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DO NOT QUOTE OR CITE AS RESULTS ARE SUBJECT TO CHANGE

Annual Energy Outlook 2015: Electricity, Coal, Nuclear and Renewables Preliminary Results

For

Joint Electricity, Coal, Nuclear, and Renewables AEO2015 Working Group

September 15, 2014 | Washington, DC

By

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

The *AEO2015* will be abridged compared to *AEO2014*

- *The U.S. Energy Information Administration is revising the schedule for production of the International Energy Outlook (IEO) and Annual Energy Outlook (AEO). The IEO and AEO will alternate annually between full and short versions.*

- *The AEO2015 will be the first short version of the Annual Energy Outlook.*
- *The shorter version will include an abbreviated discussion and results from select cases.*

	2014	2015
International Energy Outlook	Short Edition to be released summer 2014	Full Edition will be released in spring 2015
Annual Energy Outlook	Full Edition released in spring 2014	Short Edition will be released by early 2015

Assumptions

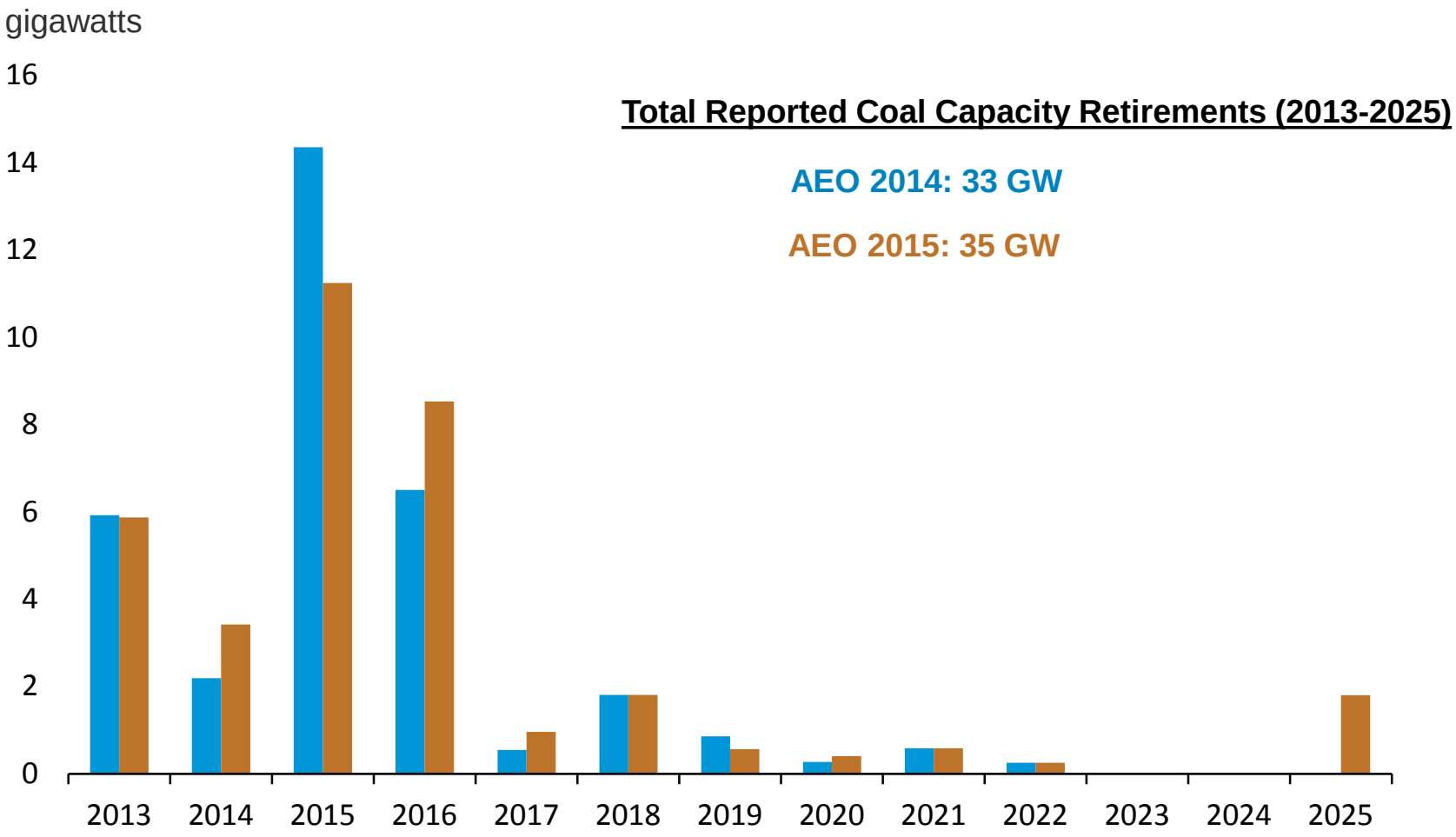
Assumptions - Environmental Rules

- Only current laws and regulations are included in EIA's reference case
- Clean Air Interstate Rule is still assumed (as in AEO2014)
  - Not modeled: Cross State Air Pollution Rule (CSAPR) – D.C. Circuit Court still has not ruled on EPA's motion to lift stay on CSAPR
- Mercury and Air Toxics Standards (MATS)
  - Assumed compliance by 2016, consistent with AEO2014

Assumptions - Environmental Rules (cont.)

- Updates to NEMS modeling of California SB1368 to remove firm contractual arrangements for coal plants upon expiration
  - Reduce firm imports to represent expiration of contracts with the Four Corners, Navajo, Reid Gardner, San Juan, and Boardman plants
  - Adjust carbon emission rate for firm imports with expiration of contracts
  - Retire Intermountain plant in 2025
- California cap-and-trade program as specified in AB32 is modeled in all affected sectors, consistent with AEO2014

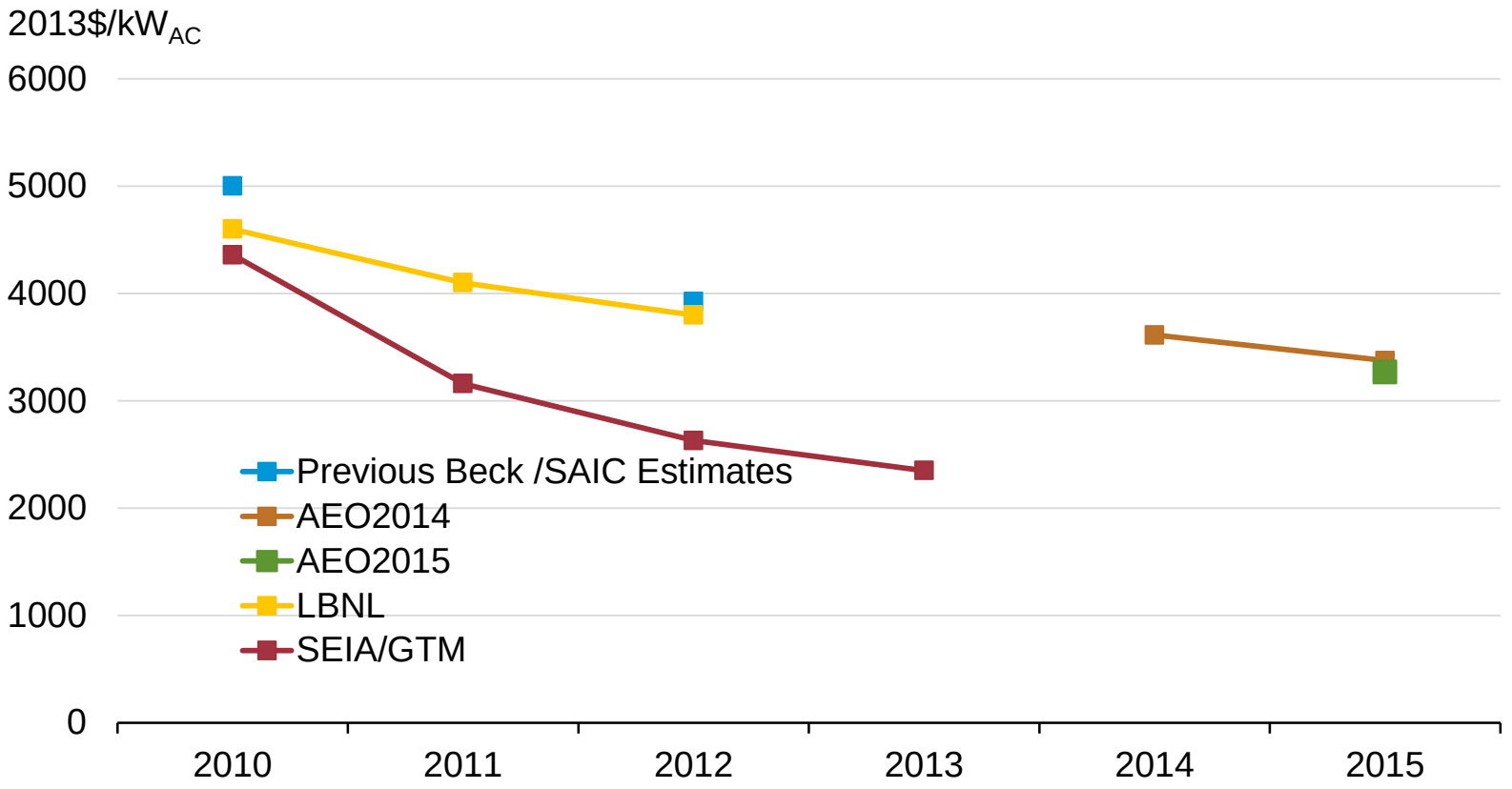
Assumptions - Planned Coal Retirements By Year



Nuclear Power Assumptions

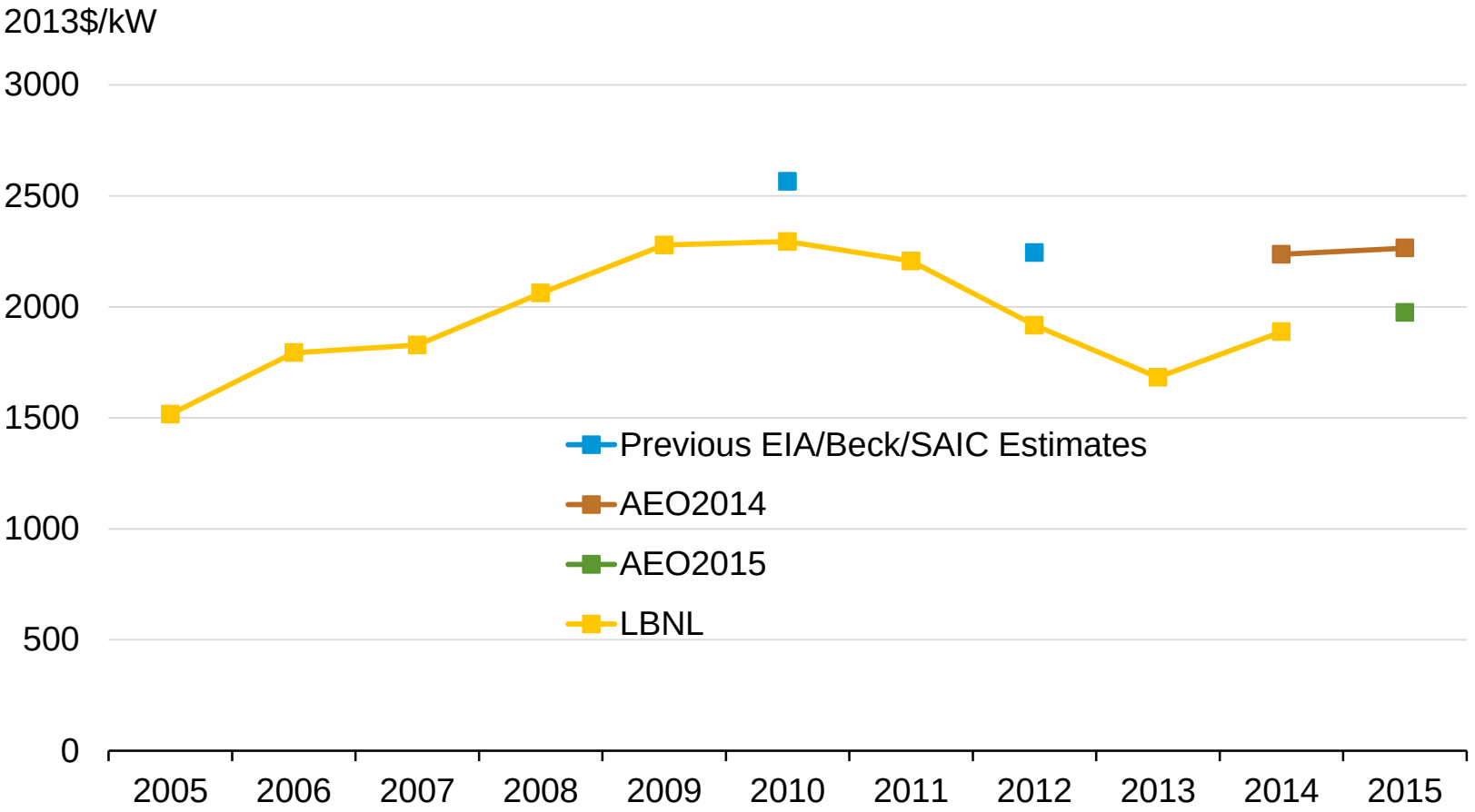
- New Plants – 5.5 GW
  - Watts Bar (2015)
  - Summer 2 & 3 (2019 & 2020) – pushed online date back 2 years
  - Vogtle 3 & 4 (2016 & 2017)
- Uprates
  - Only uprates reported to EIA will be incorporated in the Reference case; no change in assumptions from AEO2014
- Retirements
  - Announced nuclear retirements – 1.2 GW total from 2014
    - same assumptions as AEO2014 (Vermont Yankee, Oyster Creek)
  - Generic/unplanned retirements – 0 GW in current runs but still evaluating potential for retirements due to operational uncertainty (5.7 GW in AEO2014)

EIA's solar PV cost assumptions continue to be consistent with LBNL analyses of utility-scale installed system prices



Sources: EIA AEO2014 and AEO2015, R.W. Beck/SAIC "Updated Capital Cost Estimates for Electricity Generation Plants" (Nov. 2010 and April 2013); LBNL "Utility-Scale Solar 2012 and 2013 (forthcoming)"; SEIA/GTM "Solar Market Insight Q1-2014"; correspondence with Justin Baca (SEIA).

