Annual Energy Outlook 2014: Coal Supply and Demand Projections Through 2040

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October 2, 2014 | Rail Energy Transportation Advisory Committee to the Surface Transportation Board, Washington, D.C.

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

Legislation and Regulations

AEO2014 legislation and regulation assumptions

- Current laws and regulations included in the AEO2014 Reference case
  - Clean Air Interstate Rule (CAIR)
  - Mercury and Air Toxics Standards (MATS) with full compliance by 2016
  - Regional Haze Rule plans are captured in annual reporting data
  - California's cap-and-trade program (AB 32) and the Northeast's Regional Greenhouse Gas Initiative (RGGI) program
  - Uncertainty with respect to CO_2 policy addressed through a 3% higher cost of capital for new coal-fired power and coal-to-liquids plants and capital investment projects at existing coal-fired power plants
  - State Renewable Portfolio Standards (RPS)
  - Renewable energy sunset provisions as specified in law, e.g., for production tax credits for wind the "effective expiration date" is 2015 for plants under construction by the end of 2013

Legislative and regulatory actions not addressed in the AEO2014 Reference case

- EPA's CO_2 New and Existing Source Performance Standards per section 111(b) and 111(d) of the Clean Air Act, respectively
- EPA's cooling water intake regulations per section 316(b) of the Clean Water Act
- EPA's coal effluent guidelines and coal combustion residuals
- California post-2020 Greenhouse Gas (GHG) emissions target
- EPA's tailoring rule for biomass carbon emissions

Review of AEO2014 Reference Case

Key results for the AEO2014 Reference case

- Coal is no longer the leading fuel for U.S. electricity generation in 2040. Coal's share of total generation decreases over time to 32% in 2040 from 37% in 2012.

- 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 (on a Btu basis) falls from about 36% to 29%.

- Much of the 51 GW of coal-fired capacity retirements (33 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 AEO2014 Reference case

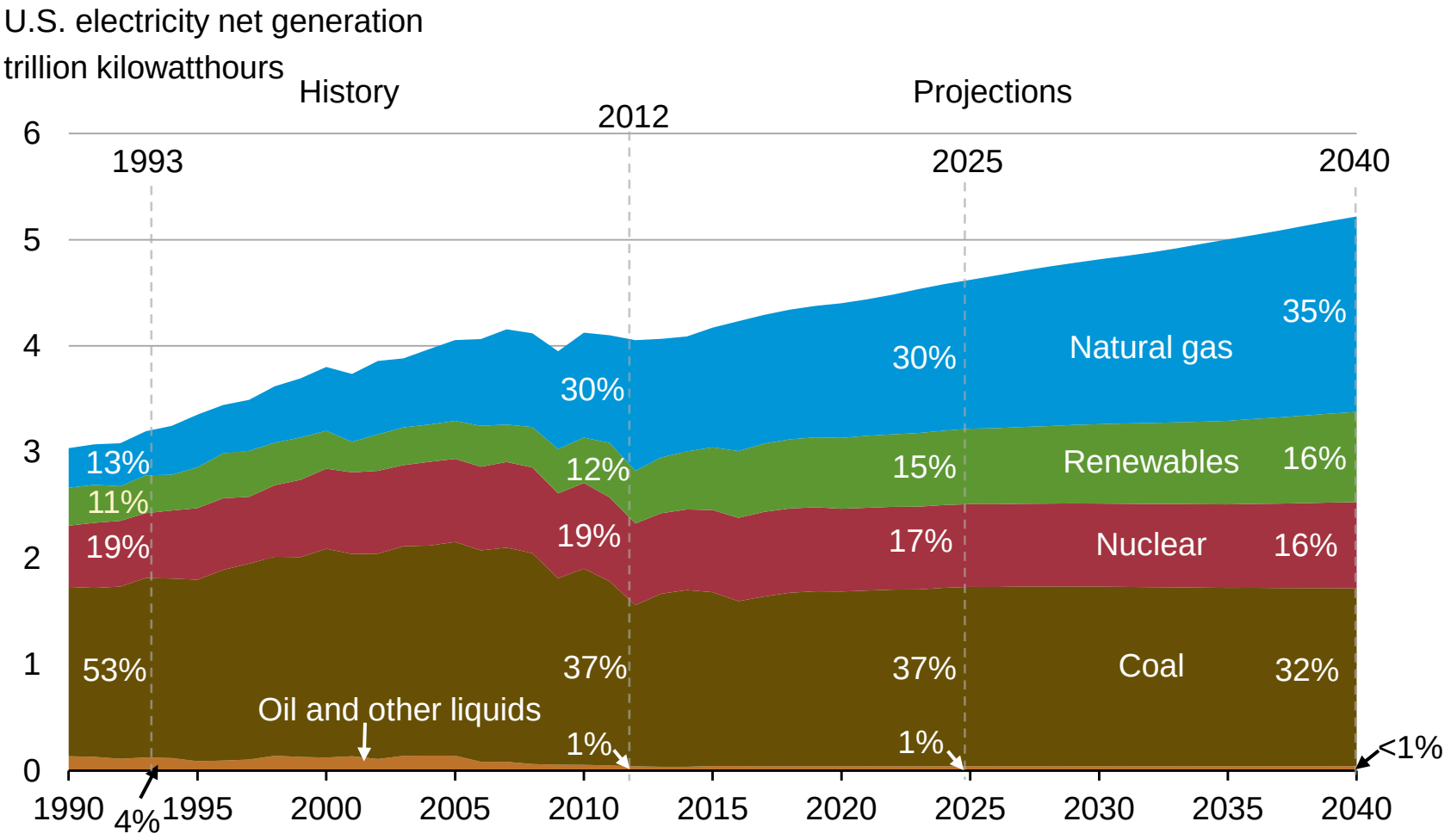
- Expanding development of shale gas resources drives increased production and competitive prices for natural gas

- A short-term recovery for coal occurs followed by a decline in consumption in 2015 and 2016 as MATS takes effect, resulting in a net gain of 26 million tons for coal in 2016 compared to 2012. After 2016, coal consumption rises, peaking in 2029 with a small decline thereafter.

- 2.6 GW of coal capacity additions (2.2 GW planned)

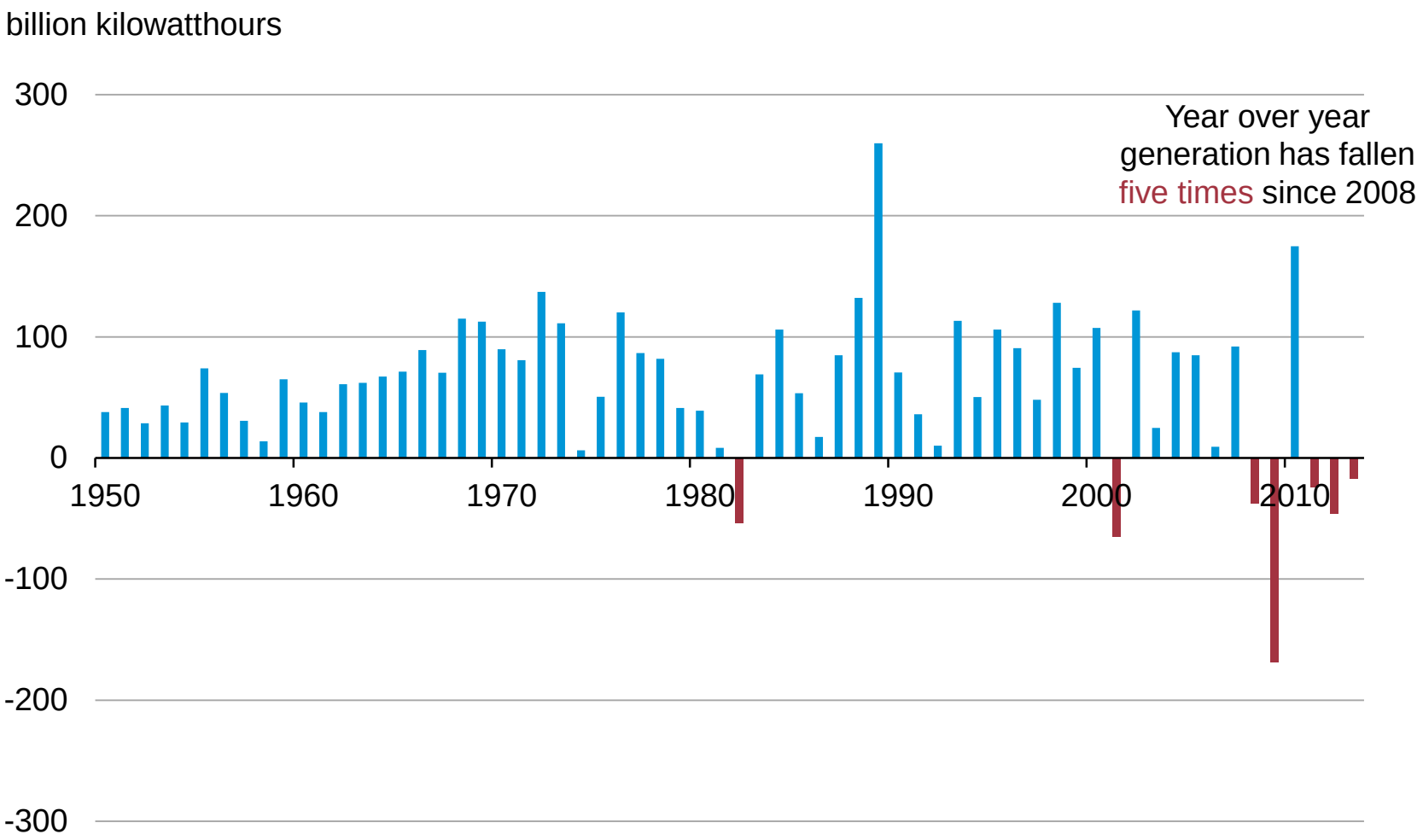
- Delivered coal prices increase gradually through 2040 at an average rate of 0.9% per year (on a per ton basis) due to declining coal mine productivity and slightly higher transportation costs

Over time the electricity mix gradually shifts towards larger shares of natural gas and renewable generation



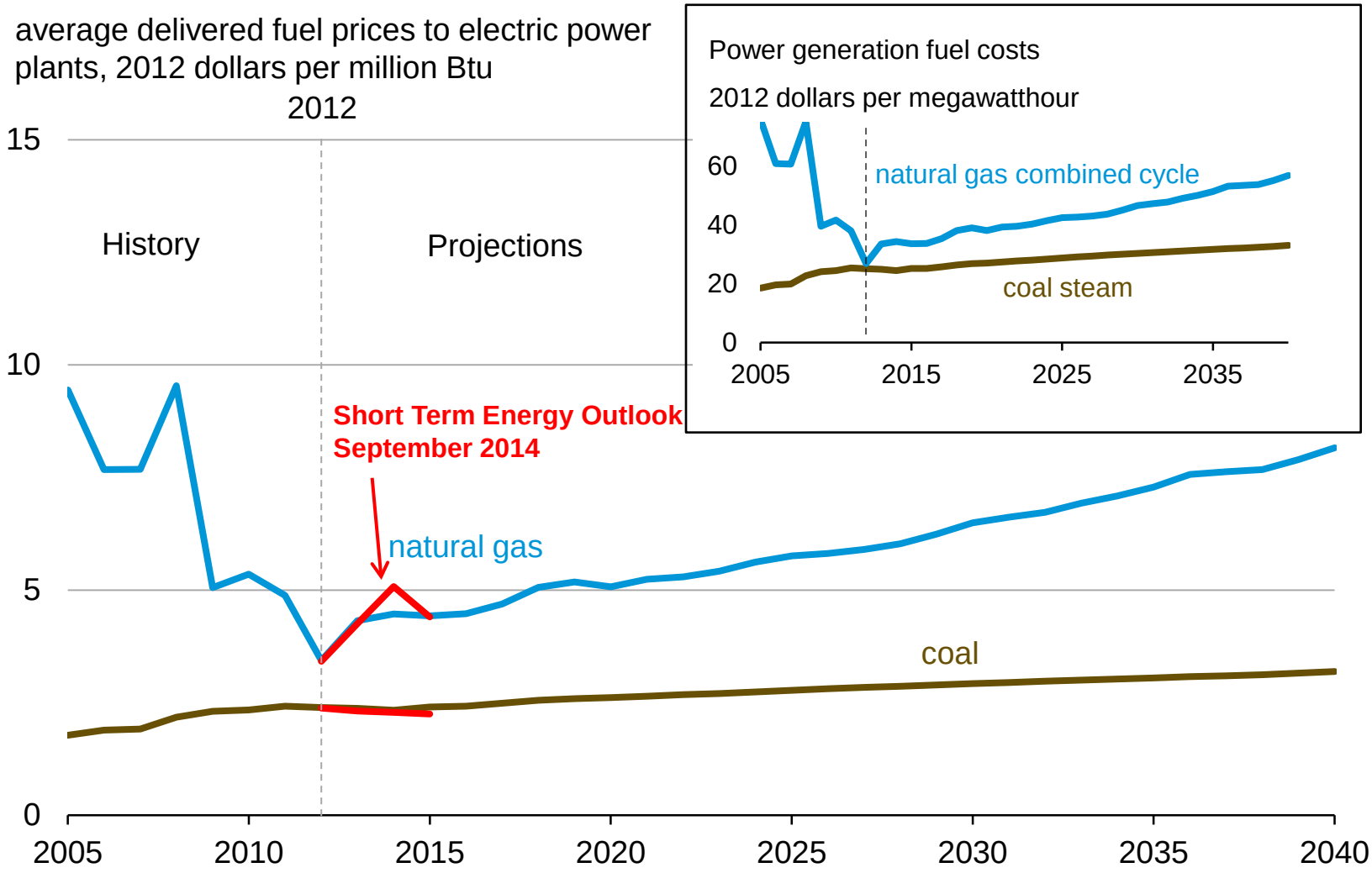
Source: EIA, Annual Energy Outlook 2014

Electricity sales have decreased in 5 of the last 6 years; prior to 2008, sales declined only twice in 58 years



Source: Energy Information Administration, Form EIA-923 and predecessor forms.

