic consultation reinitiated
  - Federal coal leasing moratorium lifted, ONRR's Consolidated Federal Oil and Gas and Federal Indian Coal Valuation Rule (Valuation Rule) repealed, and BLM's review of federal coal royalty rates suspended; Dept. of Interior formed a Royalty Policy Committee to evaluate valuation and royalty policies
  - Waters of the U.S. (WOTUS) stayed; EPA proposing rule to change definition

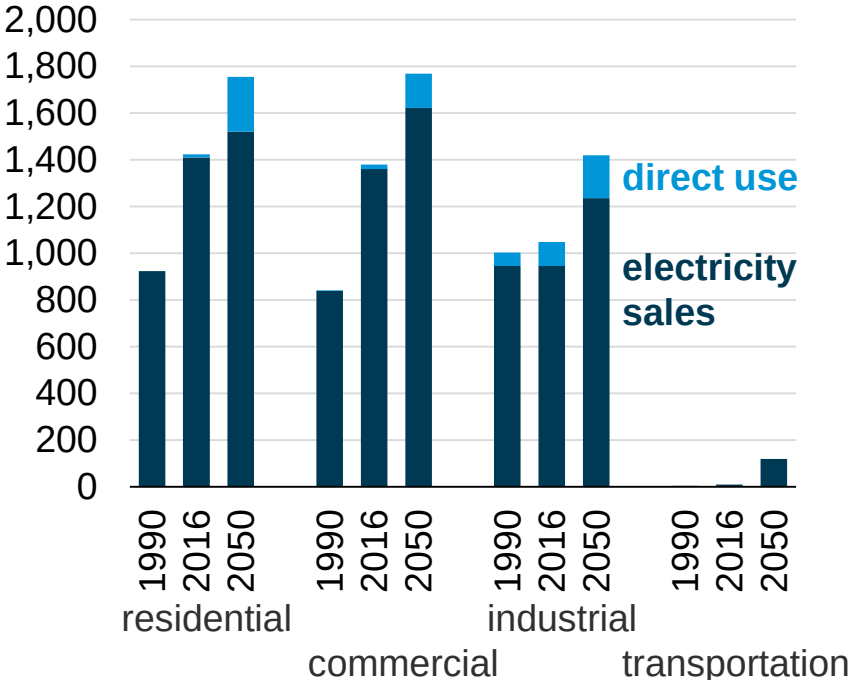
Same basic story continues to hold with respect to the trends affecting coal consumption even without the CPP

- Nationally
  - Slow electricity demand growth
  - Competition with relatively low-cost natural gas
  - Increasing competition with renewable energy
  - High plant construction costs relative to natural gas and renewables
- Regionally
  - Declining coal mining labor productivity for most regions
    - Central Appalachia encountering thinning seams and reserve depletion
    - Higher stripping ratios for WY PRB as mining moves westward
  - Illinois Basin coals competing more effectively
  - Stagnant coal export markets

Electricity use continues to increase but the rate of growth remains lower than historic averages in the AEO2017 Reference case

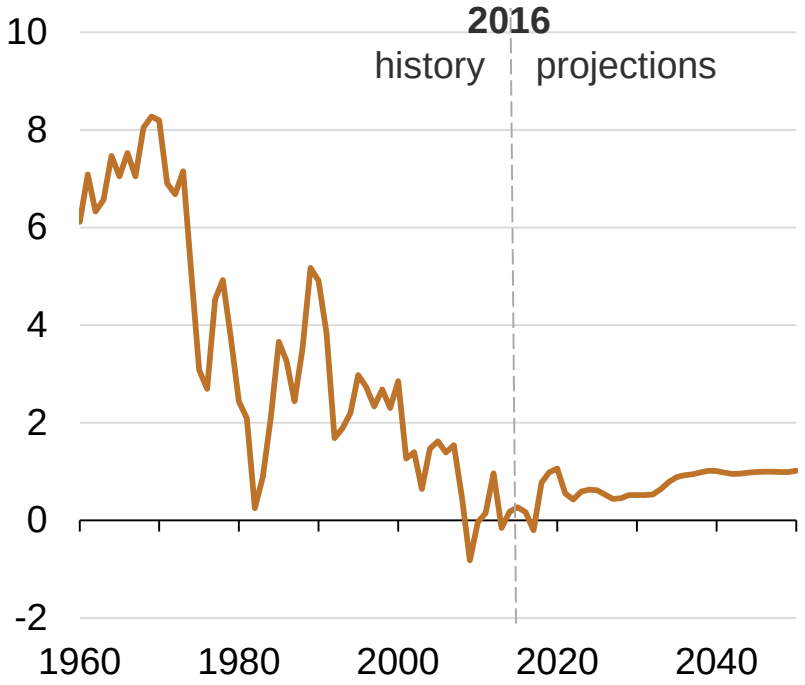
Electricity use by end-use demand sector

