Annual Energy Outlook 2014
1st Coal Working Group

Coal and Uranium Analysis Team

July 22, 2013| Washington, D.C.

Topics for discussion

- *Recoding to AIMMS; otherwise, no changes to Coal Market Module (CMM) structure or equations from AEO2013*
- Legislation and regulations
- Retirements and additions
- Pollution control retrofits
- Coal productivity trends
- Projected consumption (CTL), production, exports, and prices
- Side cases

Key results for the AEO2013 Reference case

- Coal remains the leading fuel for U.S. electricity generation, but coal's share of total generation decreases over time to 35% in 2040 (from 42% in 2011)

- Coal producers in both the Interior and Western regions see their shares of total U.S. coal production increase over the projection period, while Appalachia's share declines. From 2011 to 2040, the Appalachian region's share of total coal production (on a Btu basis) falls from 38 percent to 32 percent.

- Nearly all of the 49 GW of coal-fired capacity retirements (28 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 AEO2013 Reference case

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

- Coal consumption declines by 119 million short tons between 2011 and 2016. Between 2016 and 2040, coal consumption rises due to more intensive use of remaining coal plants as natural gas prices rise, but it never reaches the record 2007 level.

- 9 GW of additions (6 GW planned)

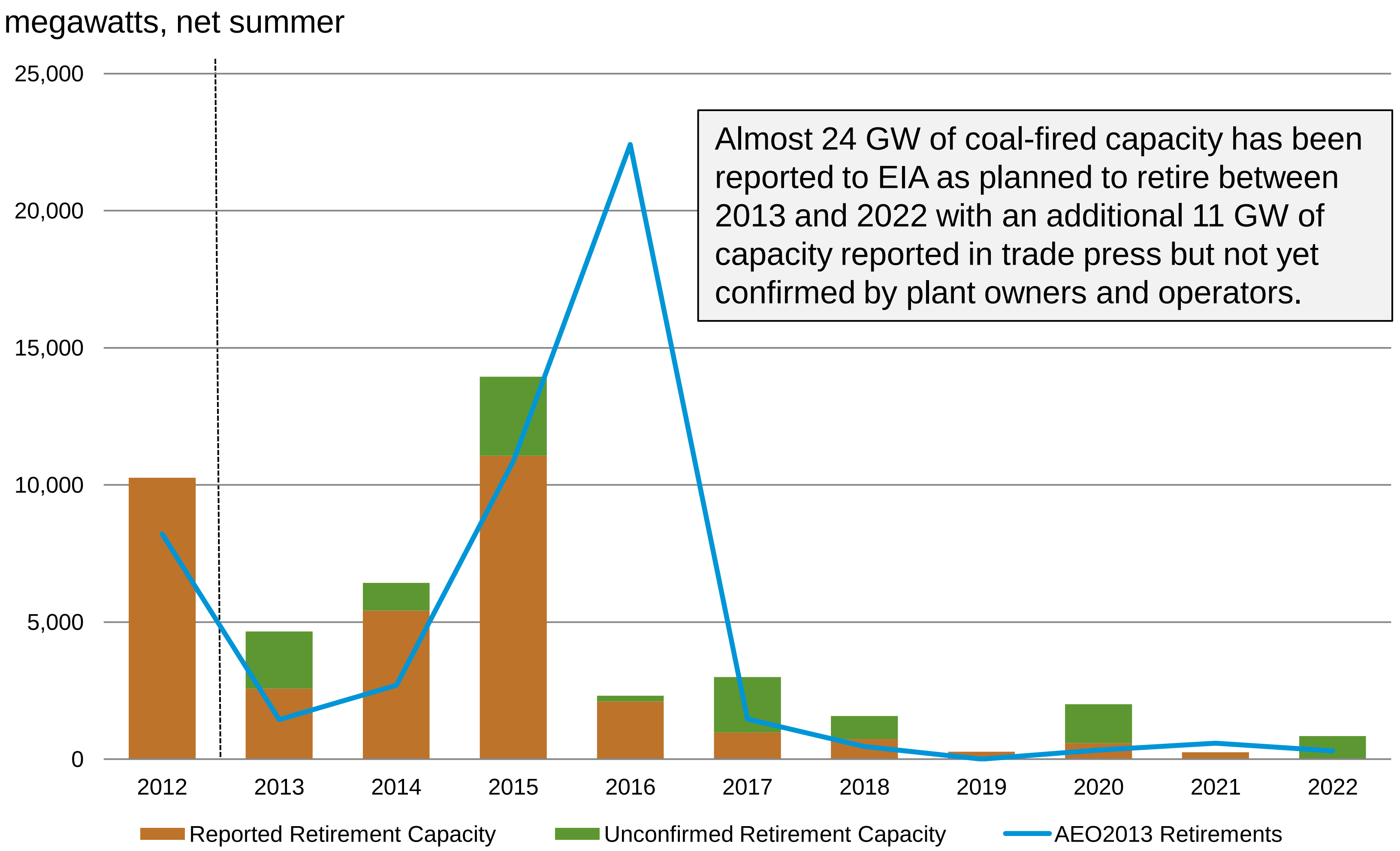
- Delivered coal prices increase gradually through 2040 at an average rate of 0.9% per year due to declining coal mine productivity and increasing transportation costs

Legislation and regulation assumptions

- Current laws and regulations addressed in the AEO2014 Reference Case
  - Clean Air Interstate Rule (CAIR)
  - Mercury and Air Toxics Standards (MATS) by 2016
  - State Renewable Portfolio Standards (RPS)
  - California's cap-and-trade program and the Northeast's RGGI program
  - Uncertainty with respect to CO_2 policy addressed through a 3% higher cost of capital for new coal-fired power plants and capital investment projects at existing coal-fired power plants

- Issues not addressed in the AEO2014 Reference Case
  - CO_2 New Source Performance Standards (NSPS)
  - Cooling water intake regulations per section 316(b) of the Clean Water Act
  - Regional haze
  - Coal combustion residuals

Planned (reported and unconfirmed) annual coal-fired capacity retirements in the electric power sector



Sources: Reported retirements were collected on U.S. Energy Information Administration Form EIA-860, "Annual Electric Generator Report;" Unconfirmed retirements were collected from various trade press. EIA-860 data for 2012 are preliminary.

Preliminary AEO2014: Planned Coal-Fired Capacity Additions (megawatts)

FACILITY CODE	PLANT NAME	GENERATOR ID	STATE	PLANT TYPE	ENERGY SOURCE	START YEAR	START MONTH	SUMMER CAPABILITY
2721	Cliffside*	6	NC	PC	BIT	2012	12	825
56564	John W Turk Jr Power Plant*	1	AR	PC	SUB	2012	12	609
56611	Sandy Creek Energy Station	S01	TX	PC	SUB	2013	5	911
1004	Edwardsport	ST,CT1,CT2	IN	IGCC	BIT	2013	6	571
57037	Kemper County IGCC Project	1A,1B,1C	MS	IGCC	LIG	2014	5	593
7570	Spiritwood	1	ND	PC	LIG	2014	6	62
55360	Two Elk Generating Station	GEN1	WY	PC	WC	2016	12	275
To be included as planned capacity additions in AEO2014:								3,846

***** Units that come on-line in December are reported in NEMS as planned additions for the next calendar year.

Note: Three coal-fired generating units that came on-line in 2012, with a combined generating capacity of 2,214 MW, were included as planned capacity additions in the AEO2013. These units will be included as existing capacity in the AEO2014. The three units were Prairie State Generating Station's units PC1 (812 MW) and PC2 (817 MW) and Virginia City Hybrid Energy Center's unit 1 (585 MW).

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

EIA-860: Coal-Fired Capacity Reported as Planned but Not Yet Under Construction (megawatts)

FACILITY CODE	PLANT NAME	GENERATOR ID	STATE	PLANT TYPE	ENERGY SOURCE	START YEAR	START MONTH	SUMMER CAPABILITY
56453	Robinson Power Company LLC	1	PA	PC	BIT	2016	4	132
56452	Medicine Bow Fuel & Power LLC	1	WY	CTL	BIT	2016	12	350
56675	Plant Washington	1	GA	PC	SUB	2018	4	850
56454	Taylorville Energy Center	MAIN	IL	IGCC	BIT	2018	6	533
Total Capacity								1,865

Note: Because these units are reported as not yet under construction on the EIA-860, these units are not included as planned capacity additions in the AEO2014.

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

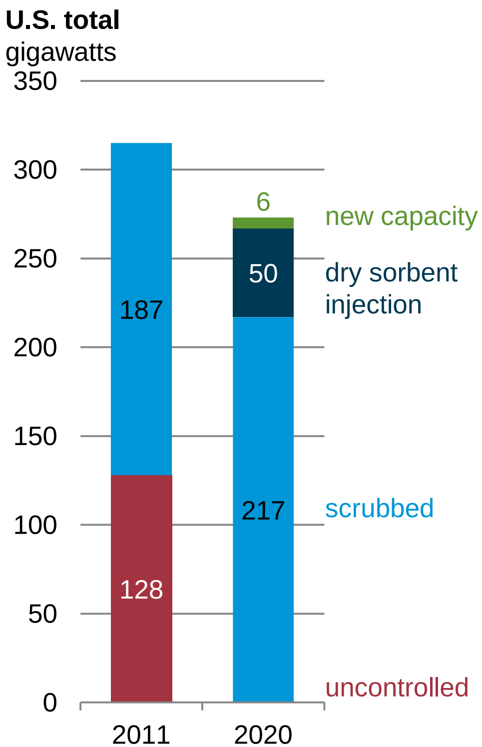
Electric Net Summer Generating Capacity by Fuel, 2008-2040 (gigawatts)

