

**WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES.
DO NOT QUOTE OR CITE AS AEO2015 MODELING ASSUMPTIONS
AND INPUTS ARE SUBJECT TO CHANGE.**

Annual Energy Outlook 2015

1st Coal Working Group



Coal and Uranium Analysis Team
July 30, 2014 | Washington, D.C.

Changes in release cycles for EIA's AEO and IEO

- To focus more resources on rapidly changing energy markets and how they might evolve over the next few years, the U.S. Energy Information Administration is revising the schedule and approach for production of the *International Energy Outlook (IEO)* and the *Annual Energy Outlook (AEO)*.
- Starting with *IEO2013*, which was released in July, 2013, EIA adopted a two-year production cycle for both the *IEO* and *AEO*.
- Under this approach, a full edition of the *IEO* and *AEO* will be produced in alternating years and an interim, shorter edition of each will completed in the “off” years.

	<u>2014</u>	<u>2015</u>
International Energy Outlook	Interim Edition will be released in mid 2014 , focusing on the liquids projection, which is used as part of the <i>AEO2014</i> . Summary tables and a short analysis will be included.	Full Edition will be released in the spring 2015
Annual Energy Outlook	Full Edition will be released in spring 2014 , including analysis of energy issues and many alternative scenarios.	Interim Edition will be released in late 2014 or early 2015 and will only include the Reference, Low and High Economic Growth, and Low and High Oil Price cases. The shorter version will include tables for these cases and short discussions.

Scope of changes limited by Interim AEO

- Data Updates
 - Planned retirements, retrofits, repowering, uprates (nuclear), and new builds
 - Historical data updates and overwrites; update to AEO base year
 - Short-Term Energy Outlook (STEO) calibration
- Model Updates and Enhancements
 - Limited to those generally needed to address changes in laws and regulations
 - Complete integration of Coal Market Module AIMMS implementation into the production NEMS system

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 only
 - California's cap-and-trade program (AB 32) and the Northeast's Regional Greenhouse Gas Initiative (RGGI) program
 - Uncertainty with respect to CO₂ 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

Changes to the legislative and regulation assumptions in the AEO2015 Reference case (1)

- Updates to NEMS modeling of California SB1368 to remove firm contractual arrangements for coal plants upon expiration
 - Prohibits CA utilities from entering into long-term financial commitments for base load generation, unless it complies with the CO2 emissions performance standard. The CO2 emissions level must be equal, or below the emissions performance standard of 1,100 lbs. per megawatt-hour (MWh).
 - EIA modeling approach
 - 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 in accordance with the expiration of contracts
 - Retire Intermountain plant in 2025 in response to announcement by Los Angeles Department of Water and Power. Announcement has not been officially reported to EIA and decision may be reconsidered and plant could be sold or converted to natural gas instead.

Changes to the legislative and regulation assumptions in the AEO2015 Reference case (2)

- Cross-State Air Pollution Rule (CSAPR) to replace Clean Air Interstate Rule (CAIR) in AEO2015 if reinstated timely to EIA development schedule
 - Requires states to reduce emissions that contribute to ozone and fine particle pollution in other states
 - U.S. Supreme Court upheld EPA's approach to CSAPR on April 29, 2014
 - EPA filed to lift stay on CSAPR on June 26, 2014
 - Appears likely that the rule will be reinstated timely during the AEO2015 cycle
 - Previously incorporated in AEO2012 cycle prior to D.C. Circuit stay in August 2012

Changes to the legislative and regulation assumptions in the AEO2015 Reference case (3)

- EPA's regional haze program is aimed at protecting national parks through implementation of Best Available Retrofit Technology (BART)
 - Requires states to lower NO_x and SO₂ emissions over time through state implementation plans (SIPs) or federal implementation plans (FIPs)
 - Implementation to occur between 2014 and 2018
 - Same as AEO2014 – retrofits or retirements associated with finalized plans captured in reporting data (assuming generating unit data updates are completed)

Monitoring other legislative and regulatory actions not addressed in the AEO2014 Reference case

- EPA's CO₂ 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

CAA 111(b) New Source Performance Standards

- Proposed rule
 - Imposes GHG controls on new generation units.
 - Limits for new coal plants were designed with the assumption that these plants will be built with CCS technologies, which will be capable of capturing a portion of the CO₂ emitted from the new unit
 - EPA proposed two standards for natural gas-fired stationary combustion units, depending on size
 - The proposed limits are based on the performance of modern natural gas combined cycle (NGCC) units.
- Current status
 - Expected to be finalized January, 2015
- EIA modeling approach
 - Rule will not be final during the AEO2015 cycle
 - Anticipated for inclusion in AEO2016

CAA 111(d) Existing Source GHG Controls

- Proposed rule
 - Cut power sector emissions 30% by 2030
 - Proposed rule calls for state-specific goals for reduced emissions, where each state can choose an approach appropriate to their situation
 - Proposed rule provides guidelines in the form of four building blocks that could be used to achieve the reductions, including heat-rate improvements, re-dispatch towards lower emitting resources (i.e. coal to natural gas), additions of low and zero-carbon resources, and increased use of demand side resources
- Current status
 - Expected to be finalized in June 2015
- EIA modeling approach
 - Rule not expected to be finalized until the AEO2016 cycle at the earliest
 - Evaluating approaches to modeling proposed rules

CWA 316(b): Cooling Water Intake Structures

- Rule

- Sets impingement controls for all facilities with design intake flow of at least 2 million gallons per day (MGD), and requires examination of entrainment controls for facilities with design intake flow of at least 125 MGD
- Final rule requires facilities having >125 MGD design intake flow to conduct studies to help permitting authorities determine what, if any, entrainment controls are needed

- Current status

- Final rule signed on May 19, 2014; still in pre-publication; supporting technical documents not yet released

- EIA modeling approach

- To be implemented in AEO2016 as technical documents necessary for determining retrofit costs for the final rule are not yet available
- ‘Case-by-case’ nature of entrainment controls for the largest facilities difficult to model
- Actively evaluating EIA data and 2011 EPA documents to determine whether impingement control costs can be estimated – costs expected to be small relative to other retrofit costs

Coal Combustion Residual Proposed Rule

- EPA is evaluating two regulatory options
 - Under the first proposal, residuals would be considered special wastes subject to regulation under subtitle C of RCRA when destined for disposal in landfills or surface impoundments, requiring measures intended to phase out the wet handling of residuals as well as existing surface impoundments
 - Under the second proposal, residuals would be regulated under subtitle D of RCRA as non-hazardous wastes, requiring liners at existing impoundments, and introduce an incentive to close these impoundments and transition to safer landfills which store coal ash in dry form
- Current status
 - Final Rule pending EPA review of supplemental data
 - Final Rule scheduled for December 19, 2014 under consent decree
- EIA modeling approach
 - Rule will not be final during the AEO2015 cycle
 - Anticipated for inclusion in AEO2016

Effluent Limitation Guidelines

- EPA is evaluating four regulatory options
 - Four options are being considered as part of the rulemaking, which would establish new or additional requirements for wastewater streams from the following processes and byproducts associated with steam electric power generation: flue gas desulfurization, fly ash, bottom ash, flue gas mercury control, and gasification of fuels such as coal and petroleum coke
- Current status
 - Proposed rule published on June 7, 2013
 - Final Rule scheduled for September 30, 2015 under consent decree
- EIA modeling approach
 - Rule will not be final during the AEO2015 cycle
 - May be included in the AEO2016 cycle if published with documentation timely

California Post-2020 GHG Emissions Target

- Executive Order

- EO-S-3-05 (2005) requires California to reduce its emissions to 20% of 2020 levels by 2050
- This executive order remains in effect and requires no legislative action

- Current status

- There is considerable uncertainty about how California will achieve the targets of EO-S-3-05 (or if they are feasible)
- Guidelines for meeting post-2020 targets are expected in 2017

- EIA modeling approach

- Wait for additional policy certainty from the 2017 guidelines before attempting to model

Tailoring Rule for Biomass Carbon Emissions

- Proposed rule

- EPA released proposed rules for carbon emission limits for new sources in 2011
- At that time, they were not ready to propose how to handle emissions from biomass resources
 - Literature was conflicting on extent to which biomass carbon could be considered “net zero”, “net positive”, or even “net negative”
- Subsequent court rulings said EPA couldn’t wait 3-years

- Current status

- EPA’s proposed 3-year study period ends in July 2014
- Indications are that the rule is close to ready for release

- EIA modeling approach

- Could impact how EIA models biomass’ role in GHG policy cases

Review of AEO2014 Reference Case

Key results for the AEO2014 Reference case

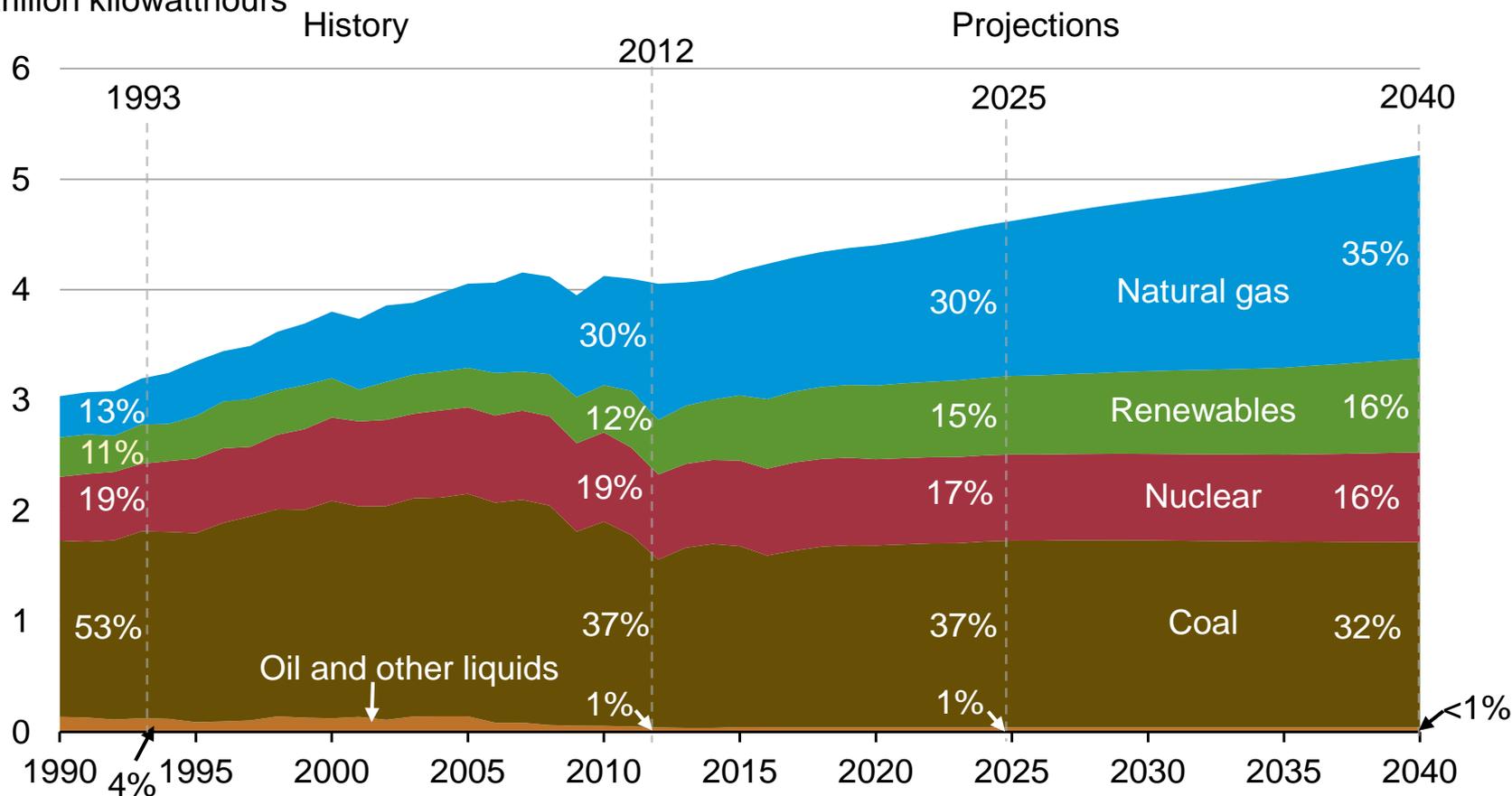
- Coal is no longer the leading fuel for U.S. electricity generation in 2040. Coal's share of total generation decreases over time to 32% in 2040 from 37% in 2012.
- Coal producers in the Interior region gain share while Appalachia loses share of total U.S. coal production. From 2012 to 2040, the Appalachian 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 to lower-carbon options, led by growth in natural gas and renewable generation