billion kilowatthours

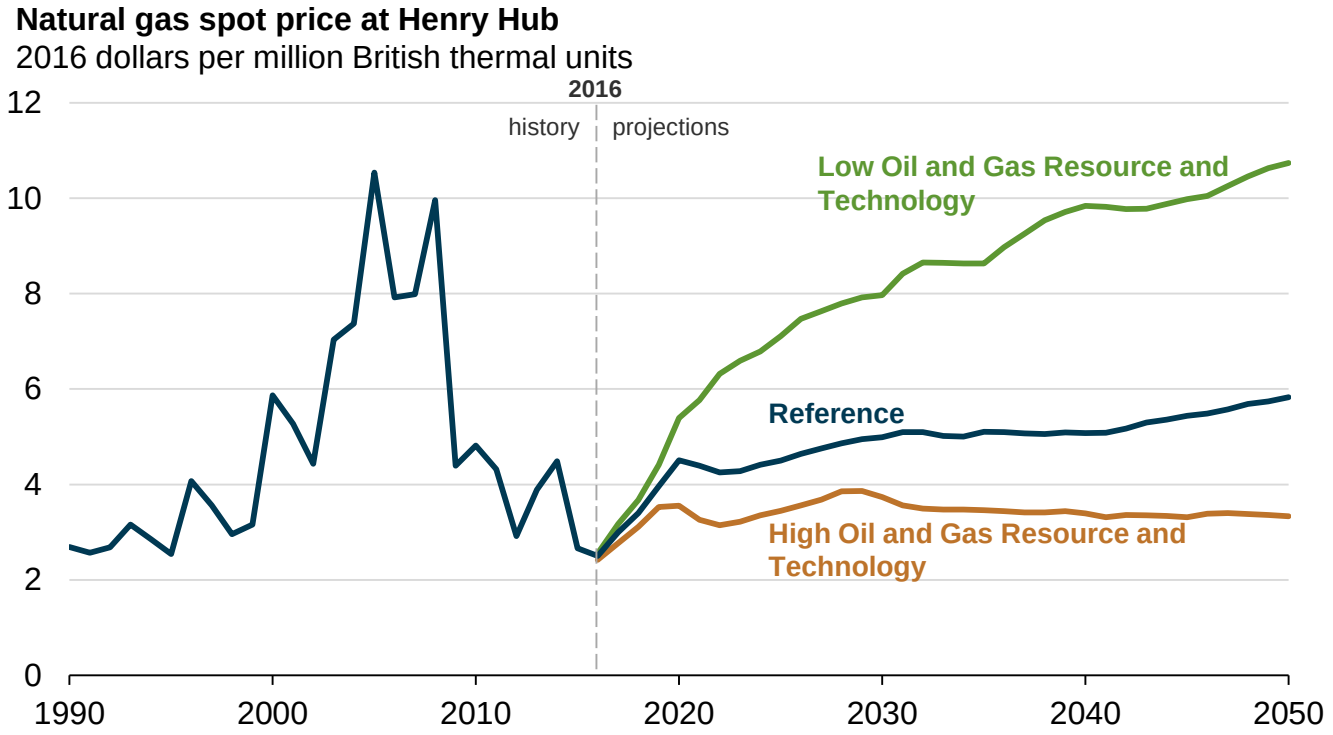


Electricity use growth rate

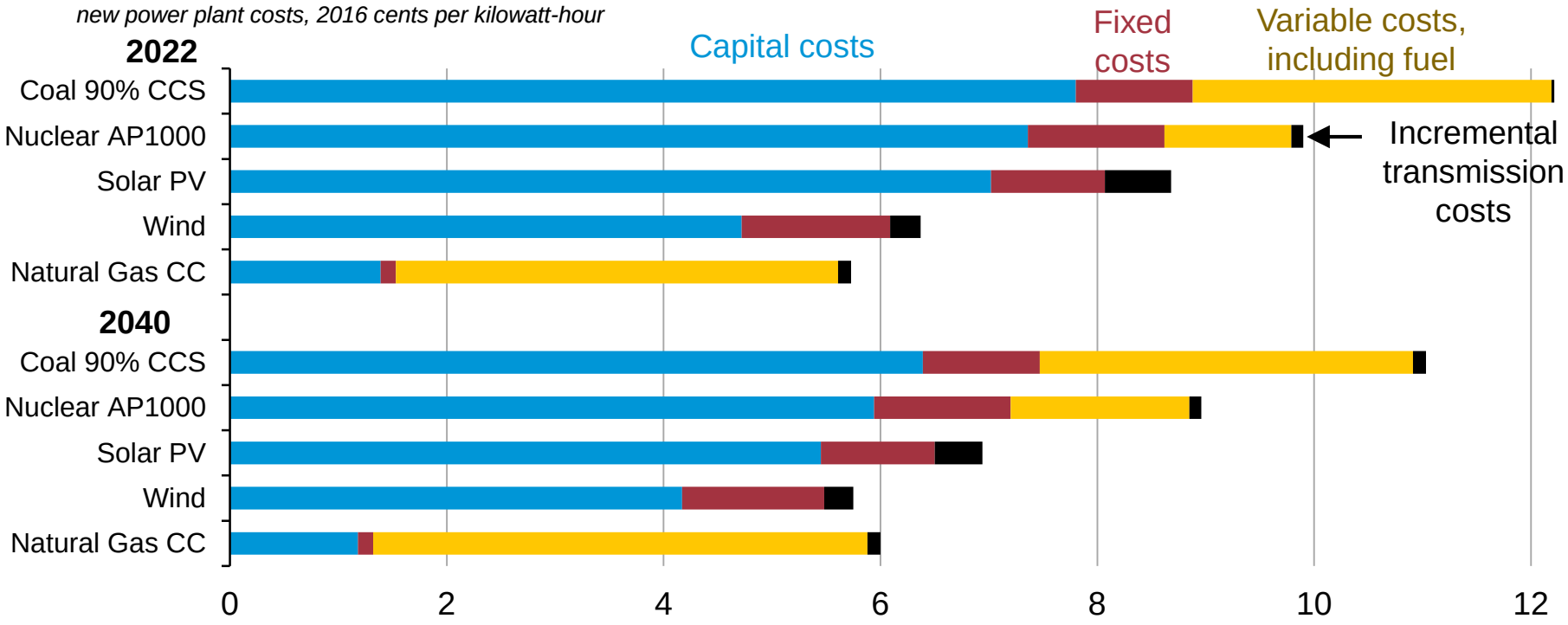
percent growth (three-year rolling average)



AEO2017 Reference case natural gas prices remain relatively low but price paths in the side cases are very different from those in the Reference case



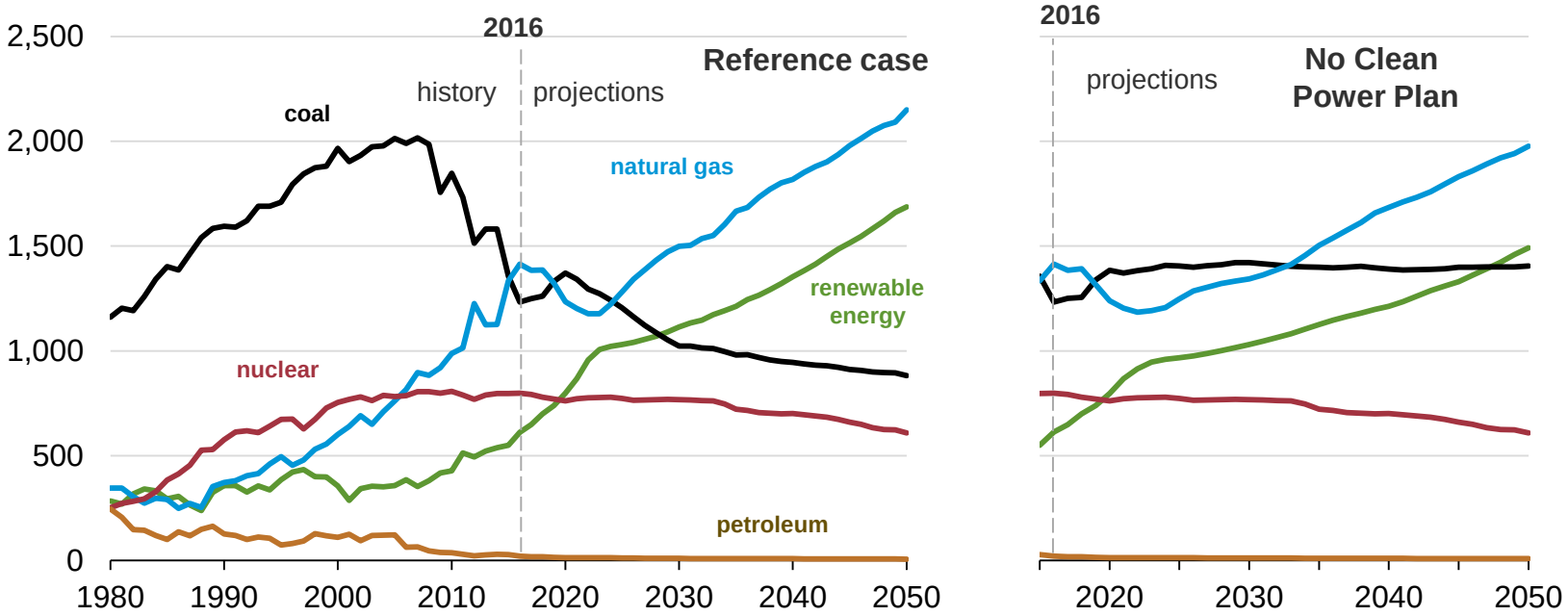
Relatively high levelized cost of energy for coal prohibits the addition of coal in any case evaluated in AEO2017



Source: "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the AEO2017", April 2017, Excerpted from Table 1b (2022) and Table B1b (2040)

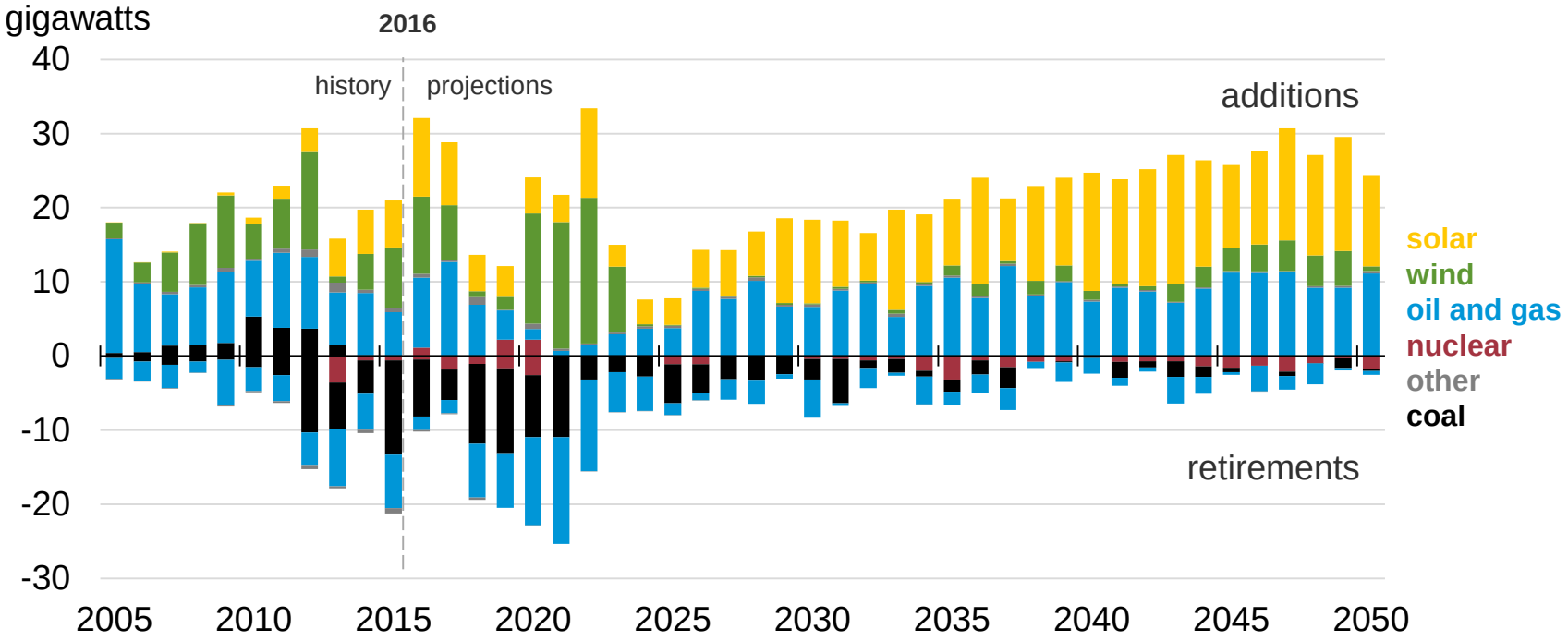
Fuel prices and current laws and regulations drive growing shares of renewables and natural gas in the electricity generation mix as coal's share declines over time in the AEO2017 Reference case