EIA reduced initial wind capital cost assumptions by 10% to reflect recent cost trends reported in LBNL's 2013 Wind Technologies Report (for plants 50-150 MW)



Sources: EIA AEO2014 and AEO2015, R.W. Beck/SAIC "Updated Capital Cost Estimates for Electricity Generation Plants" (Nov. 2010 and April 2013); LBNL "Wind Technologies Report 2013" (using sample of plants 50-150 MW)

Results

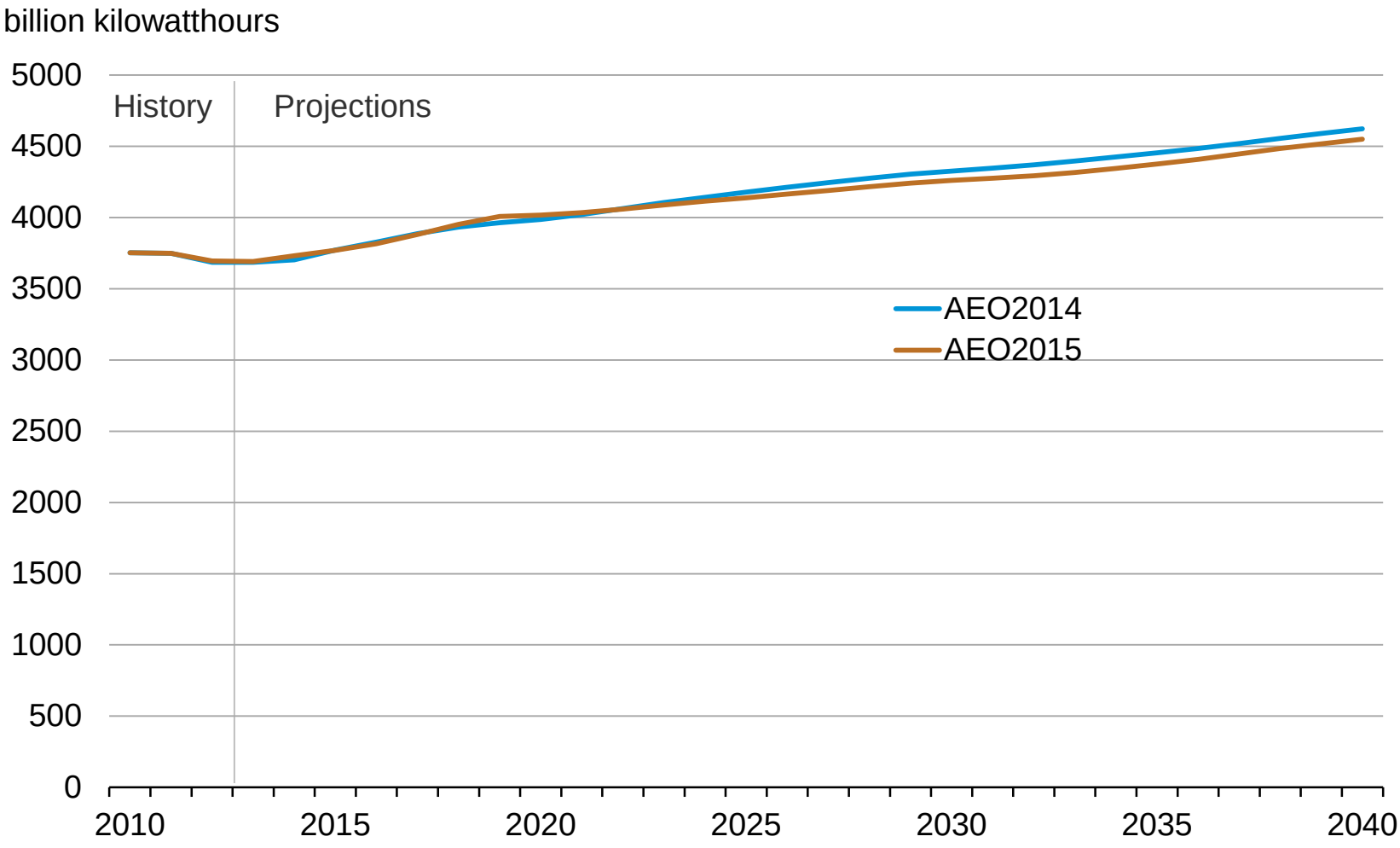
Major summary results changes in electricity, coal, nuclear, and renewables

- Relative to AEO2014, power sector natural gas-fired generation is lower in later years of the projection, due to several factors:
  - Higher levels of renewable electricity generation
  - Lower electricity sales
  - Higher levels of end-use natural gas-fired generation
  - Less natural gas-fired capacity additions in the power sector
  - Removal of the fixed 5.7 GW unannounced nuclear retirements assumption
- Coal retirements are similar to AEO2014

Major summary results changes in electricity, coal, nuclear, and renewables (cont'd)

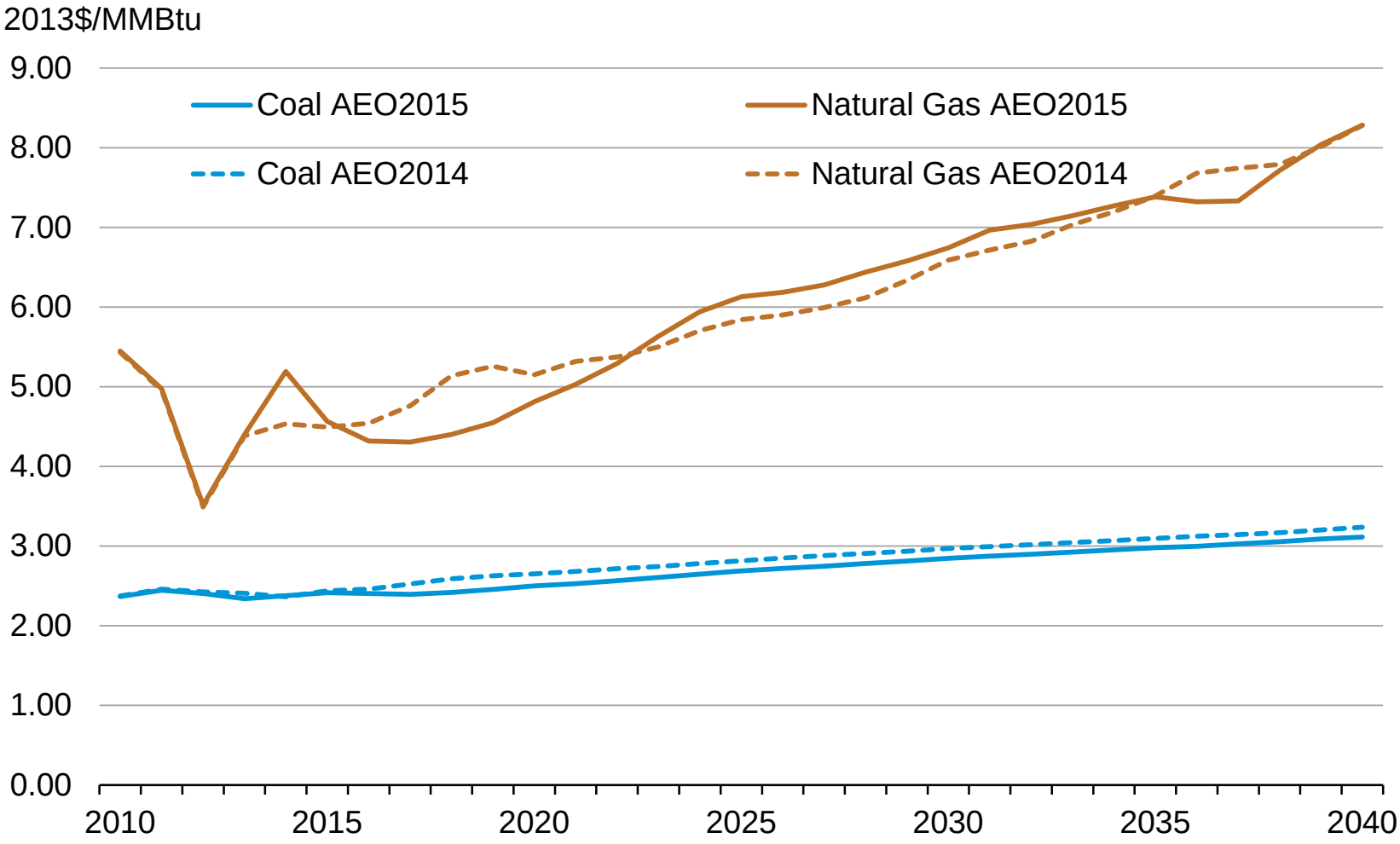
- More renewable capacity additions through 2016 and 2030-2040. Renewable capacity is about 25% higher (50 GW) by 2040 in the AEO2015 than AEO2014, primarily due to solar PV and wind.
  - Near-term growth reflects updated planned builds
  - Longer-term growth primarily from reduced costs

Total Electricity Sales



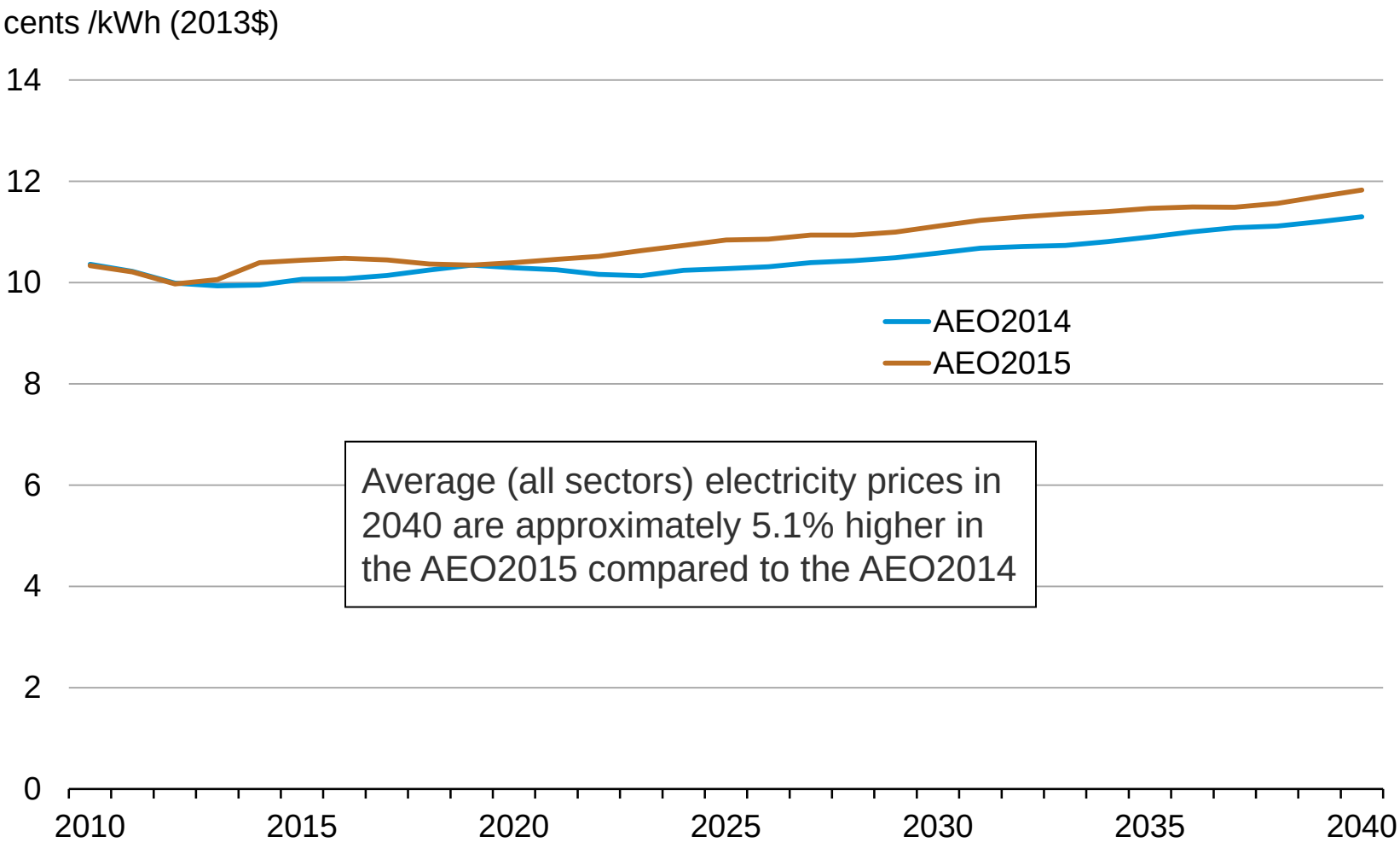
Source: AEO2015 NEMS run ref2015d091014a, AEO2014 Ref2014

Power Sector Fuel Prices



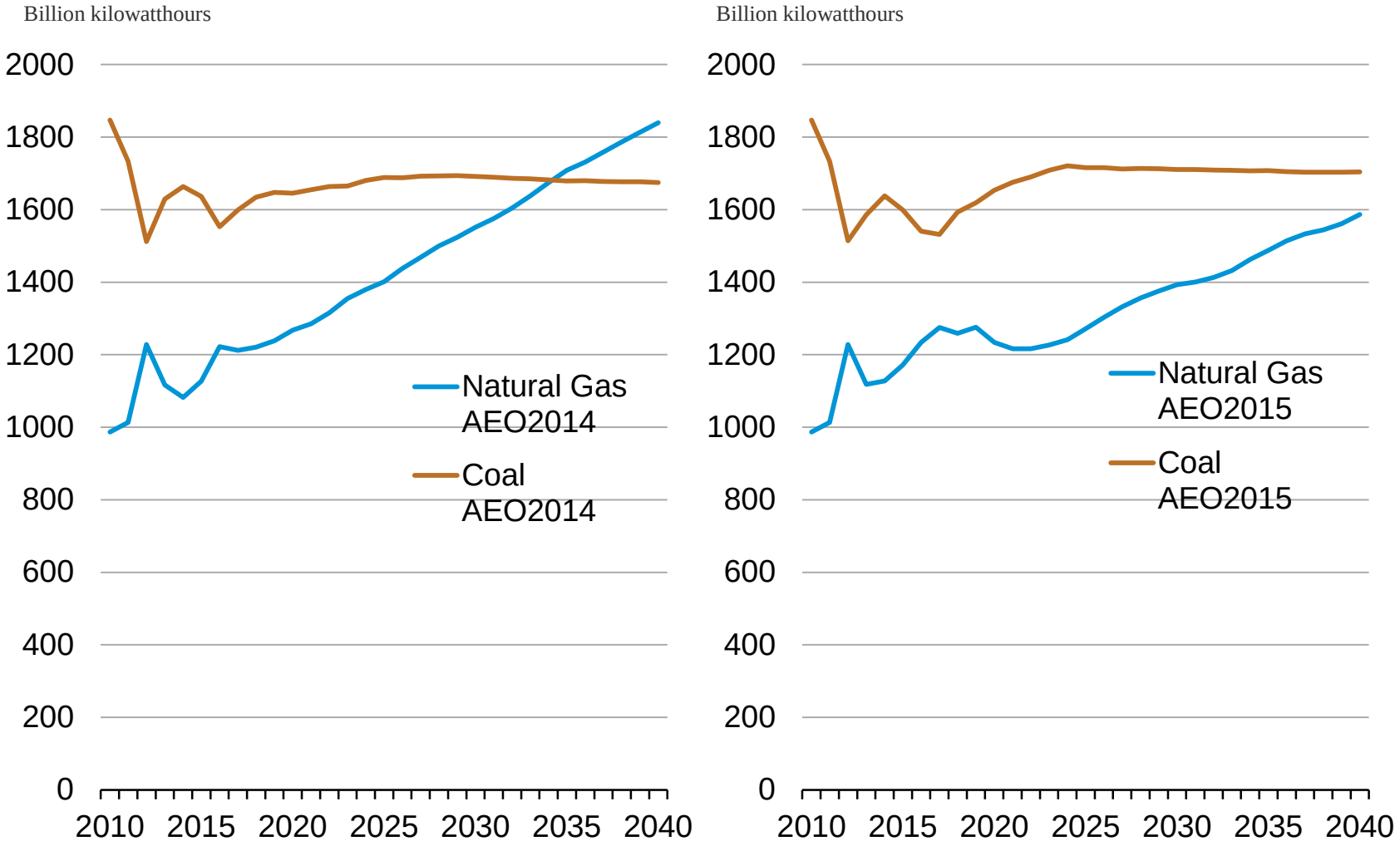
Source: AEO2015 NEMS run ref2015d091014a, AEO2014 Ref2014