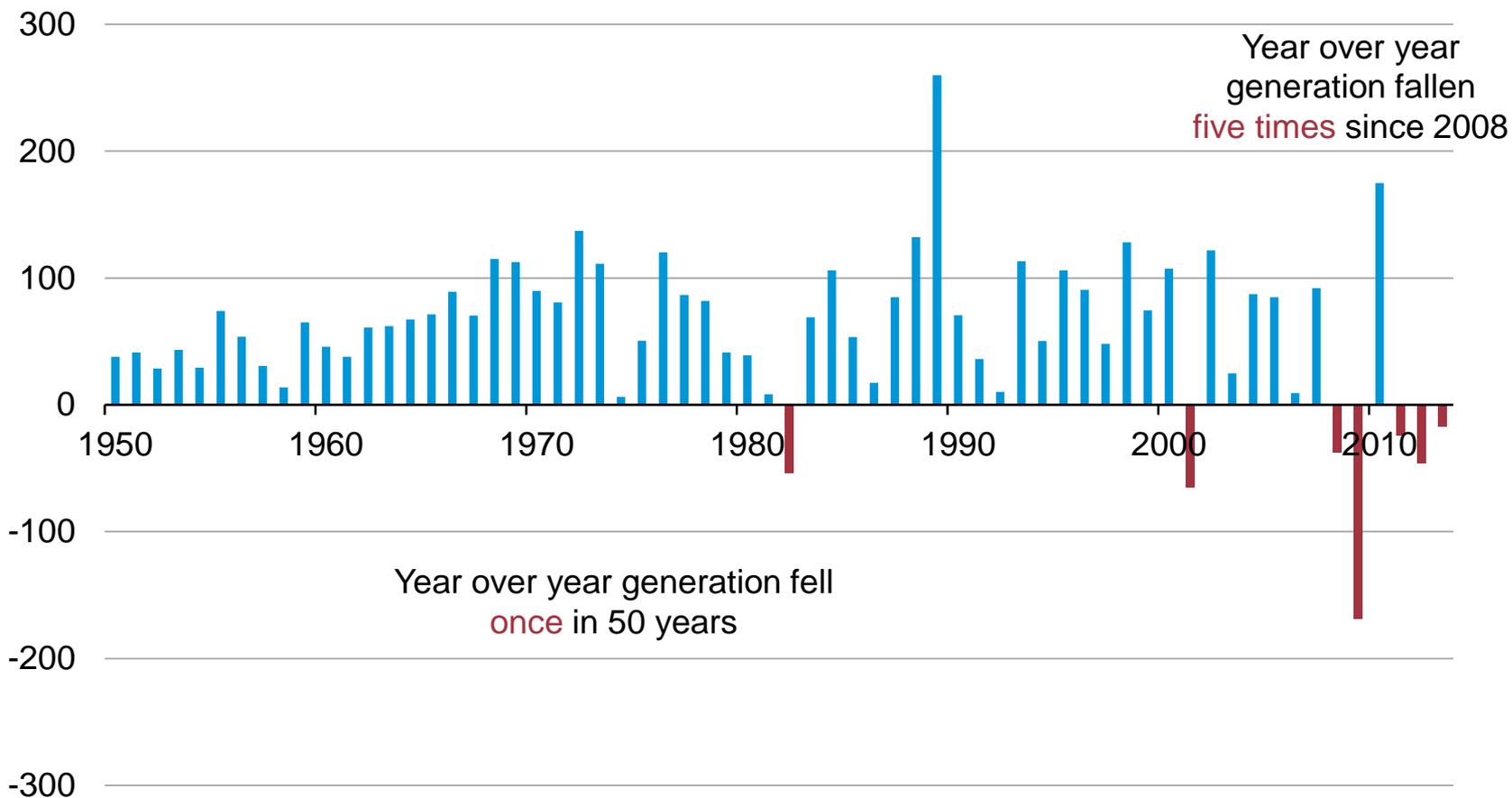
U.S. electricity net generation
trillion kilowatthours



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

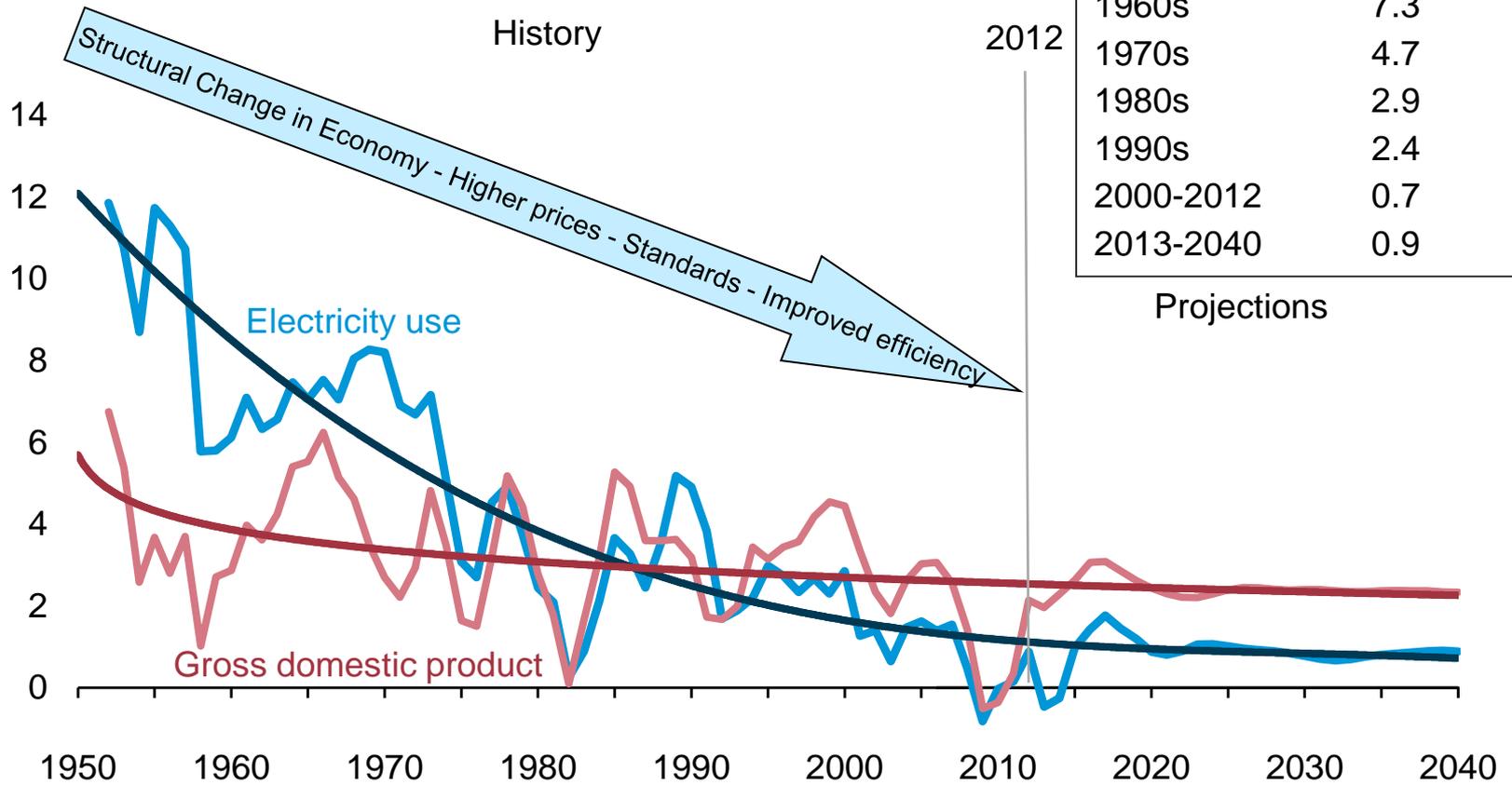
billion kilowatthours



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

Growth in electricity use slows, but still increases by 28% from 2012 to 2040

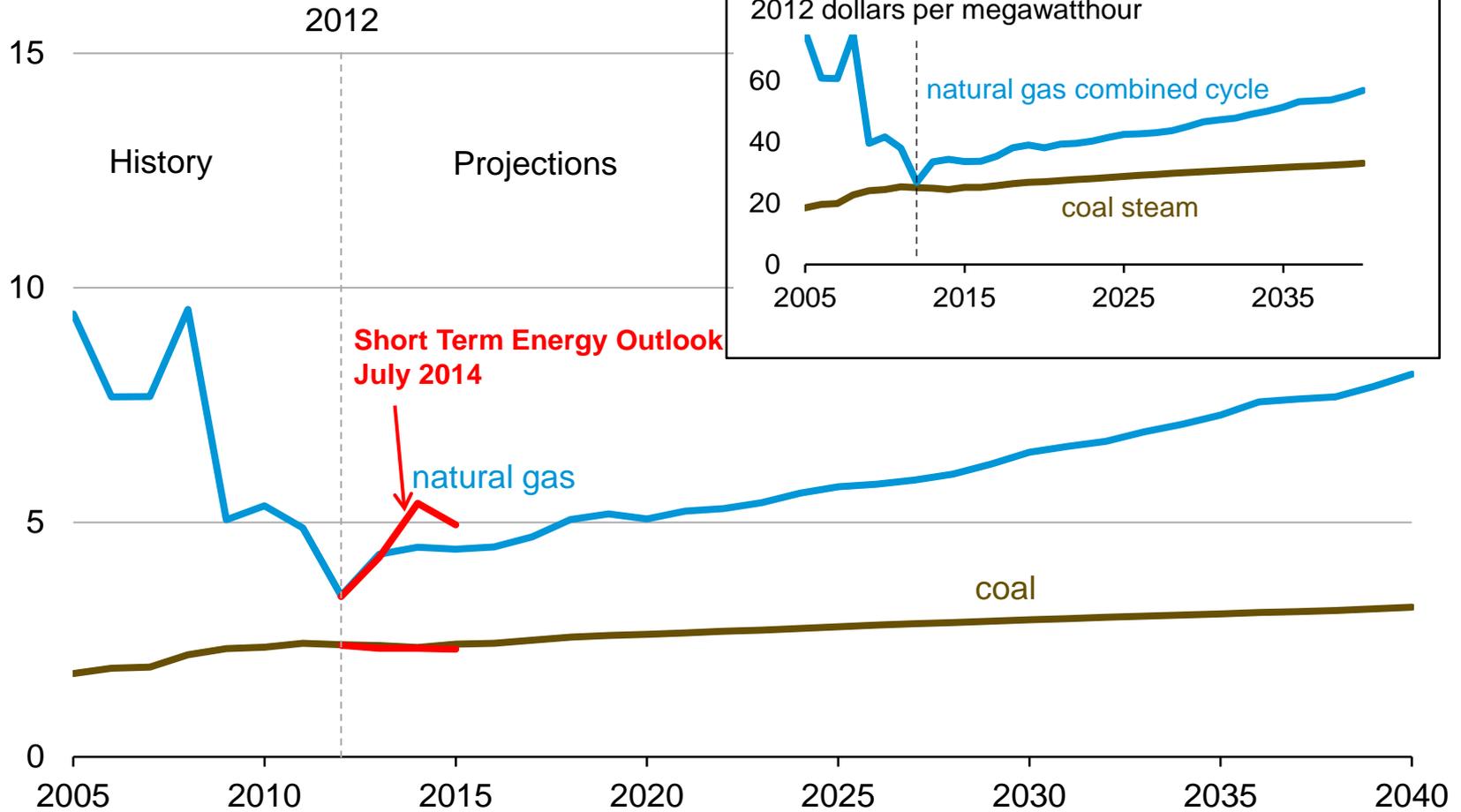
U.S. electricity use
percent growth (3-year rolling average)



Source: AEO2014 Reference Case (April 2014)