U.S. net electricity generation from select fuels
billion kilowatthours

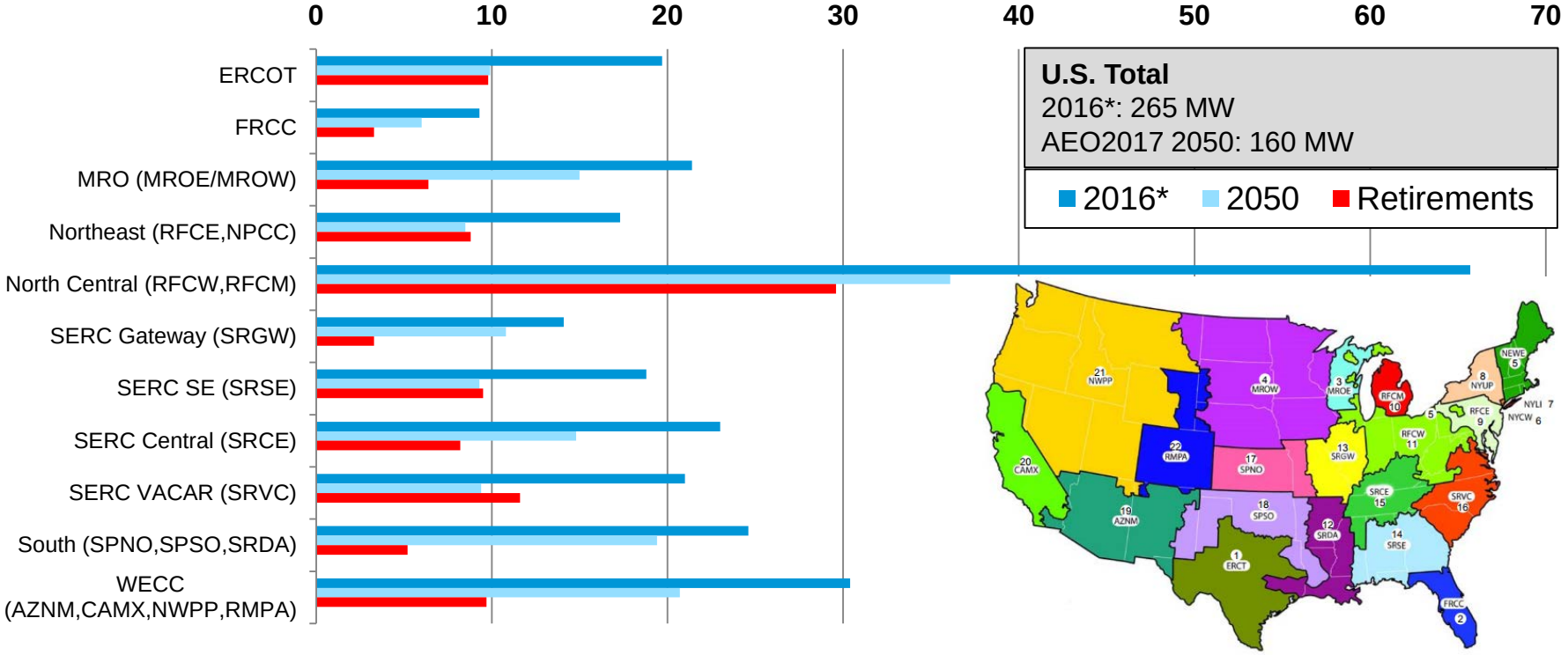


Lower capital costs and the availability of tax credits boost near-term wind additions and sustain solar additions whereas coal-fired unit retirements in the AEO2017 Reference case are driven by low natural gas prices and the Clean Power Plan

Annual electricity generating capacity additions and retirements (Reference case)



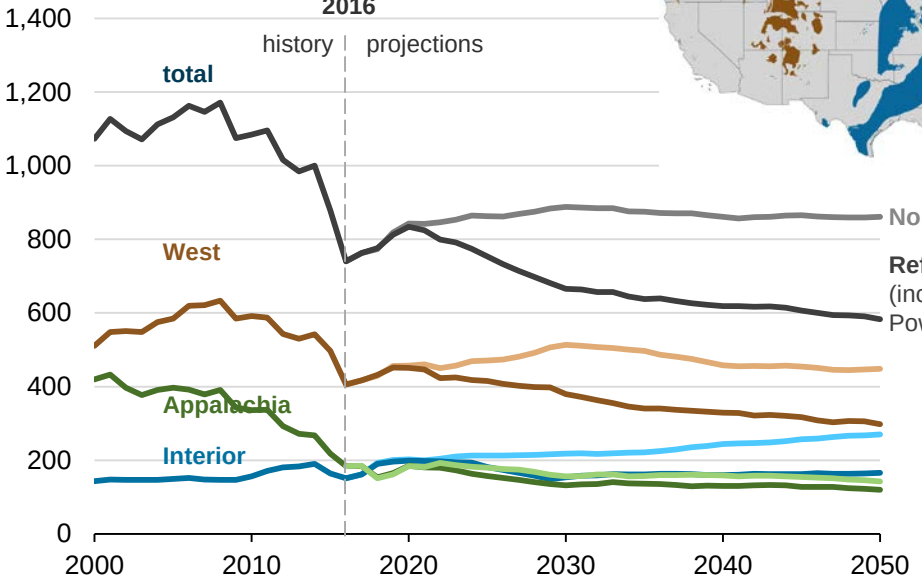
Net summer coal-fired generating capacity in the electric power sector declines disproportionately by region in the AEO2017 Reference case



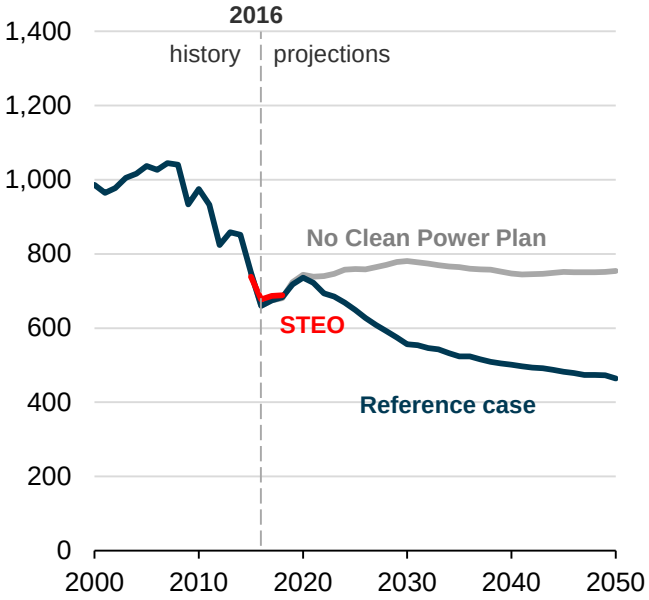
Source: *AEO2017 Reference case (ref2017.d120816a); *2016 capacity numbers are projected numbers from the AEO2017*