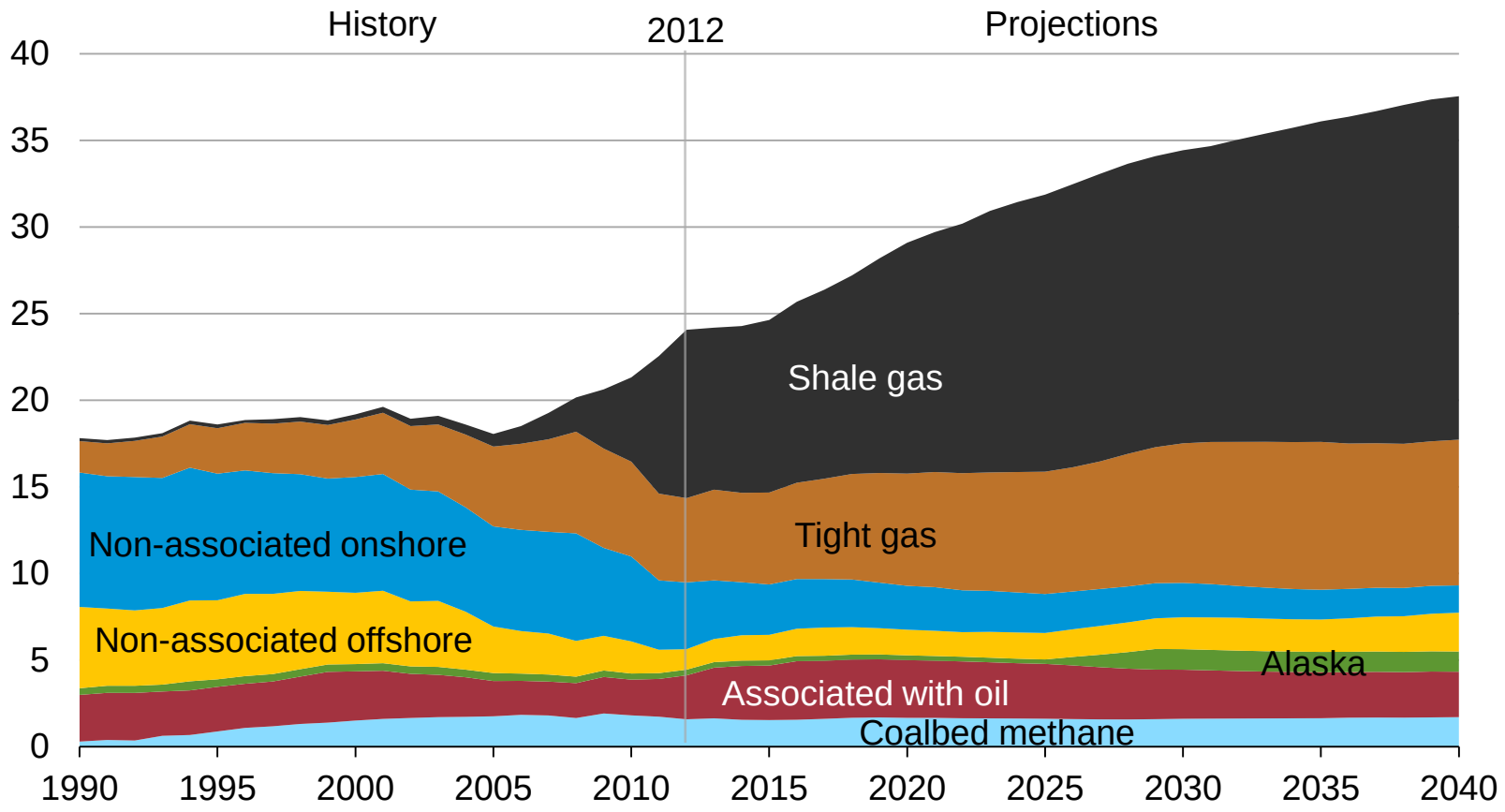
Delivered prices of natural gas and coal to the electric power sector in the Reference case



Source: AEO2014 Reference case (April 2014).

Shale gas leads U.S. production growth

U.S. dry natural gas production
trillion cubic feet

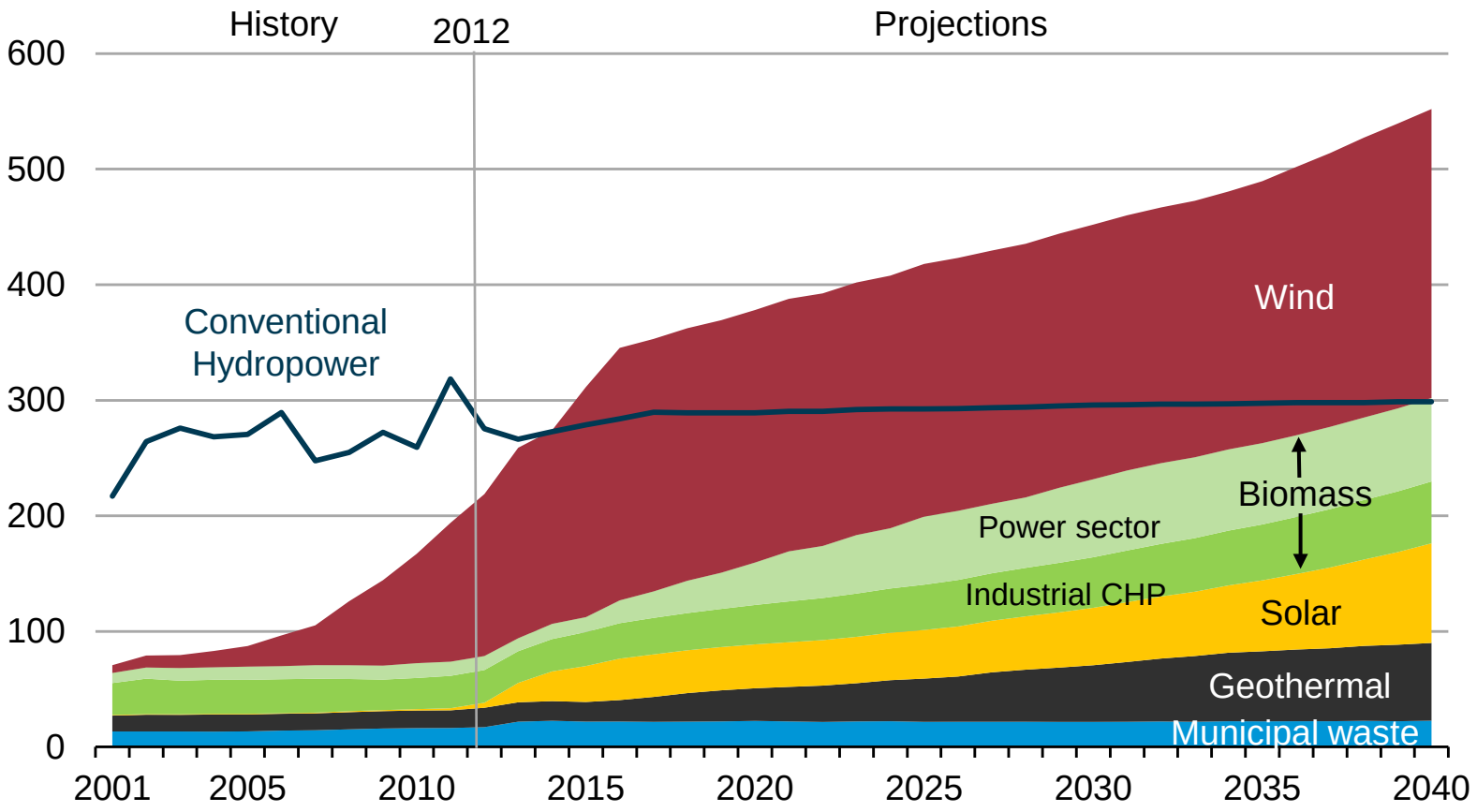


Source: AEO2014 Reference Case (April 2014)