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

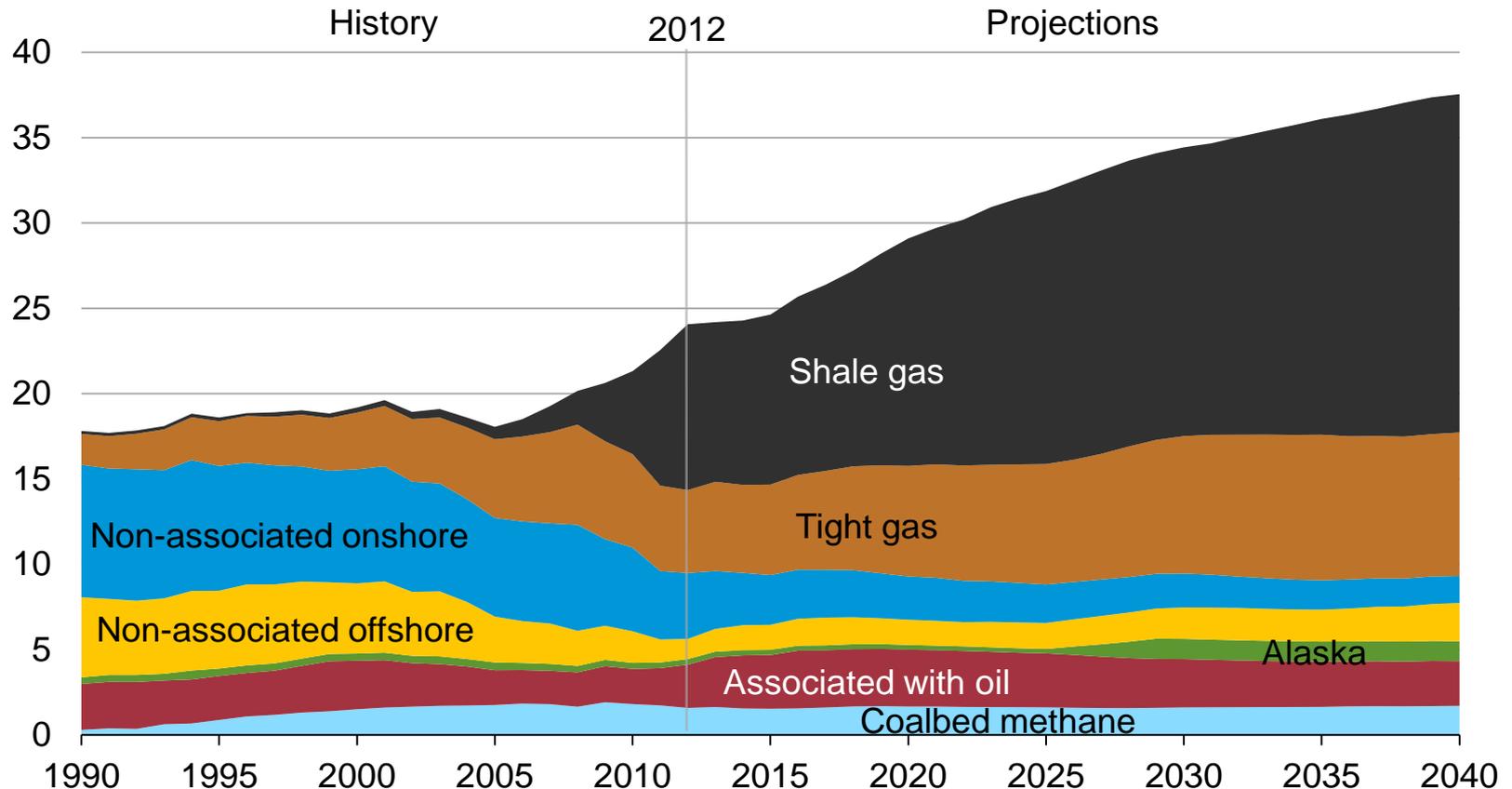
average delivered fuel prices to electric power plants, 2012 dollars per million Btu



Source: AEO2014 Reference case (April 2014).

Shale gas leads U.S. production growth

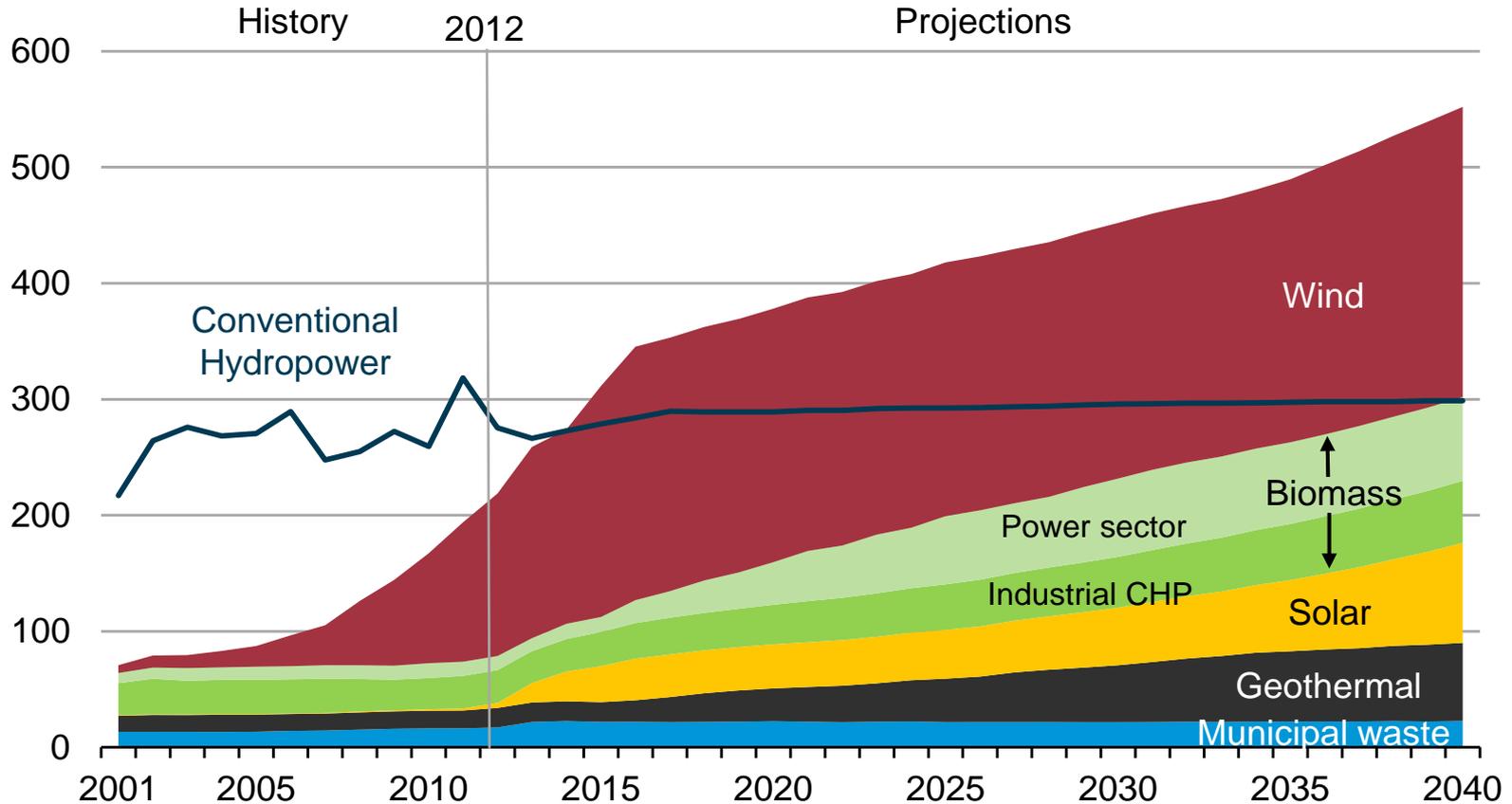
U.S. dry natural gas production
trillion cubic feet



Source: AEO2014 Reference Case (April 2014)

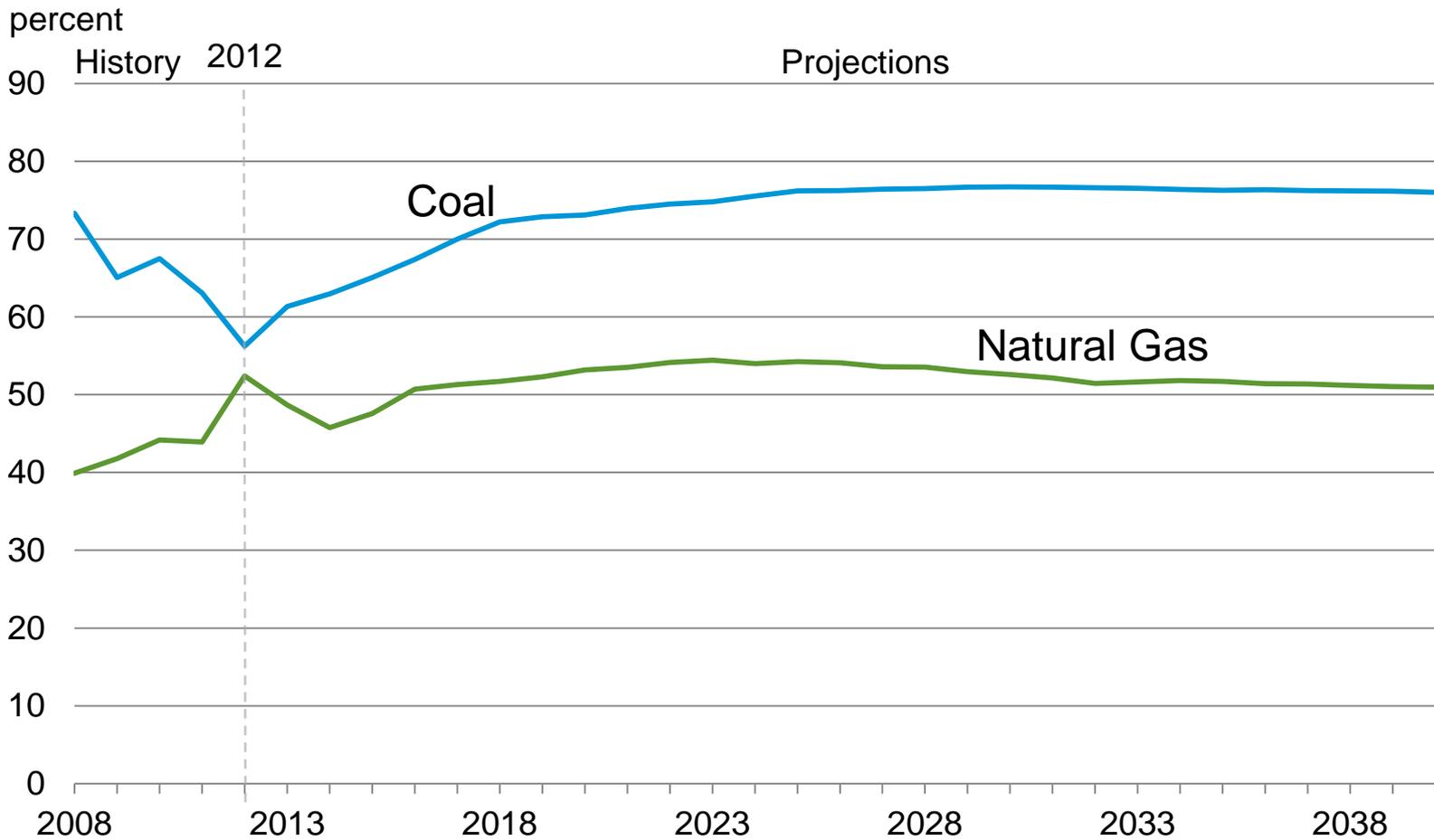
Non-hydro renewable generation more than doubles between 2012 and 2040