Electricity Price Projections



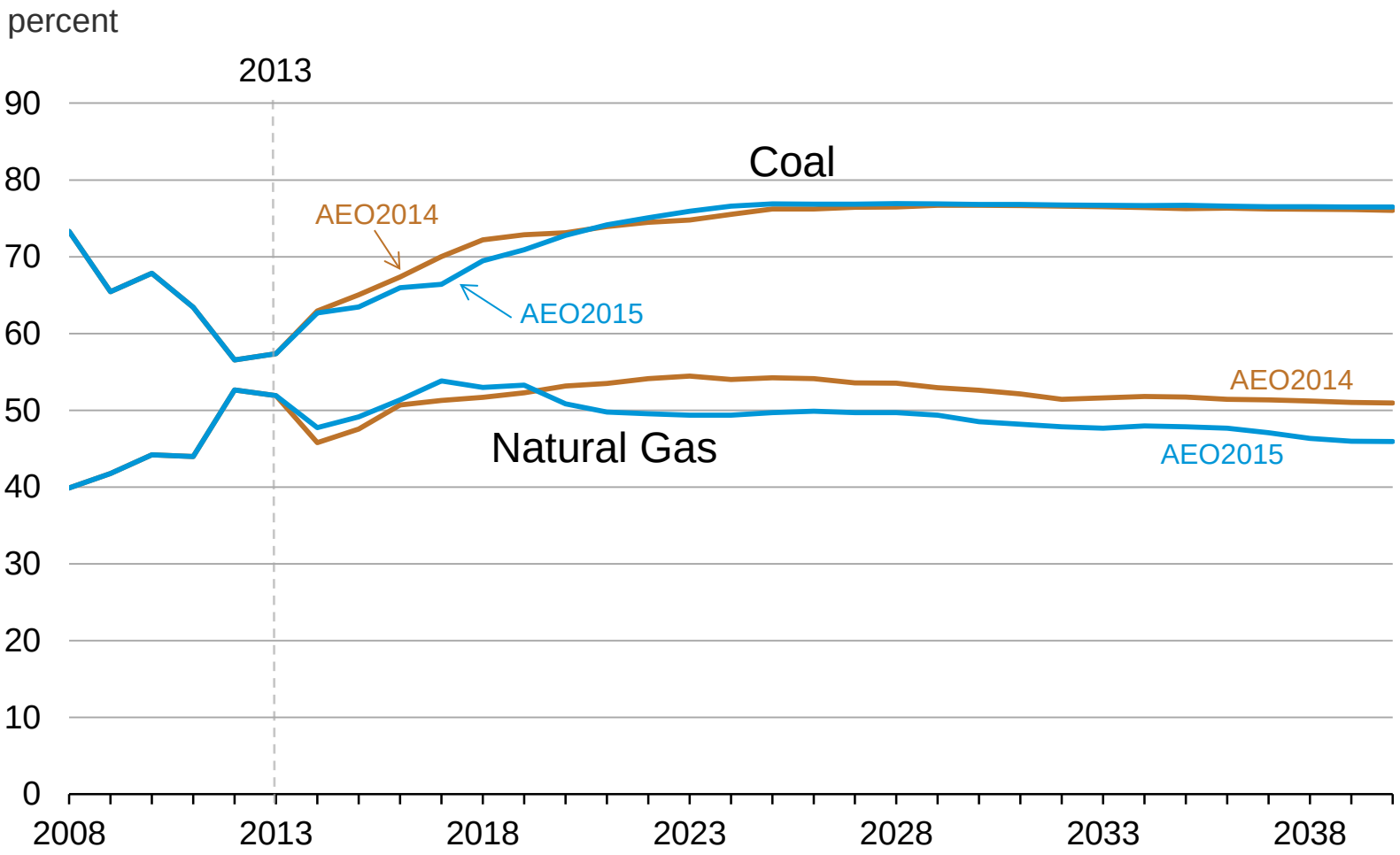
Source: AEO2015 NEMS run ref2015d091014a, AEO2014 Ref2014

Natural gas and coal-fired generation, AEO2014 vs. preliminary AEO2015



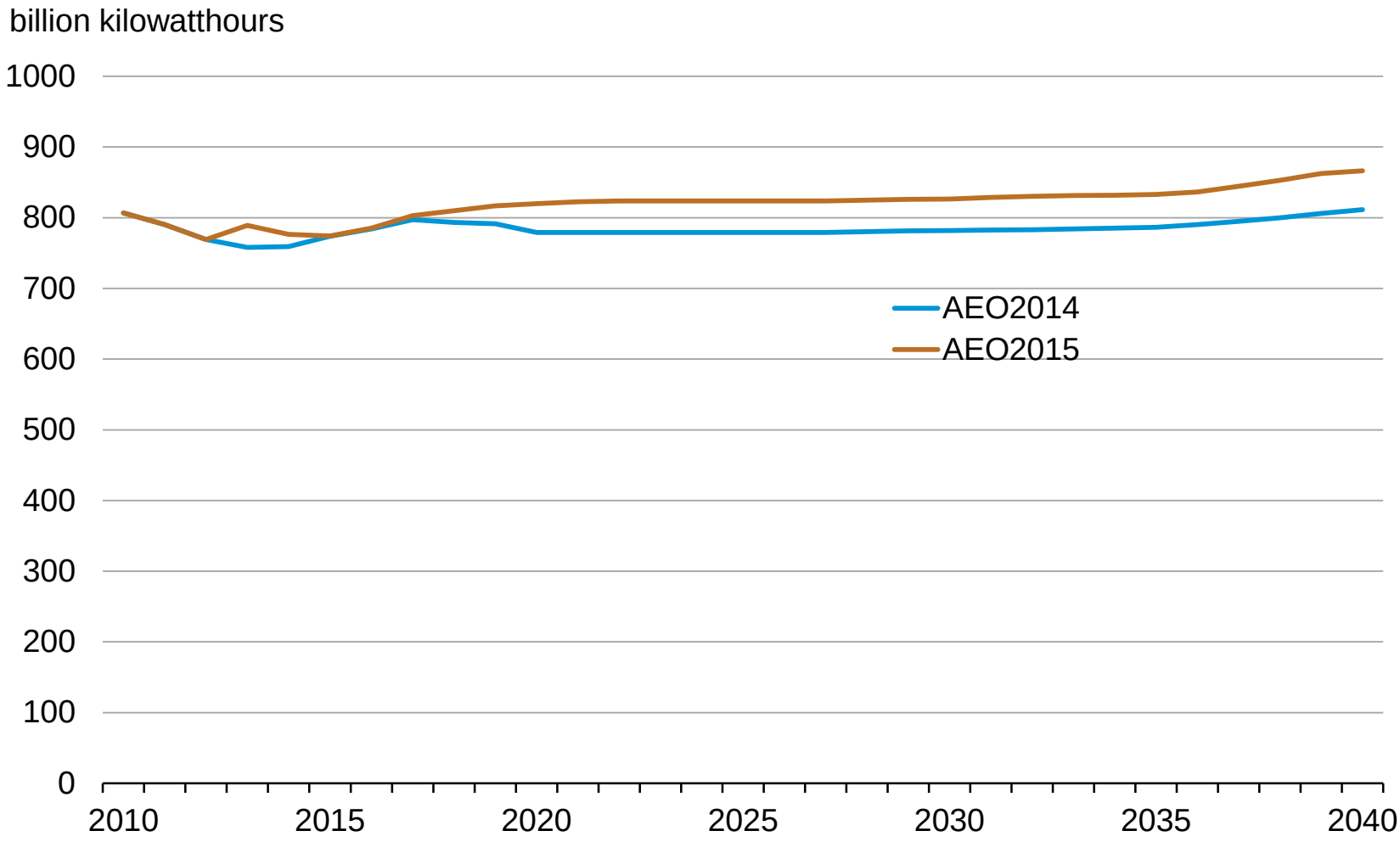
Source: AEO2015 NEMS run ref2015d091014a, AEO2014 Ref2014

Average capacity utilization of natural gas combined cycle and coal generating capacity, 2008-2040



Source: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014.