Coal production decreases primarily in the Western region due primarily to differences in state-level emissions reductions required under the CPP

U.S. coal production by region, 2000-2050
million short tons



Coal consumption in electric power sector
million short tons

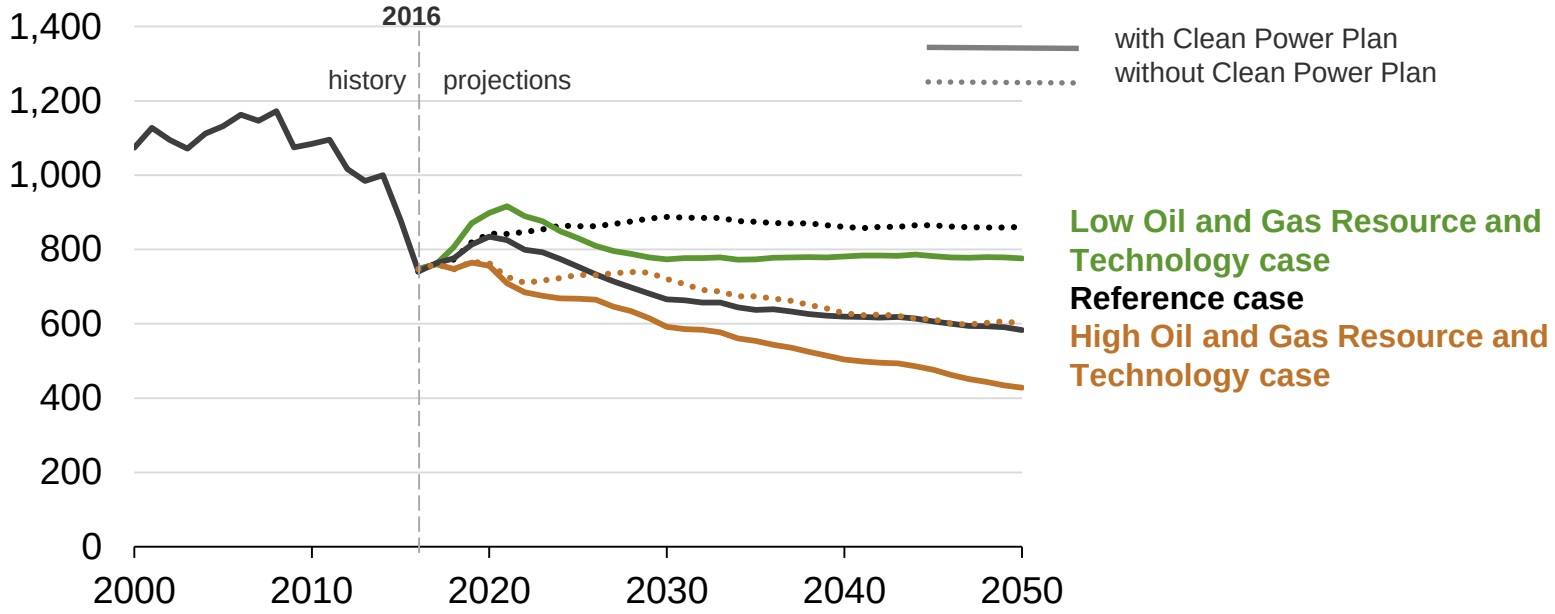


Source: AEO2017 Reference case (ref2017.d120816a)

Future coal production depends on resources and technology, not just policy choices

U.S. coal production, 2000-2050

million short tons



Source: EIA Today in Energy, June 26 2017.

Coal mining productivity projected to decline in all regions except Eastern Interior in AEO2017

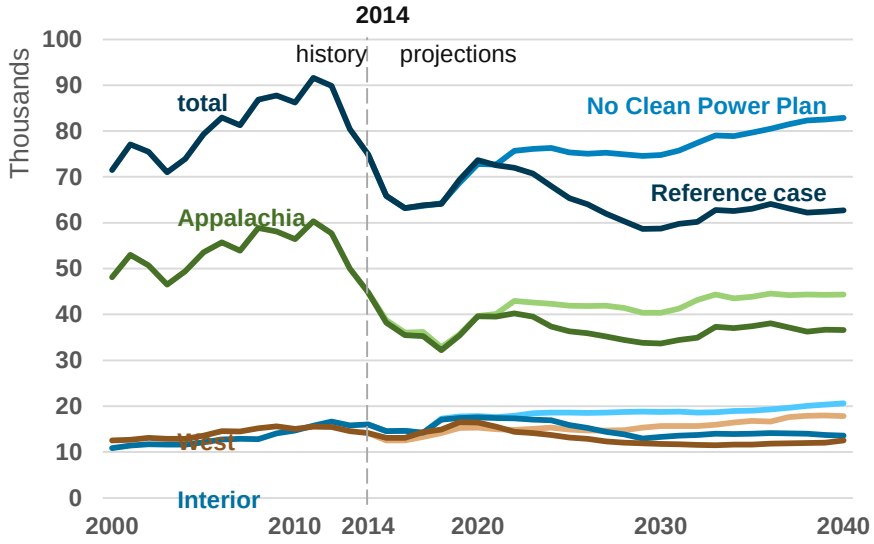
Short tons per miner hour Supply Region	2014	2020	2025	2030	2035	2040	Average Annual Growth 2014-2040
Northern Appalachia	3.43	3.26	3.06	2.82	2.72	2.59	-1.1%
Central Appalachia	2.20	1.77	1.62	1.38	1.26	1.29	-2.0%
Southern Appalachia	1.88	1.61	1.46	1.33	1.24	1.17	-1.8%
Eastern Interior	4.64	4.98	5.11	5.26	5.40	5.54	0.7%
Western Interior	2.73	2.38	2.24	2.11	2.04	1.99	-1.2%
Gulf Lignite	6.94	6.40	6.09	5.79	5.57	5.38	-1.0%
Dakota Lignite	11.53	11.53	10.96	10.42	10.03	9.69	-0.7%
Western Montana	16.58	14.76	16.39	15.85	14.69	13.55	-0.8%
Wyoming, Northern Powder River Basin	29.35	28.20	26.85	26.65	24.27	22.23	-1.1%
Wyoming, Southern Powder River Basin	34.32	26.87	24.78	23.73	23.31	22.99	-1.5%
Western Wyoming	6.36	7.37	7.01	6.67	6.44	6.25	-0.1%
Rocky Mountain	6.12	5.01	4.42	3.89	3.56	3.32	-2.3%
Arizona/New Mexico	8.01	7.57	7.24	6.90	6.67	6.47	-0.8%
Alaska/Washington	5.42	5.84	5.96	6.08	6.15	6.22	0.5%
U.S. Average	5.64	6.22	6.22	6.16	5.55	5.45	-0.1%

Source: U.S. Energy Information Administration, AEO2017 National Energy Modeling System run REF2017.D120816A.