Fuel	2008	2011	2015	2016*	2020	2035	2040
Coal	311	318	301	278	277	277	278
Electric Power Sector	308	314	297	275	273	272	273
End-Use Sectors	4	4	4	4	4	5	5
Natural Gas	335	359	379	380	390	519	566
Petroleum	115	103	99	97	88	68	66
Nuclear Power	101	101	104	106	111	109	113
Renewable Sources	117	143	171	175	178	208	245
Other (includes pumped storage)	25	25	25	25	25	25	25
Total	1004	1050	1079	1061	1068	1206	1293

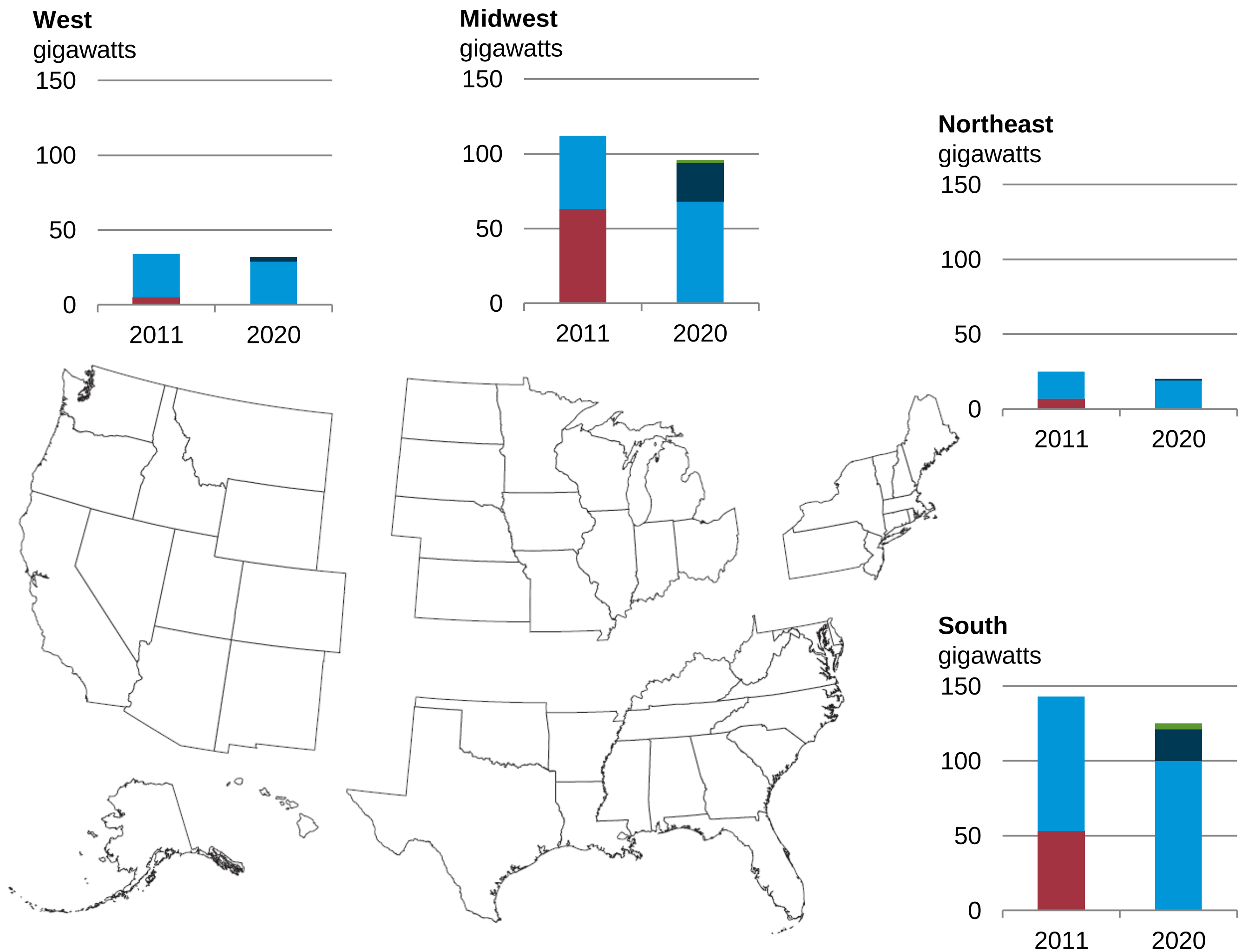
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013,* Reference *Case*

**MATS compliance assumed to begin*

Electricity Sector Net Summer Generating Capacity by SO_2 Control Type and Region, 2011 and 2020 in AEO2013

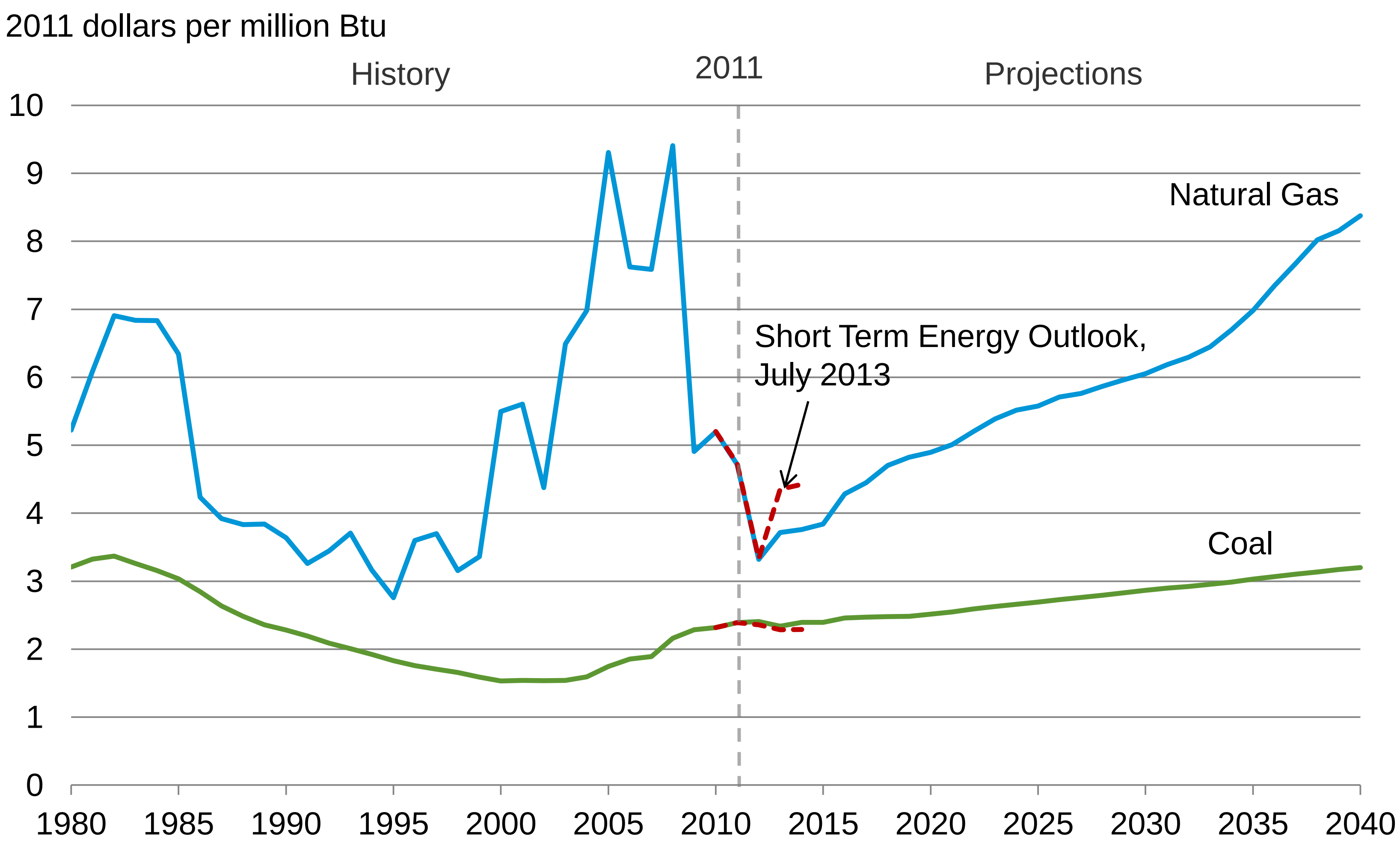


Note: Scrubbed capacity includes capacity equipped with flue gas desulfurization (FGD) equipment and coal plants employing integrated gasification combined (IGCC) cycle or circulating fluidized bed (CFB) combustion technologies.