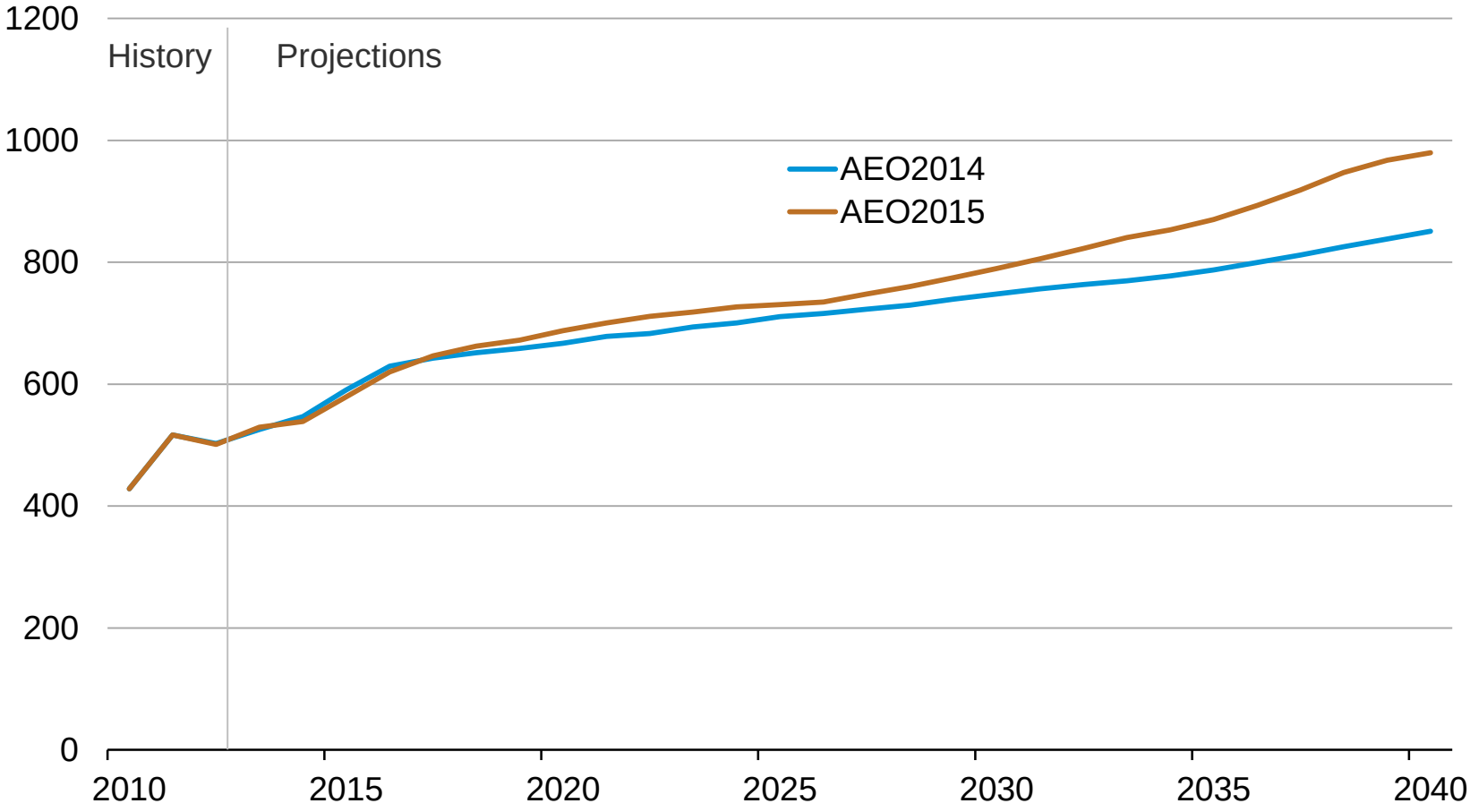
Nuclear Generation



Source: AEO2015 NEMS run ref2015d091014a, AEO2014 Ref2014

Renewable Generation

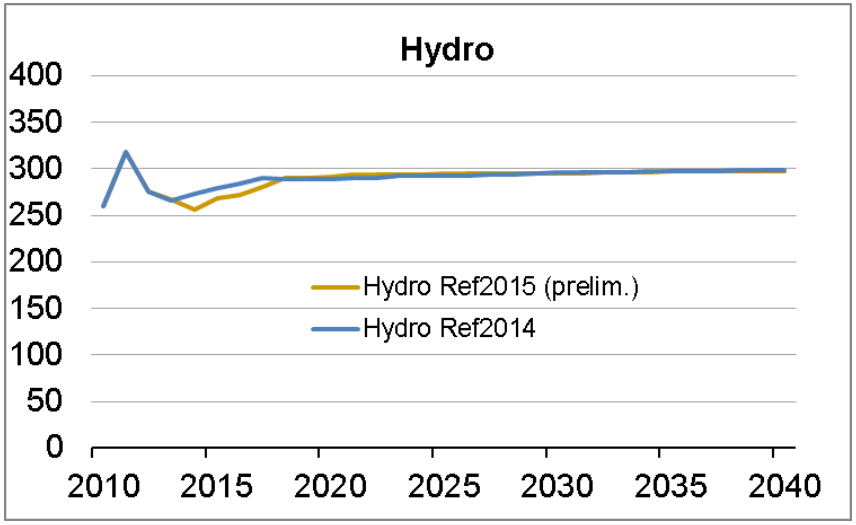
billion kilowatthours

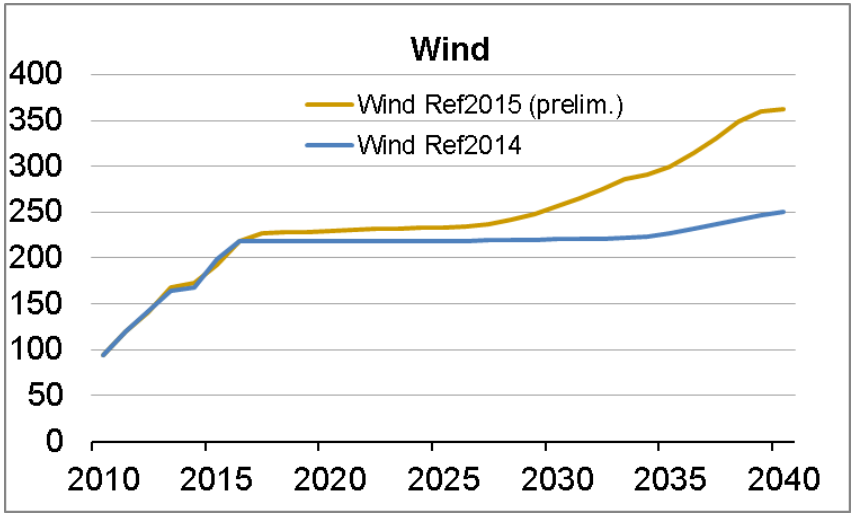


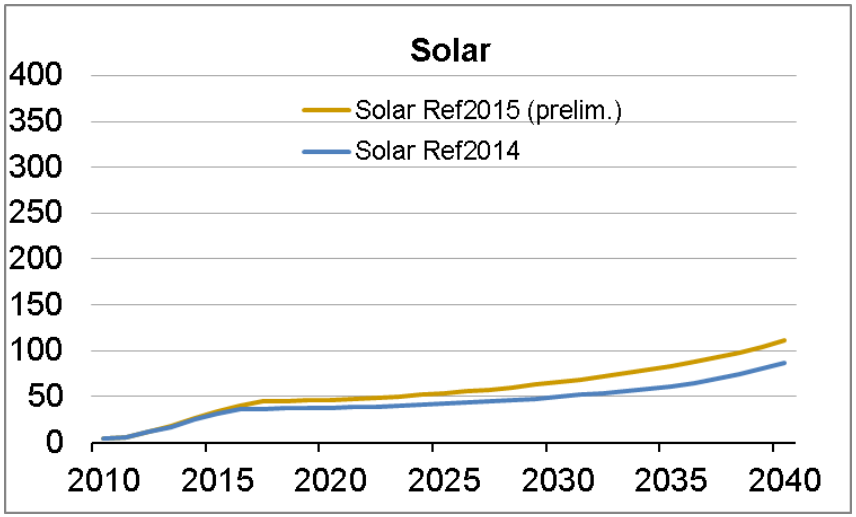
Source: AEO2015 NEMS run ref2015d091014a, AEO2014 Ref2014

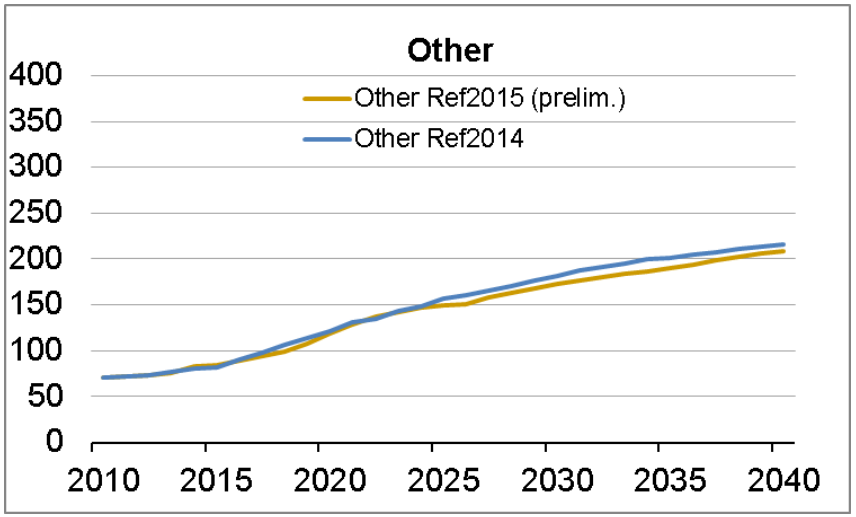
Renewable Generation

billion kilowatthours







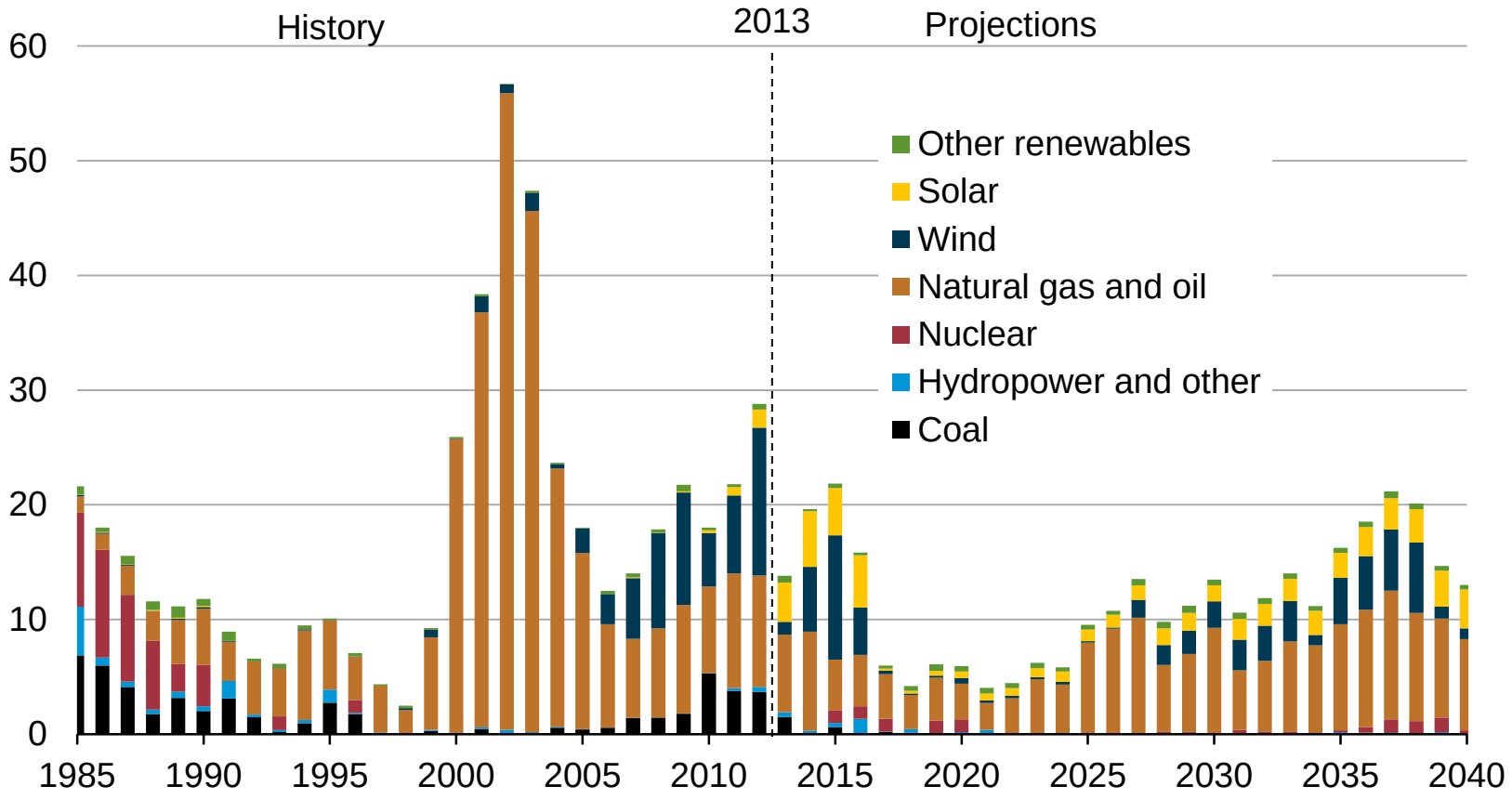


Source: AEO2015 NEMS run ref2015d091014a, AEO2014 Ref2014

AEO2015 projected annual generating capacity additions are moderate relative to historical levels

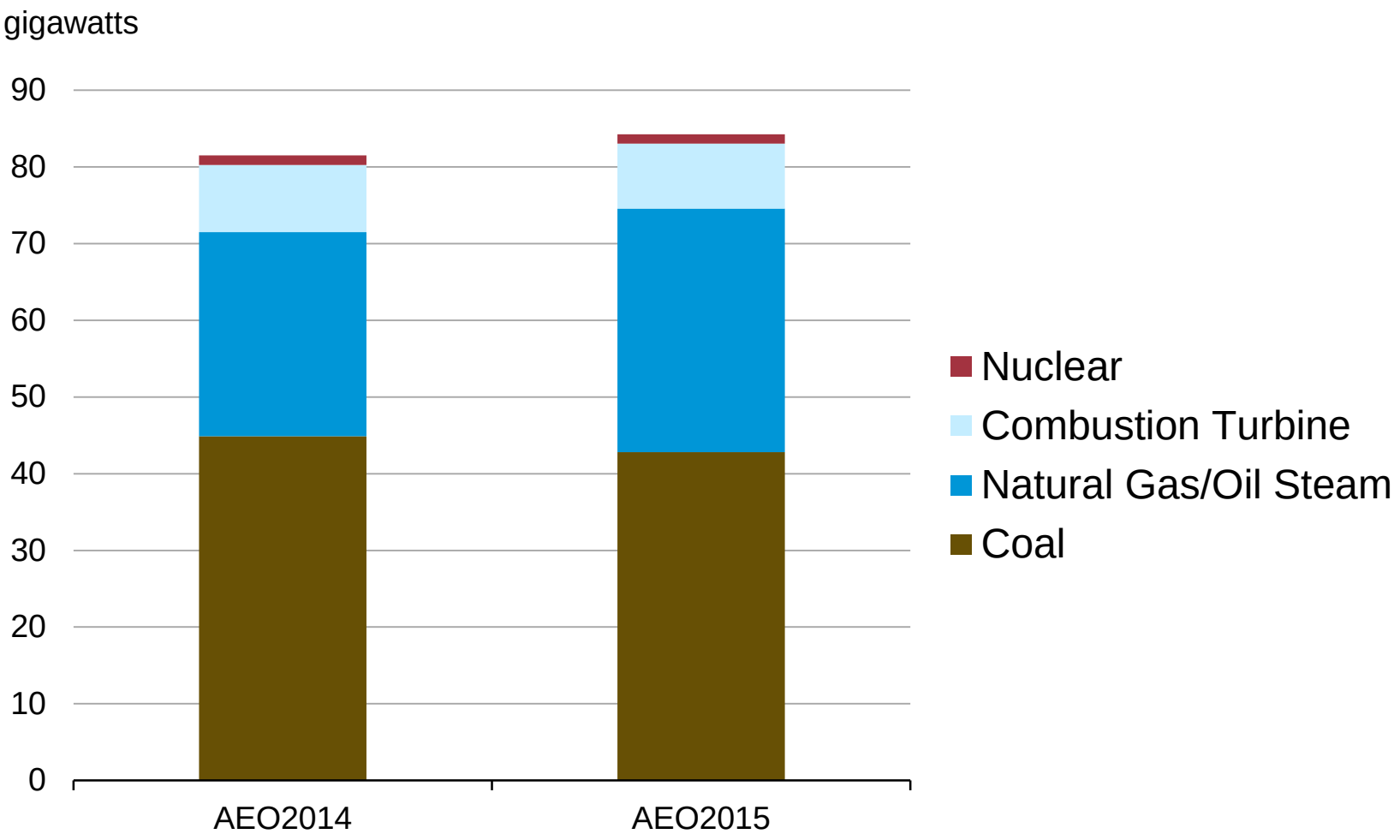
Additions to electricity generating capacity, 1985-2040