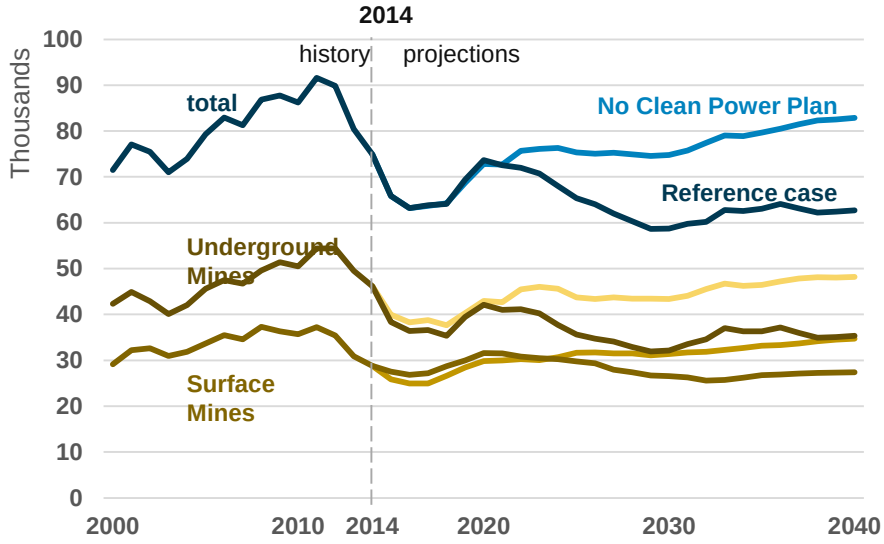
PRB assumptions were updated for AEO2017

Coal mine employment trends reflect impact of declining labor productivity against backdrop of declining production

Coal Mine Employment
Number of Miners

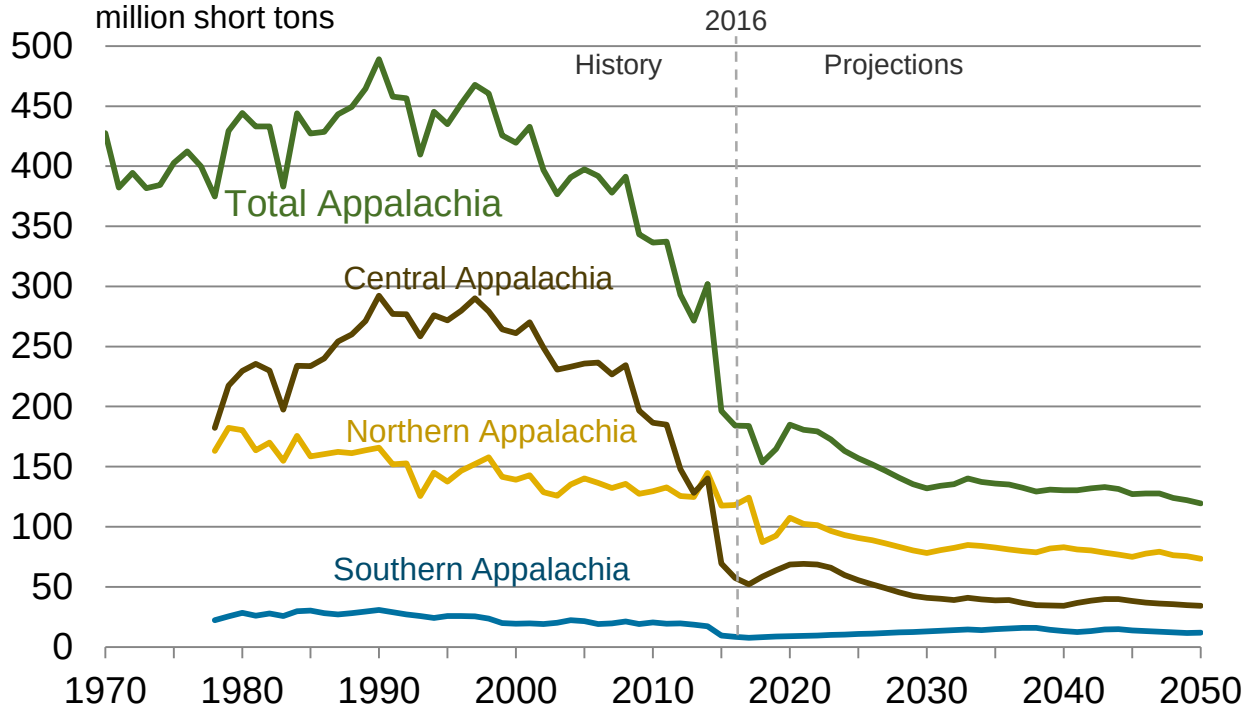


Coal Mine Employment
Number of Miners



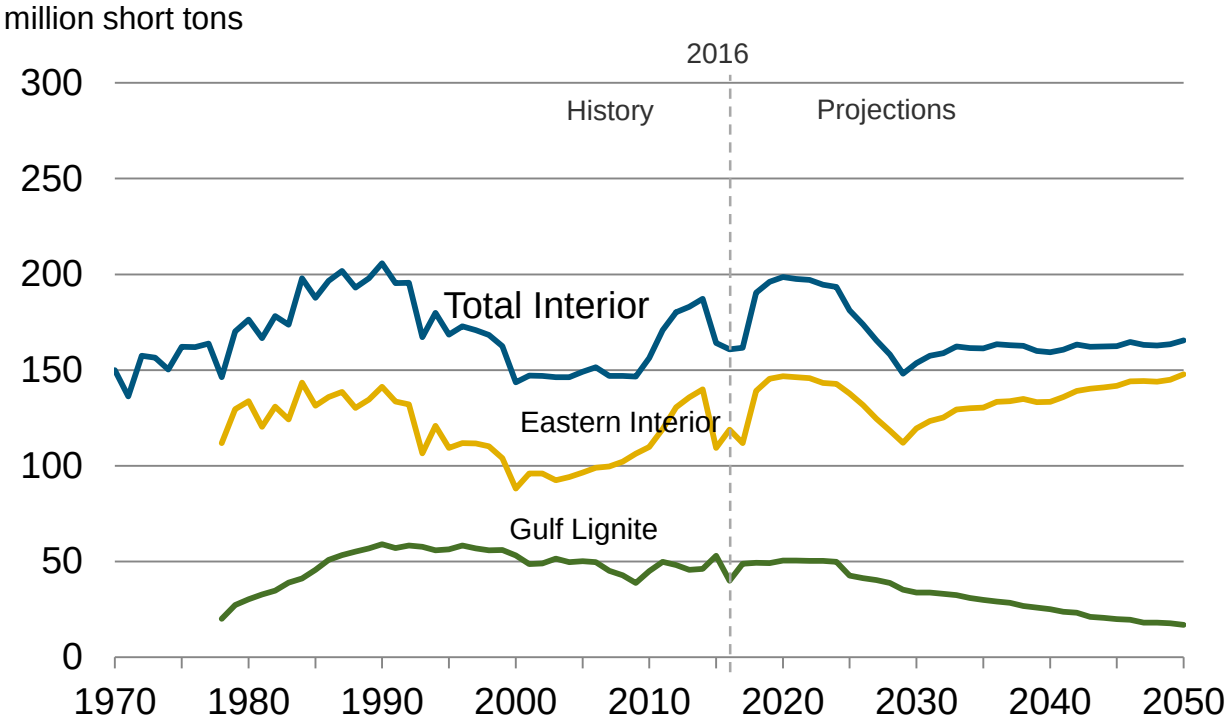
Source: AEO2017 Reference case (ref2017.d120816a)

Appalachian coal production declines gradually as productivity declines, but is buffered by relatively steady met coal demand



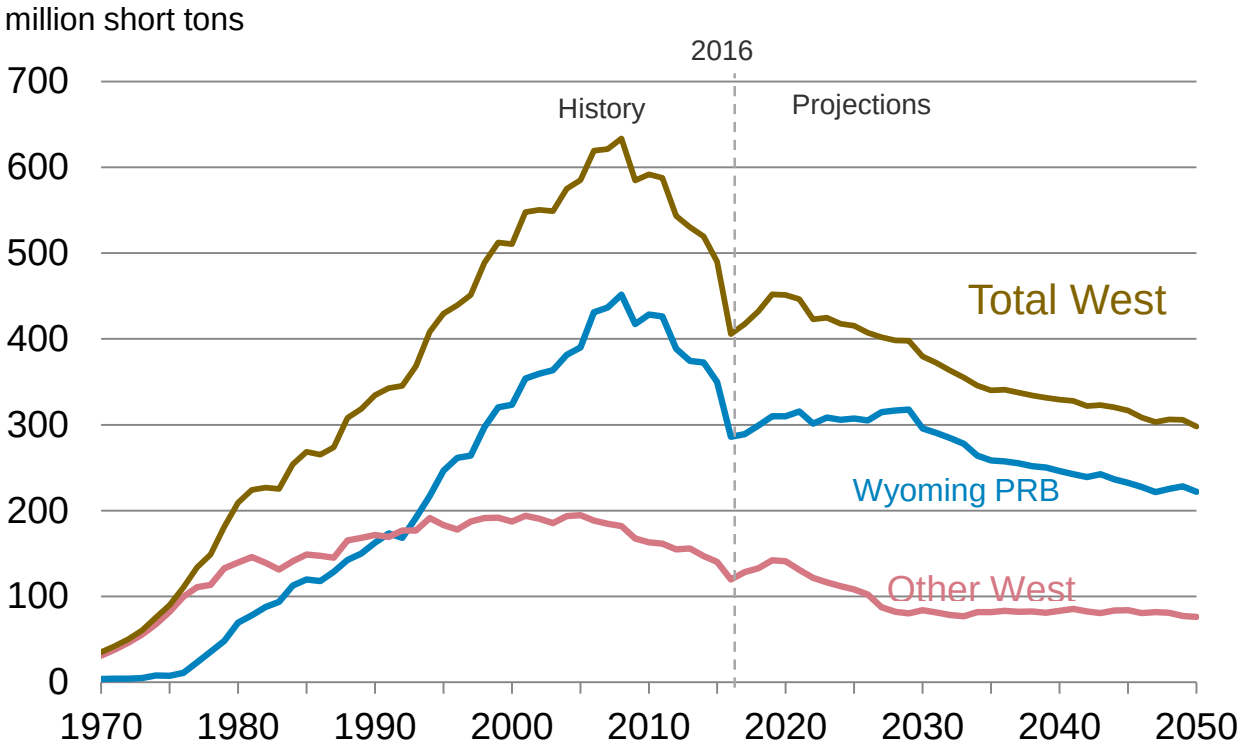
- Source: AEO2017 Reference case (ref2017.d120816a),
- Except for Appalachian total, data for 1978-1985 exclude production from small (<10,000 short tons) coal mines