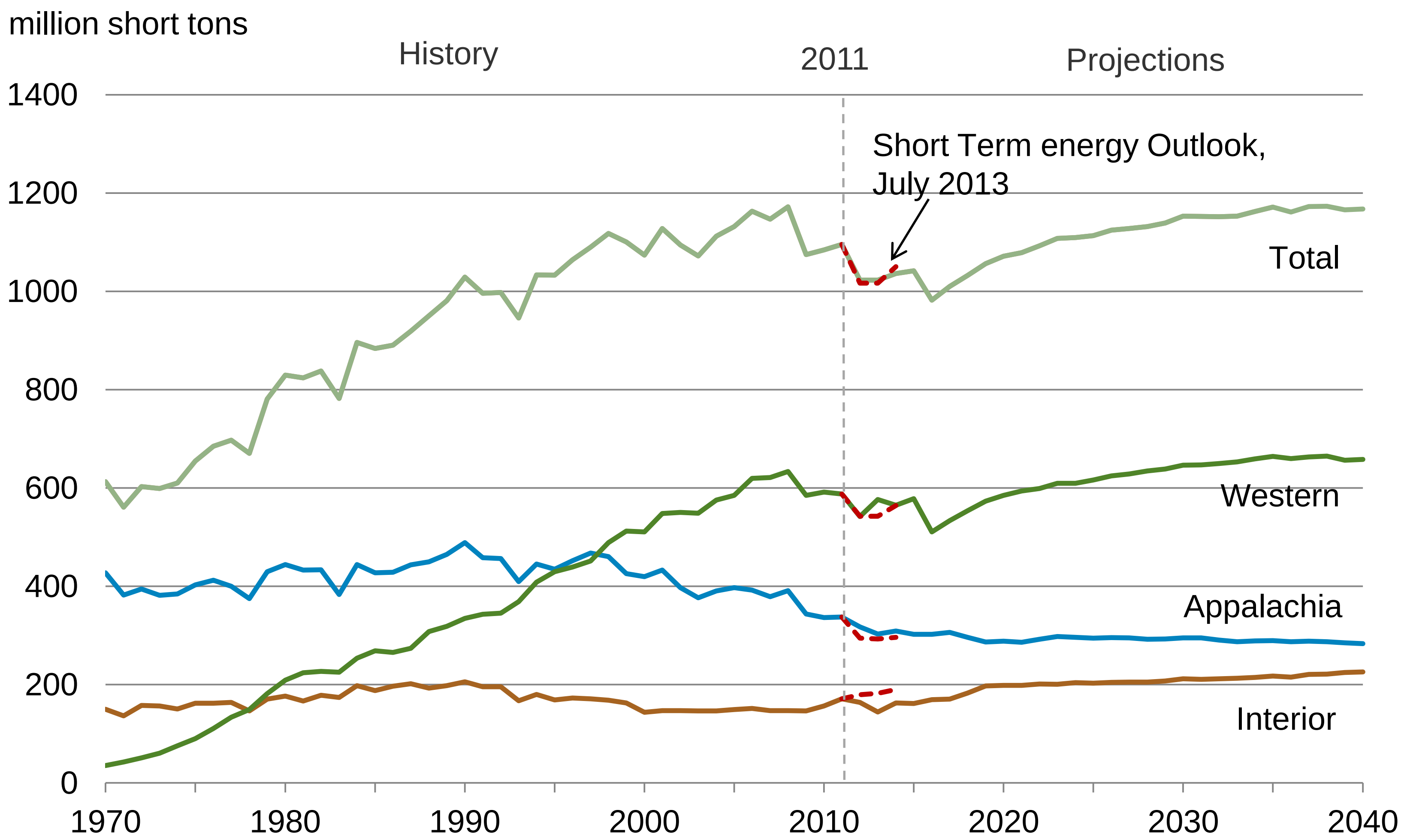
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013,* Reference *Case*

Average Delivered Price of Coal and Natural Gas to the Electric Power Sector, 1980-2040



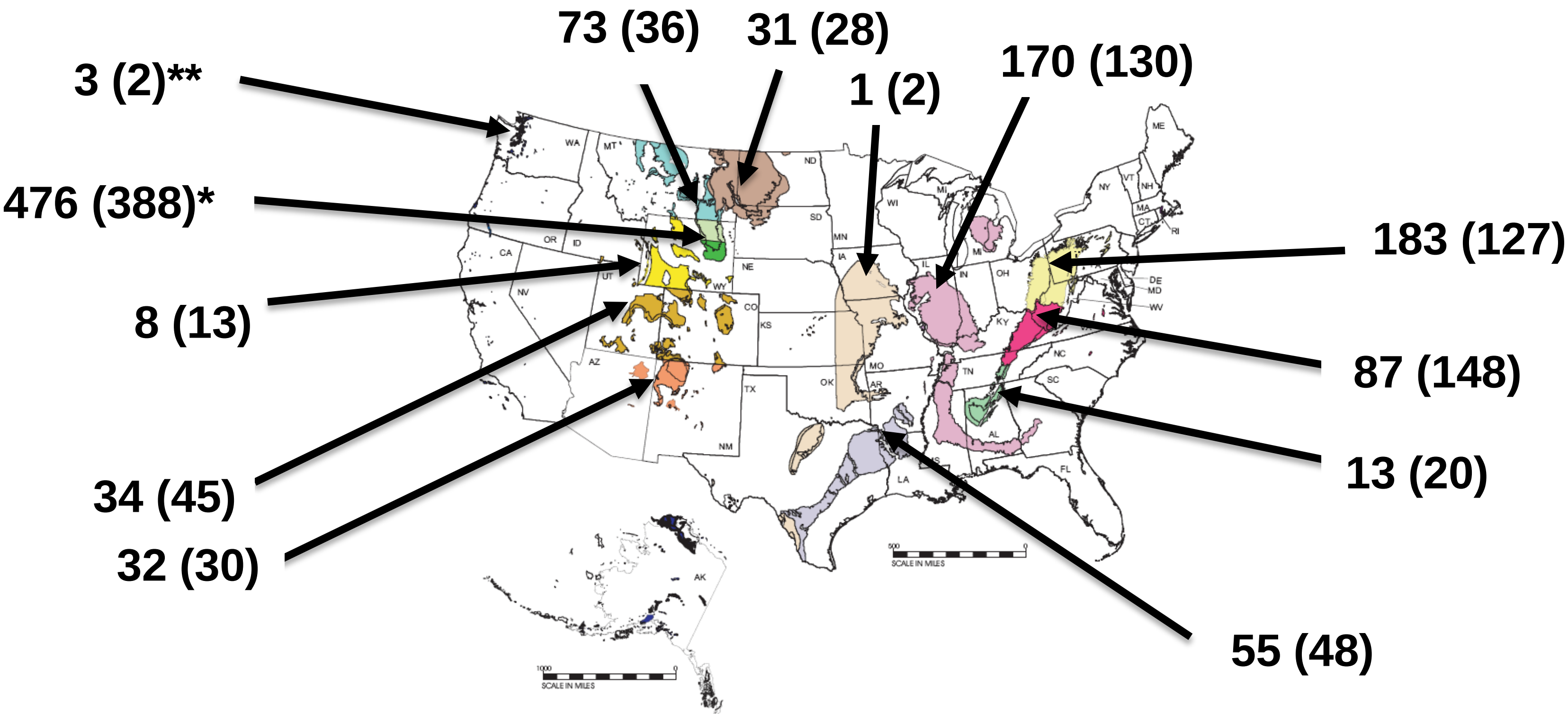
Source: **History:** U.S. Energy Information Administration (EIA), *Monthly Energy Review* and *Electric Power Monthly*; **Projections:** EIA, *Annual Energy Outlook 2013,* Reference Case

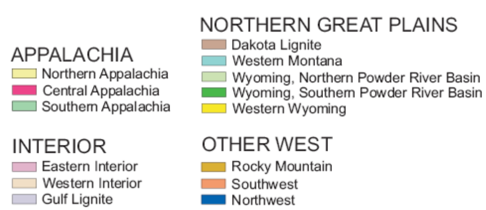
Coal production by region, 1970-2040



Source: History: U.S. Energy Information Administration (EIA), *Annual Coal Report;*
Projections: EIA, *Annual Energy Outlook 2013,* Reference Case

Coal production, 2040 (and 2012)
(million short tons)





U.S. Total:
1,167 (1,016)

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

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

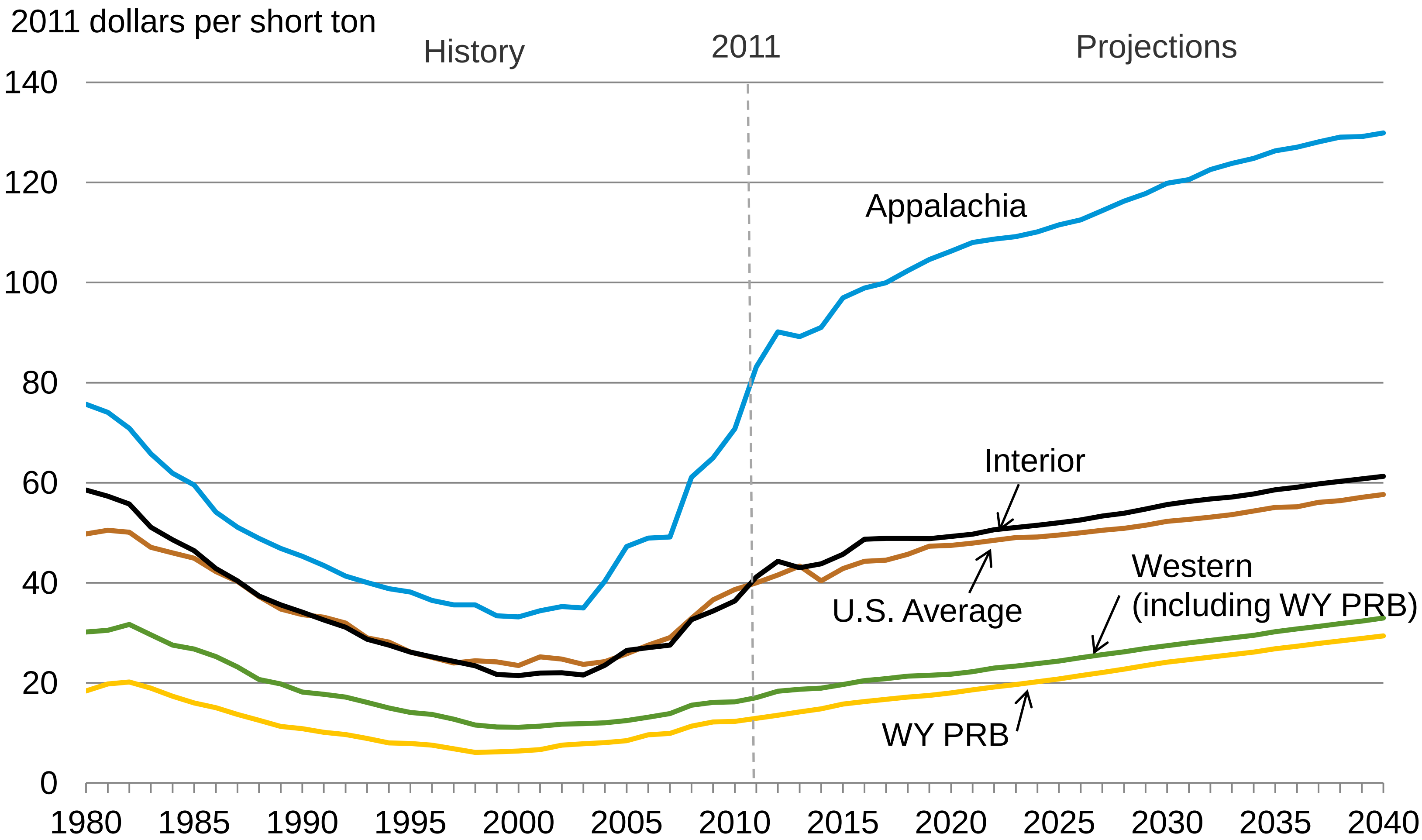
Source: 2012: Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine and Employment and Coal Production Report;" **2040:** U.S. Energy Information Administration, *Annual Energy Outlook 2013,* Reference Case