Non-hydro renewable generation more than doubles between 2012 and 2040

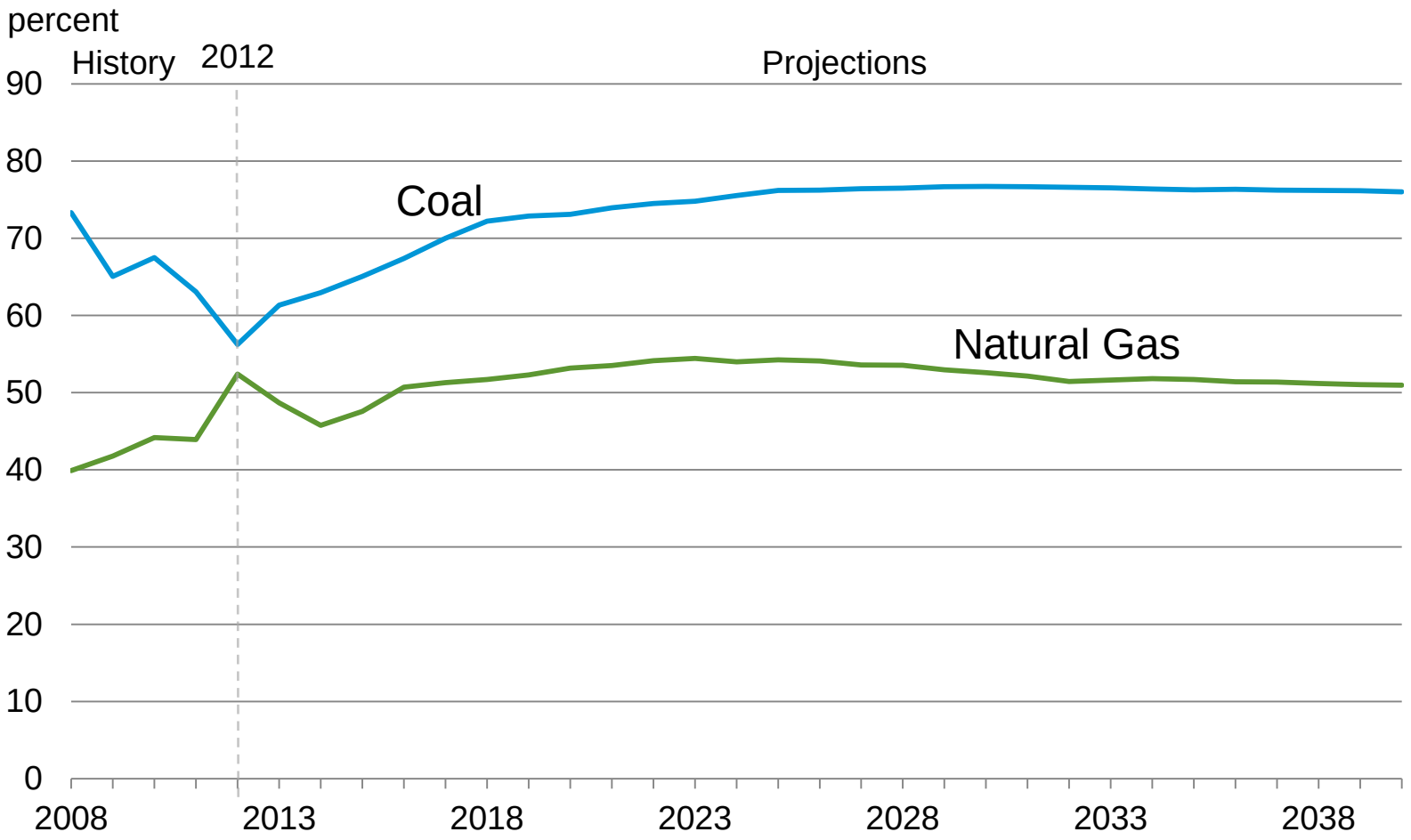
renewable generation

billion kilowatthours per year



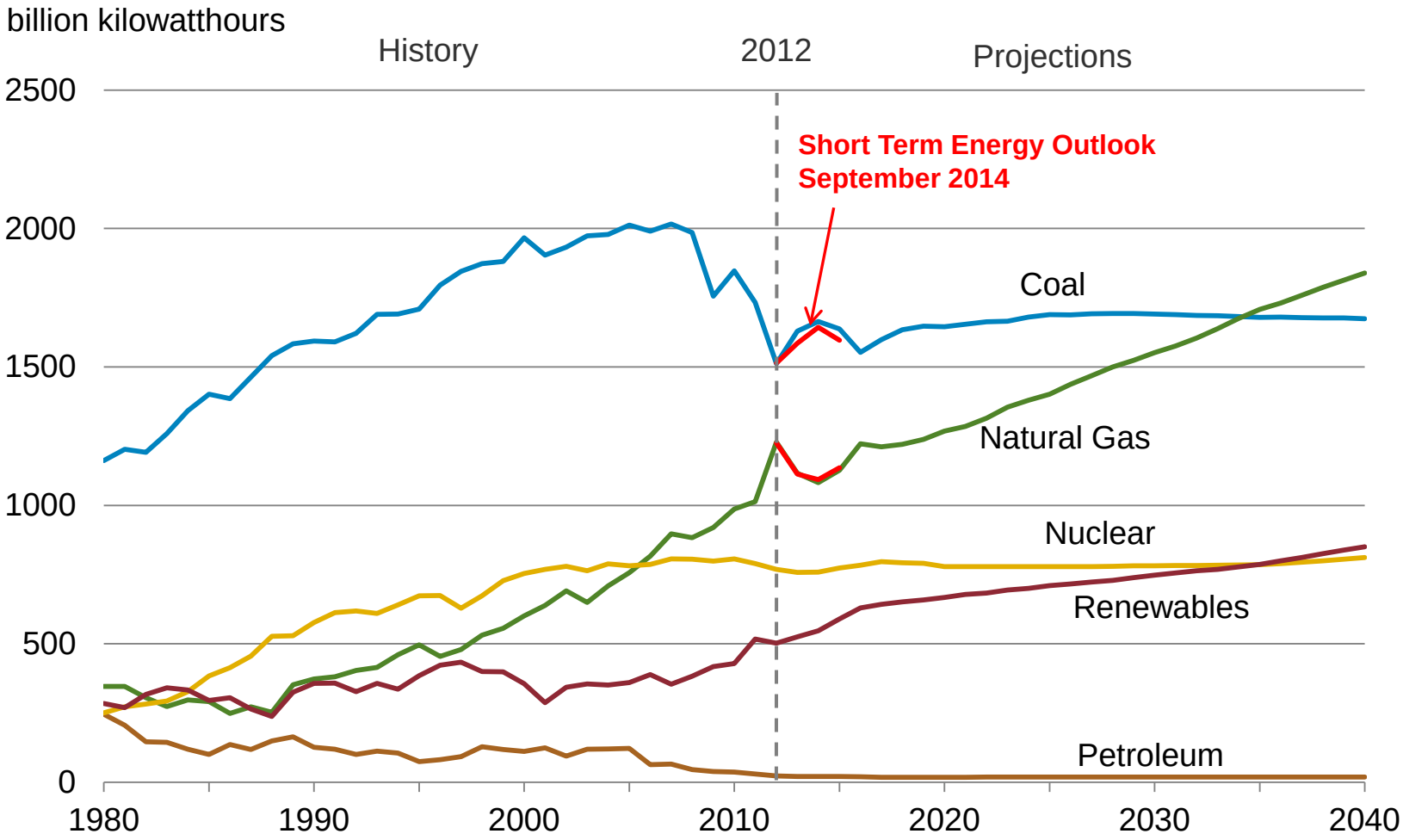
Source: EIA, Annual Energy Outlook 2014

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



Source: AEO2014 Reference Case (April 2014)

Electricity Generation by Fuel, 1980-2040

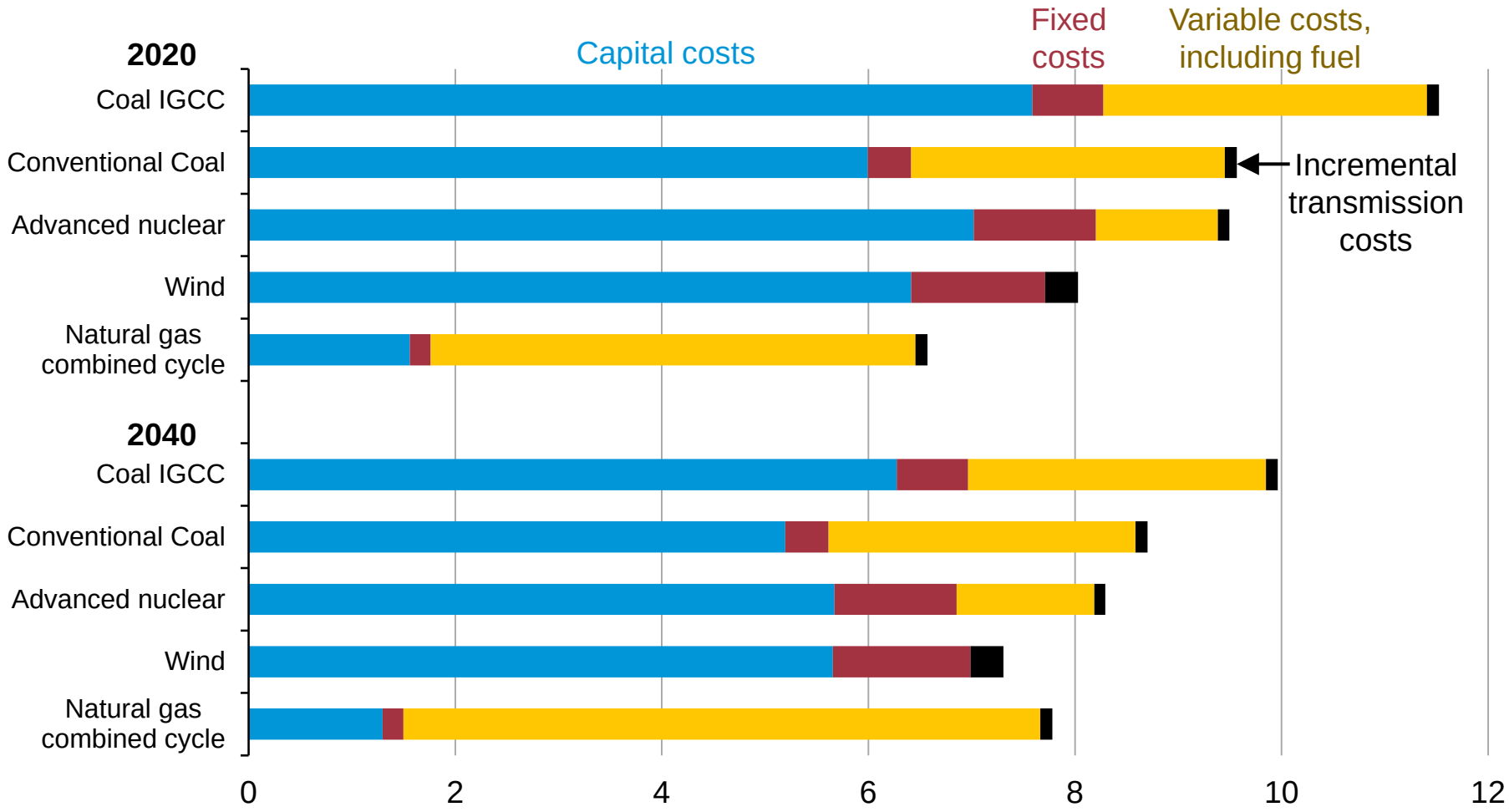


Note: Includes generation from plants in both the electric power and end-use sectors.

Source: History: U.S. Energy Information Administration (EIA), *Annual Energy Review;*
Projections: AEO2014 Reference Case (April 2014).

Average levelized electricity costs for new power plants, excluding subsidies, in the Reference case, 2020 and 2040

new power plant costs, 2012 cents per kilowatthour

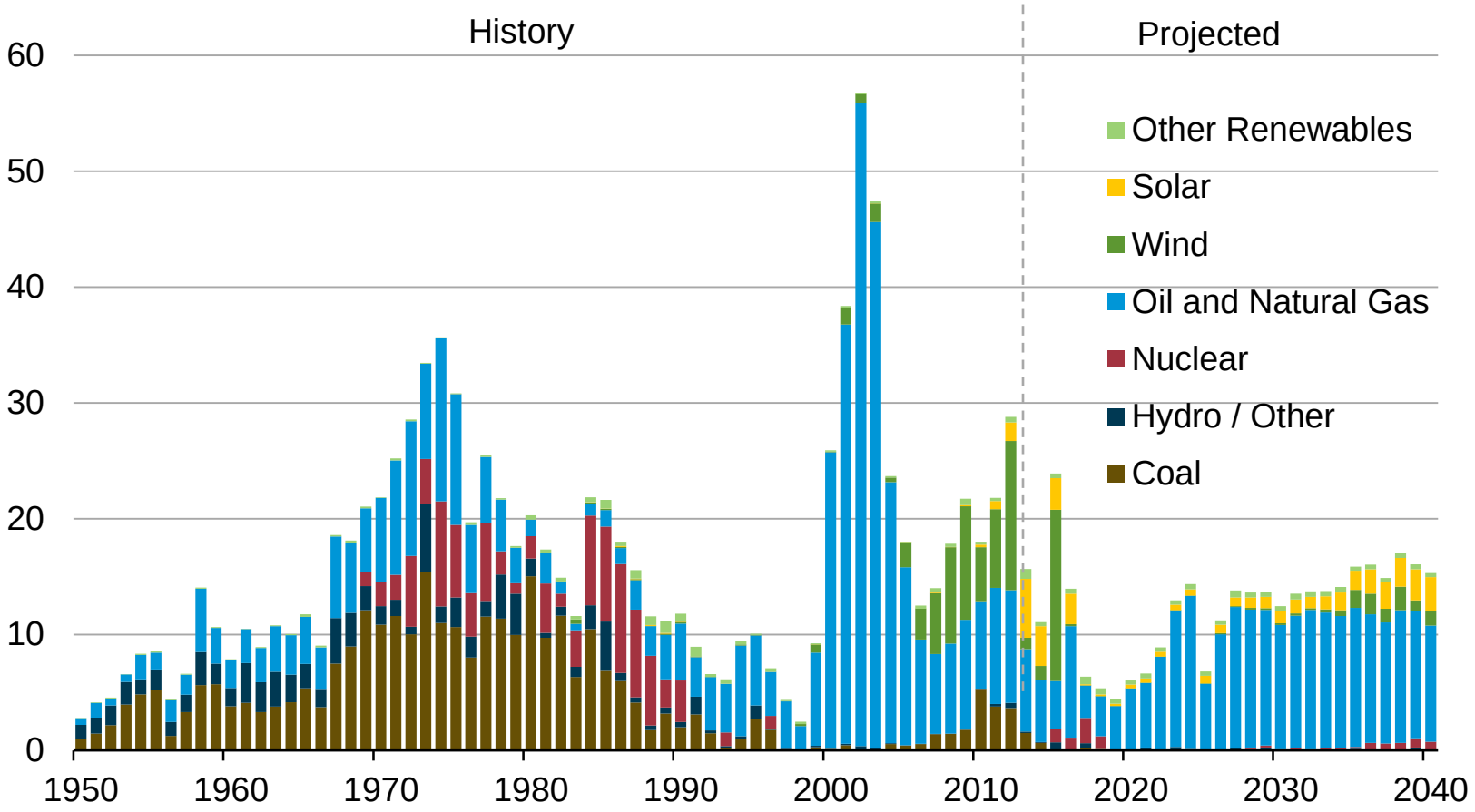


Source: AEO2014 Reference Case (April 2014)

Gas-fueled units account for most projected capacity additions in the *AEO2014* Reference case

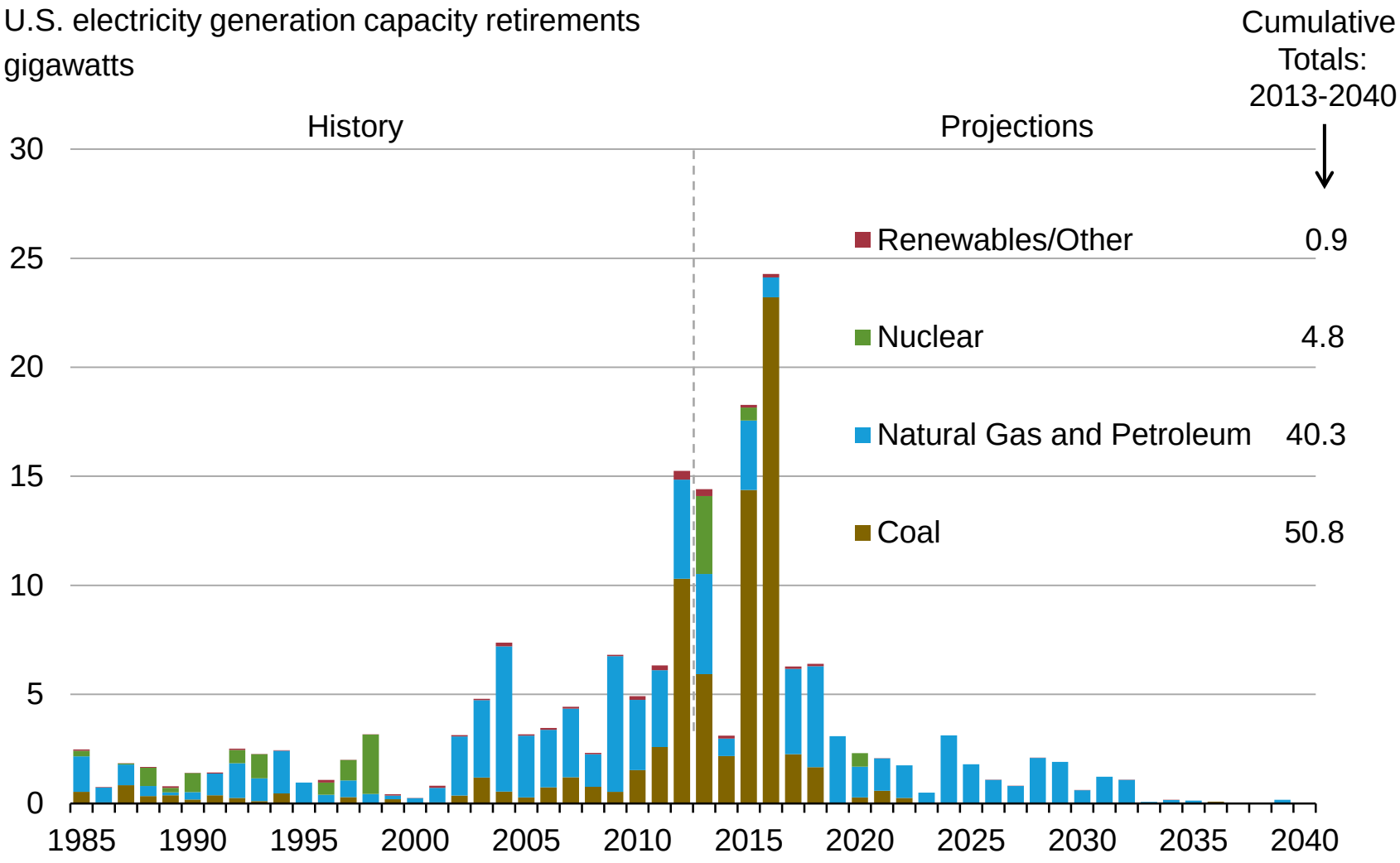
U.S. electricity generation capacity additions

gigawatts



Source: Form EIA-860 & EIA Annual Energy Outlook 2014

Coal accounts for more than half of the projected capacity retirements in the *AEO2014* Reference case