Interior coal production remains declines only slightly from 2016 levels under the CPP due to increasing productivity and competitiveness with low-sulfur coals



Source: AEO2017 Reference case (ref2017.d120816a)

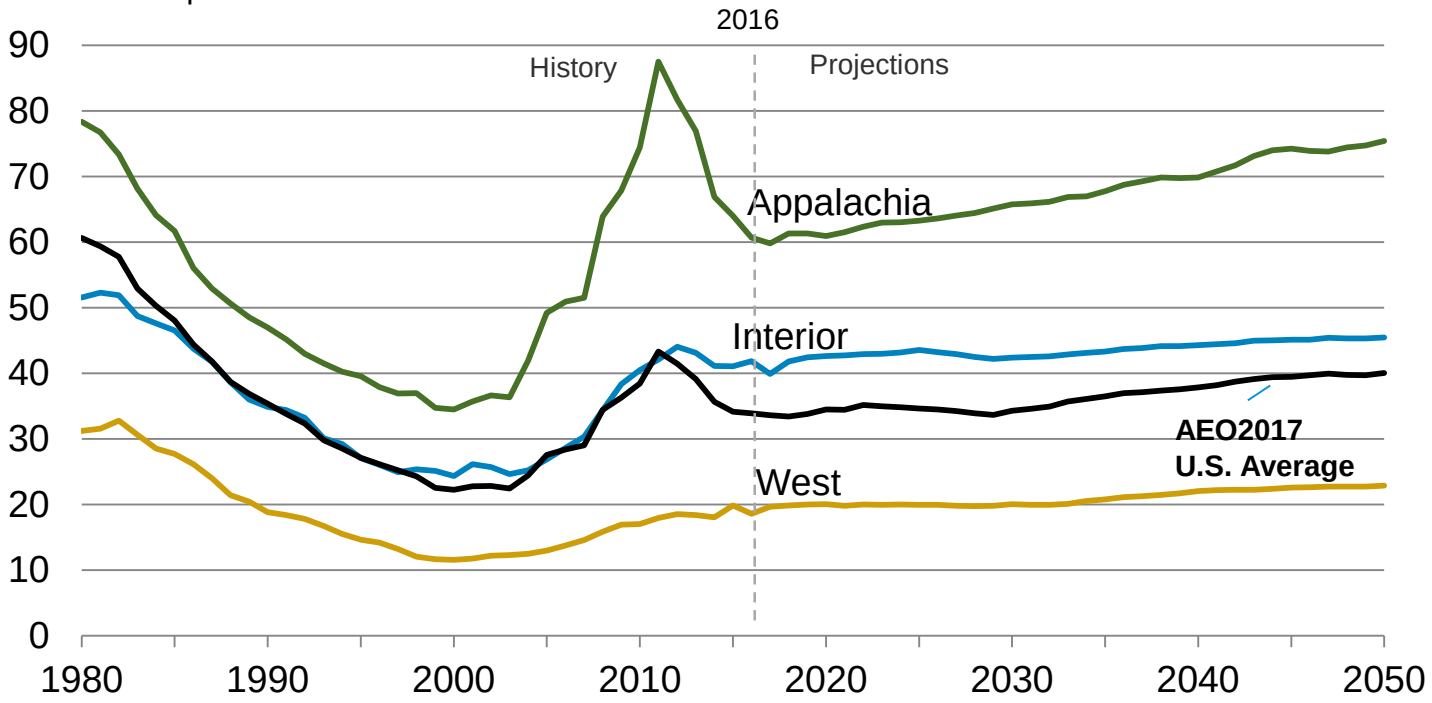
Western coal production sees the greatest rate of decline under the CPP



Source: AEO2017 Reference case (ref2017.d120816a)

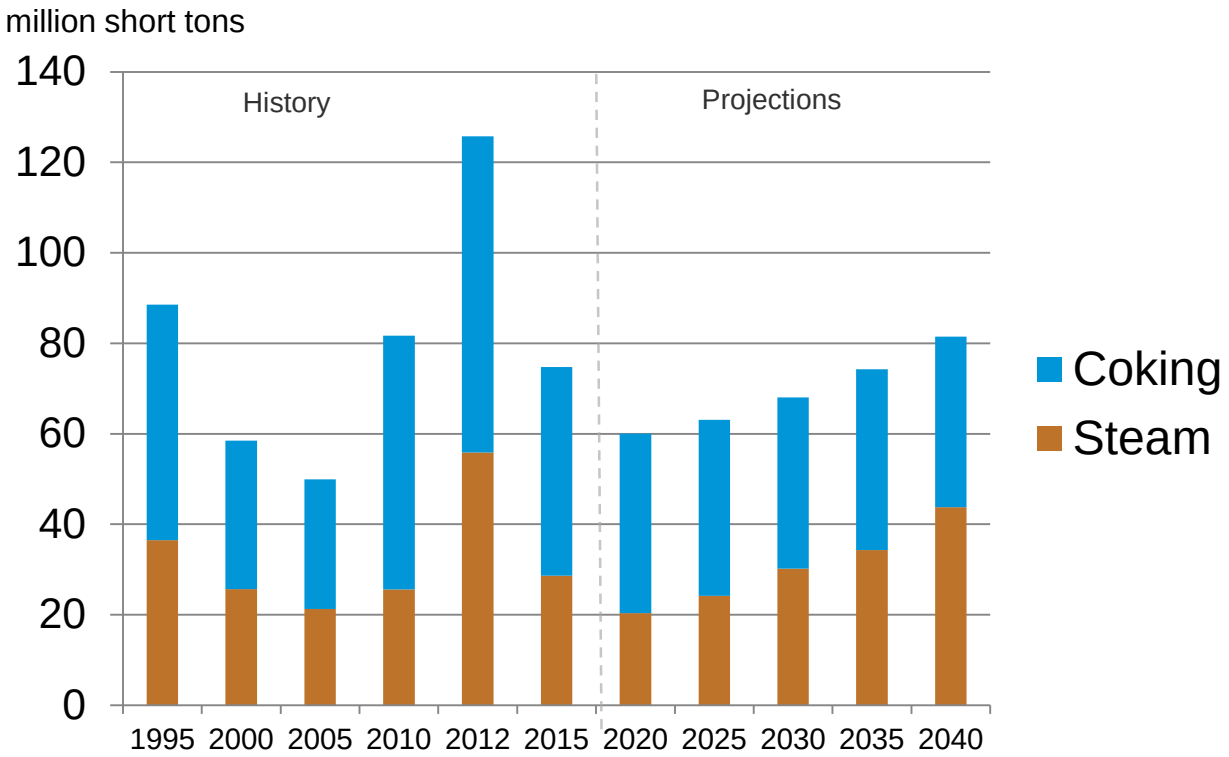
Average minemouth coal prices increase gradually as productivity decreases over time