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

Coal Supply Region	1980-1990	1990-2000	2000-2011	2011-2040	2011-2012
Northern Appalachia	5.4	5.5	-2.5	-1.2	-3.6
Central Appalachia	7.3	4.4	-6.1	-3.6	-3.8
Eastern Interior	4.8	3.7	-1.4	-0.6	5.8
Gulf Lignite	2.6	2.4	-2.7	-2.3	-4.2
Dakota Lignite	6.0	1.0	-3.3	-0.9	-4.5
Western Montana	4.6	2.0	-3.0	-1.7	-11.7
WY, Northern Powder River Basin	7.5	3.2	-3.0	-1.7	-5.8
WY, Southern Powder River Basin	7.2	4.9	-2.7	-1.7	-6.6
Rocky Mountain	7.8	5.5	-3.3	-1.9	2.9
U.S. Average	7.1	6.2	-2.7	-1.4	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: EIA, *Annual Energy Outlook 2013*, Reference Case

Average minemouth coal price by region, 1980-2040

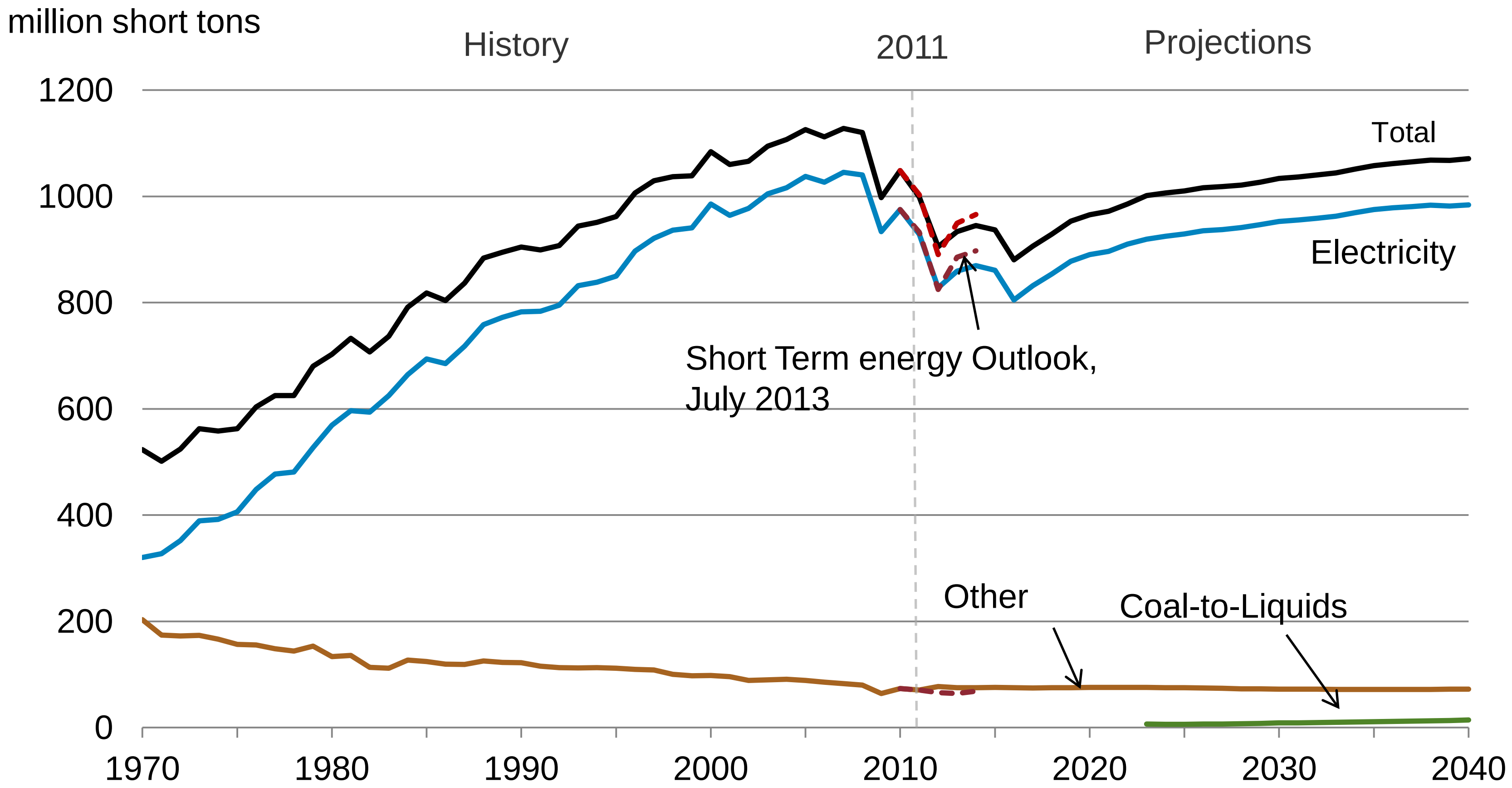


Note: Historical price data for Wyoming's PRB is represented by data for Campbell county.

Source: History: U.S. Energy Information Administration (EIA), *Annual Coal Report;*

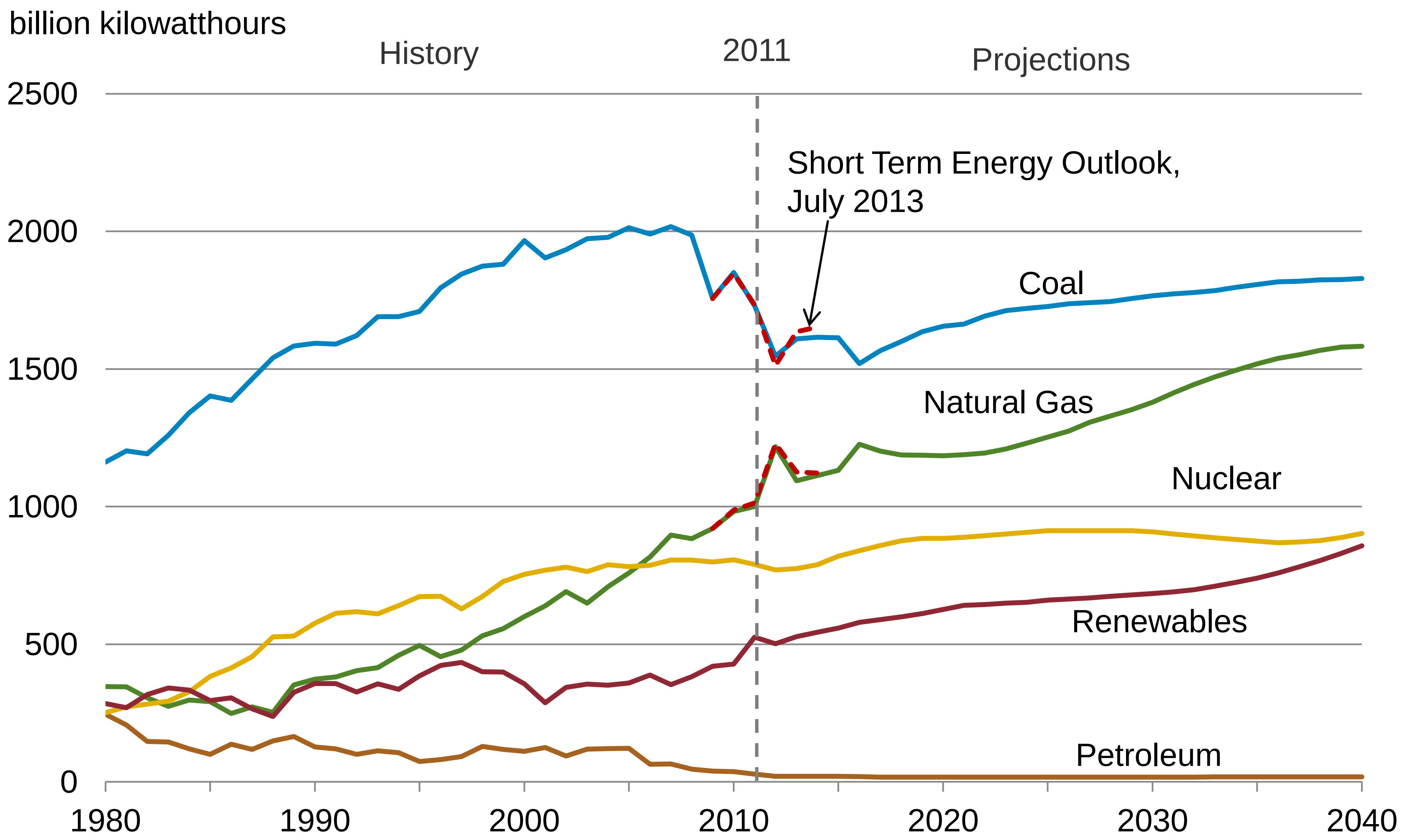
Projections: EIA, *Annual Energy Outlook 2013,* Reference Case