Source: Form EIA-860 and AEO2014 Reference Case (April 2014)

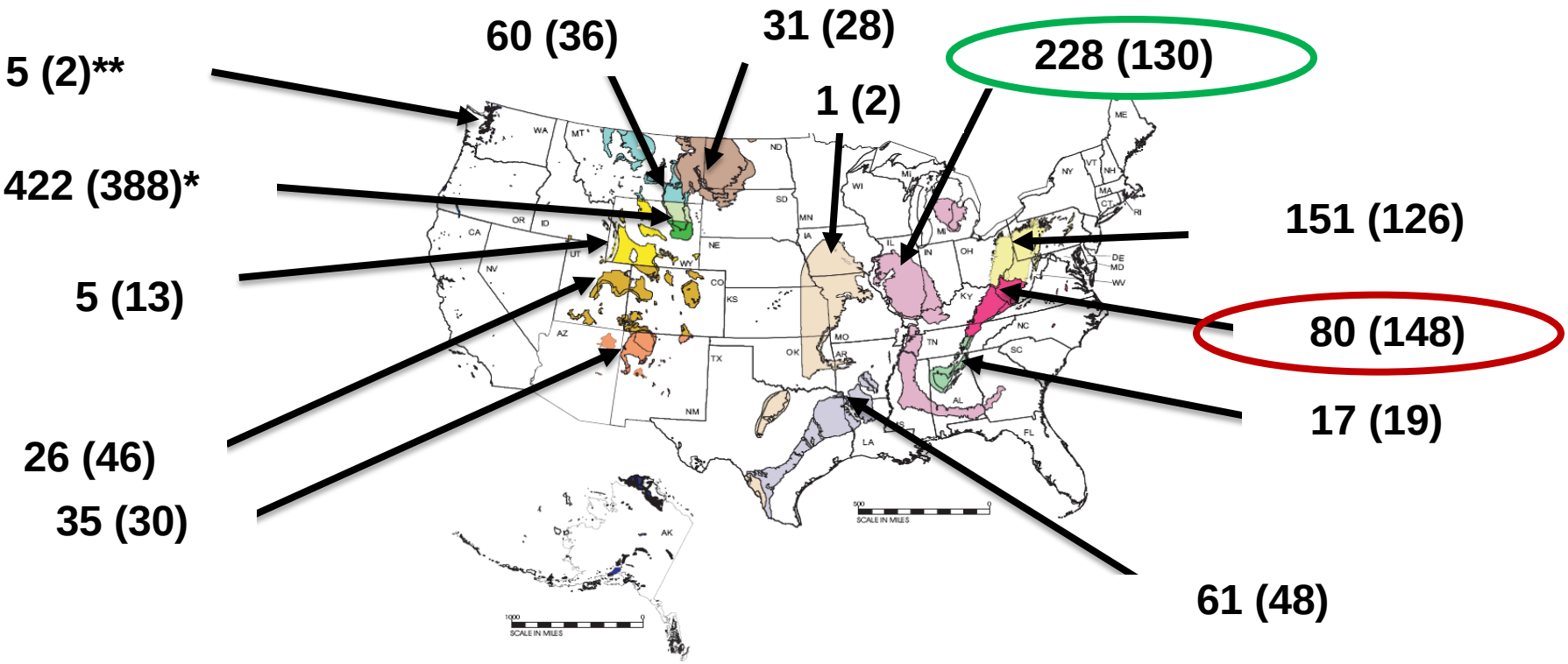
Electric Net Summer Generating Capacity by Fuel, 2008-2040 (gigawatts)

Fuel	2008	2011	2012	2015	2016*	2020	2030	2040
Coal	311	316	310	290	266	263	262	262
Electric Power Sector	308	313	307	286	263	259	258	258
End-Use Sectors	4	4	3	3	3	3	3	3
Natural Gas & Petroleum	450	463	469	477	486	488	575	684
Nuclear Power	101	101	102	99	100	98	98	102
Renewable Sources	117	143	159	189	192	195	208	242
Other (includes pumped storage)	25	25	25	26	26	26	26	26
Total	1004	1049	1066	1081	1070	1069	1168	1316

Source: AEO2014 Reference Case (April 2014)

**MATS compliance assumed to begin **Excludes natural gas and oil CC /CT generating capacity in the end-use sectors*

Coal production, AEO2014 in 2040 (vs. 2012) (million short tons)



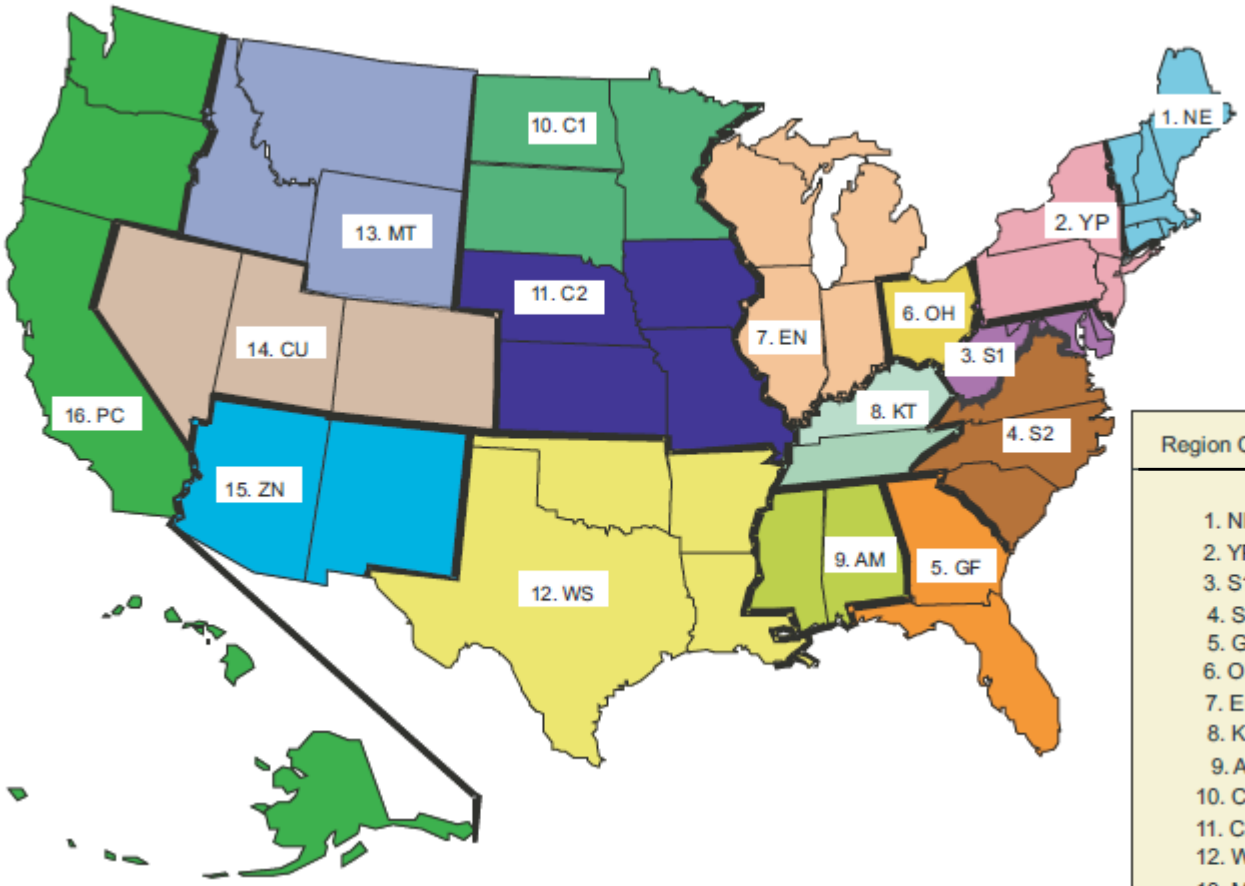
U.S. Total: 1,121 (1,016)

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

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

Source: 2012: Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine and Employment and Coal Production Report;" 2040: AEO2014 Reference Case (April 2014).