gigawatts



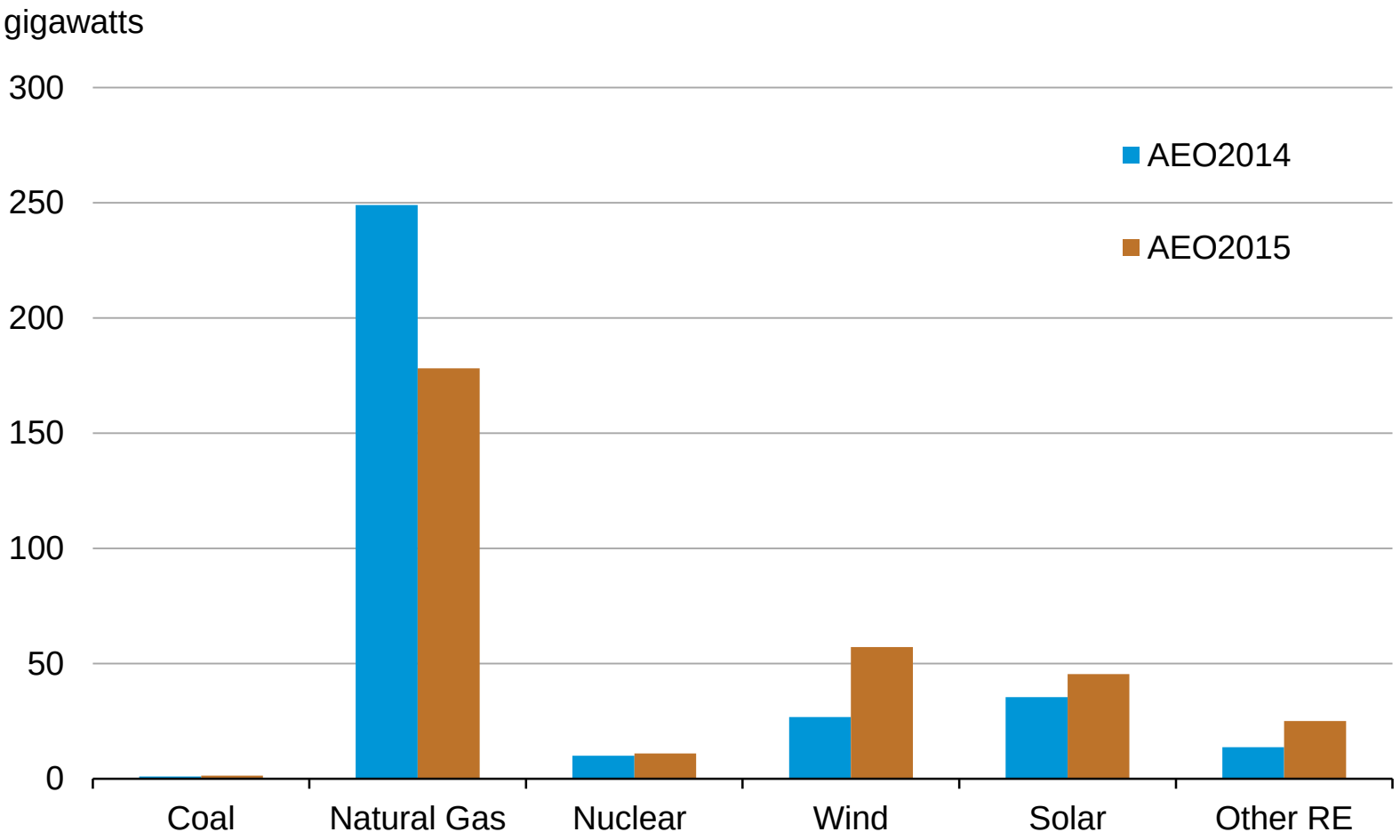
Source: EIA, Annual Energy Outlook 2015

Plant Retirements through 2040



Source: AEO2015 NEMS run ref2015d091014a, AEO2014 Ref2014

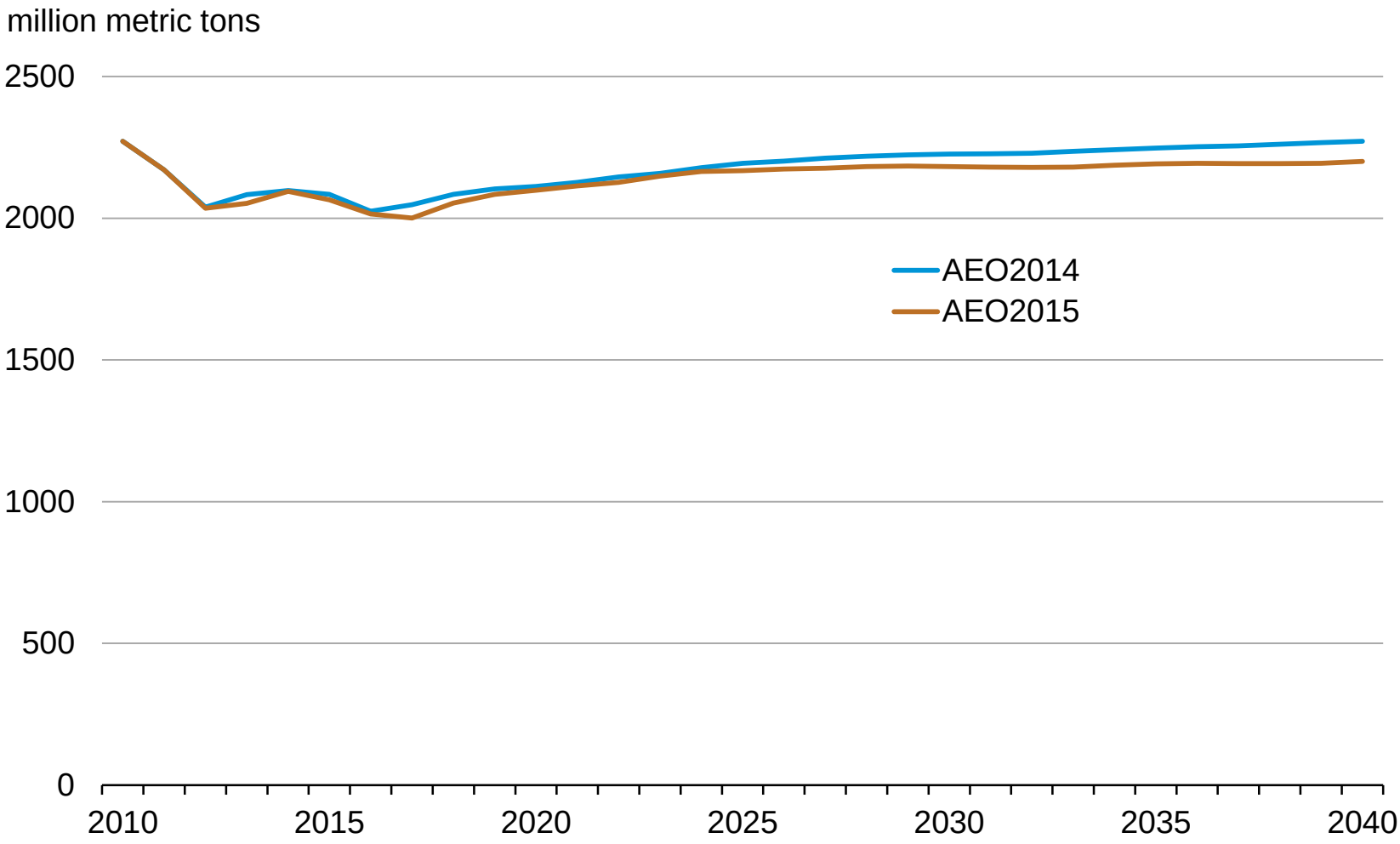
Capacity Additions 2014 through 2040



Source: AEO 2015 NEMS run ref2015d091014a, AEO2014 Ref2014

Note: Other Renewable Energy (RE) includes Hydroelectric, Geothermal, MSW, Wood and Other Biomass

Power Sector CO_2 Emissions



Source: AEO2015 NEMS run ref2015d091014a, AEO2014 Ref2014

Coal

Key results for the AEO2015 Reference case

- Coal continues to be the leading fuel for U.S. electricity generation through 2040 though it declines from 39% in 2013 to 33% in 2040. This differs from the AEO2014 where natural gas beat out coal by 2035.
- As in AEO2014, coal producers in the Interior region gain share while Appalachia loses share of total U.S. coal production. From 2012 to 2040, the Appalachian region's share of total coal production falls from about 28% to 22%.
- Nearly all of the 43 GW of coal-fired capacity retirements (30 GW planned) occur by 2016 largely because of the combination of MATS, relatively low natural gas prices, and relatively low electricity demand.

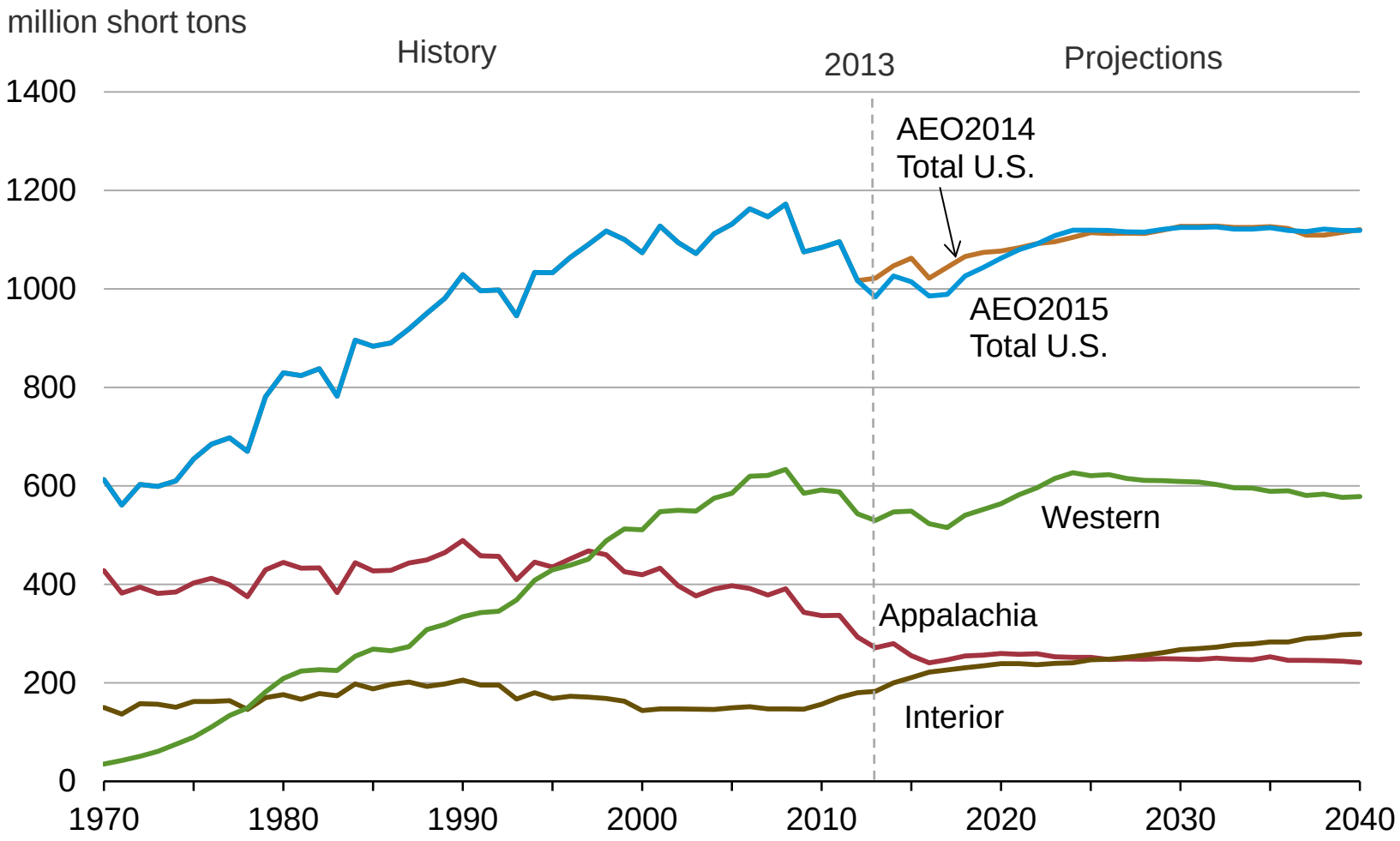
Key results for the AEO2015 Reference case

- Coal production remains near 2013 levels through 2017 as the average utilization rate for existing coal plants increases offsetting generation losses from retirements; between 2017 and 2023, coal production rises as natural gas prices rise and coal exports increase

- 1.4 GW of additions (0.7 GW planned)

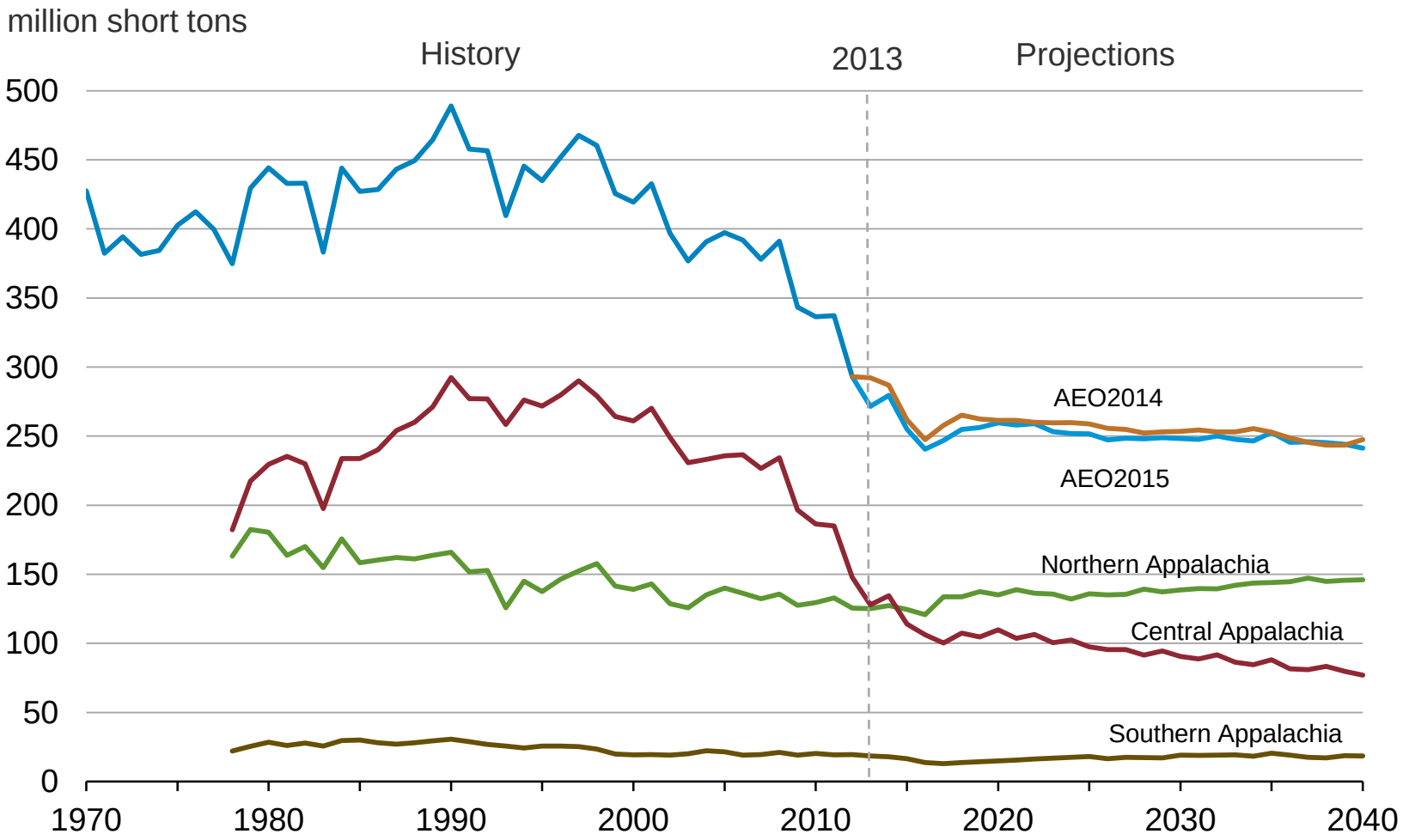
- Delivered coal prices increase gradually through 2040 at an average rate of 1.0% per year (on a per ton basis) due to declining coal mine productivity and increasing transportation costs