Coal consumption by sector, 1970-2040



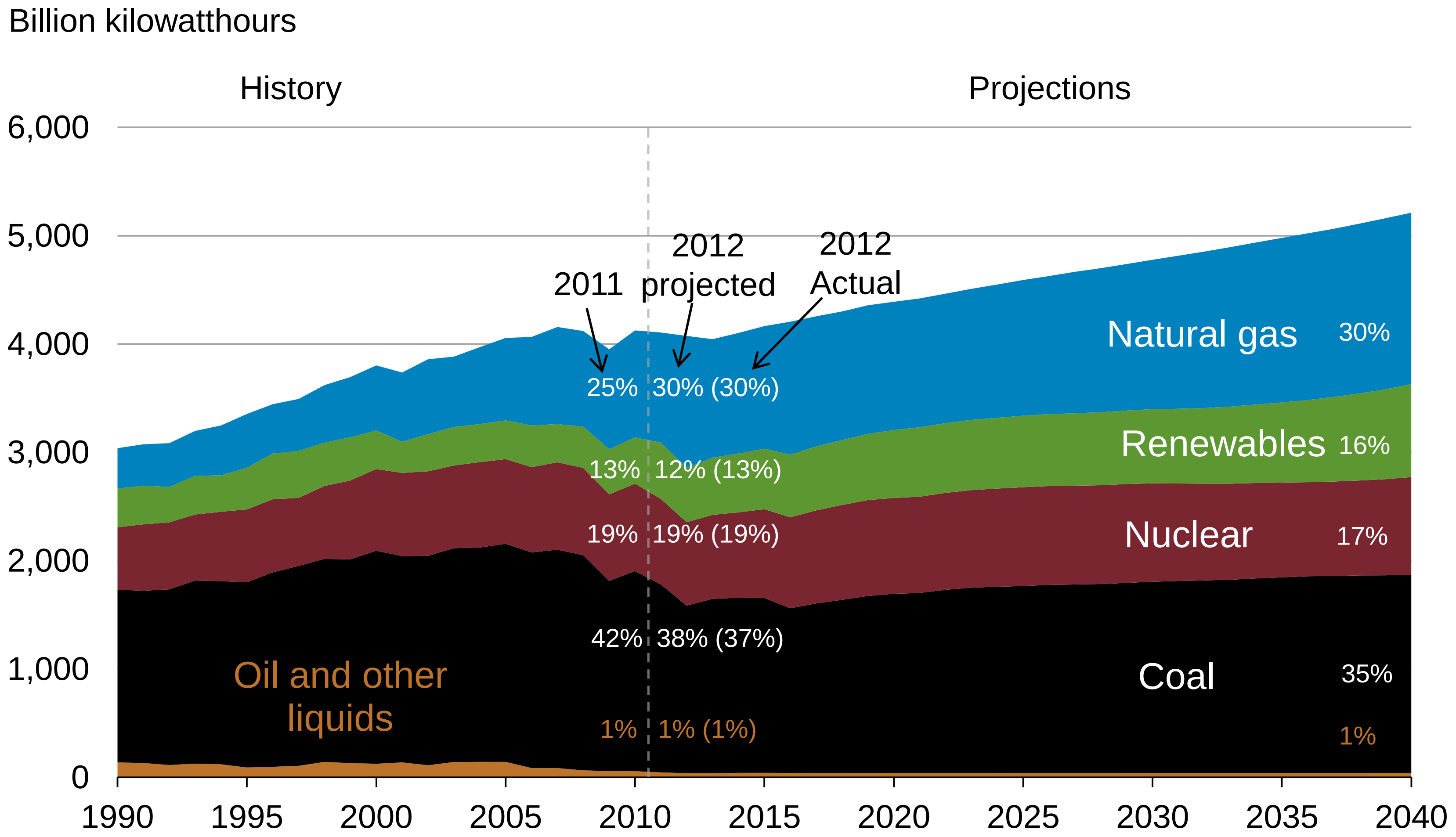
Source: History: U.S. Energy Information Administration (EIA), *Annual Energy Review;*
Projections: EIA, *Annual Energy Outlook 2013 (AEO2013),* Reference Case

Electricity Generation by Fuel, 1980-2040



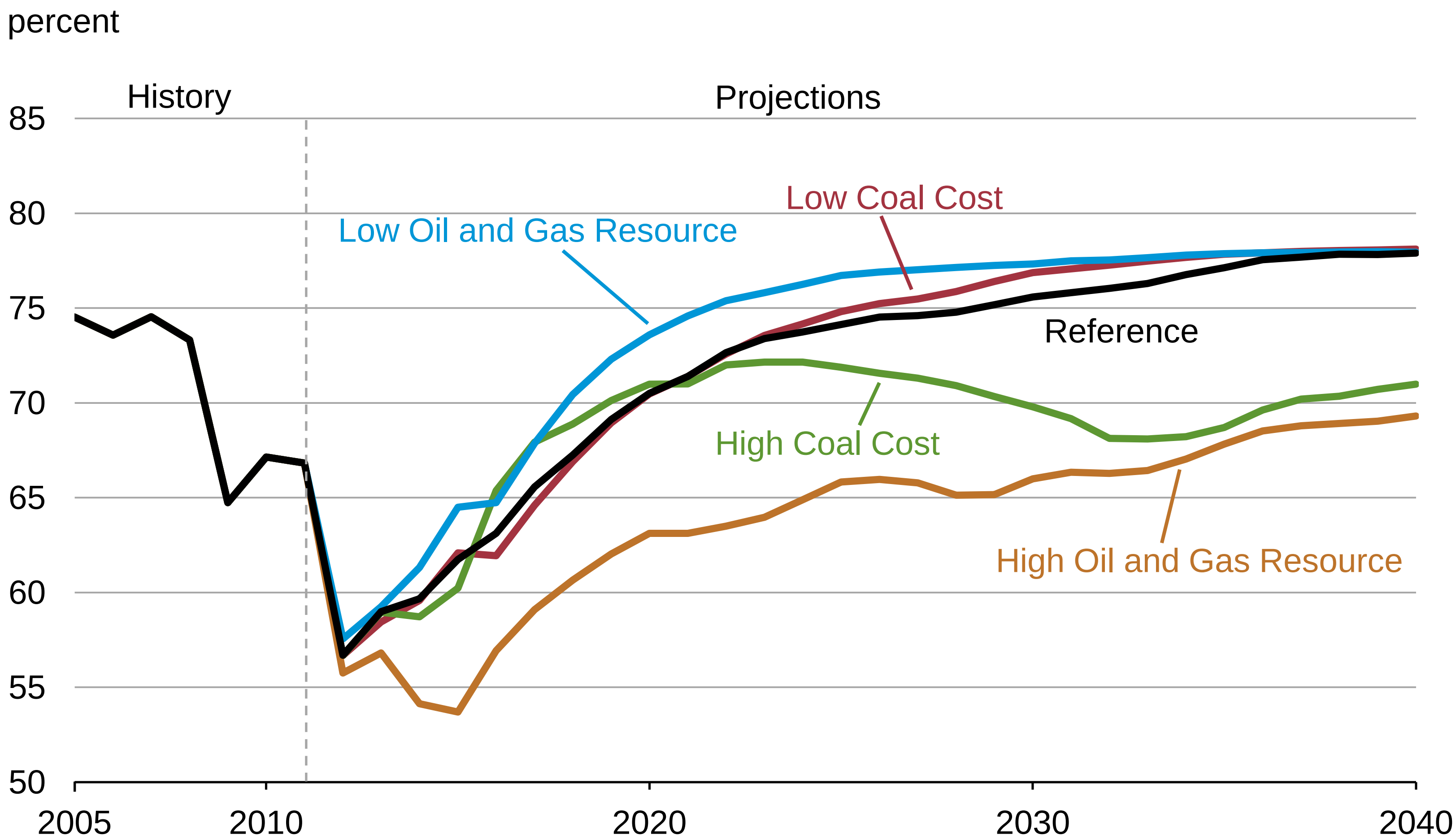
Note: Includes generation from plants in both the electric power and end-use sectors.
Source: **History:** U.S. Energy Information Administration (EIA), *Annual Energy Review;*
Projections: EIA, *Annual Energy Outlook 2013,* Reference Case.