2016 dollars per short ton



Source: AEO2017 Reference case (ref2017.d120816a)

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



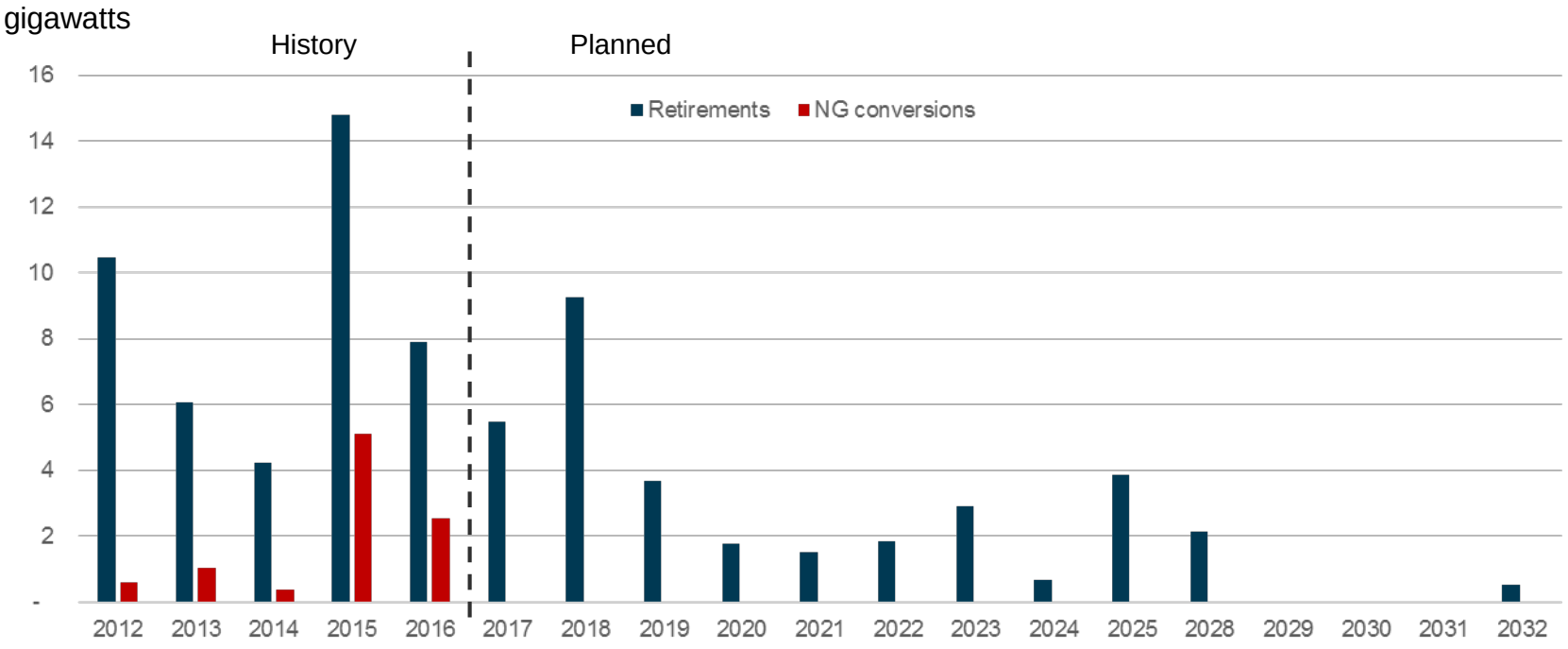
Source: AEO2017 Reference case (ref2017.d120816a)

AEO2018 Development Cycle Efforts

Staff focused primarily on data updating processes for AEO2018 development cycle

- Primary focus is on updating historical data for 2014 and 2015 and automating and documenting these processes to the extent possible to accommodate staff departures
- Develop reporting capabilities in the AIMMS code to enhance assessment of model results and analysis of trends
  - Supply curve viewer
  - Regional data views
  - NEMS reporting requirements
- Evaluating updates to the Coal Production Submodule (CPS) regression equation parameters in the Coal Market Module (CMM) in NEMS; effort will extend into AEO2019 development cycle
- Coordinating integration of contractor recommendations for updating and enhancing the coal transportation rate, international coal supply curve, and international freight rate methodologies in the Coal Market Module (CMM) in NEMS
- Developing a design concept for an International Coal Market Module (ICMM) for integration into EIA's WEPS+ modeling system used to develop IEO projections

Reported changes in electric generating capacity: planned coal retirements/ coal-to-gas conversions (actuals as of 8/10/2017)

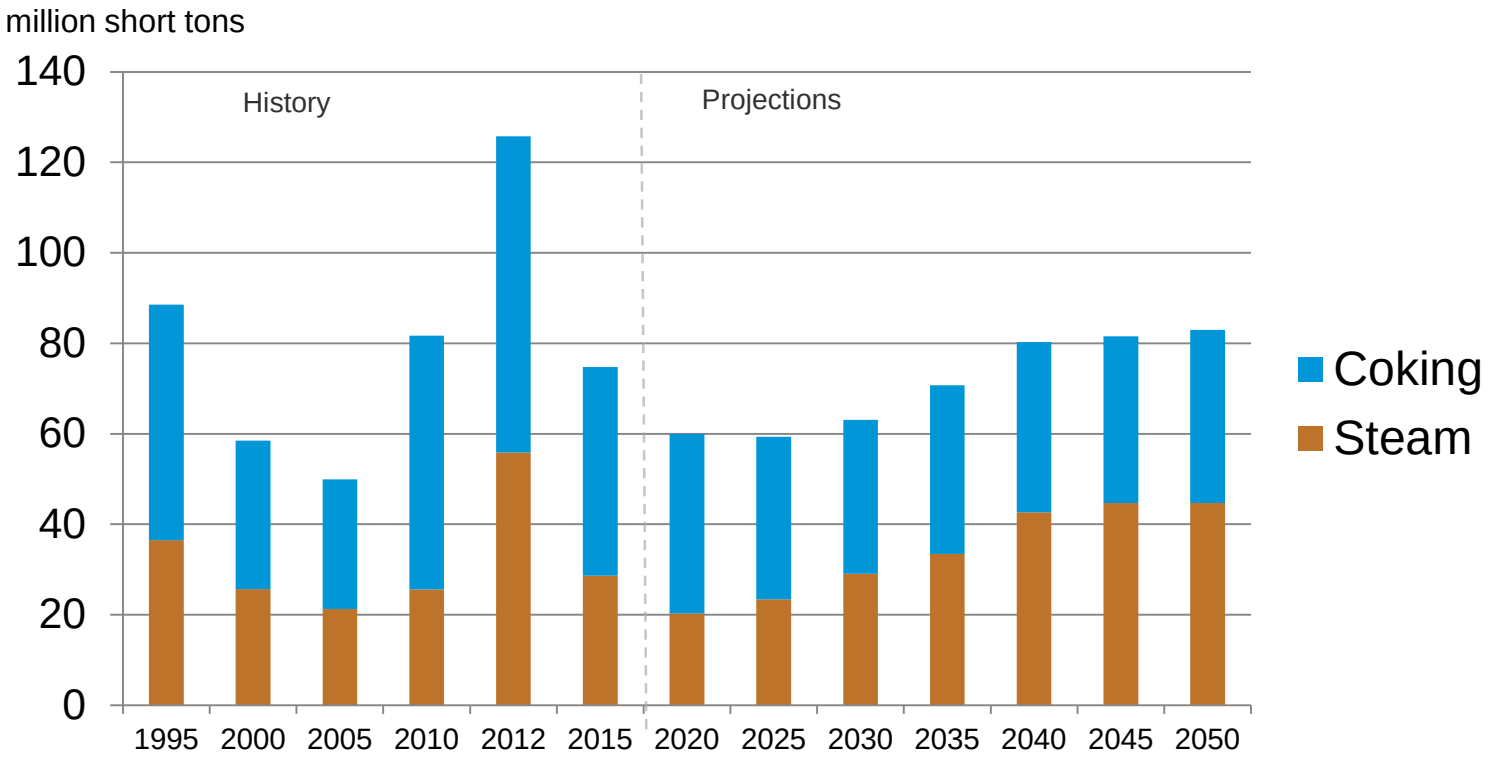


Source: Form EIA-860 and supplemental sources

AEO2018 will incorporate international trade forecast from EIA's International Energy Outlook 2017 (IEO2017)

- EIA's IEO2017 is almost complete – results are still preliminary
- Projections include our most recent estimates of world coal demand and modeled solution of how world coal supply will satisfy demand through international trade
- Similar to IEO2016/AEO2016, U.S. coal exports are projected to return to about 80 Million Short Tons by 2040 through 2050 in the IEO2017, almost evenly split between metallurgical and steam coal
- Coal trade of 1.5 Billion tons by 2050 account for less than 20% of 9.5 Billion tons produced world wide

IEO2017 (PRELIMINARY) U.S. coal export projections



Source: Projections - Preliminary IEO2017 Projection; History – U.S. Energy Information Administration (EIA), Quarterly Coal Report;.