renewable generation
billion kilowatthours per year



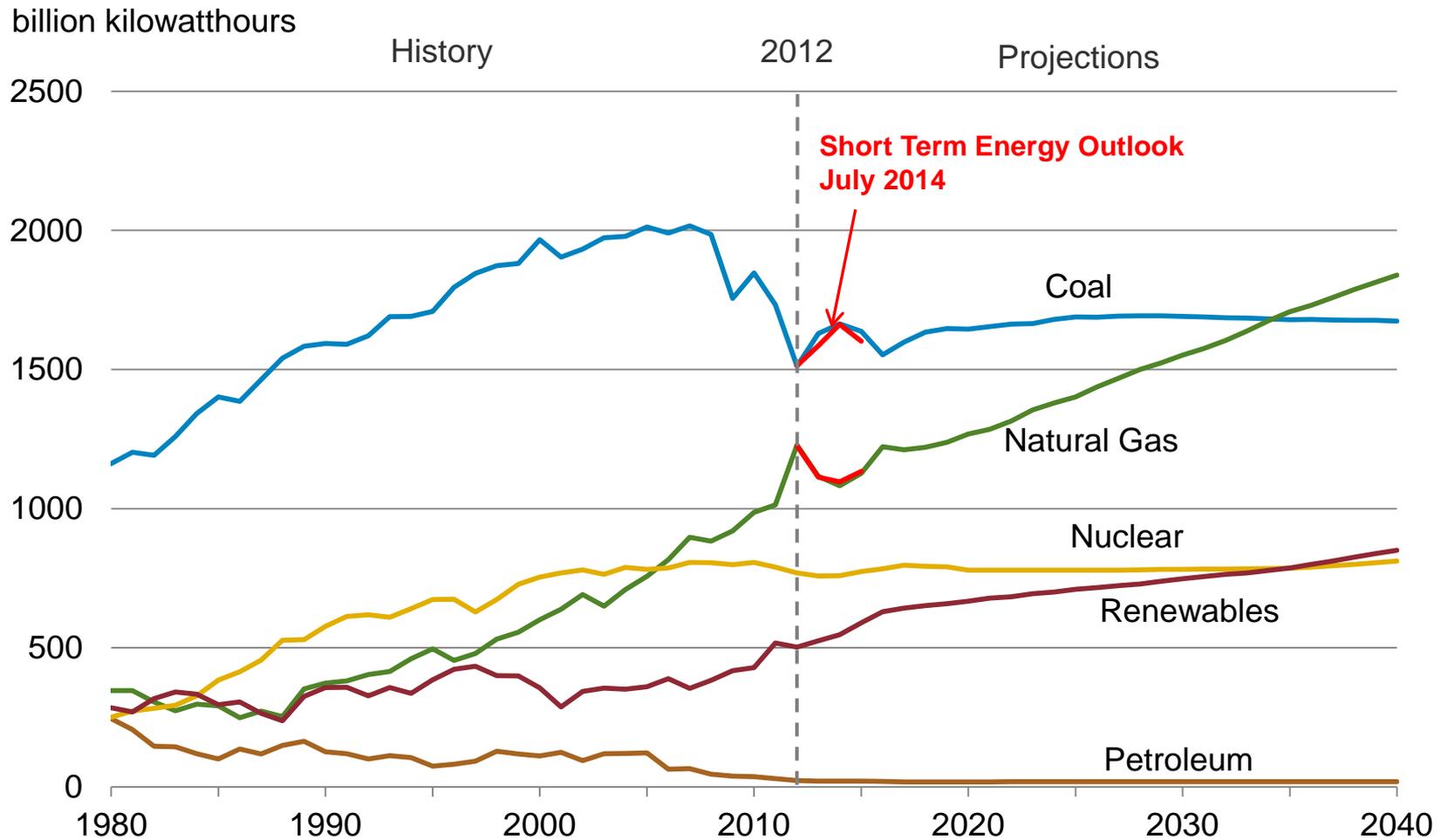
Source: EIA, Annual Energy Outlook 2014

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

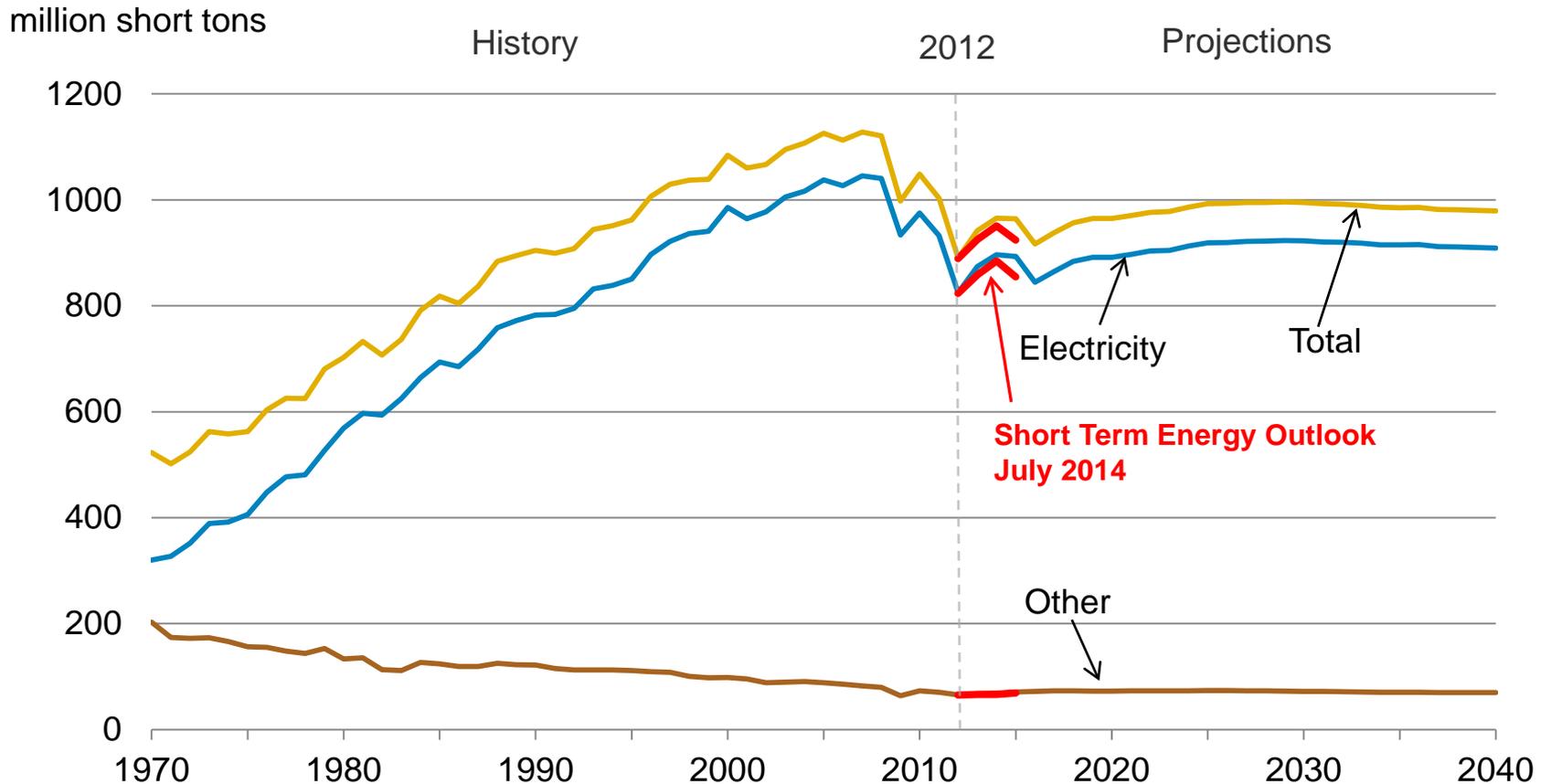


Note: Includes generation from plants in both the electric power and end-use sectors.

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

Projections: AEO2014 Reference Case (April 2014).

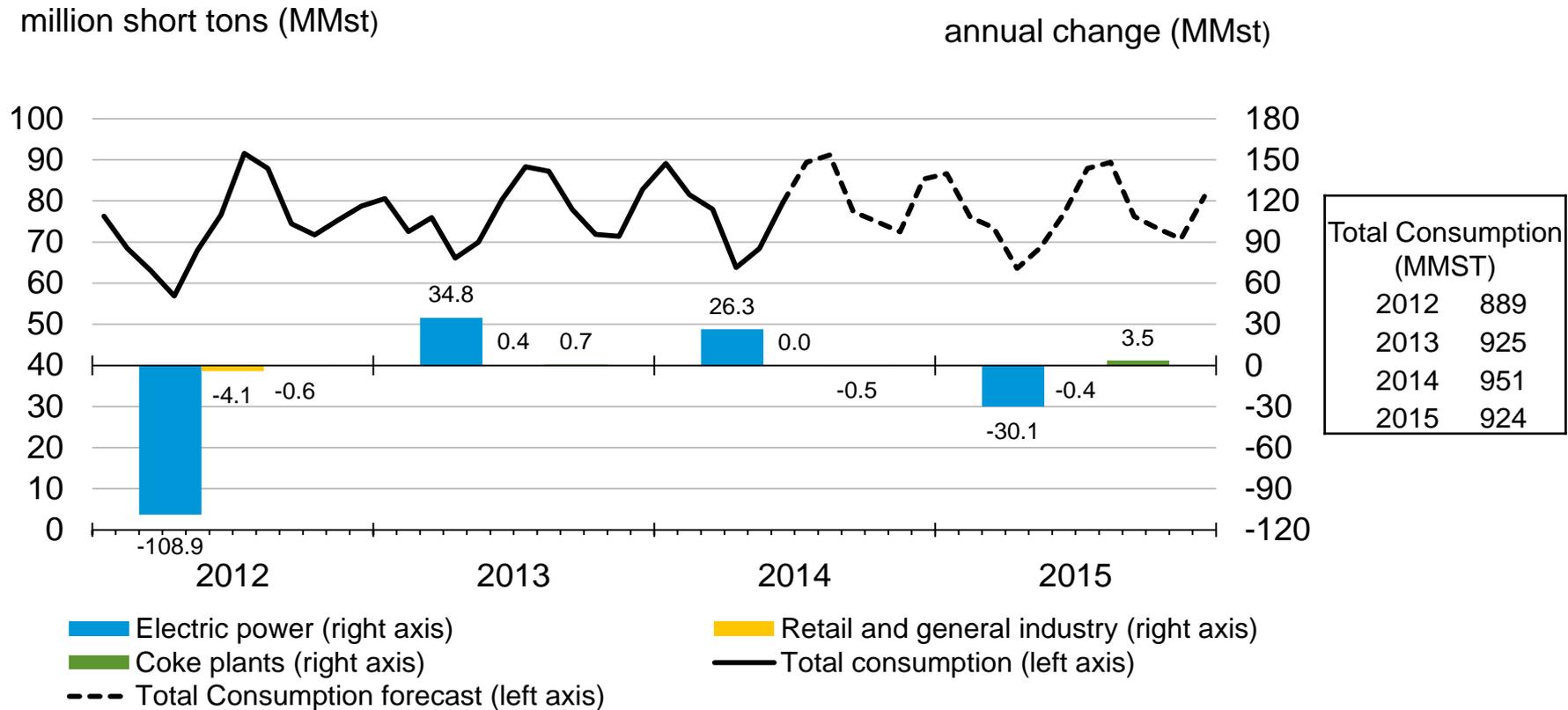
Coal consumption by sector, 1970-2040



Note: Other includes coke plants, other industrial, and commercial/institutional.

Source: AEO2014 Reference Case (April 2014)

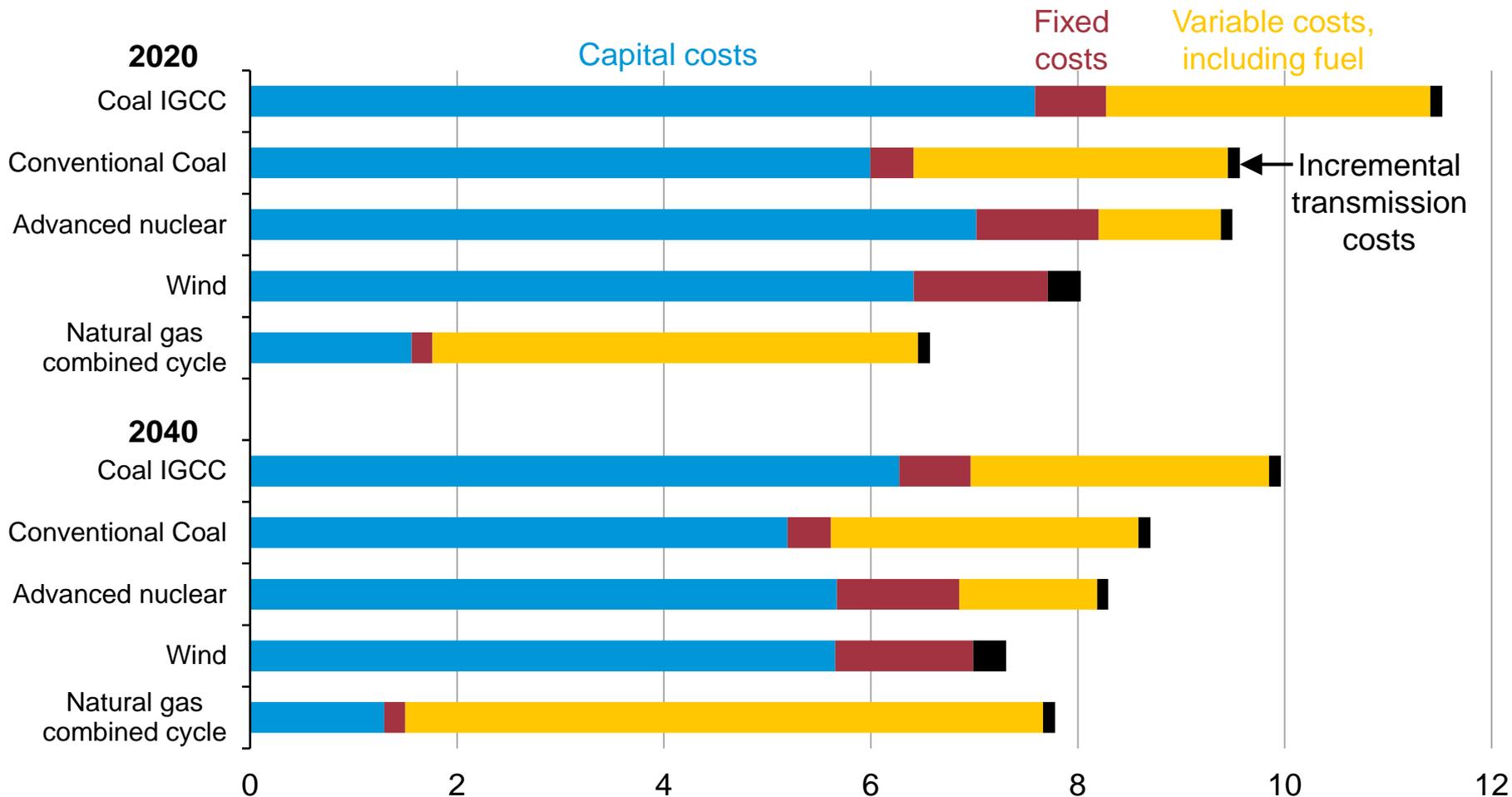
U.S. Coal Consumption, Short-Term Energy Outlook, July 2014