Coal production by region, 1970-2040



Source: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014

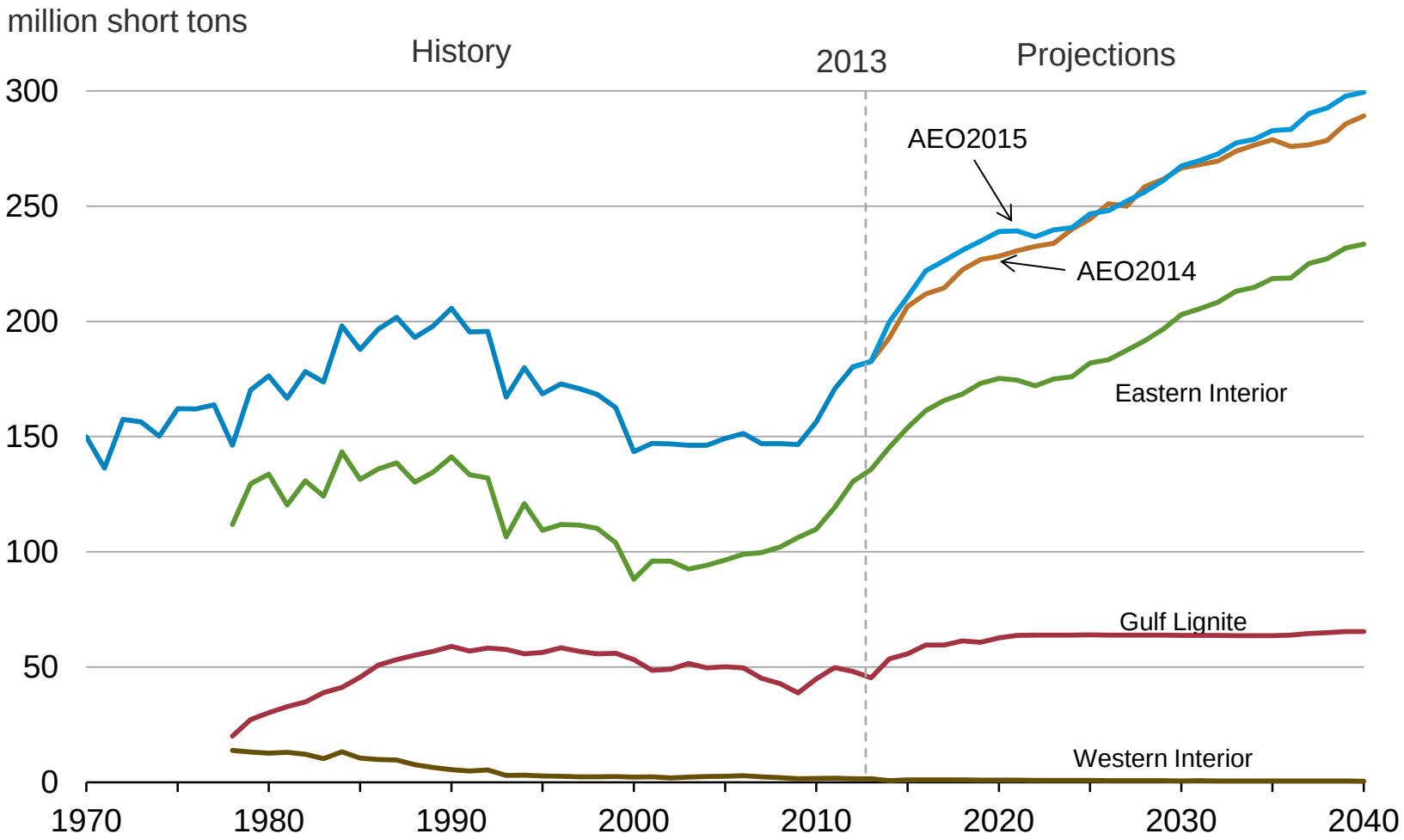
Appalachian coal production, 1970-2040



Source: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014

Except for Appalachian total, data for 1978-1985 exclude production from small (<10,000 short tons) coal mines

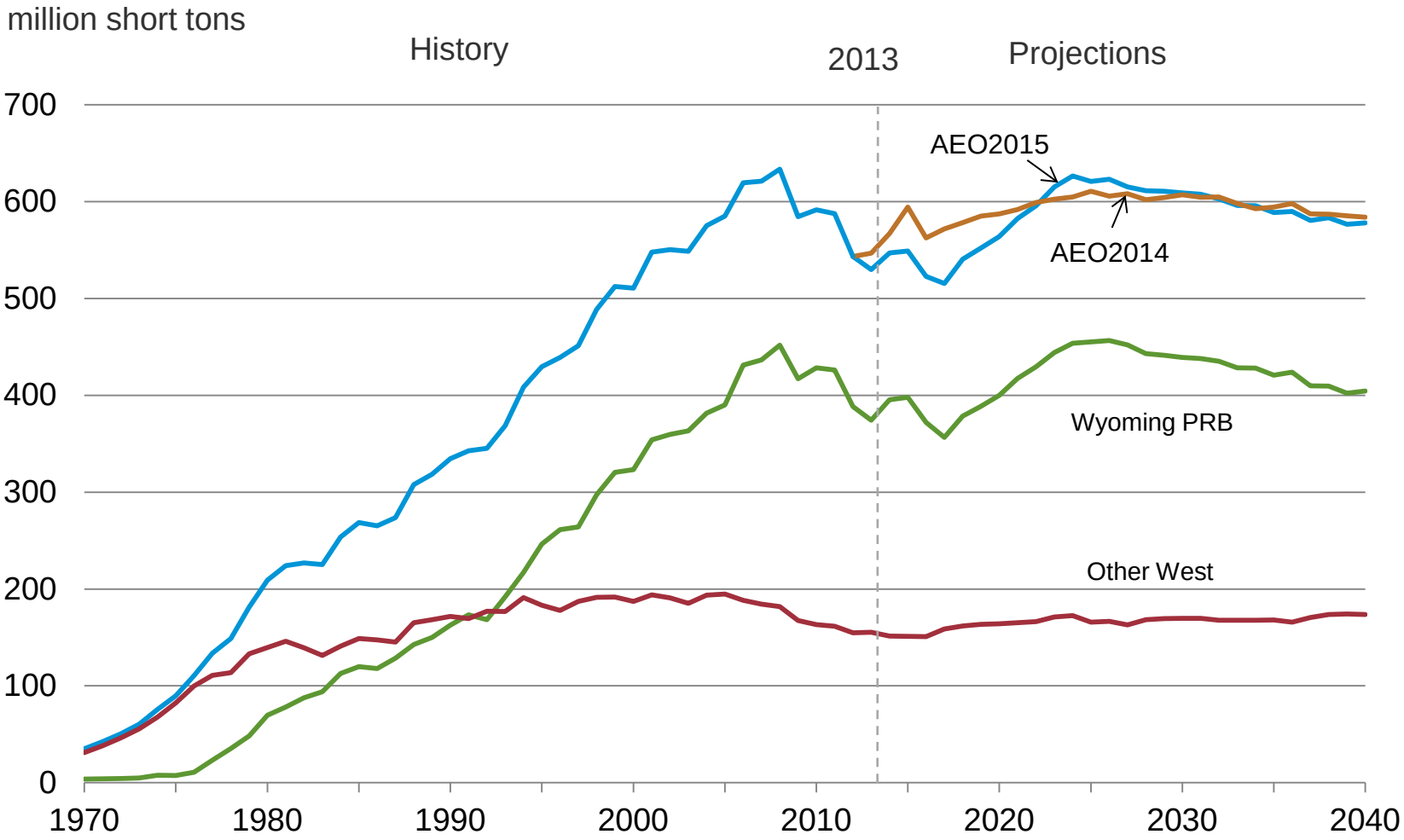
Interior coal production, 1970-2040



Source: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014.

Except for Interior total, data for 1978-1985 exclude production from small (<10,000 short tons) coal mines

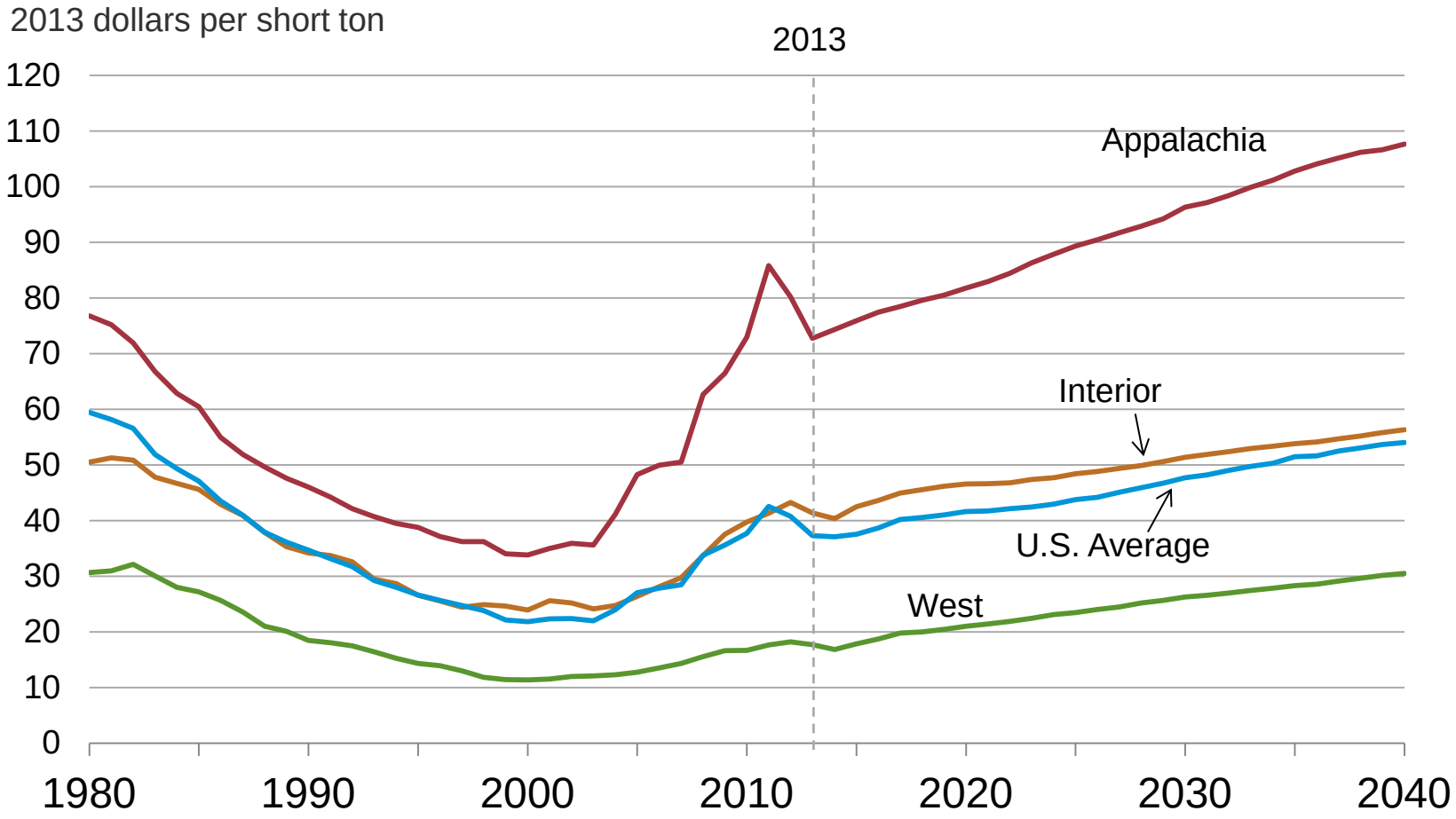
Western coal production, 1970-2040



Source: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014.

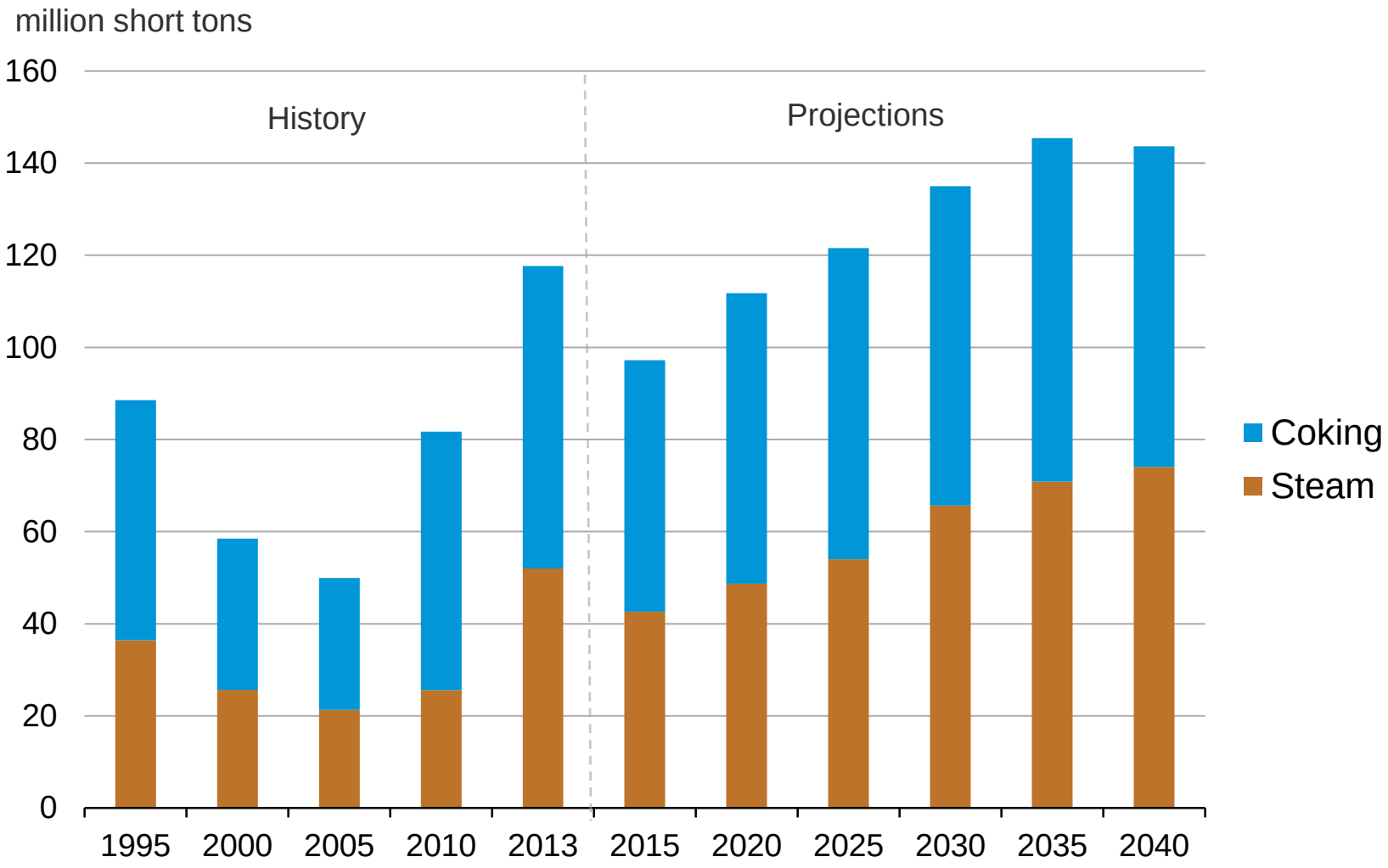
Except for Western total, data for 1978-1985 exclude production from small (<10,000 short tons) coal mines