Electricity generation by fuel, 1990-2040



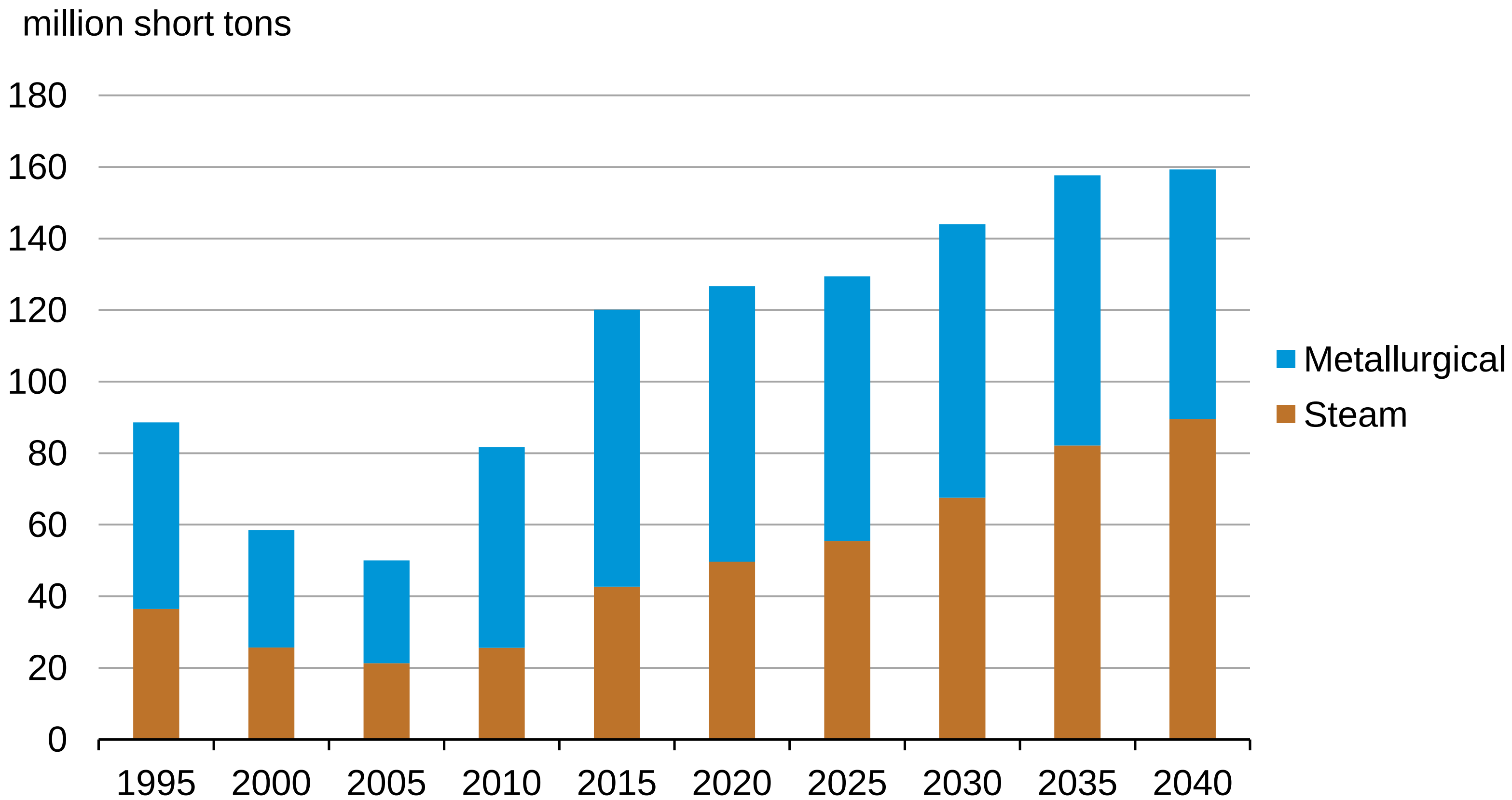
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013,* Reference *Case*

Average Capacity Utilization Rate for Coal-Fired Generating Capacity in Five Cases, 2005-2040



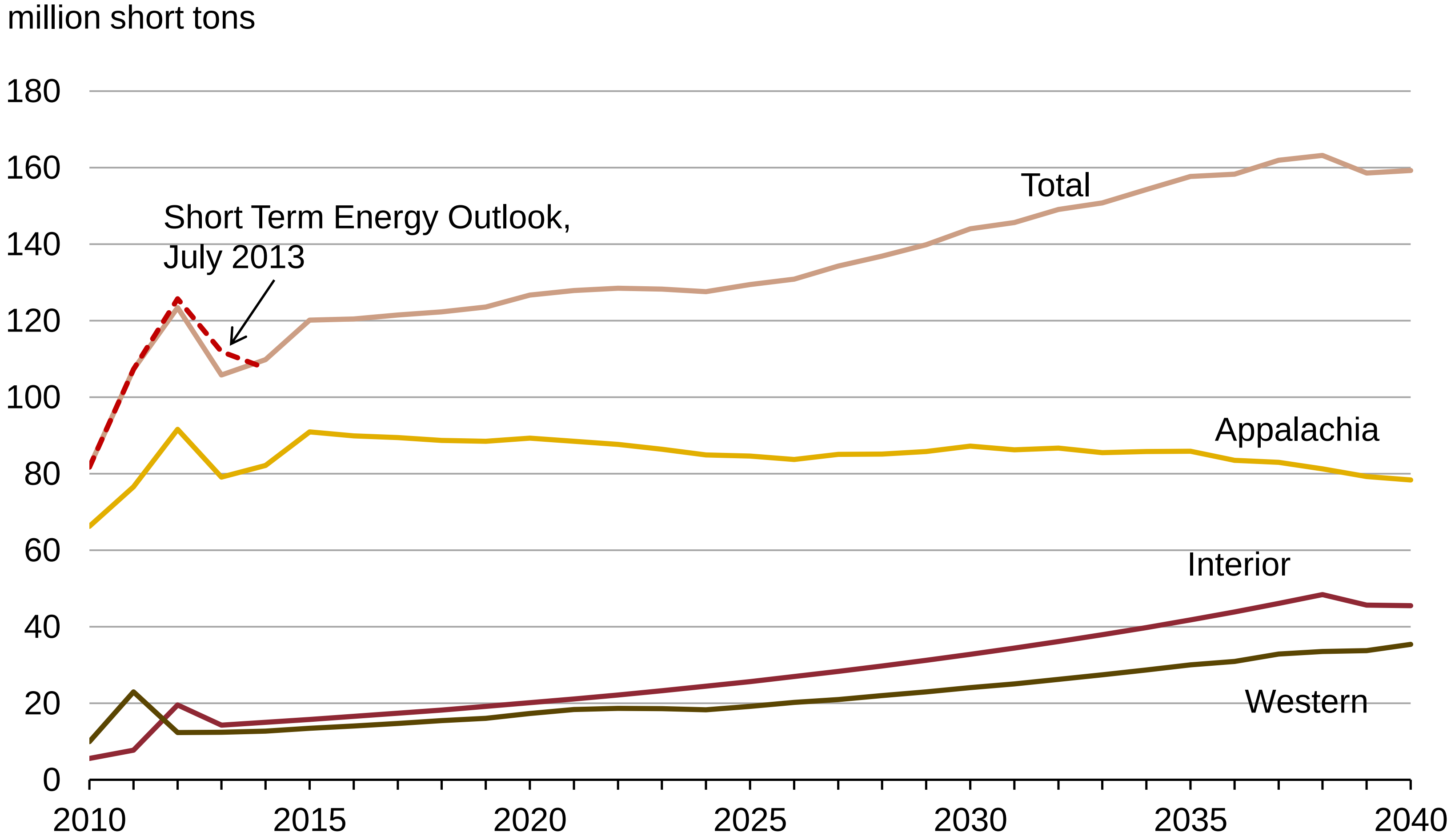
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013,* National Energy Modeling System runs REF2013.D102312A, LCCST13.D112112A, HCCST13.D112112A, HIGHRESOURCE.D021413A, and LOWRESOURCE.D012813A.

U.S. Coal Exports, 1995-2040



Source: History: U.S. Energy Information Administration (EIA), *Quarterly Coal Report;* **Projections:** EIA, *Annual Energy Outlook 2013 (AEO2013),* Reference Case

Coal exports by major coal-producing region, 2010-2040



Source: 2010 and 2011: U.S. Energy Information Administration (EIA), *Annual Coal Distribution Report;*
Projections: EIA, *Annual Energy Outlook 2013 (AEO2013), Reference Case*

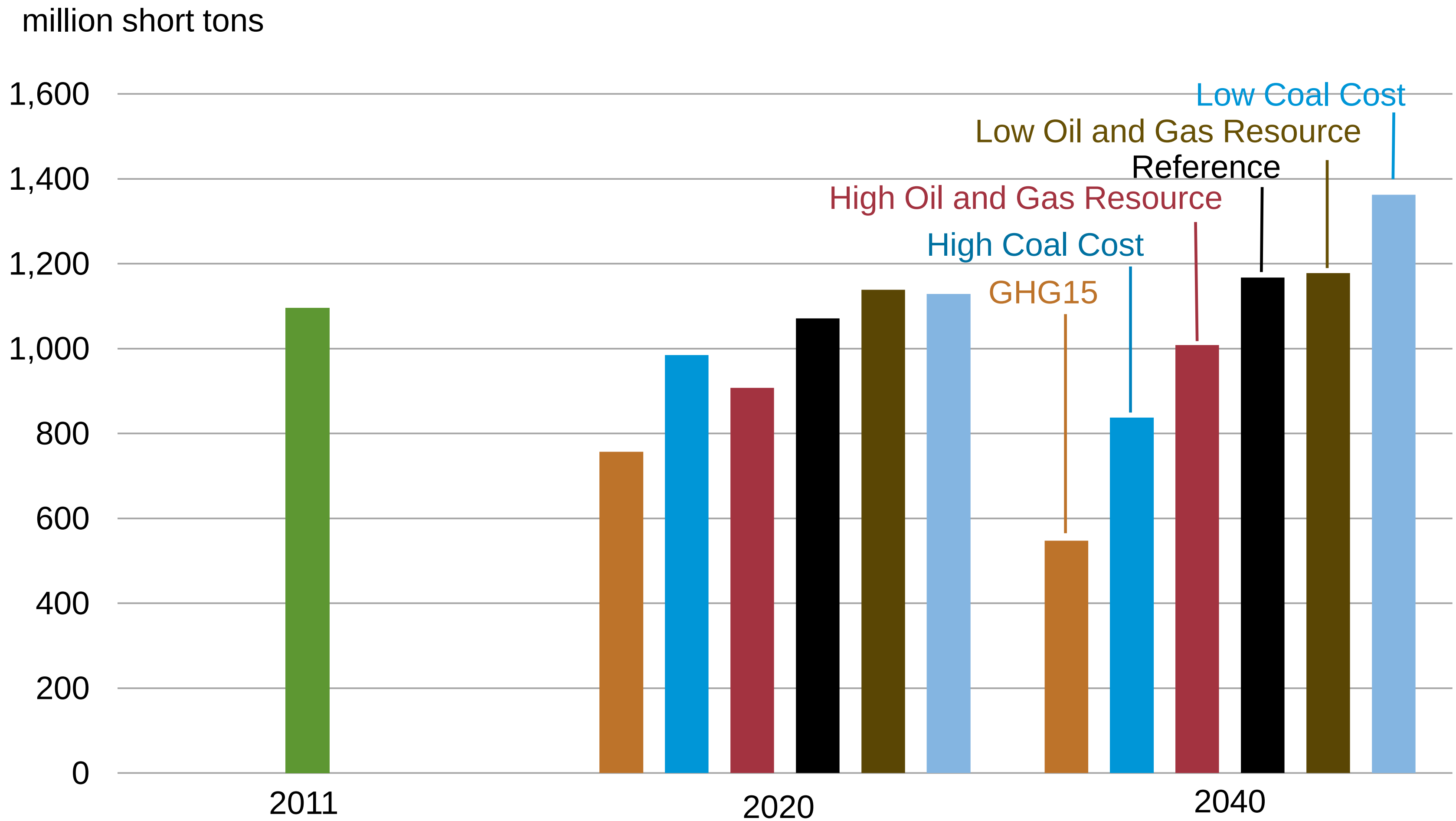
Uncertainty is explored with numerous alternative cases