Source: 2012-2013: U.S. Energy Information Administration (EIA), Monthly Energy Review;
 2014-2015: STEO (July 2014)

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

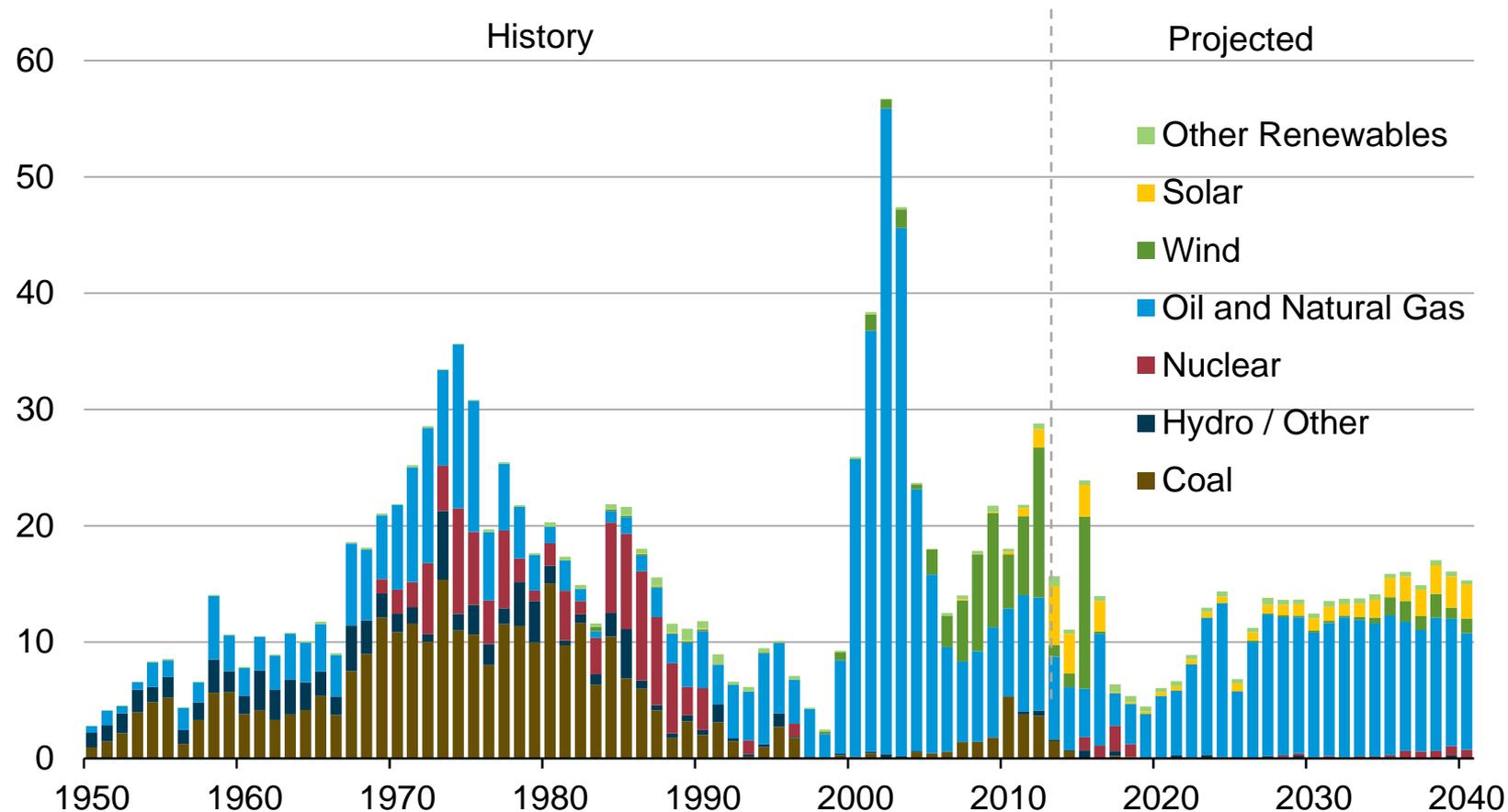
new power plant costs, 2012 cents per kilowatthour



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-fired capacity additions: recent completions and units under construction (megawatts)

FACILITY CODE	PLANT NAME	GENERATOR ID	STATE	PLANT TYPE	ENERGY SOURCE	START YEAR	START MONTH	SUMMER CAPABILITY
56611	Sandy Creek Energy Station	S01	TX	PC	SUB	2013	5	937
1004	Edwardsport	ST,CT1,CT2	IN	IGCC	BIT	2013	6	571
Included as existing capacity for 2013 in AEO2015:								1,507
57037	Kemper County IGCC Project	1A,1B,1C	MS	IGCC	LIG	2014	8	522
56786	Spiritwood	1	ND	PC	LIG	2014	11	62
Included as planned capacity additions in AEO2015:								584

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

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

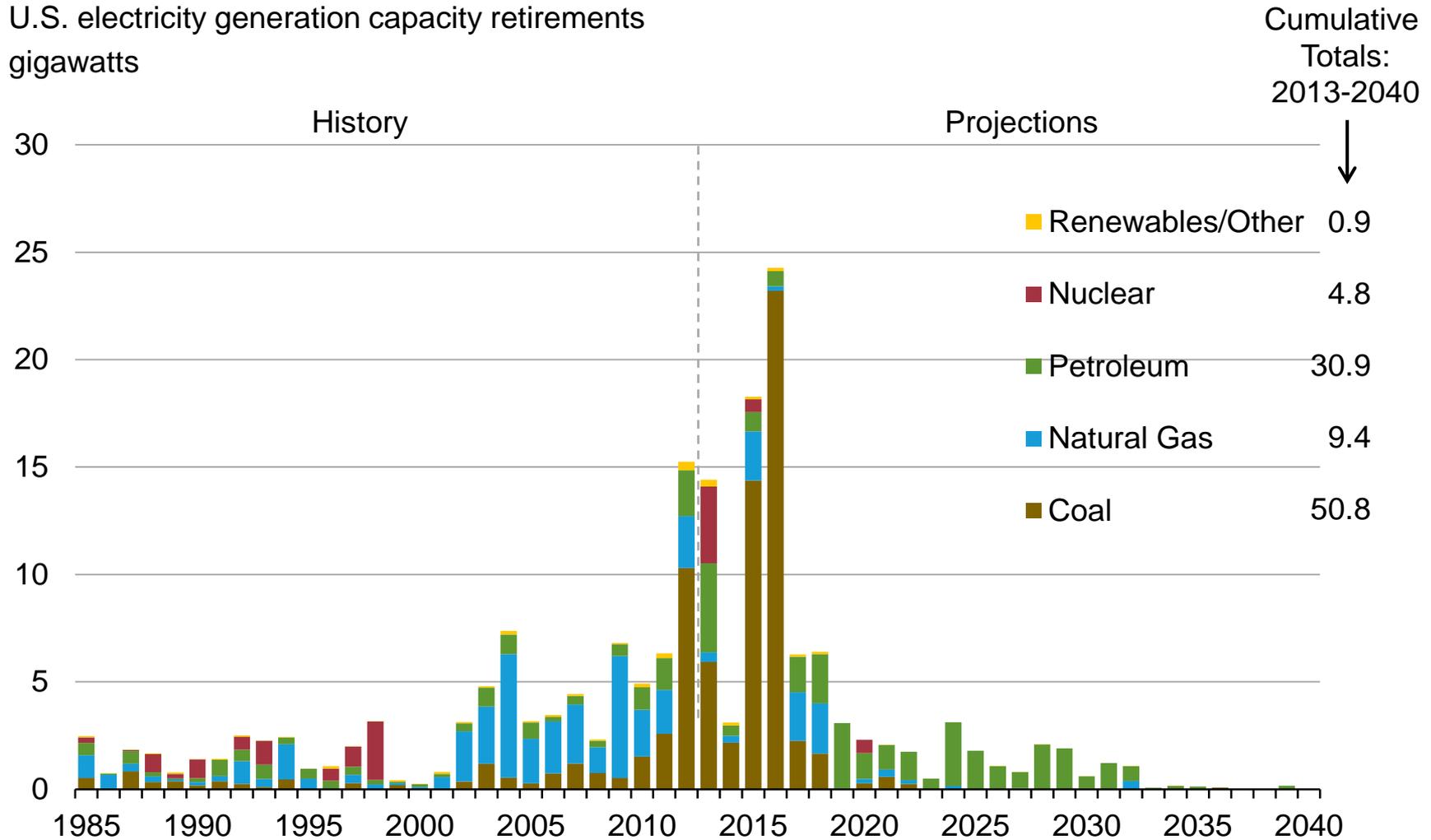
FACILITY CODE	PLANT NAME	GENERATOR ID	STATE	PLANT TYPE	ENERGY SOURCE	START YEAR	START MONTH	SUMMER CAPABILITY
56453	Robinson Power Company LLC	1	PA	PC	BIT	2016	4	132
56452	Medicine Bow Fuel & Power LLC	1	WY	CTL	BIT	2016	12	350
55360	Two Elk Generating Station	GEN1	WY	PC	WC	2016	12	275
56675	Plant Washington	MAIN	GA	PC	SUB	2018	4	850
56454	Taylorville Energy Center	1	IL	IGCC	BIT	2018	6	533
Total Capacity								2,140

Note: Because these units are reported as not yet under construction on the Form EIA-860, these units are not included as planned capacity additions in the AEO2015.