Average minemouth coal prices by region, 1980-2040



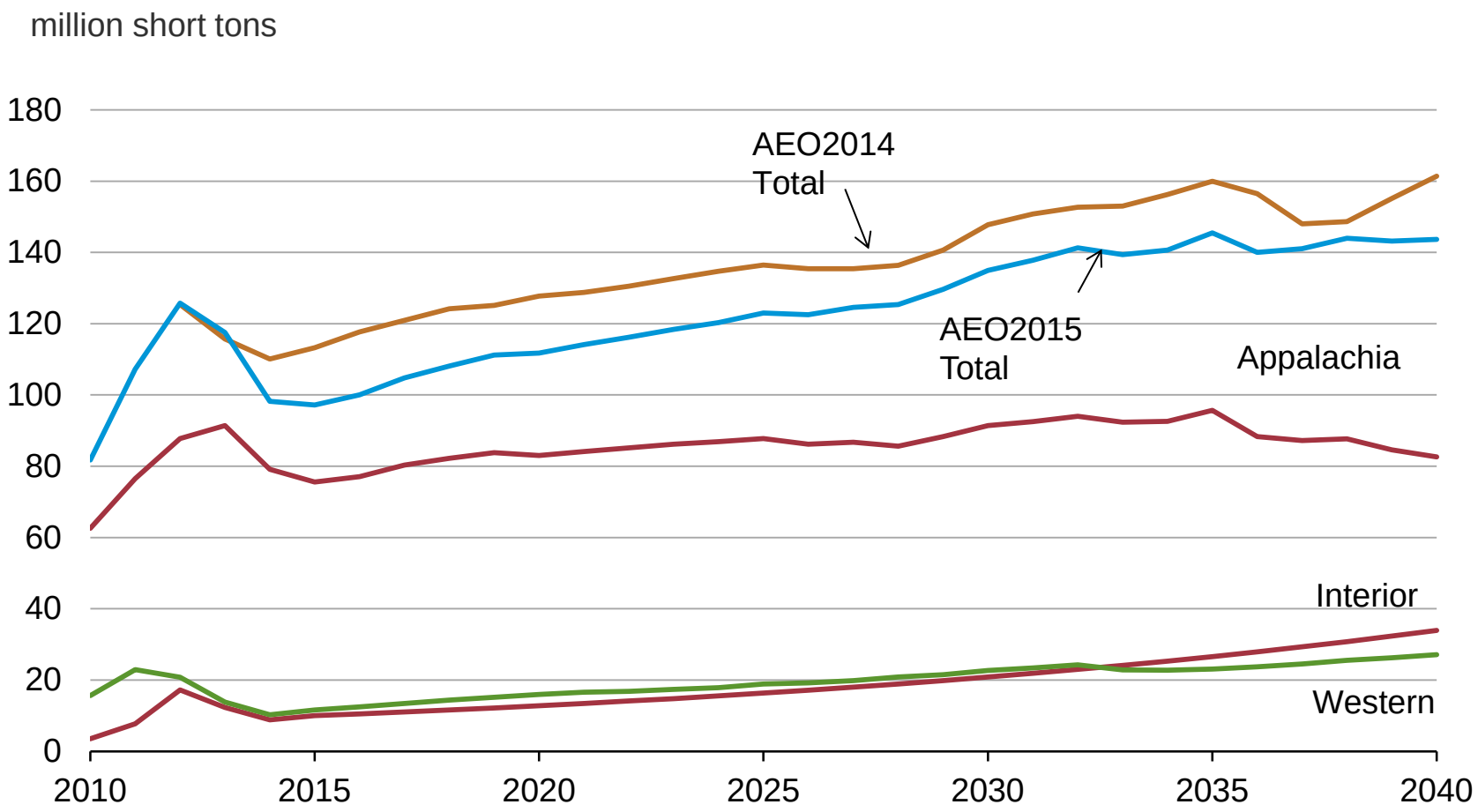
Source: Preliminary AEO2015 (NEMS run ref2015.d091014a)

U.S. Coal Exports, 1995-2040



Source: History: U.S. Energy Information Administration (EIA), Quarterly Coal Report; Projections: Preliminary AEO2015 (NEMS run ref2015.d091014a).

Coal exports by major supply region, 2010-2040



Source: 2010-2012: U.S. Energy Information Administration (EIA), Annual Coal Distribution Report; 2013-2040: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014.

For more information

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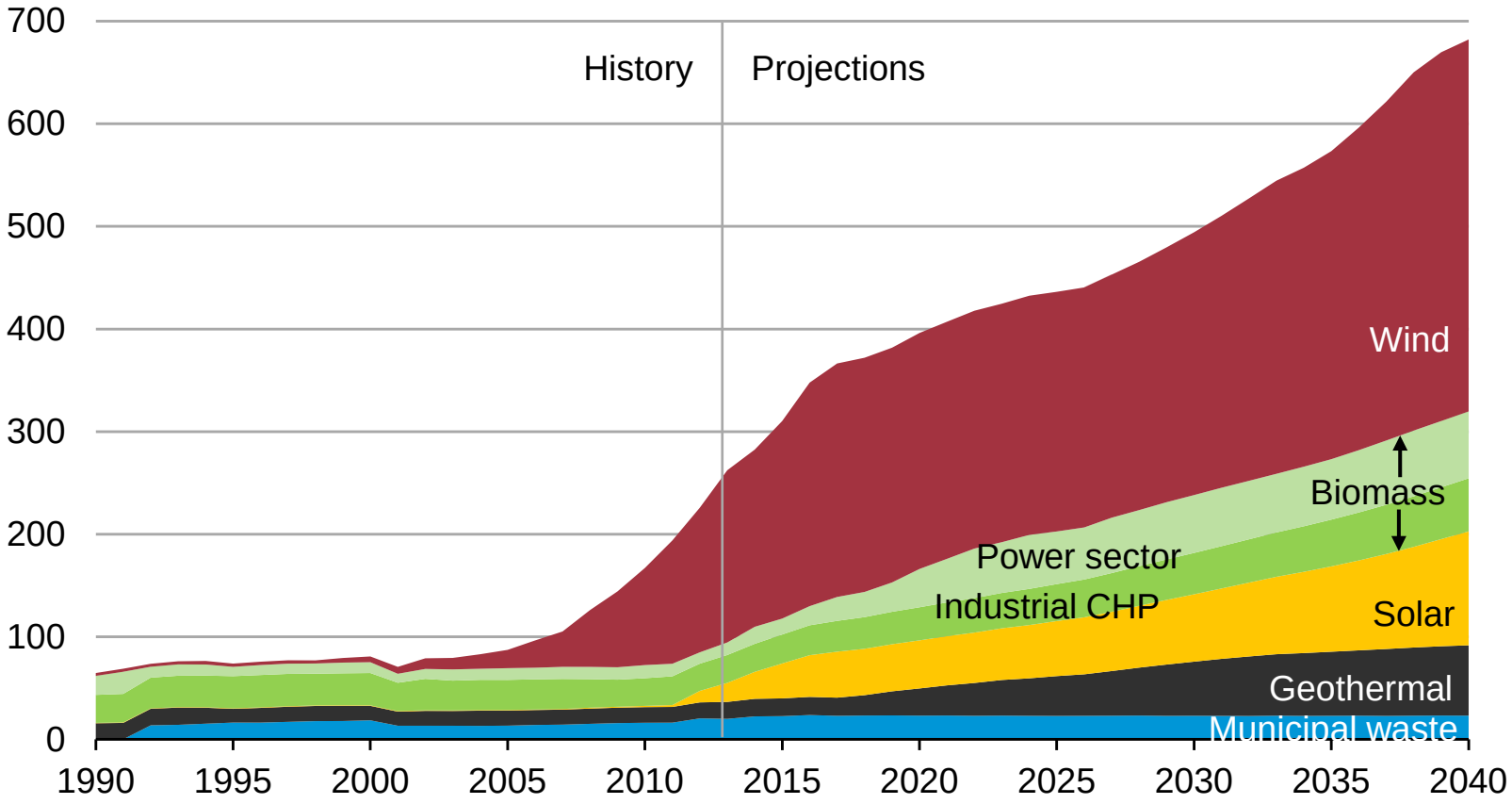
Backup Slides

Non-Hydro Renewable Generation more than doubles between 2012 and 2040 in the Reference case

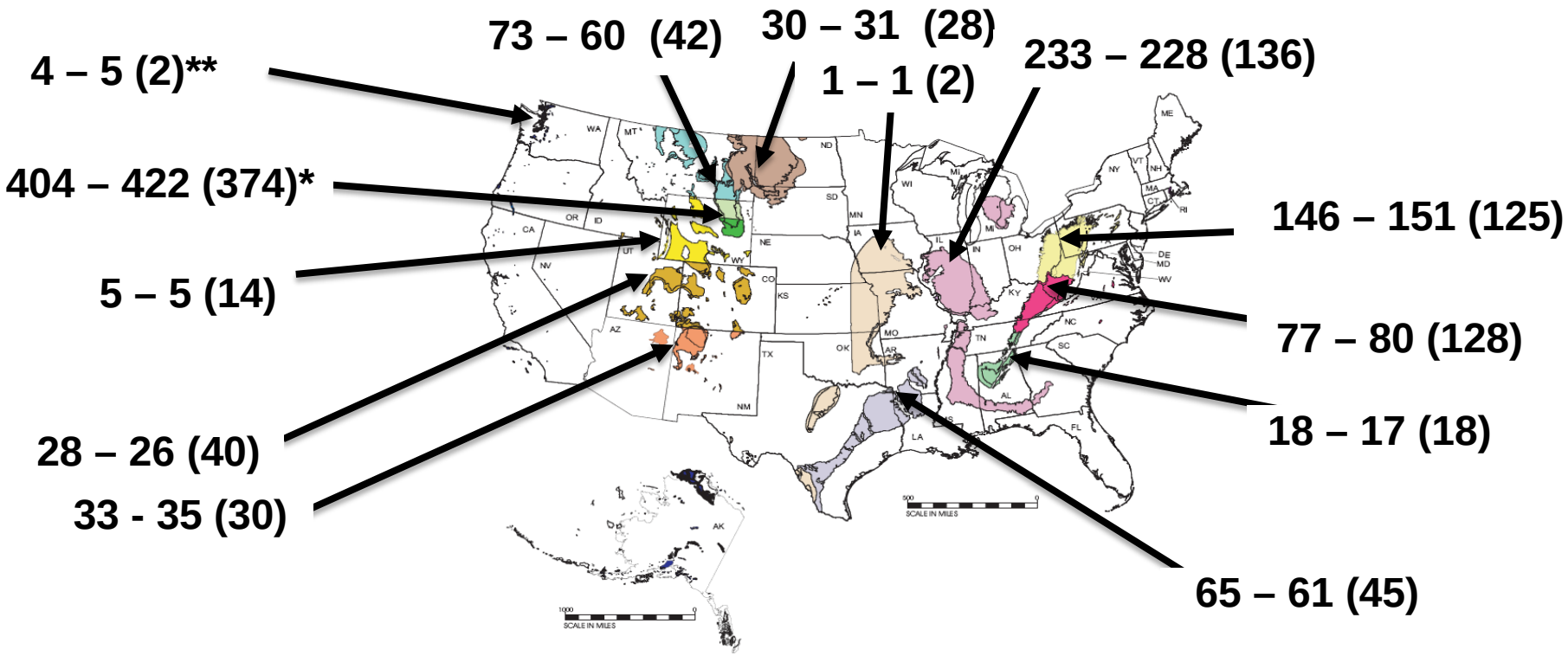
Non-hydro renewable generation in the AEO2015 Reference case

billion kilowatthours



Source: EIA, Annual Energy Outlook 2015 (Reference case run: d091014a)

Coal production, AEO2015 vs. AEO2014 in 2040 (and 2013) (million short tons)



U.S. Total:
1,119 – 1,121 (984)

* Includes production from all mines in Wyoming's Powder River Basin.

** Includes production from mines in both Alaska and Washington.

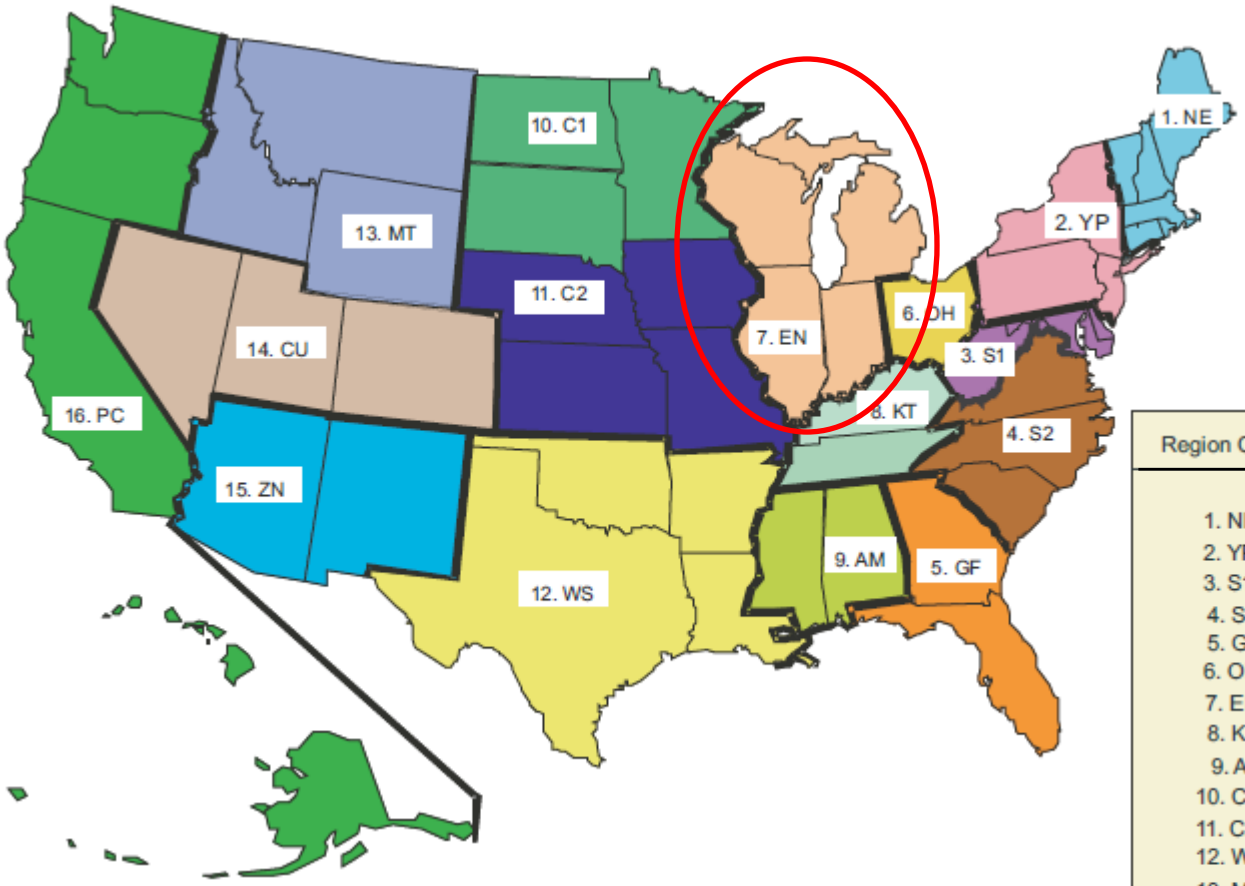
Source: 2013 (preliminary): Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine and Employment and Coal Production Report;" 2040: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014.