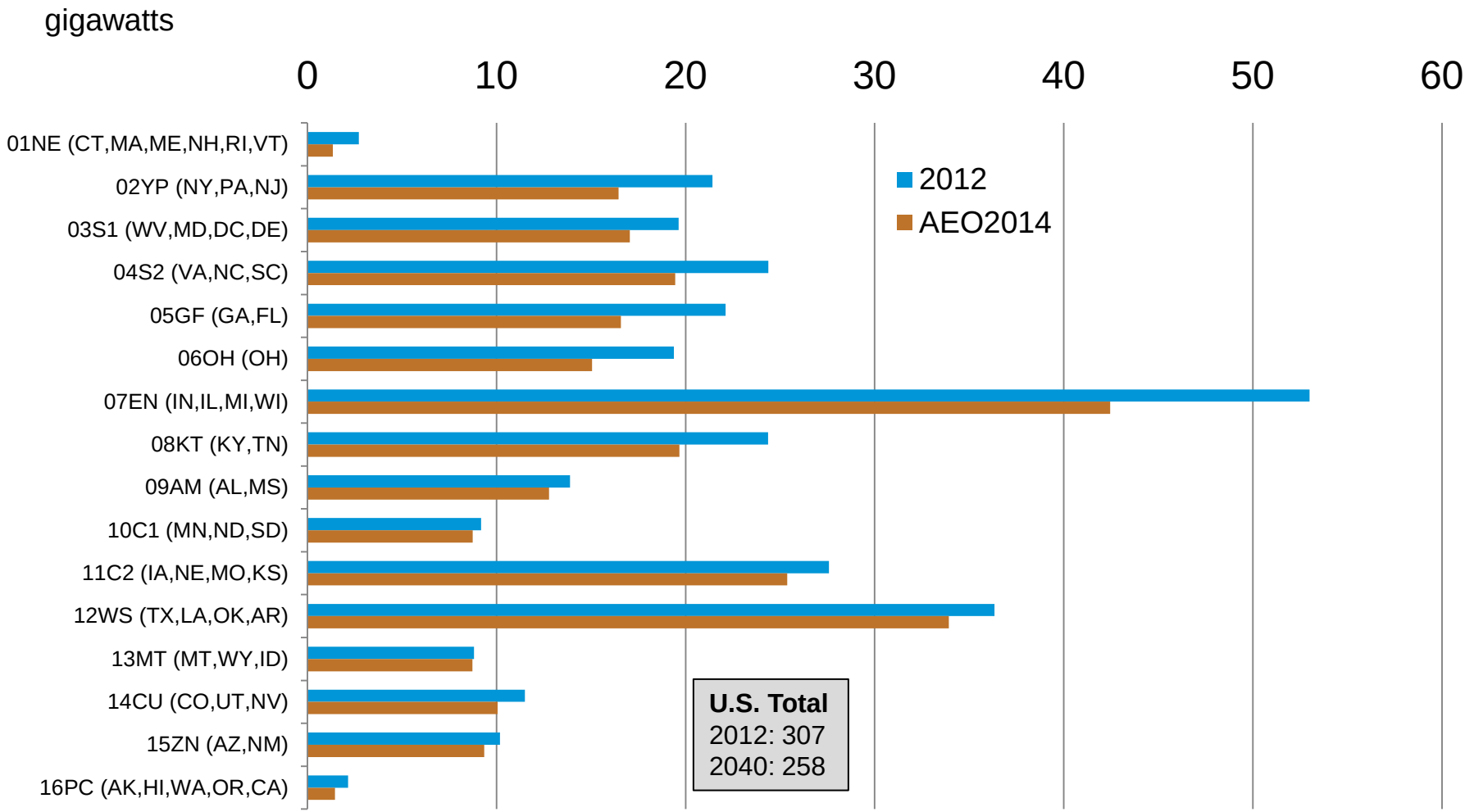
Coal demand regions



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

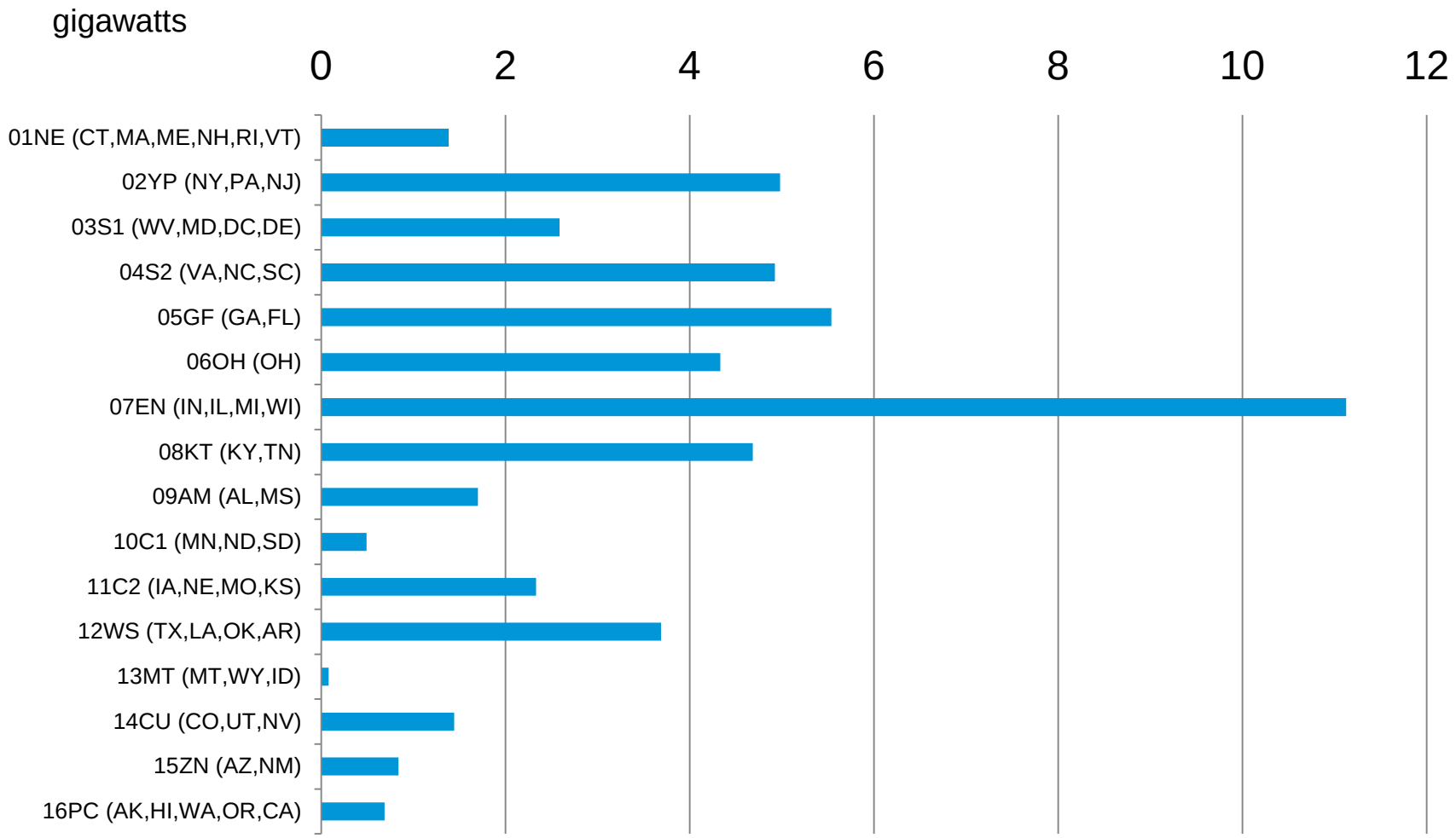
Source: U.S. Energy Information Administration, Office of Energy Analysis

Net summer coal-fired generating capacity in the electric power sector by coal demand region, 2012 and 2040



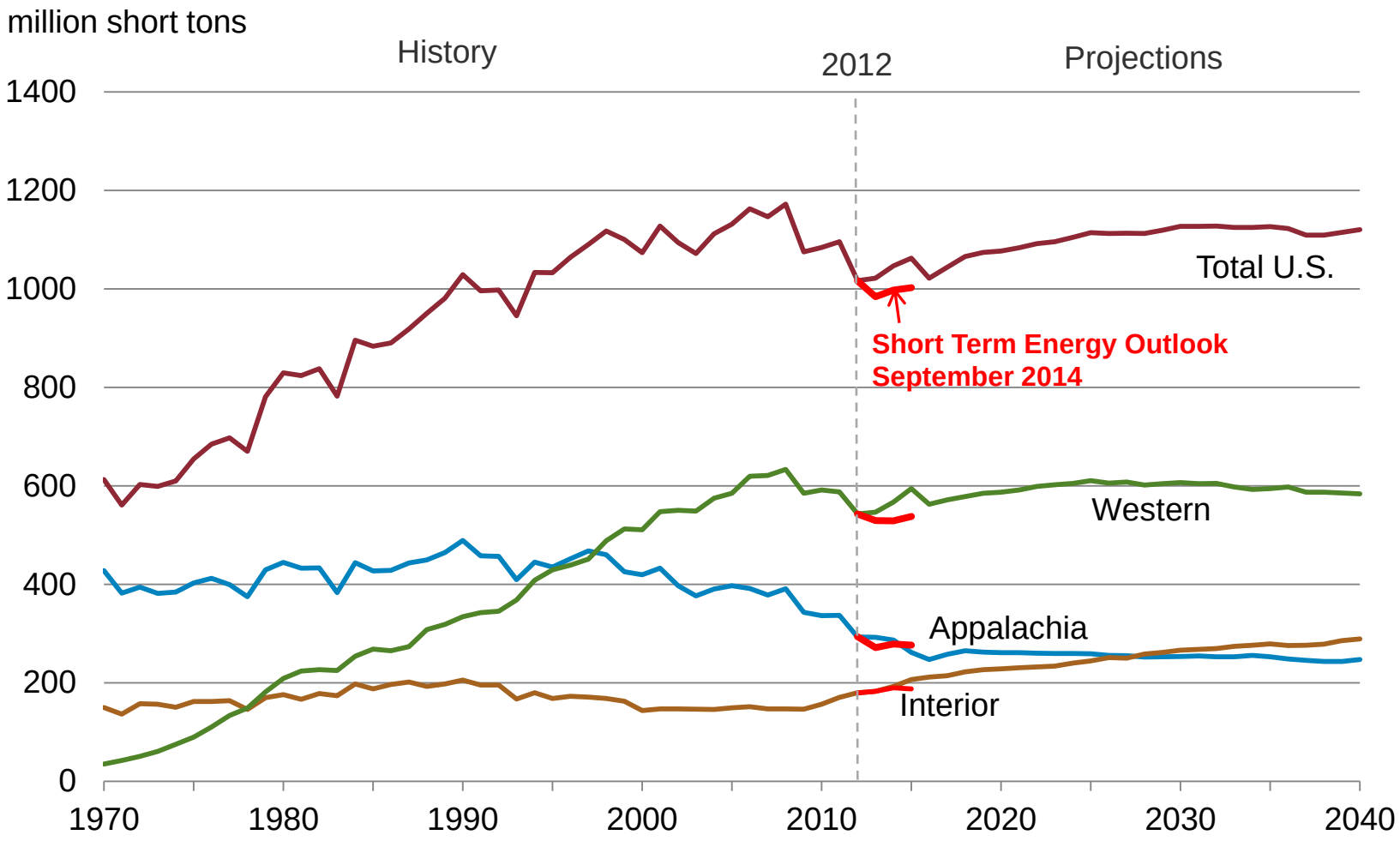
Source: AEO2014 Reference Case (April 2014)

Cumulative net summer coal-fired capacity retirements by coal demand region, 2013-2040



Source: AEO2014 Reference Case (April 2014)

Coal production by region, 1970-2040



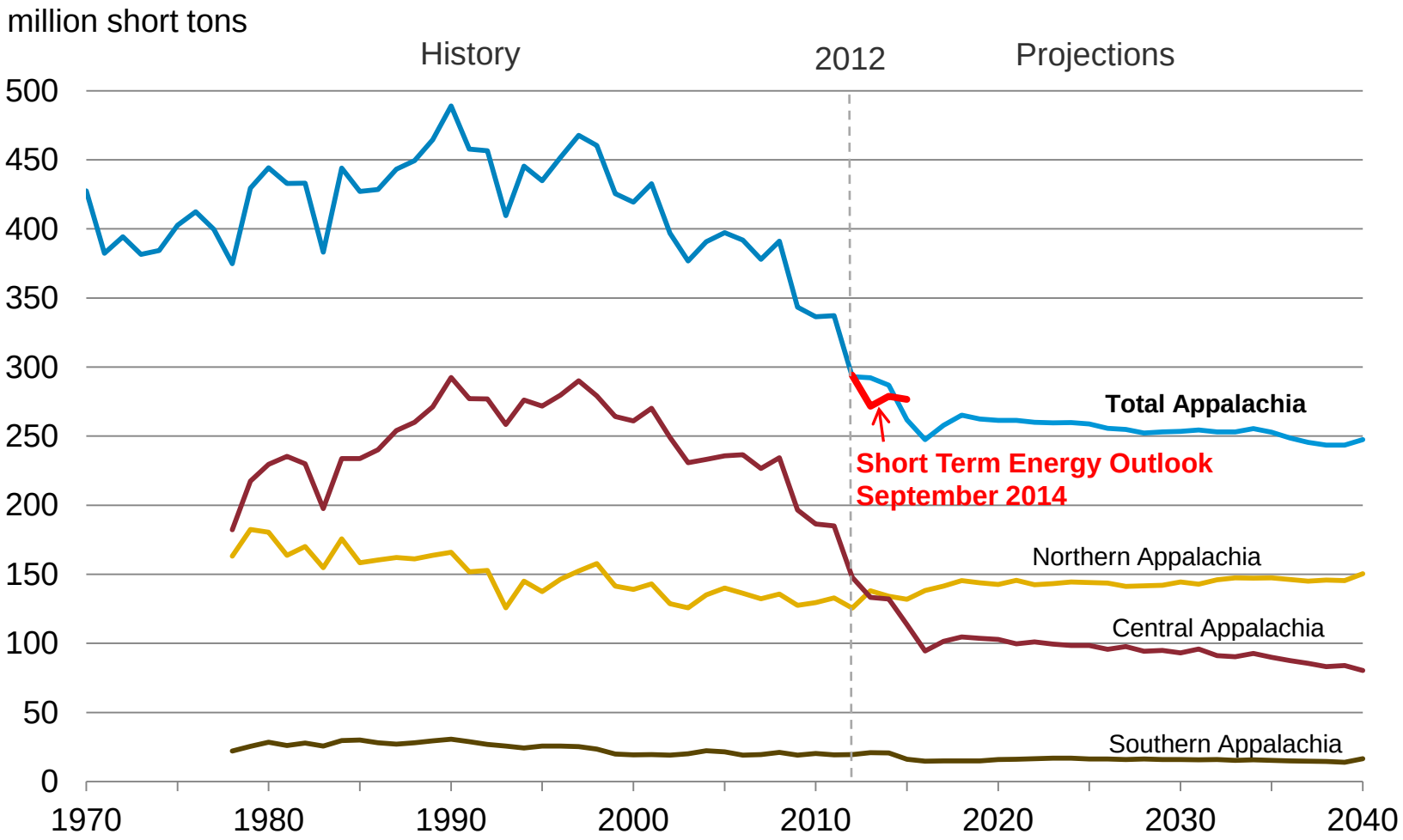
Source: AEO2014 Reference Case (April 2014)

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

Coal Supply Region	1980-1990	1990-2000	2000-2012	2005-2012	2011-2012	2012-2040
Northern Appalachia	5.4	5.5	-2.7	-3.8	-4.9	-1.3
Central Appalachia	7.3	4.4	-5.9	-5.9	-3.8	-3.4
Eastern Interior	4.8	3.7	-0.8	-0.1	6.1	0.1
Gulf Lignite	2.6	2.4	-2.8	-4.5	-4.2	-1.0
Dakota Lignite	6.0	1.0	-3.5	-5.2	-4.8	-1.0
Western Montana	4.6	2.0	-3.7	-6.6	-11.7	-1.3
WY, Northern Powder River Basin	7.5	3.2	-3.2	-5.0	-5.7	-1.7
WY, Southern Powder River Basin	7.2	4.9	-3.0	-4.1	-6.4	-1.7
Rocky Mountain	7.8	5.5	-2.7	-4.4	3.5	-2.5
U.S. Average	7.1	6.2	-2.4	-2.9	-0.2	-1.2

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: AEO2014 Reference Case (April 2014).