International Coal Supply Curve Methodology study resulted in recommendations to improve the existing, static supply curve specifications

- The goals of the project were three-fold
  - Develop an approach to modeling international supply curves more consistent with the current, econometric-based methodology for modeling U.S. coal supply and mine prices in the CMM
  - Research and utilize a set of publicly-available data sources that can be utilized for periodic updating of the supply curve equations
  - Develop a methodology and related data sources to better forecast ocean freight rates for international coal shipments

- Hellerworx recently delivered their study results, which recommended an instrumental variable (2SLS) regression format for key exporting regions by coal type, provided a set of publicly-available data sources, and an updated approach to modeling freight rates that accounts for vessel rates and fuel prices

Coal Transportation Rate Analysis study resulted in recommendations to address challenges from declining coal shipments

- The goals of the project were to assess the current coal transportation rate methodology used in the Coal Distribution Submodule (CDS) of the CMM and suggest enhancements to the methods used to estimate base transportation rates and escalate prices over time
  - Assess the impact of slowing coal demand on coal transportation rates and railroad fuel surcharge programs
  - Evaluate the two-tier rate structure in CMM
  - Suggest a new methodology for escalating base year transportation rates

- Hellerworx evaluated recent data on coal transportation rates against and applied their industry experience with coal transportation to arrive at a suggested methodology for EIA to consider
  - Only apply Tier 2 transportation rates in the event coal production exceeds the peak 2008 volume
  - Use a single, national cost-based escalation index based on labor, fuel, equipment and other costs and productivity, rather than separate factors for east and west based on a set of indicative variables for each region
  - Pass through half of railroad productivity gains to shippers and treat fuel costs directly in the in the cost escalation index rather than making separate adjustment to reflect fuel adjustment clauses

International Coal Market Module (ICMM) being pursued to improve international coal production and trade projections in the IEO

- Energy Ventures Analysis and OnLocation each completed independent Component Design Reports (CDR) to recommend possible methodologies

- The goal was to create a new coal module with the capability to project regional coal prices and coal supply as well as distribution of coal to industrial and electric consumers for the IEO, and model coal production and inter-regional trade in response to changing patterns of consumption

- The CDRs delivered in April 2017 presented two distinct designs featuring LP and NLP methodologies respectively, and included suggestions for model design as well as implementation and integration with the International Electricity Market Model (IEMM) currently in development

Changes in modeling- enhancements to EMM: characterizing generation at risk

- Issues to be analyzed
  - Going forward costs: can we represent a distribution of costs?
  - Fixed O&M costs: represented by a greater range of values than modeled in past cycles?
  - Electricity price volatility: is it greater (e.g. in regions with high renewables growth) than has been represented?
    - Or is it some combination of all of the above factors causing greater generation-at-risk?
  - Retirements: how many units ultimately retire of those at-risk?
    - What factors are particular to certain types of generation that make them more or less likely to retire?
    - How do these factors vary by region?

AEO2018 Outlook Schedule

- Model development: Aug-Oct 2017
- 2nd Working Group Session: mid-Sep 2017
- Expected AEO release: Jan 2018

For more information

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InfoCtr@eia.gov

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24-hour automated information line about EIA and frequently asked questions.

What is the Reference case?

- The Reference case projection assumes trend improvement in known technologies, along with a view of economic and demographic trends reflecting the current central views of leading economic forecasters and demographers.

- It generally assumes that current laws and regulations affecting the energy sector, including sunset dates for laws that have them, are unchanged throughout the projection period.

- The potential impacts of proposed legislation, regulations, or standards are not reflected in the Reference case.

- EIA addresses the uncertainty inherent in energy projections by developing side cases with different assumptions of macroeconomic growth, world oil prices, technological progress, and energy policies.

- Projections in the AEO should be interpreted with a clear understanding of the assumptions that inform them and the limitations inherent in any modeling effort.

What are the side cases included in the AEO2017?

- Oil prices are driven by global market balances that are mainly influenced by factors external to the NEMS model. In the High Oil Price case, the price of Brent crude in 2016 dollars reaches $226 per barrel (b) by 2040, compared to $109/b in the Reference case and $43/b in the Low Oil Price case.

- In the High Oil and Gas Resource and Technology case, lower costs and higher resource availability than in the Reference case allow for higher production at lower prices. In the Low Oil and Gas Resource and Technology case, more pessimistic assumptions about resources and costs are applied , the price of natural gas at Henry Hub in 2016 dollars falls to $3.40 per MMBtu by 2040 in the High Resource case, compared to $5.07/MMBtu in the Reference case and $9.76/MMBtu in the Low Resource case.

- The effects of economic assumptions on energy consumption are addressed in the High and Low Economic Growth cases, which assume compound annual growth rates for U.S. gross domestic product of 2.6% and 1.6%, respectively, from 2016–40, compared with 2.2% annual growth in the Reference case.

- A case assuming that the Clean Power Plan (CPP) is not implemented can be compared with the Reference case to show how the absence of that policy could affect energy markets and emissions.

Coal-Fired Capacity Omitted from AEO2017

FACILITY CODE	PLANT NAME	GENERATOR ID	STATE	PLANT TYPE	ENERGY SOURCE	REPORTED START YEAR	SUMMER CAPABILITY
55360	Two Elk Generating Station	GEN1	WY	PC	waste coal	2020	275 MW
	Texas Clean Energy Project		TX	IGCC	WY PRB	2017	400 MW
Total Capacity							675 MW

Source: U.S. Energy Information Administration, Form EIA-860 “Annual Electric Generator Report”

- While the Two Elk is reported as ‘under construction’ on the Form EIA-860, other references suggest that the project is, minimally, delayed as the developer has recently cancelled an appeal hearing. The hearing would have appealed the denial of its request for a permit extension.
- DOE has suspended funding for the Texas Clean Energy Project. This project is not reported on the Form EIA-860.

http://wyomingpublicmedia.org/post/two-elk-power-plant-hearing-cancelled

https://insideclimatenews.org/news/12052016/department-energy-moniz-carbon-capture-ccs-climate-change-texas-clean-energy-project

Average annual growth in coal mining labor productivity for selected supply regions (percent)

	1980 - 2014			Recent year-over-year changes			AEO2017 projections
Coal Supply Region	**1980-1990**	**1990-2000**	**2000-2014**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2040**
Northern Appalachia	5.4	5.5	-2.0	-4.9	3.7	1.0	-1.1
Central Appalachia	7.3	4.4	-4.8	-3.8	3.1	0.7	-2.0
Eastern Interior	4.8	3.7	-0.2	6.1	7.1	-0.5	0.7
Gulf Lignite	2.6	2.4	-2.6	-4.2	-1.2	-0.5	-1.0
Dakota Lignite	6.0	1.0	-3.0	-4.8	-1.7	1.7	-0.7
Western Montana	4.6	2.0	-1.4	-11.7	15.4	11.8	-0.8
WY, Northern Powder River Basin	7.5	3.2	-2.9	-5.7	-2.6	0.0	-1.1
WY, Southern Powder River Basin	7.2	4.9	-2.3	-6.4	4.9	0.0	-1.5
Rocky Mountain	7.8	5.5	-2.3	3.5	1.3	-0.2	-2.3
U.S. Average	7.1	6.2	-1.6	-0.2	6.7	0.7	-0.1

Source: History: U.S. Energy Information Administration (EIA), *Annual Coal Report*; and Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine and Employment and Coal Production Report;" **Projections:** Preliminary AEO2016 (ref2016.d020616a)