Key differences between alternate cases

	AEO2013 Reference	Low Economic Growth	High Economic Growth	Low Coal Cost	High Coal Cost	High Oil and Gas Resource	Low Oil and Gas Resource	GHG15 (CO2 fee of $15 in 2014 increasing to $53 in 2040)	GHG25 (CO2 fee of $25 in 2014 increasing to $89 in 2040)
GDP growth (avg. annual change from 2011)	2.5%	1.9%	2.9%						
Electricity demand (avg. annual change from 2011)	0.9%	0.6%	1.2%						
Delivered natural gas price to the electricity sector, 2040 (2011 dollars per million Btu)	$8.38					$5.13	$10.55	$11.01*	$11.10*
Delivered coal price to the electricity sector , 2040 (2011 dollars per million Btu)	$3.20			$1.88	$5.68			$7.71*	$9.45*
Minemouth coal price, 2040 (2011 dollars per short ton)	$61.28			$33.90	$128.09				
Western coal transportation rates (percent change from 2011, constant dollar basis)	0.0%			-24%	27%				
Coal mining productivity (avg. annual change from 2011)	-1.4%			0.9%	-4.3%				
Coal with CCS in power sector, 2040 (gigawatts)	0.9							2.6	3.9
NGCC with CCS in power sector, 2040 (gigawatts)	0.0							5.8	49.9

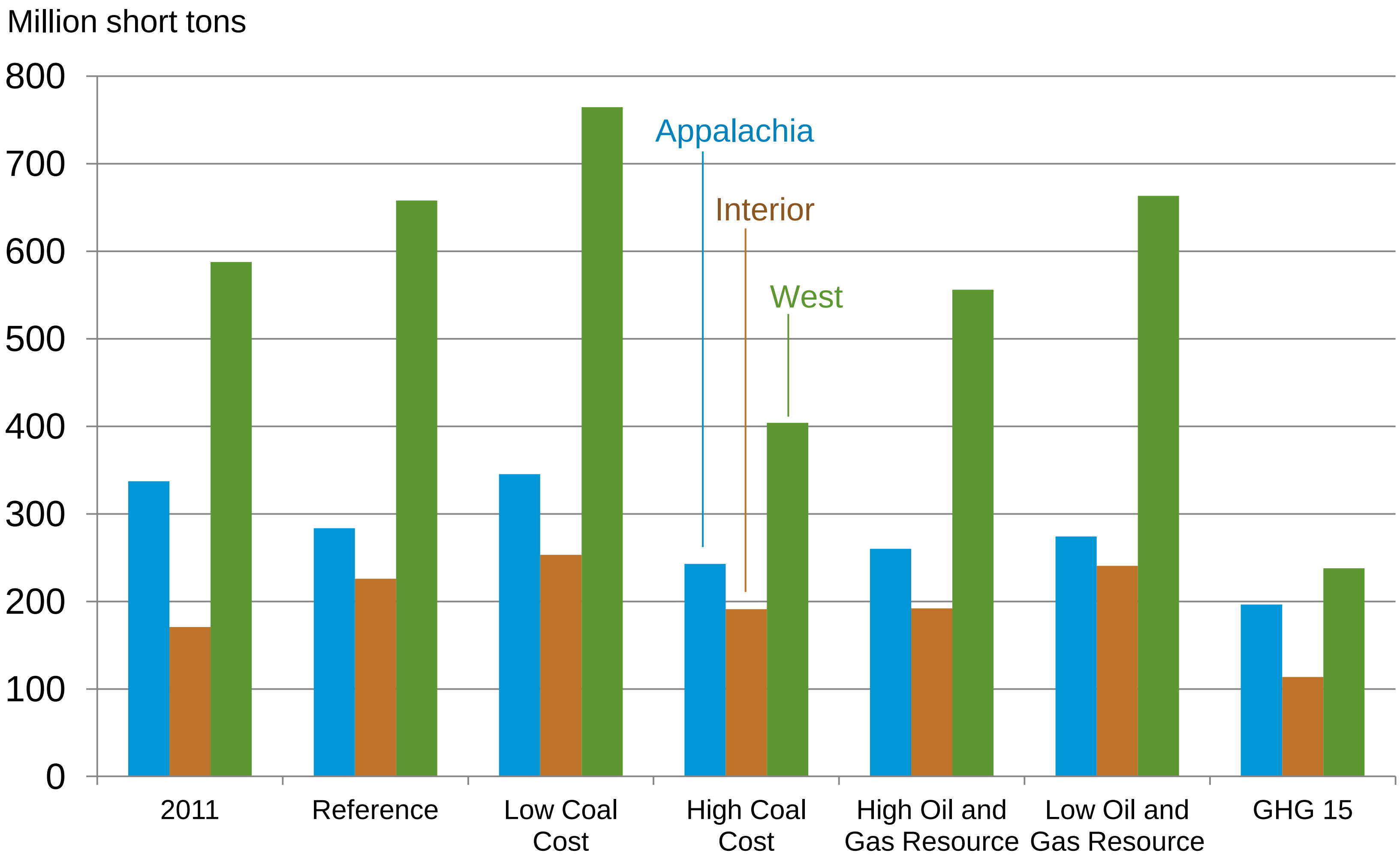
*Includes CO_2 fee

U.S. Coal Production, 2020 and 2040



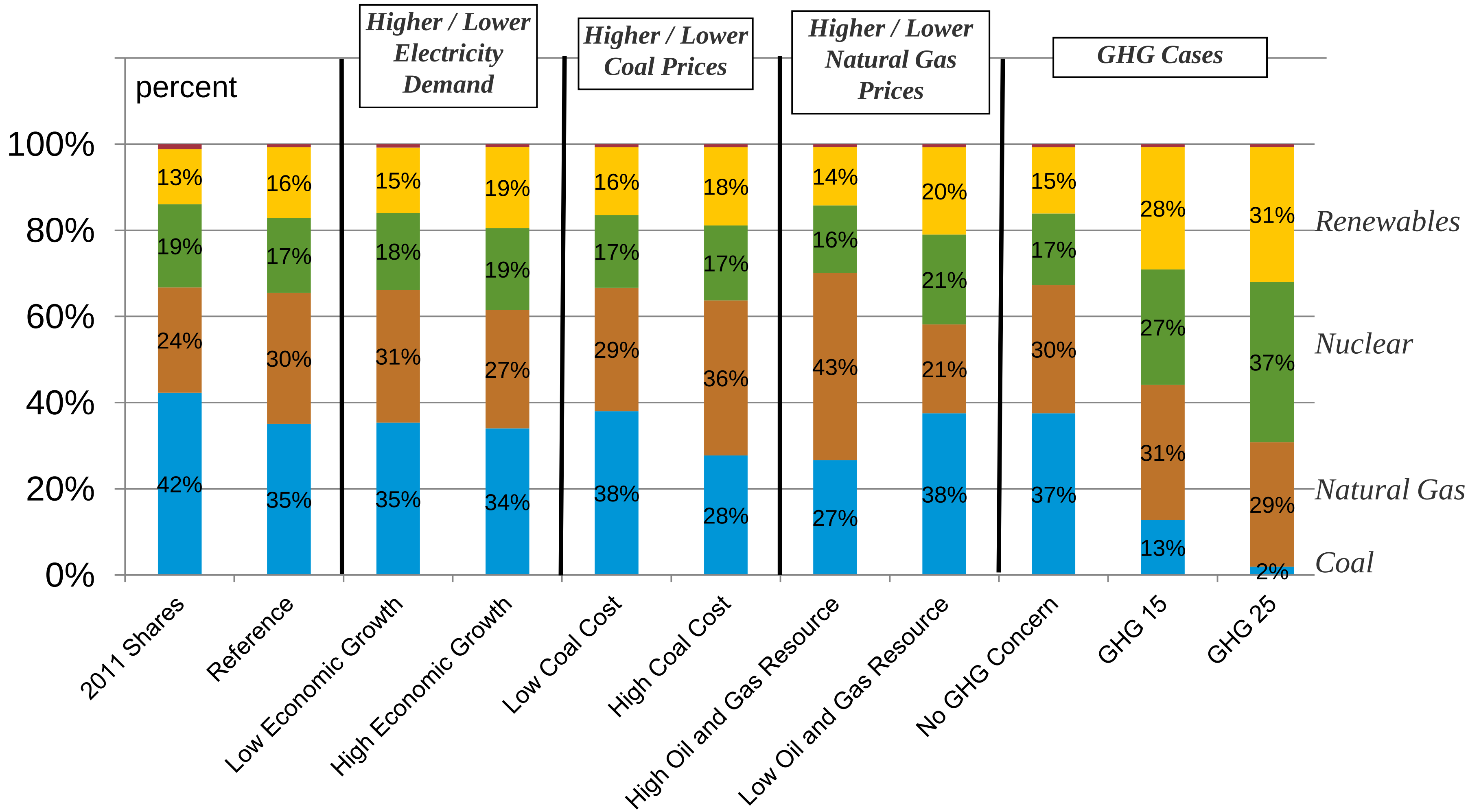
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013,* National Energy Modeling System runs REF2013.D102312A, LCCST13.D112112A, HCCST13.D112112A, HIGHRESOURCE.D021413A, LOWRESOURCE.D012813A, and CO2FEE15.D021413A.