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

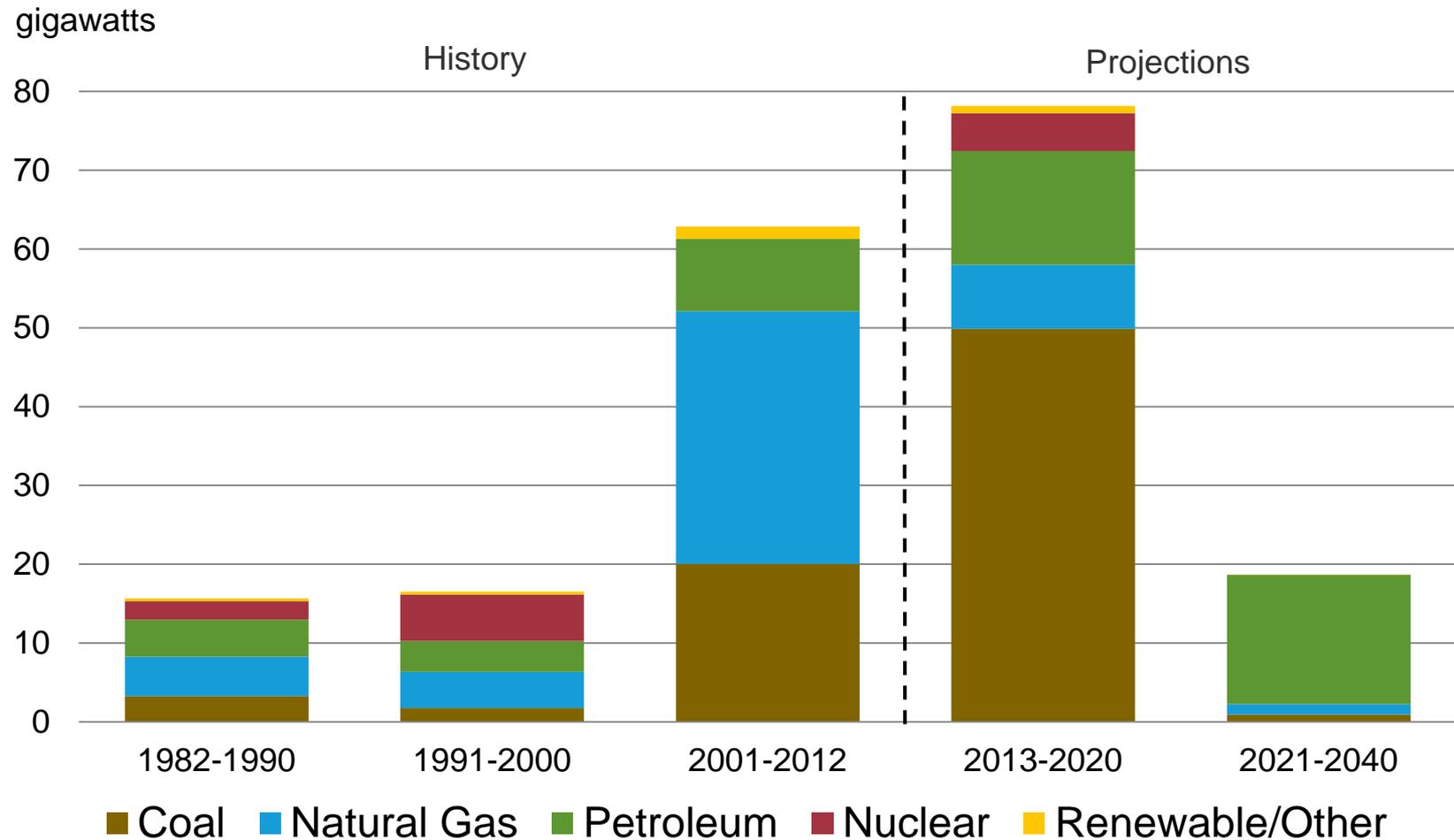
Coal accounts for more than half of the projected capacity retirements in the AEO2014 Reference case

U.S. electricity generation capacity retirements
gigawatts



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

Electric net summer generating capacity retirements by fuel, 1982-2040

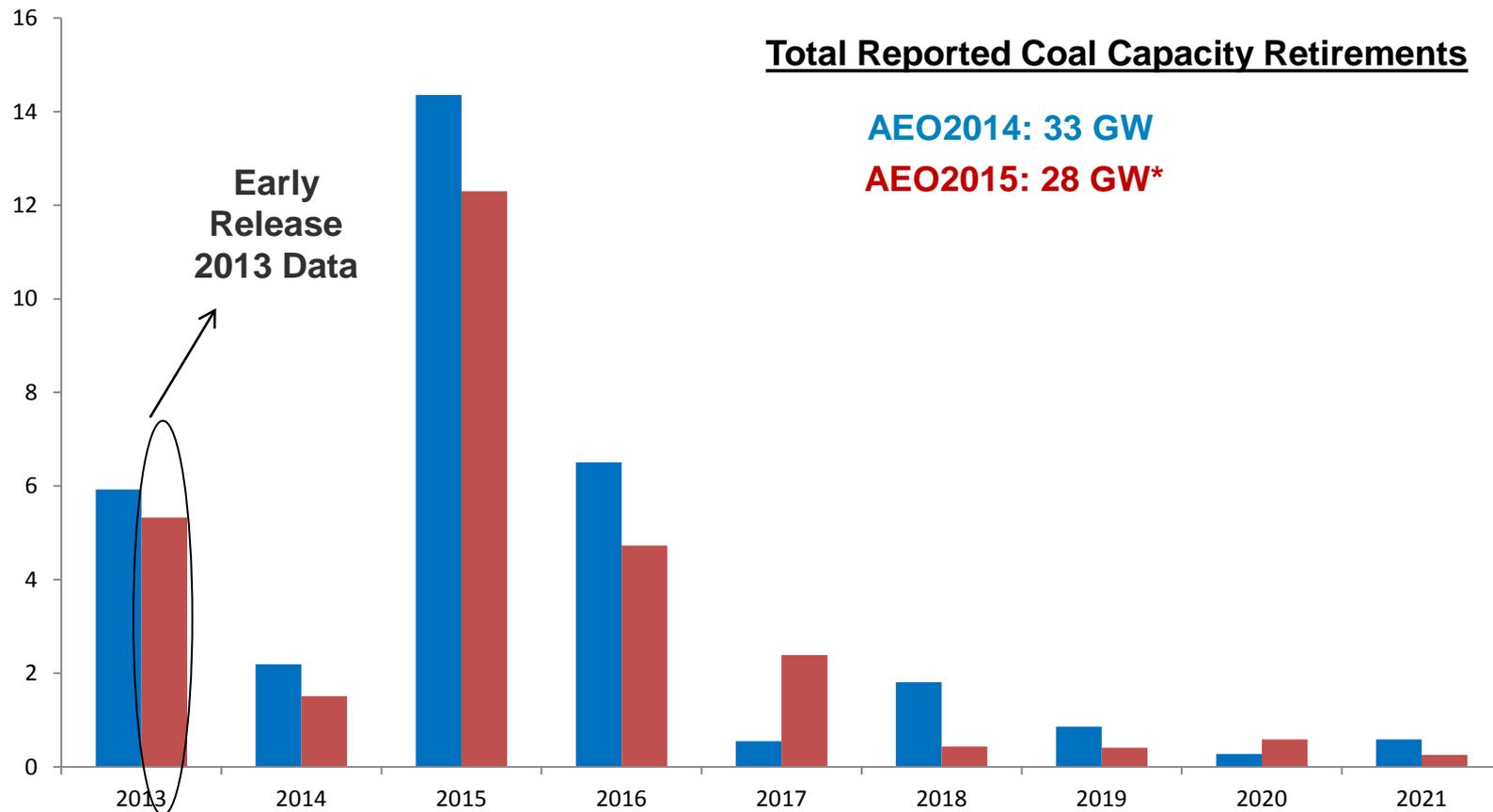


Source: History: U.S. Energy Information Administration (EIA), *Inventory of Power Plants* (various issues), *Electric Power Annual* (various issues), and Form EIA-860, “Annual Electric Generator Report” data files

<http://www.eia.gov/electricity/capacity/>; **Projections:** *Annual Energy Outlook 2014* Reference Case.

Reported Net Summer Coal Capacity Retirements By Year

gigawatts



*Reported capacity retirements for the AEO2015 are preliminary and subject to change.

Source: **AEO2014:** AEO2014 Reference Case (April 2014); and **AEO2015:** Form EIA-860, 'Annual Electric Generator Report,' and Form EIA-860M, 'Monthly Update to the Annual Electric Generator Report.'

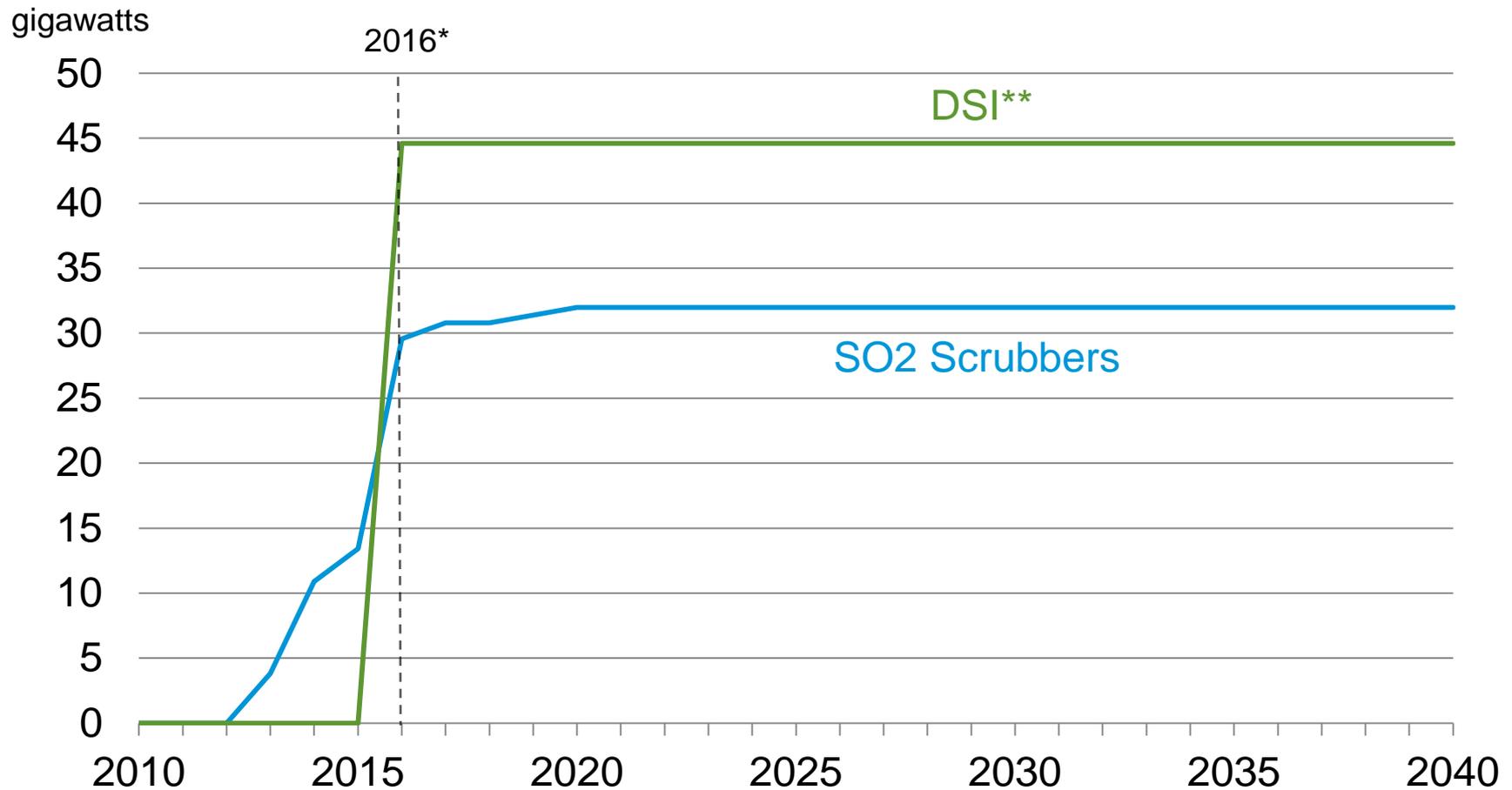
Electric Net Summer Generating Capacity by Fuel, 2008-2040 (gigawatts)

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 & Oil: CC/CT	320	343	352	364	373	381	470	566
Other Natural Gas & Oil	130	120	118	113	113	108	105	118
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

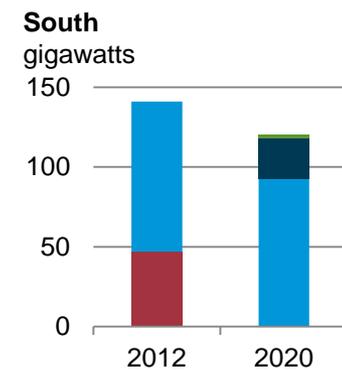
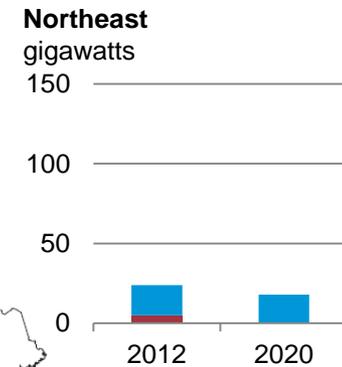
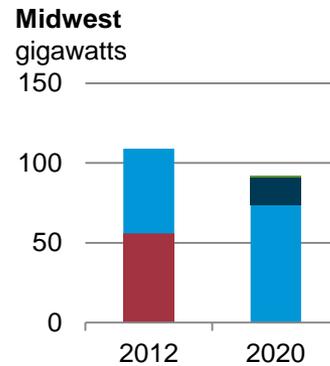
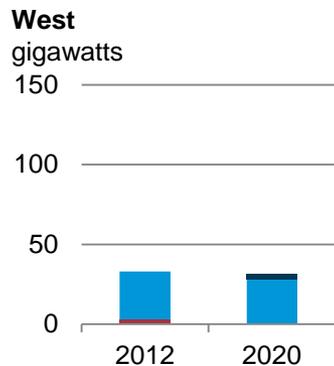
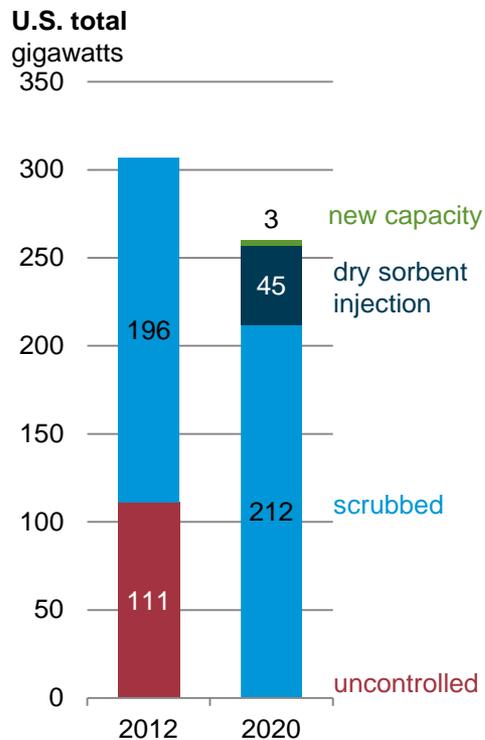
Cumulative SO2 scrubber and DSI retrofits, 2013-2040