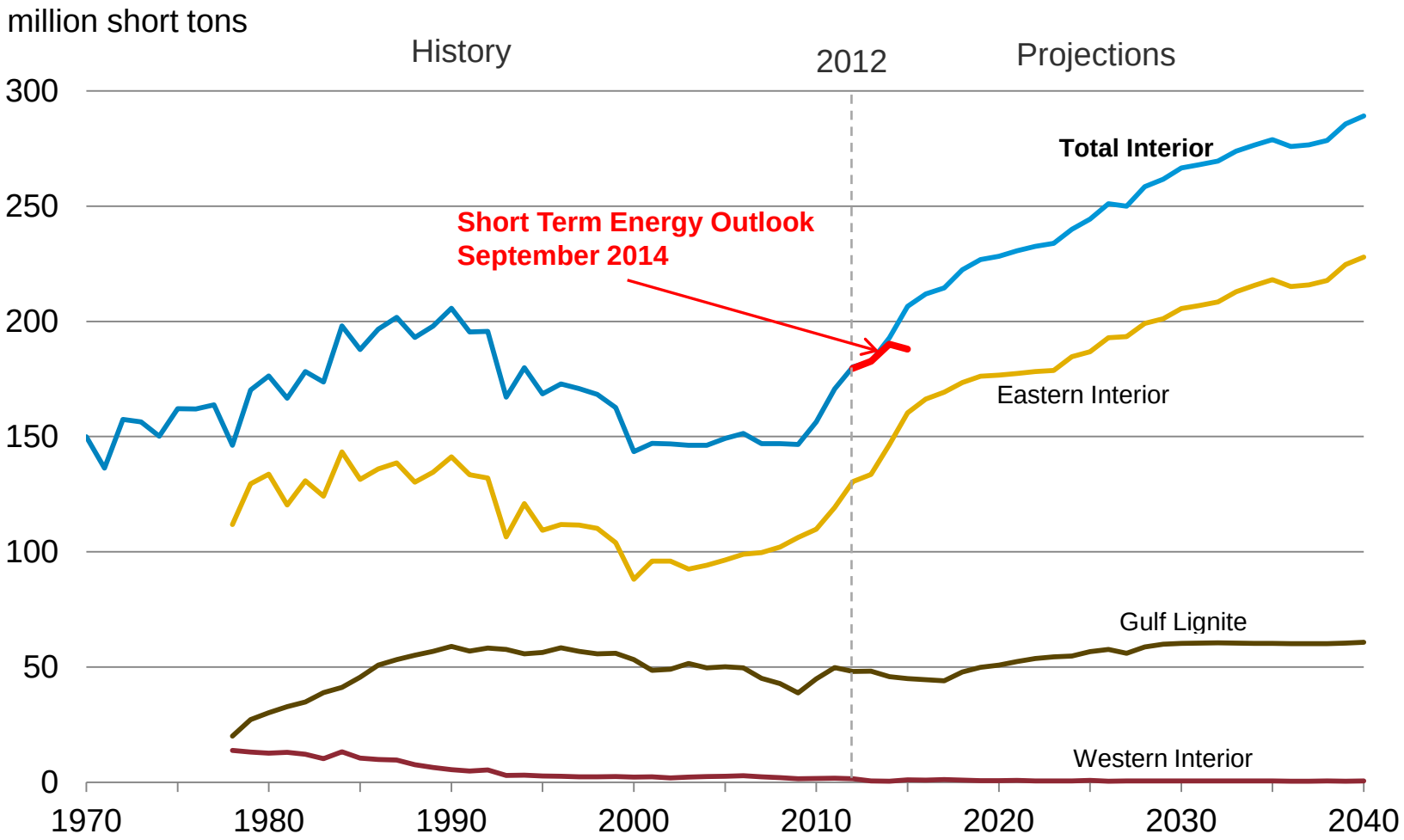
Appalachian coal production, 1970-2040



Source: AEO2014 Reference Case (April 2014)

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

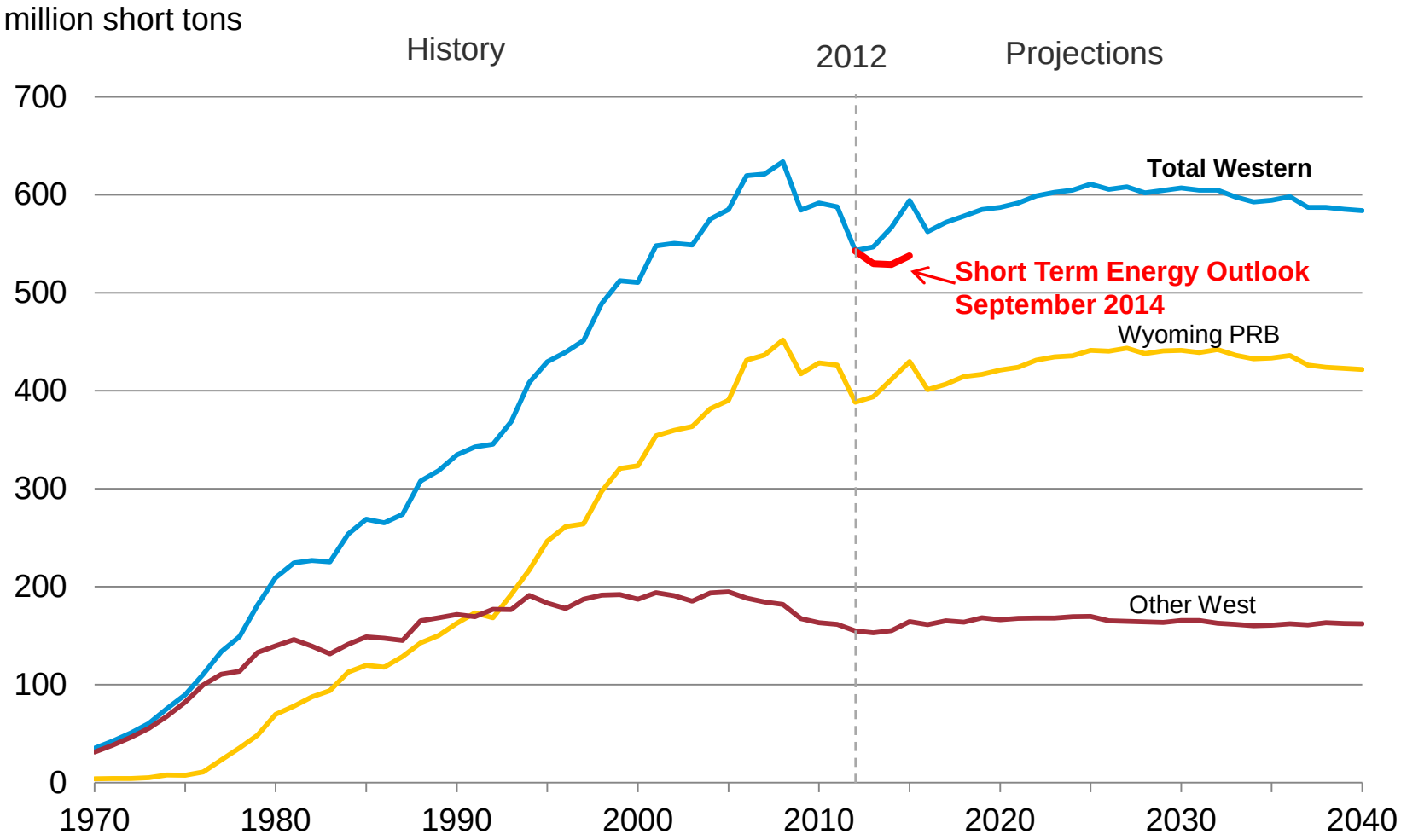
Interior coal production, 1970-2040



Source: AEO2014 Reference Case (April 2014)

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

Western coal production, 1970-2040

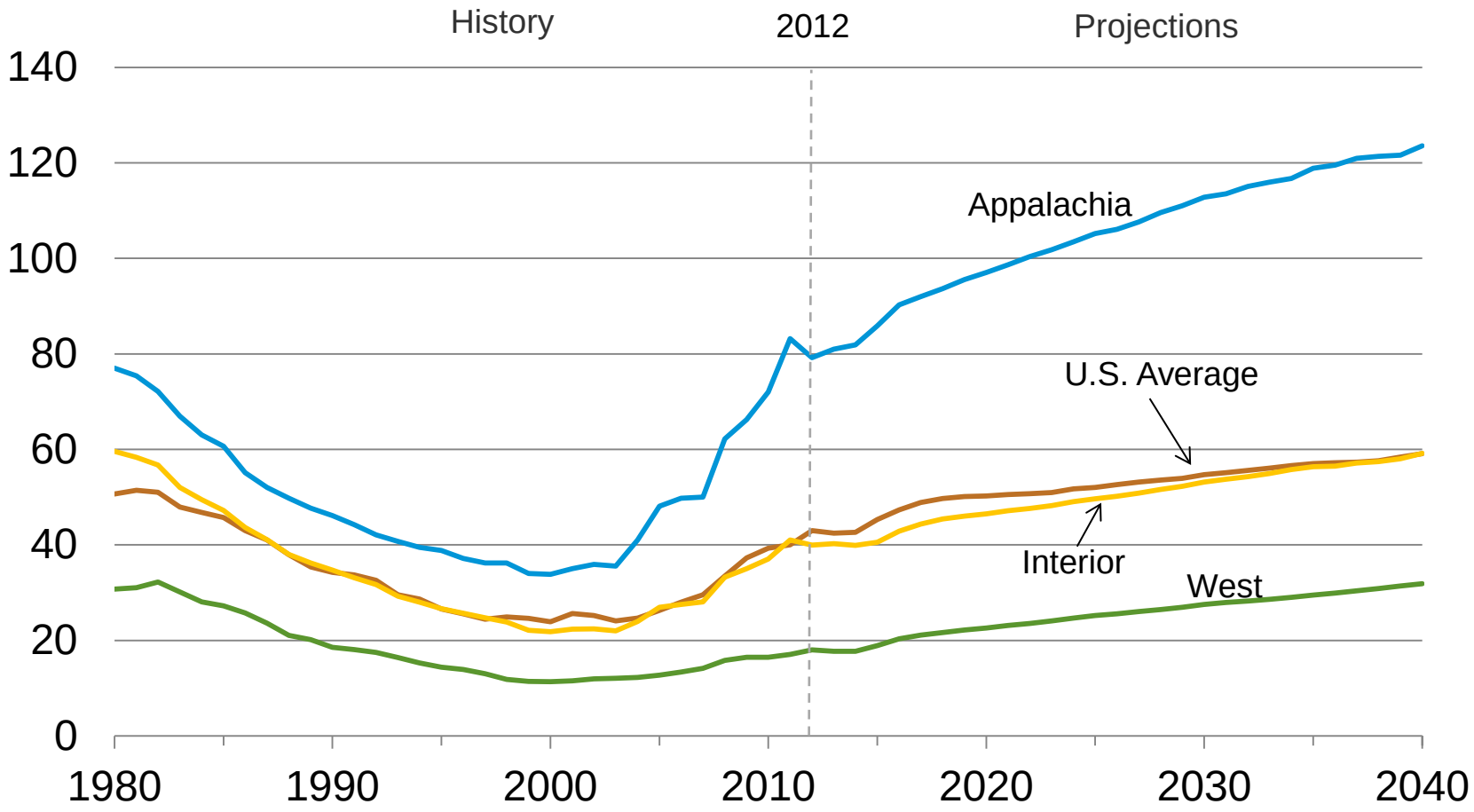


Source: AEO2014 Reference Case (April 2014)

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

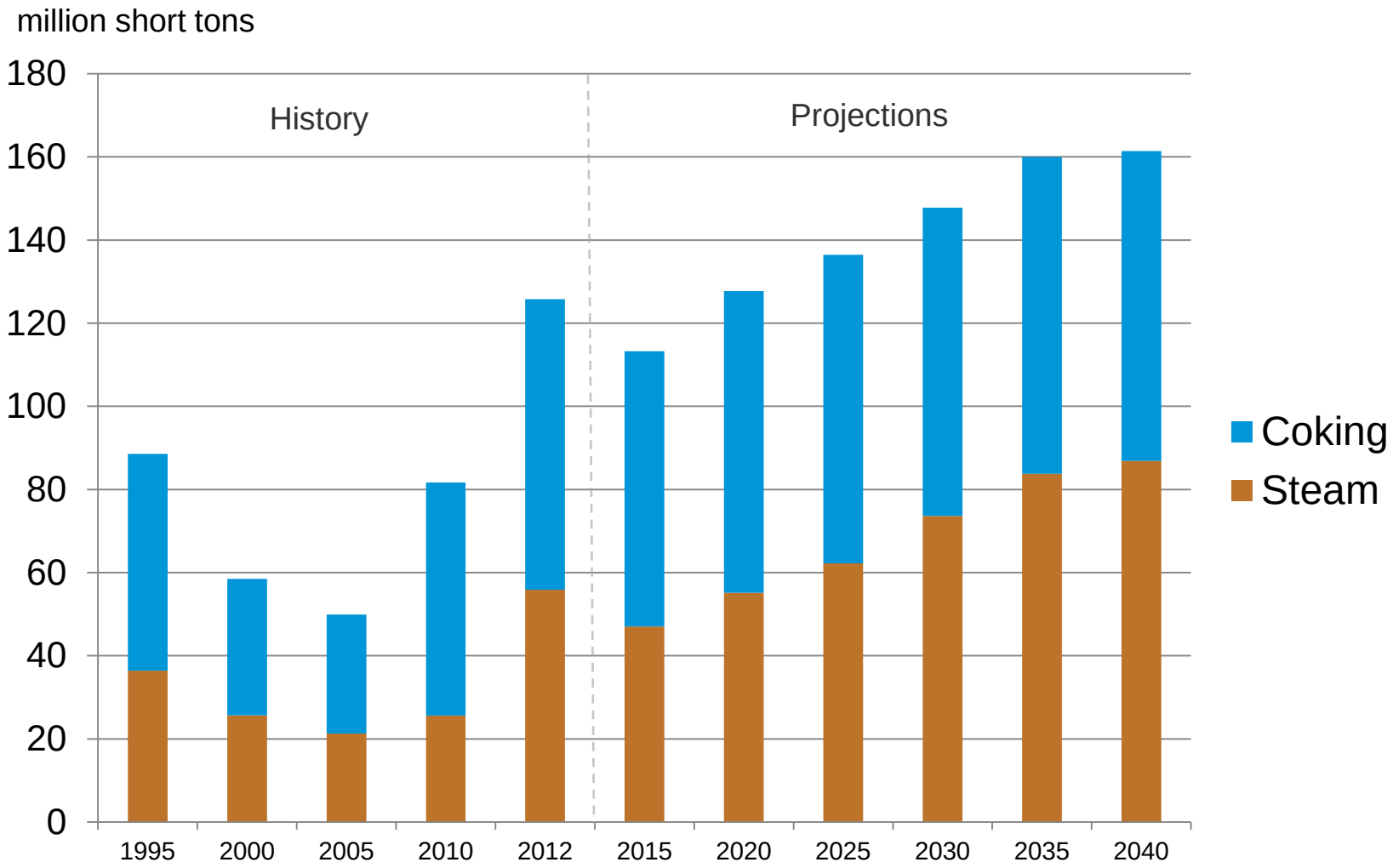
Average minemouth coal prices by region, 1980-2040