Coal production by region, 2040



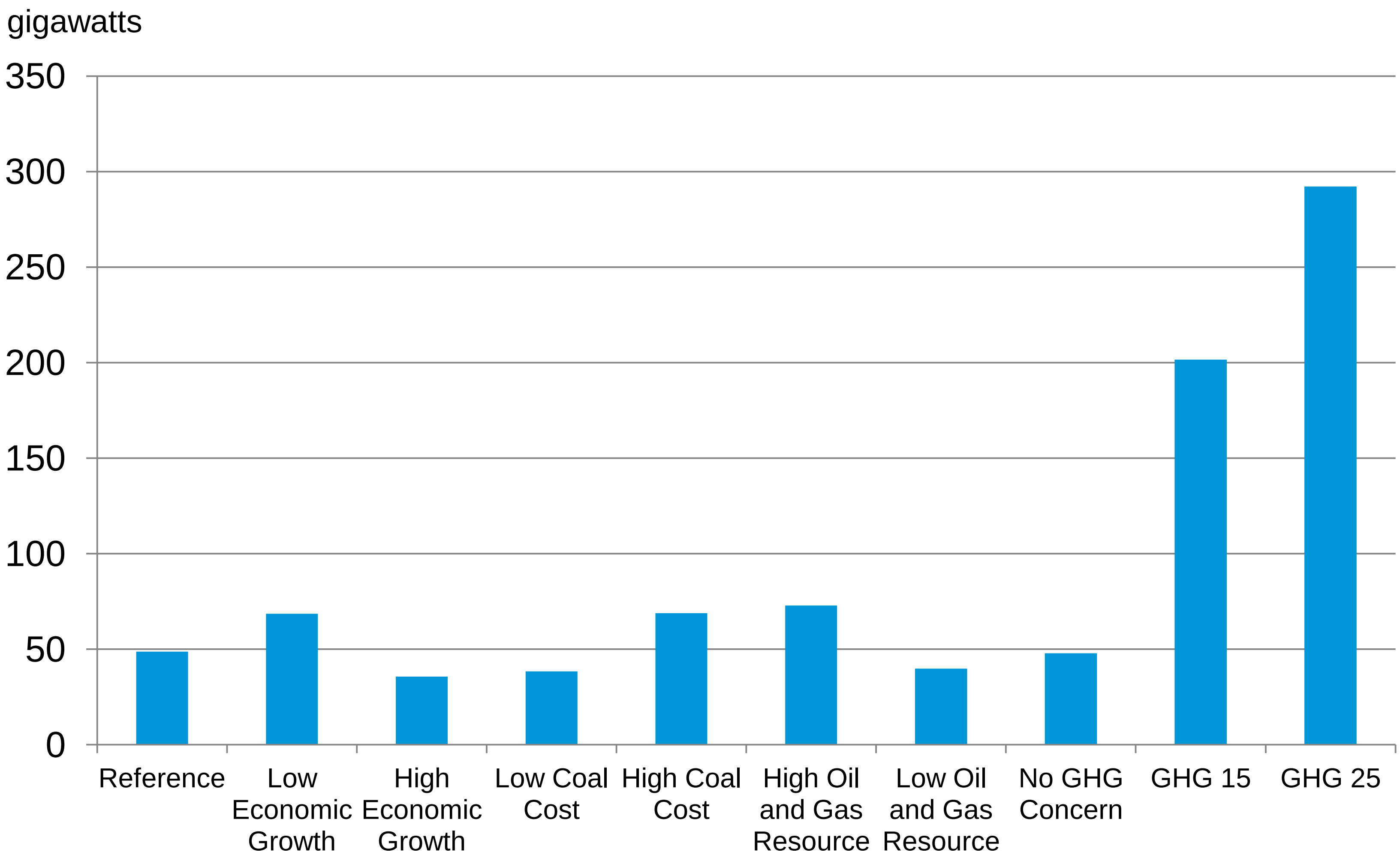
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013,* National Energy Modeling System runs REF2013.D102312A, LCCST13.D112112A, HCCST13.D112112A, HIGHRESOURCE.D021413A, LOWRESOURCE.D012813A, and CO2FEE15.D021413A.

2040 electricity generation shares



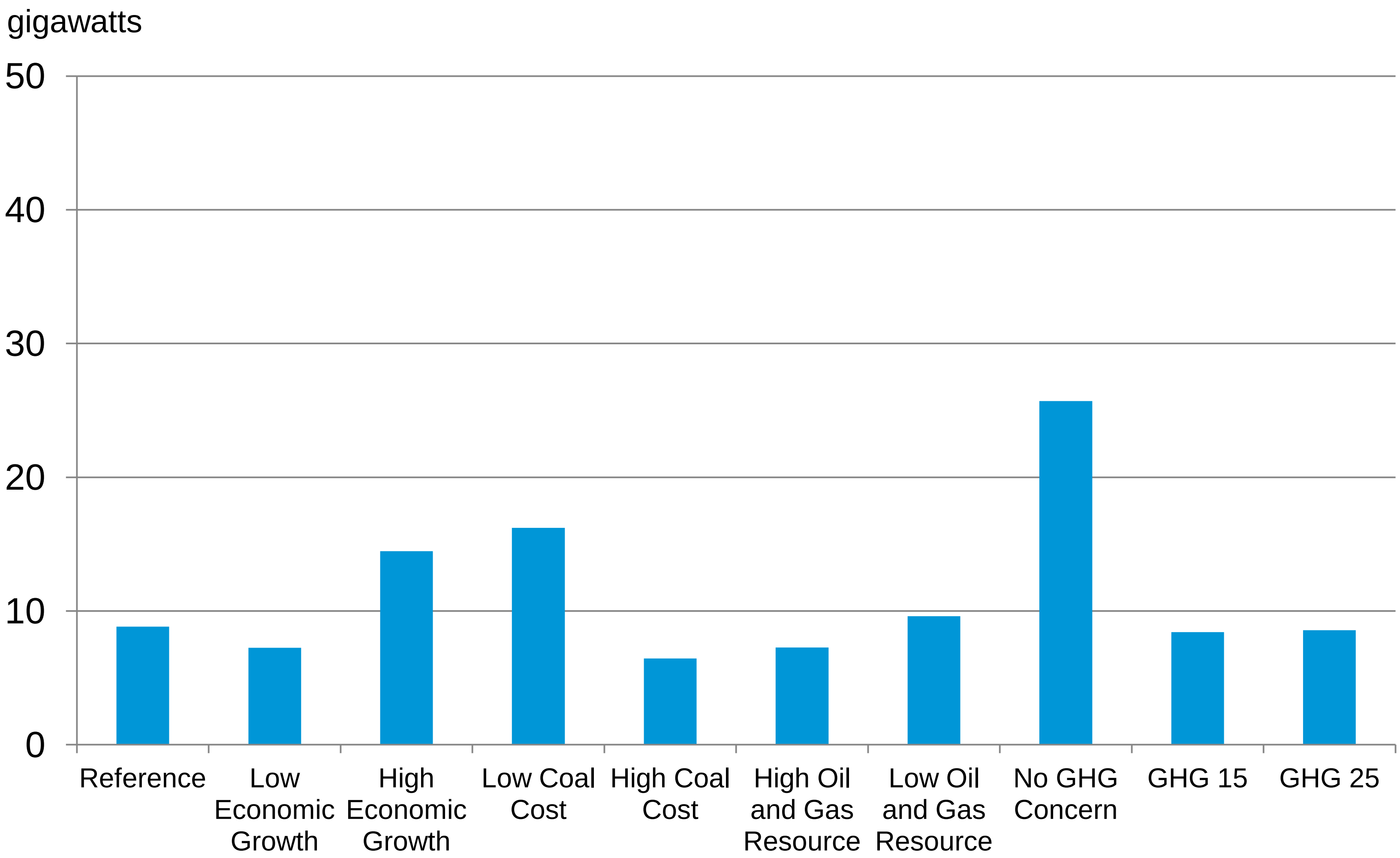
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013,* National Energy Modeling System runs REF2013.D102312A, LOWMACRO.D110912A, HIGHMACRO.D110912A, LCCST13.D112112A HCCST13.D112112A, HIGHRESOURCE.D021413A, LOWRESOURCE.D012813A, NOGHGCONCERN.D110912A, CO2FEE15.D021413A, and CO2FEE25.D021413A.

Cumulative coal-fired capacity retirements, 2012-2040



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013,* National Energy Modeling System runs REF2013.D102312A, LOWMACRO.D110912A, HIGHMACRO.D110912A, LCCST13.D112112A HCCST13.D112112A, HIGHRESOURCE.D021413A, LOWRESOURCE.D012813A, NOGHGCONCERN.D110912A, CO2FEE15.D021413A, and CO2FEE25.D021413A.

Cumulative coal-fired capacity additions, 2012-2040



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013,* National Energy Modeling System runs REF2013.D102312A, LOWMACRO.D110912A, HIGHMACRO.D110912A, LCCST13.D112112A HCCST13.D112112A, HIGHRESOURCE.D021413A, LOWRESOURCE.D012813A, NOGHGCONCERN.D110912A, CO2FEE15.D021413A, and CO2FEE25.D021413A.

For more information

greg.adams@eia.gov, (202) 586-7343

ayaka.jones@eia.gov, (202) 586-0998

diane.kearney@eia.gov, (202) 586-2415

michael.mellish@eia.gov, (202) 586-2136

vlad.dorjets@eia.gov, (202) 586-3141

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

Annual Energy Outlook | www.eia.gov/aeo

International Energy Outlook | www.eia.gov/ieo

EIA Information Center

InfoCtr@eia.gov

Our average response time is within three business days.

(202) 586-8800

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