Source: AEO2014 Reference Case (April 2014)

*MATS compliance assumed to begin; **DSI: Dry Sorbent Injection

Electricity Sector Net Summer Generating Capacity by SO₂ Control Type and Region, 2012 and 2020 in AEO2014

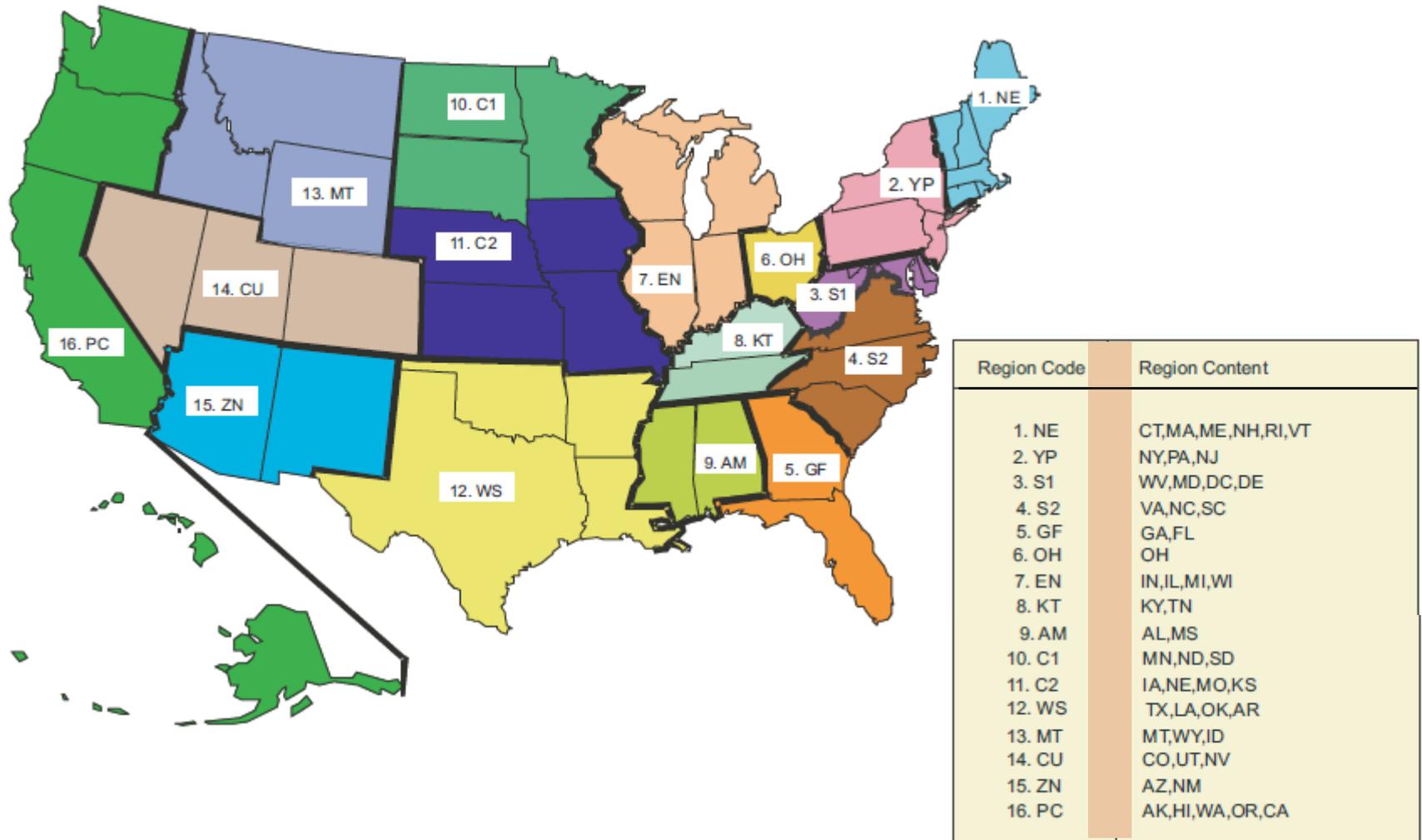


Note: Scrubbed capacity includes capacity equipped with flue gas desulfurization (FGD) equipment and coal plants employing integrated gasification combined (IGCC) cycle or circulating fluidized bed (CFB) combustion technologies.

Source: AEO2014 Reference Case (April 2014)

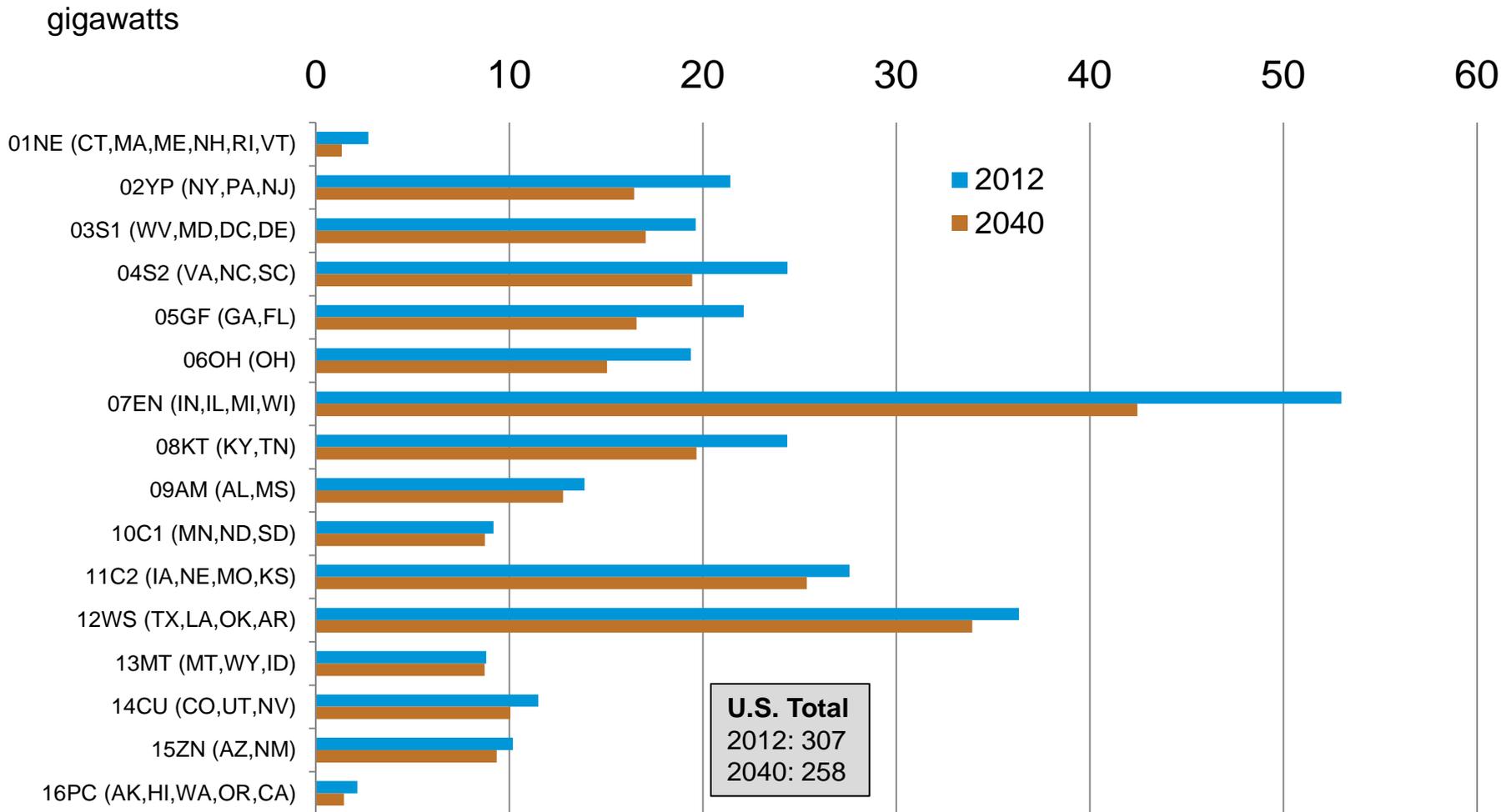
**WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES.
DO NOT QUOTE OR CITE AS AEO2015 MODELING ASSUMPTIONS AND
INPUTS ARE SUBJECT TO CHANGE.**

Coal demand regions



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

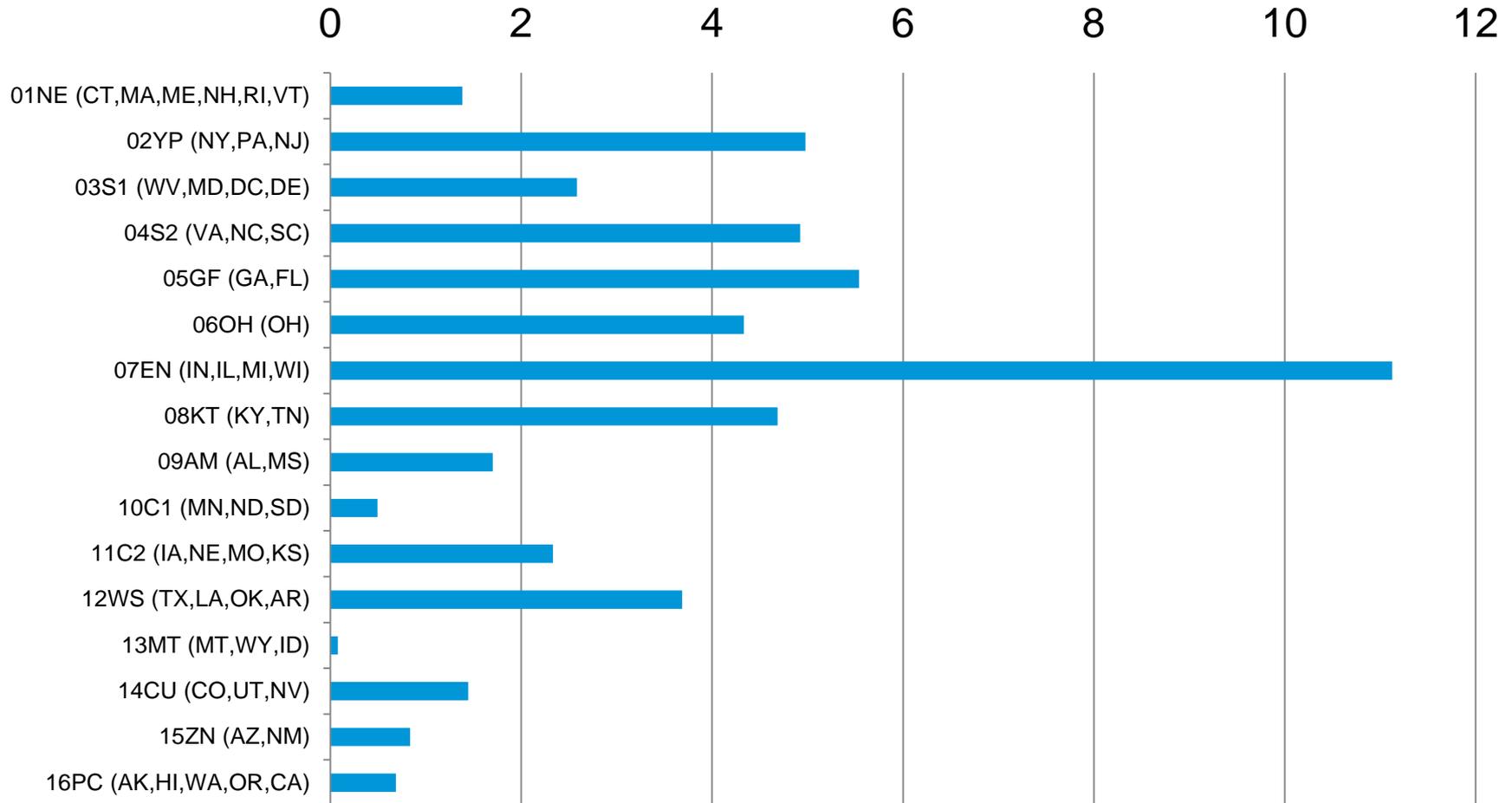
Net summer coal-fired generating capacity in the electric power sector by coal demand region, 2012 and 2040