2012 dollars per short ton



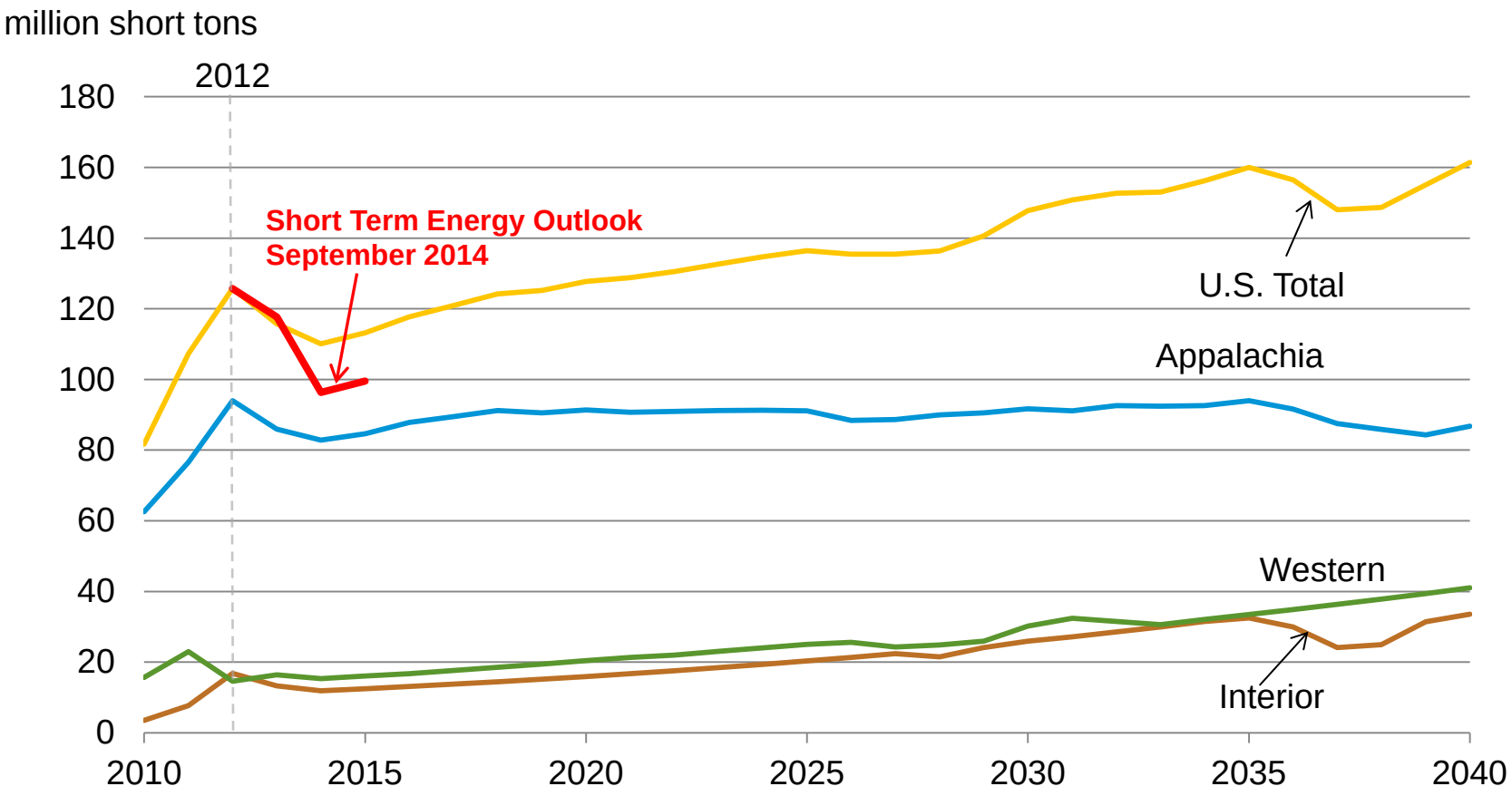
Source: AEO2014 Reference Case (April 2014)

U.S. Coal Exports, 1995-2040



Source: History: U.S. Energy Information Administration (EIA), *Quarterly Coal Report;*
Projections: AEO2014 Reference Case (April 2014).

Coal exports by major supply region, 2010-2040



Source: 2010-2011: U.S. Energy Information Administration (EIA), Annual Coal Distribution Report;
2012-2040: AEO2014 Reference Case (April 2014).

EIA Data Browsers and Energy Mapping System

Electricity Data Browser - http://www.eia.gov/electricity/data/browser/

Coal Data Browser (Beta) - http://www.eia.gov/beta/coal/data/browser/

Nuclear Outage Browser (Beta) - http://www.eia.gov/beta/outages/

Energy Mapping System - http://www.eia.gov/state/maps.cfm

Short-Term Energy Outlook - http://www.eia.gov/forecasts/steo/query/

Annual Energy Outlook - http://www.eia.gov/oiaf/aeo/tablebrowser/

International Energy Outlook - http://www.eia.gov/oiaf/aeo/tablebrowser/

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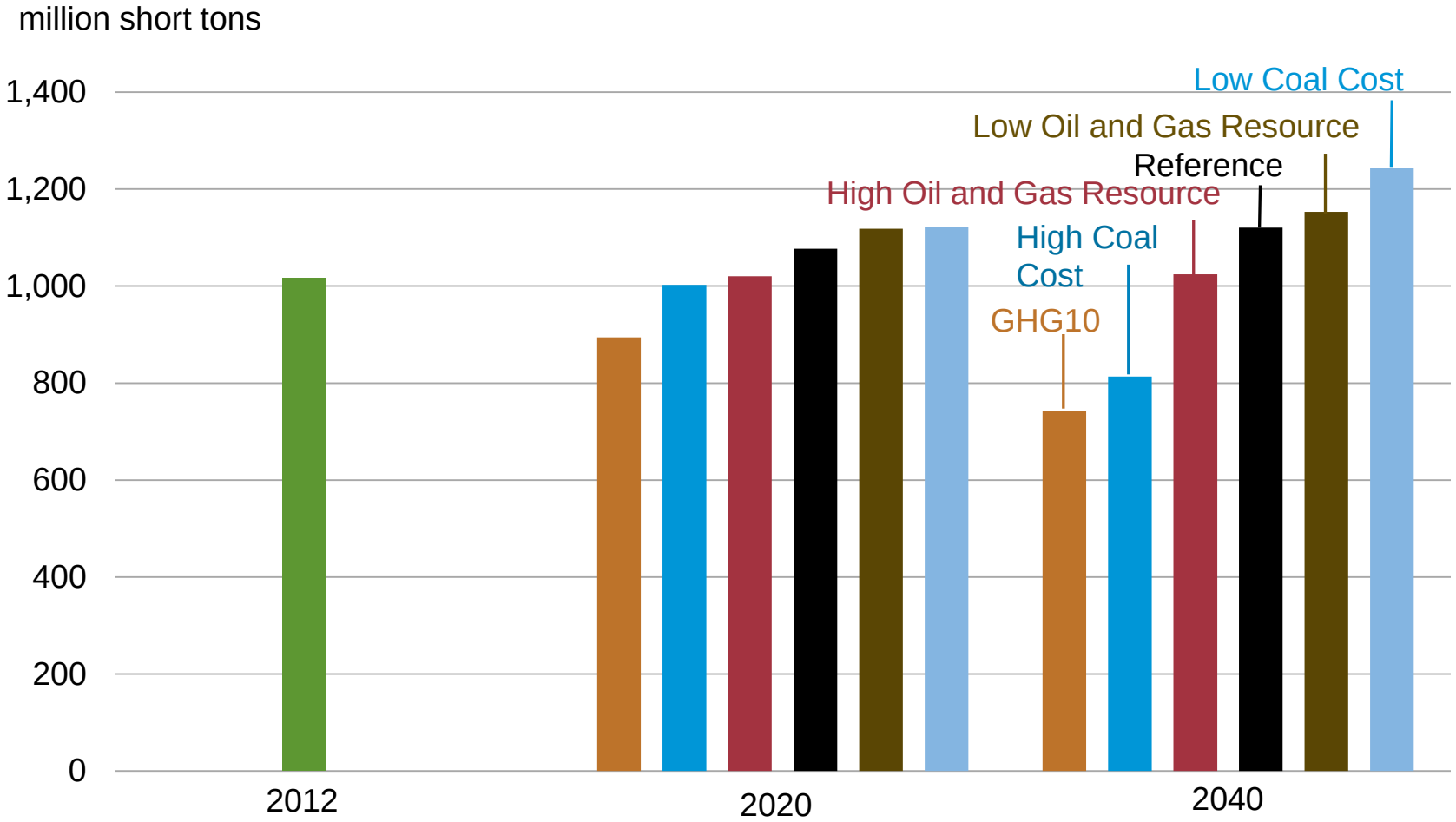
Assessing Uncertainty: Side Cases

Key differences between alternate cases

	AEO2014 Reference	Low Economic Growth	High Economic Growth	Low Coal Cost	High Coal Cost	High Oil and Gas Resource	Low Oil and Gas Resource	GHG10 (CO2 fee of $10 in 2015 increasing to $34 in 2040)	GHG25 (CO2 fee of $25 in 2015 increasing to $85 in 2040)
GDP growth (avg. annual change from 2012)	2.4%	1.9%	2.8%						
Electricity demand (avg. annual change from 2012)	0.9%	0.6%	1.2%						
Delivered natural gas price to the electricity sector, 2040 (2012 dollars per million Btu)	$8.16					$5.17	$10.82	$9.57*	$12.38*
Delivered coal price to the electricity sector , 2040 (2012 dollars per million Btu)	$3.19			$1.89	$5.36			$6.08*	$10.27*
Minemouth coal price, 2040 (2012 dollars per short ton)	$59.16			$32.29	$113.47				
Western coal transportation rates (percent change from 2012, constant dollar basis)	-0.4%			-25%	25%				
Coal mining productivity (avg. annual change from 2012)	-1.2%			1.0%	-4.0%				
Coal with CCS in power sector, 2040 (gigawatts)	0.9							8.5	3.9
NGCC with CCS in power sector, 2040 (gigawatts)	0.3							13.2	67.2