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

Coal Supply Region	1980-1990	1990-2000	2000-2013	2011-2012	2012-2013	AEO2015 2012-2040	AEO2014 2012-2040
Northern Appalachia	5.4	5.5	-2.2	-4.9	4.3	-1.1	-1.3
Central Appalachia	7.3	4.4	-5.2	-3.8	3.3	-2.9	-3.4
Eastern Interior	4.8	3.7	-0.2	6.1	7.0	0.3	0.1
Gulf Lignite	2.6	2.4	-2.7	-4.2	-1.8	-1.0	-1.0
Dakota Lignite	6.0	1.0	-3.1	-4.8	0.7	-0.9	-1.0
Western Montana	4.6	2.0	-2.4	-11.7	15.4	-0.5	-1.7
WY, Northern Powder River Basin	7.5	3.2	-3.2	-5.7	-2.6	-1.6	-1.7
WY, Southern Powder River Basin	7.2	4.9	-2.4	-6.4	4.9	-1.4	-1.7
Rocky Mountain	7.8	5.5	-2.5	3.5	-0.2	-2.2	-2.5
U.S. Average	7.1	6.2	-1.8	-0.2	6.9	-0.9	-1.2

Note: Data for 2013 are preliminary.
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 AEO2015 (NEMS run ref2015.d091014a); and AEO2014 Reference case.

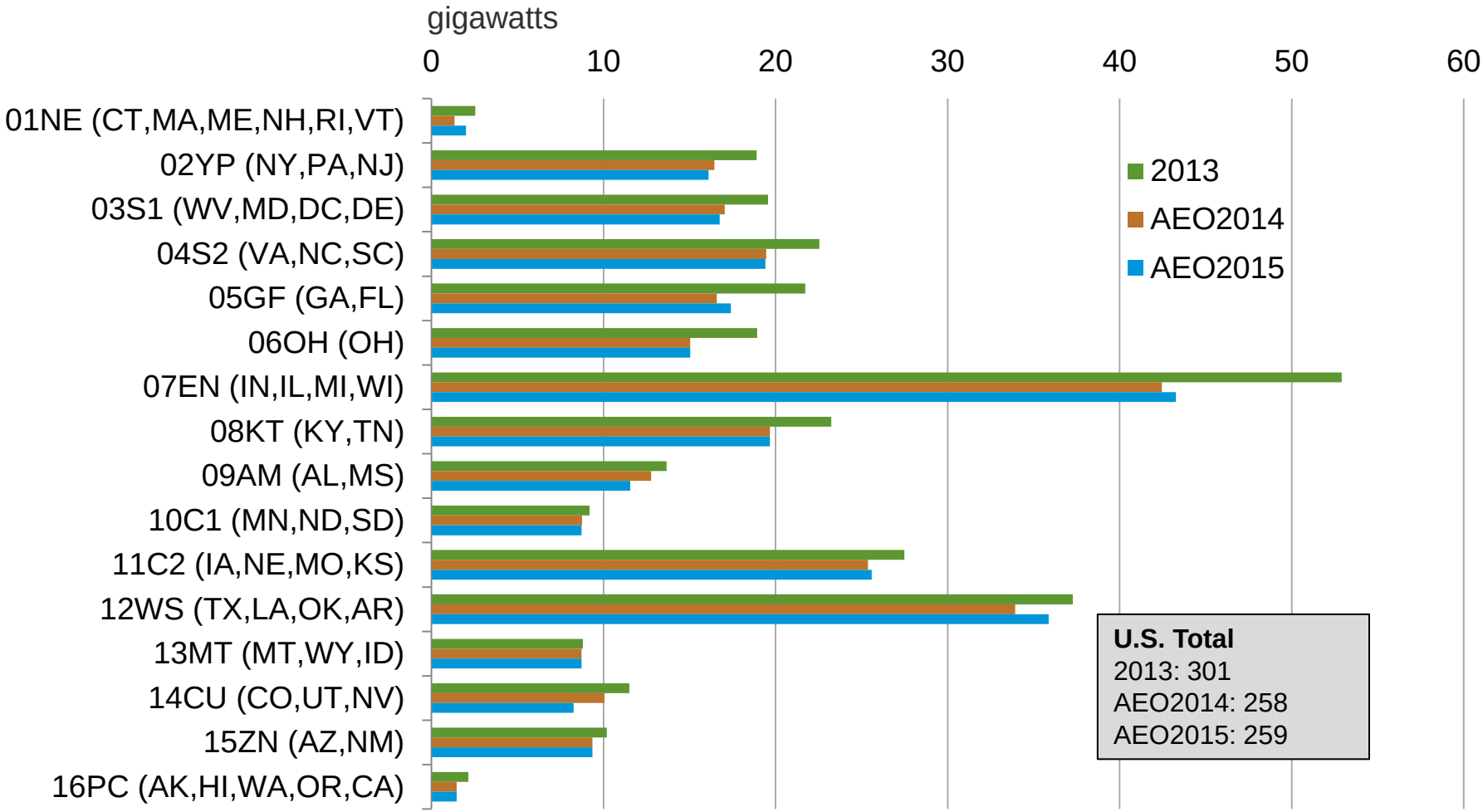
Coal demand regions



Region Code	Region Content
1. NE	CT,MA,ME,NH,RI,VT
2. YP	NY,PA,NJ
3. S1	WV,MD,DC,DE
4. S2	VA,NC,SC
5. GF	GA,FL
6. OH	OH
7. EN	IN,IL,MI,WI
8. KT	KY,TN
9. AM	AL,MS
10. C1	MN,ND,SD
11. C2	IA,NE,MO,KS
12. WS	TX,LA,OK,AR
13. MT	MT,WY,ID
14. CU	CO,UT,NV
15. ZN	AZ,NM
16. PC	AK,HI,WA,OR,CA

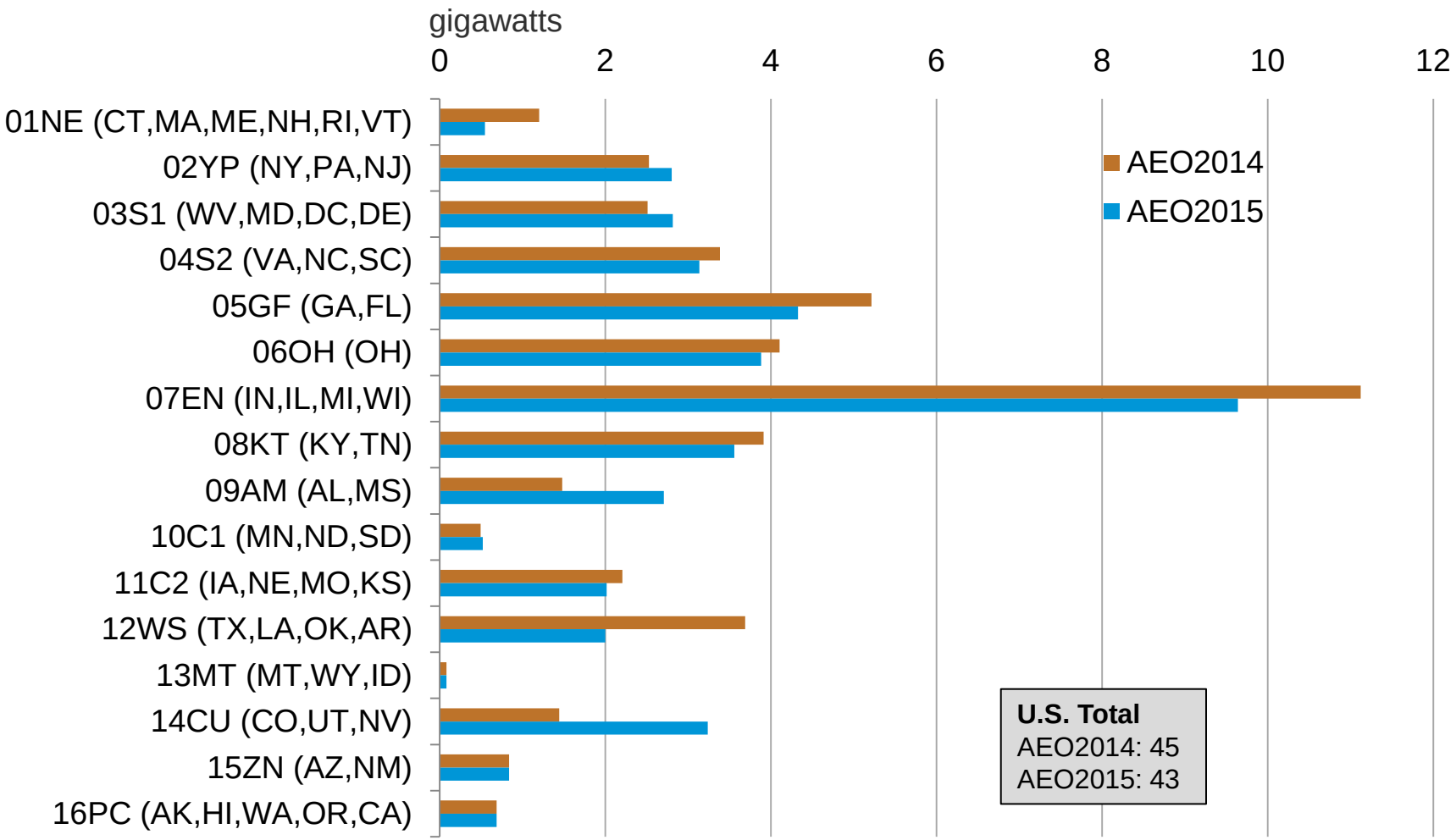
Source: U.S. Energy Information Administration, Office of Energy Analysis

Net summer coal-fired generating capacity in the electric power sector by coal demand region, 2013 and 2040



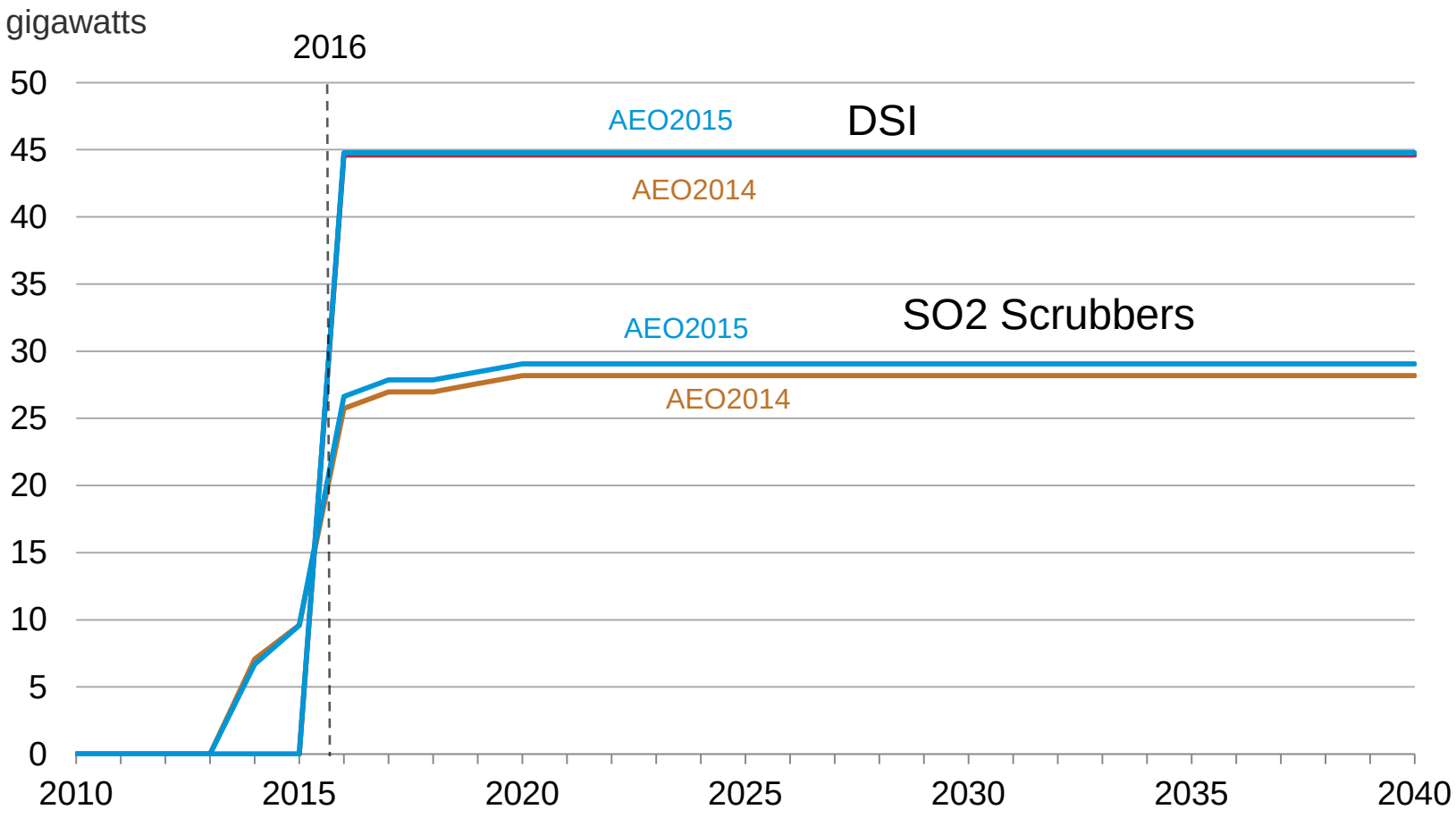
Source: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014.

Cumulative net summer coal-fired capacity retirements by coal demand region, 2014-2040



Source: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014.

Cumulative SO2 scrubber and Dry Sorbent Injection (DSI) retrofits, 2014-2040



Source: Preliminary AEO2015 (NEMS run ref2015.d091014a); and AEO2014.