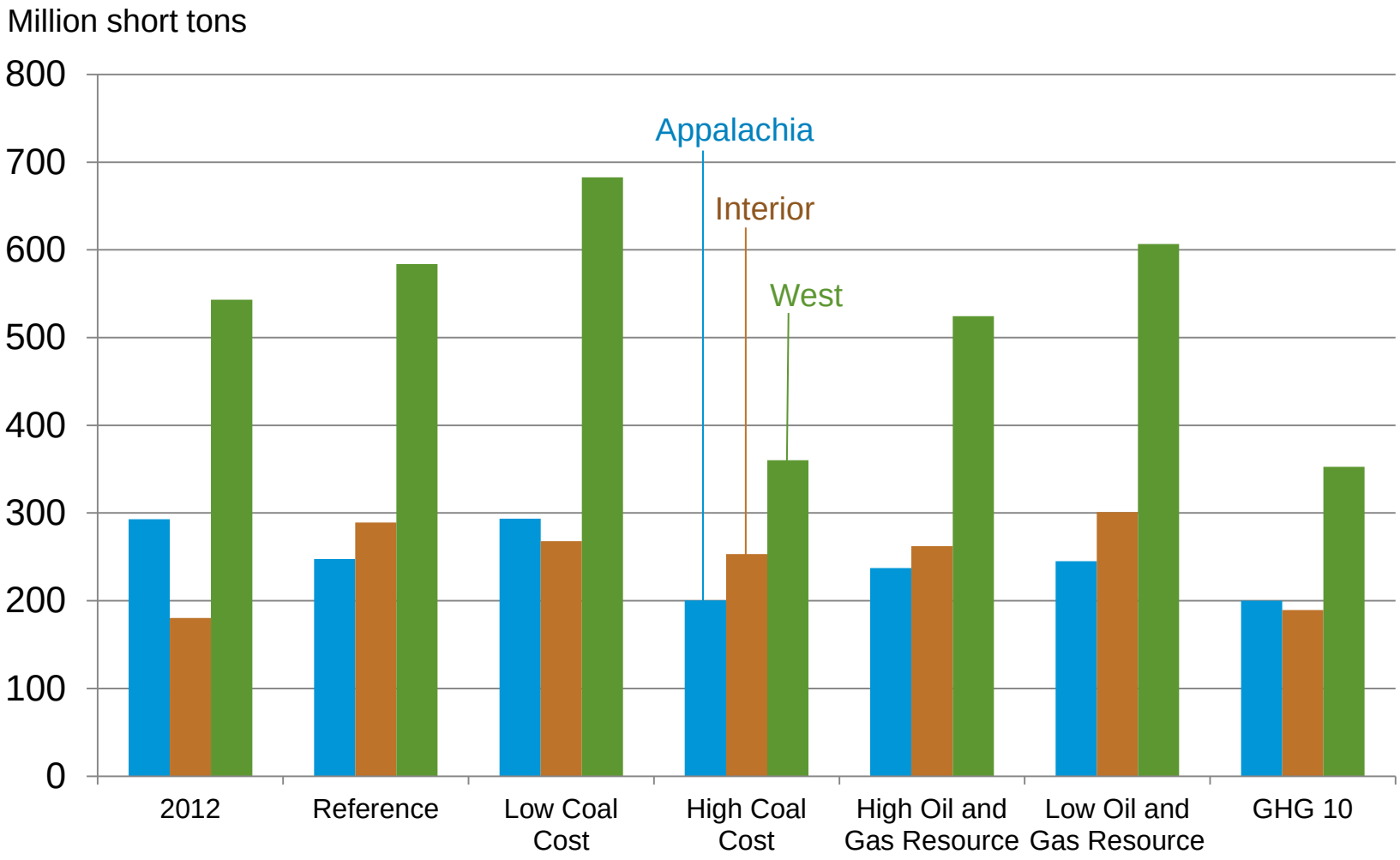
*Includes CO_2 fee

U.S. Coal Production, 2020 and 2040



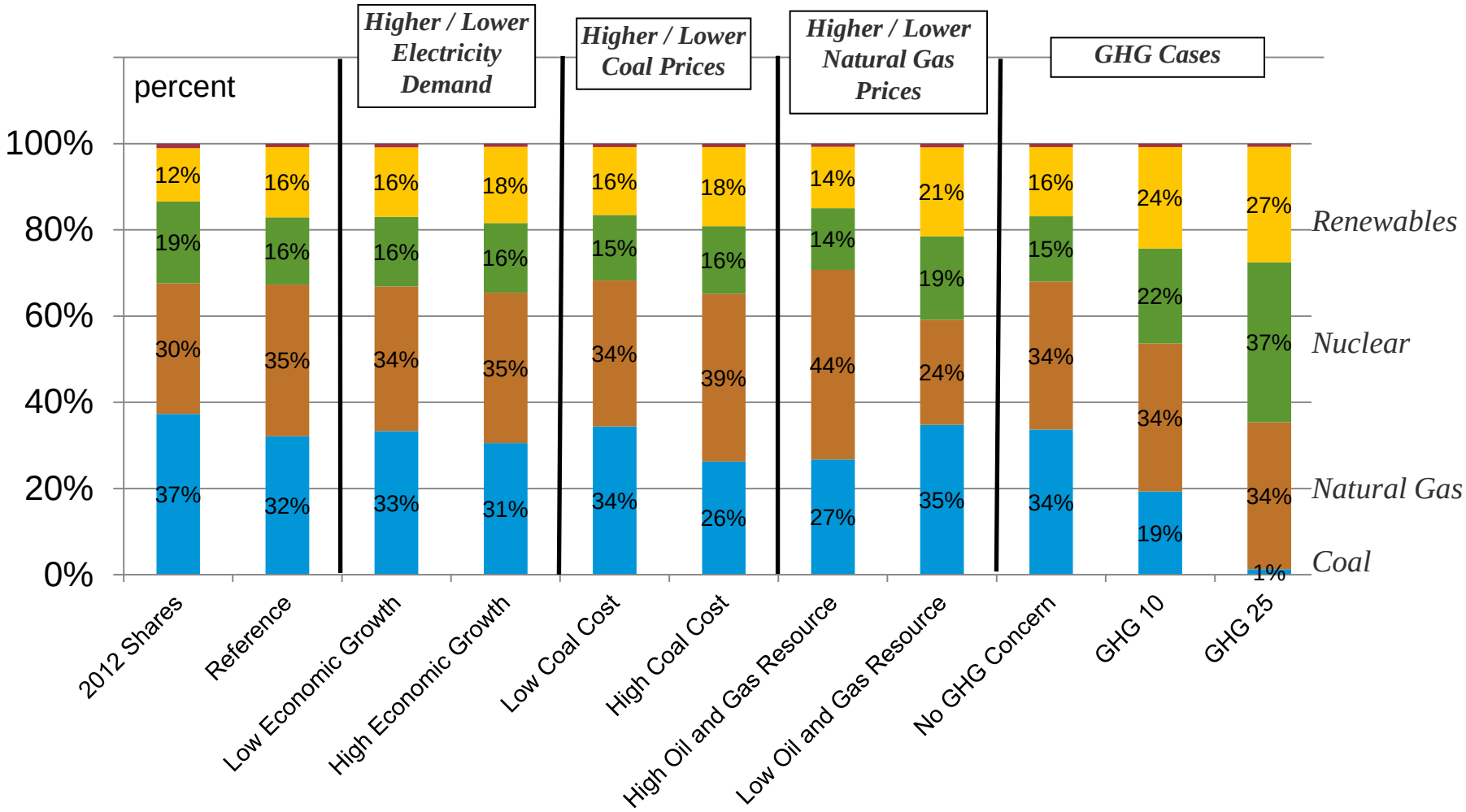
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2014* National Energy Modeling System runs REF2014.D102413A, LCCST14.D120413A, HCCST14.D120413A, HIGHRESOURCE.D112913B, LOWRESOURCE.D112913A, and CO2FEE10.D011614A.

Coal production by region, 2040



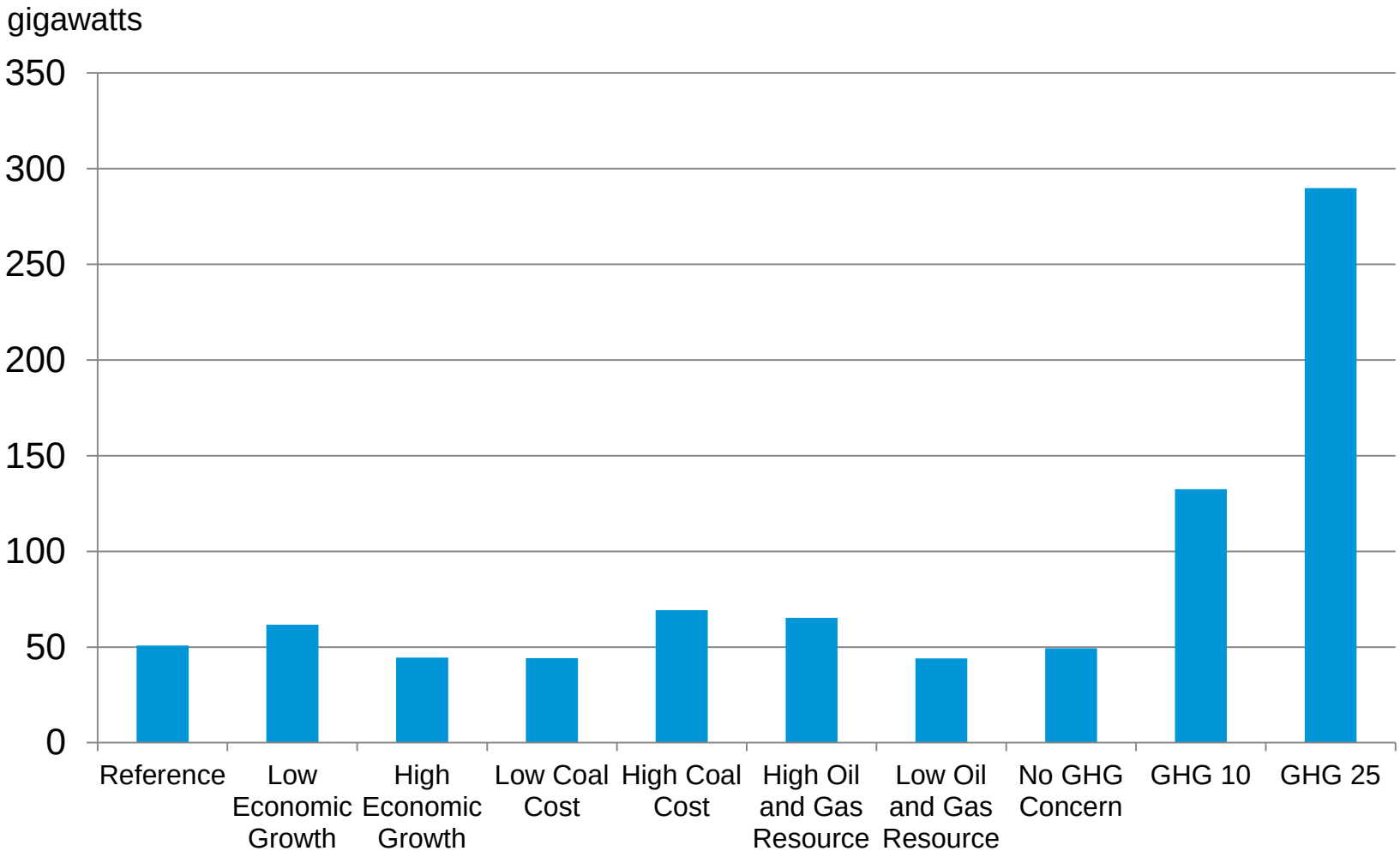
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2014* National Energy Modeling System runs REF2014.D102413A, LCCST14.D120413A, HCCST14.D120413A, HIGHRESOURCE.D112913B, LOWRESOURCE.D112913A, and CO2FEE10.D011614A.

2040 electricity generation shares



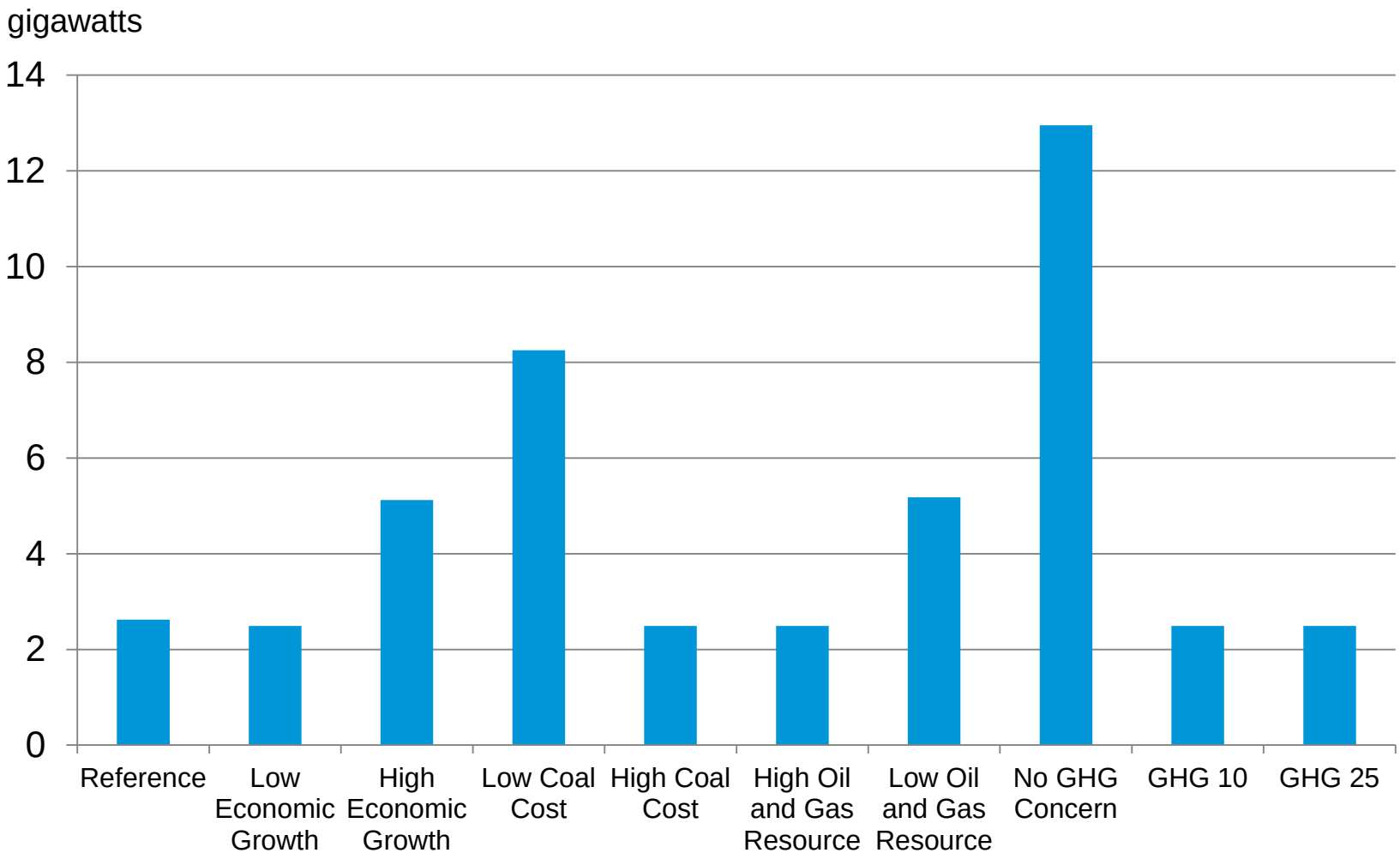
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2014* National Energy Modeling System runs REF2014.D102413A, LOWMACRO.D112913A, HIGHMACRO.D112913A, LCCST14.D120413A, HCCST14.D120413A, HIGHRESOURCE.D112913B, LOWRESOURCE.D112913A, NOGHGCONCERN.D120413A, CO2FEE10.D011614A, and CO2FEE25.D011614A

Cumulative coal-fired capacity retirements, 2012-2040



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2014* National Energy Modeling System runs REF2014.D102413A, LOWMACRO.D112913A, HIGHMACRO.D112913A, LCCST14.D120413A, HCCST14.D120413A, HIGHRESOURCE.D112913B, LOWRESOURCE.D112913A, NOGHGCONCERN.D120413A, CO2FEE10.D011614A, and CO2FEE25.D011614A

Cumulative coal-fired capacity additions, 2012-2040



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2014* National Energy Modeling System runs REF2014.D102413A, LOWMACRO.D112913A, HIGHMACRO.D112913A, LCCST14.D120413A, HCCST14.D120413A, HIGHRESOURCE.D112913B, LOWRESOURCE.D112913A, NOGHGCONCERN.D120413A, CO2FEE10.D011614A, and CO2FEE25.D011614A