Source: AEO2014 Reference Case (April 2014)

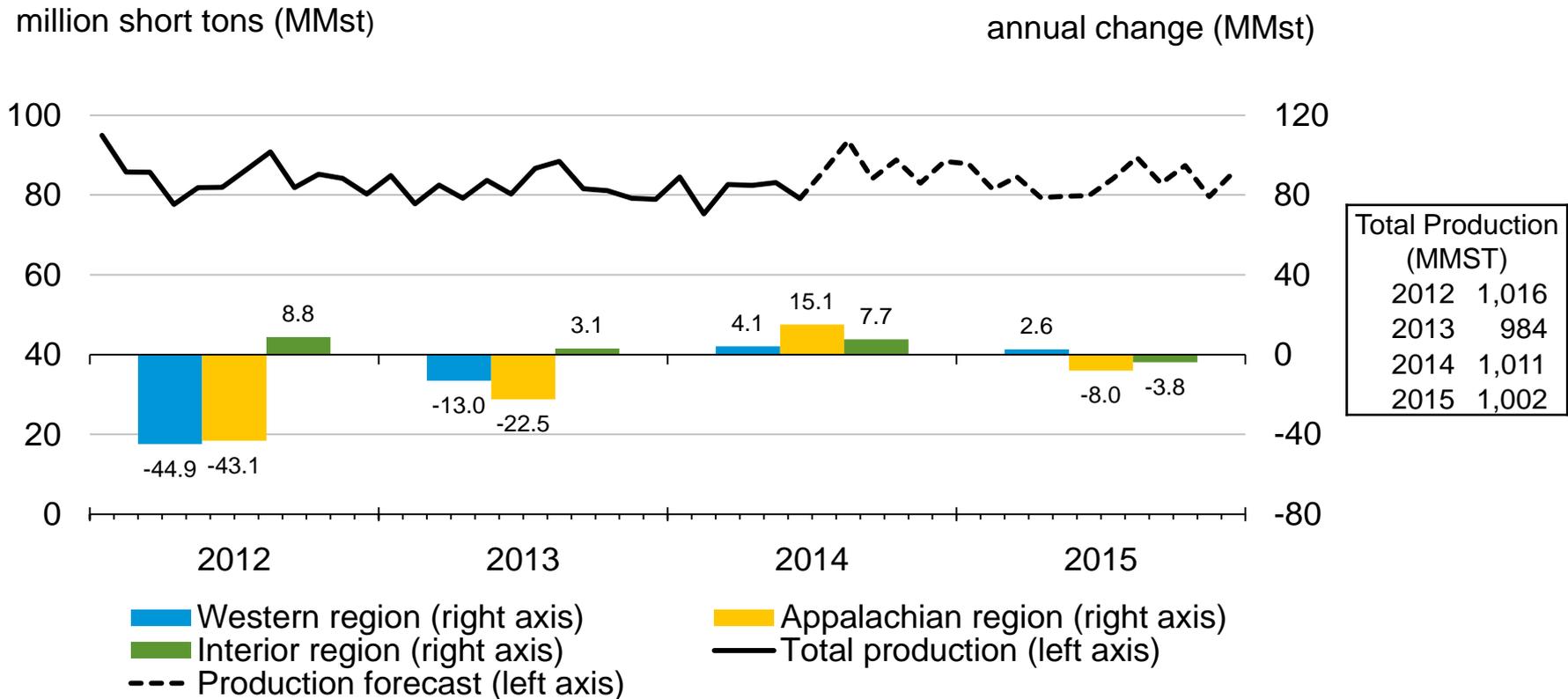
Cumulative net summer coal-fired capacity retirements by coal demand region, 2013-2040

gigawatts



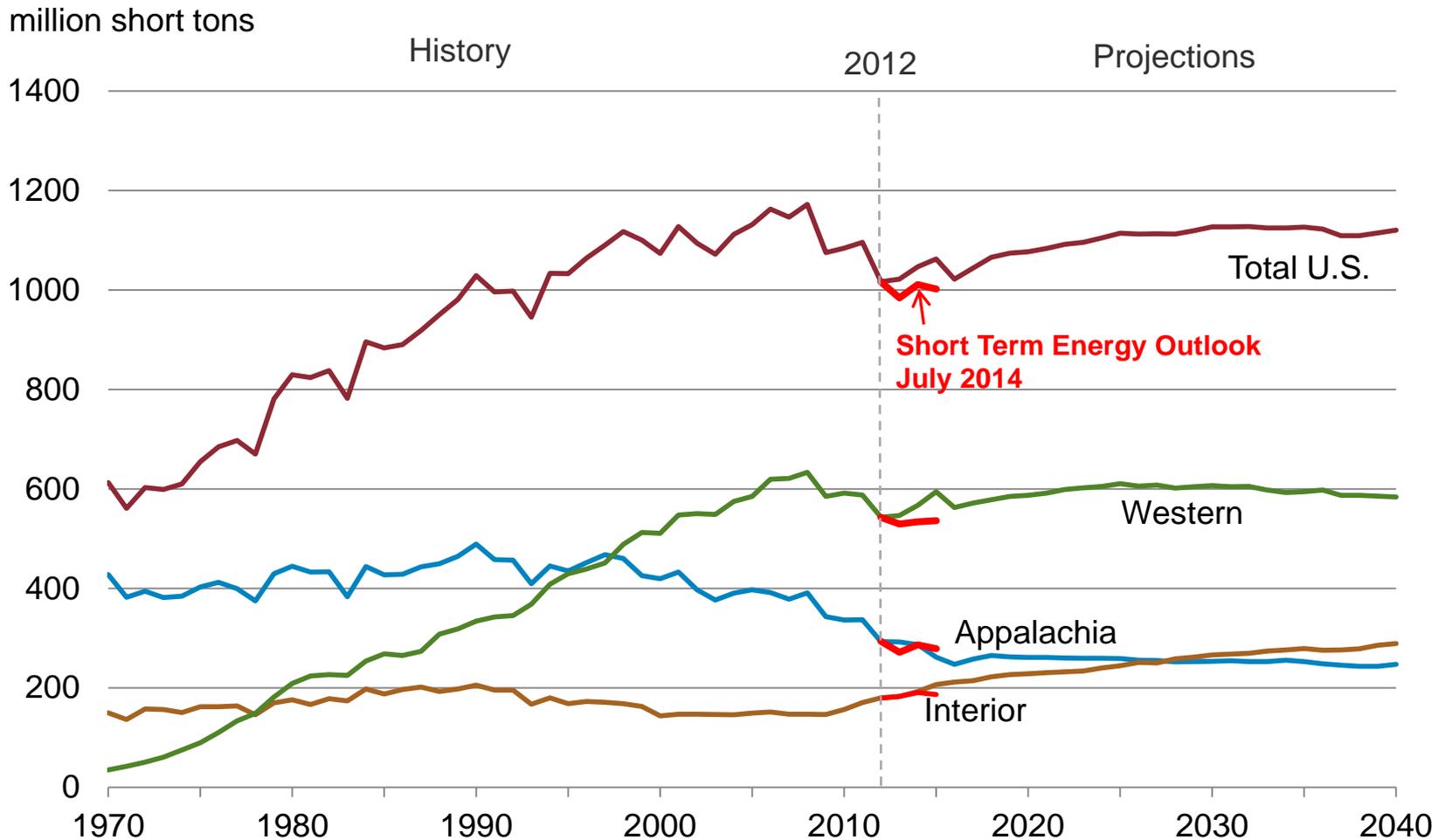
Source: AEO2014 Reference Case (April 2014)

U.S. Coal Production, Short-Term Energy Outlook, July 2014



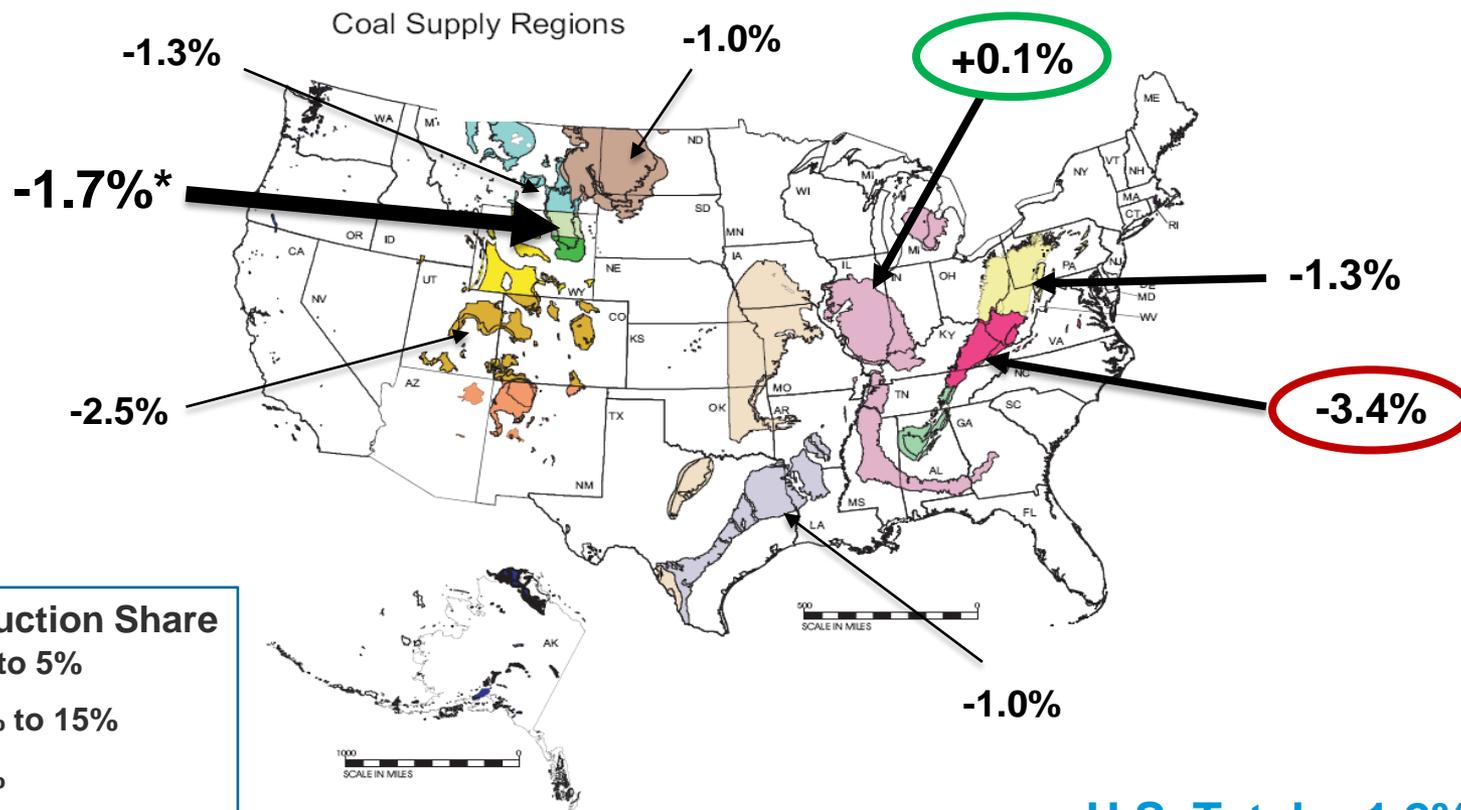
Source: 2012-2013: U.S. Energy Information Administration (EIA), Monthly Energy Review;
 2014-2015: STEO (July 2014)

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)



APPALACHIA

- Northern Appalachia
- Central Appalachia
- Southern Appalachia

NORTHERN GREAT PLAINS

- Dakota Lignite
- Western Montana
- Wyoming, Northern Powder River Basin
- Wyoming, Southern Powder River Basin
- Western Wyoming

INTERIOR

- Eastern Interior
- Western Interior
- Gulf Lignite

OTHER WEST

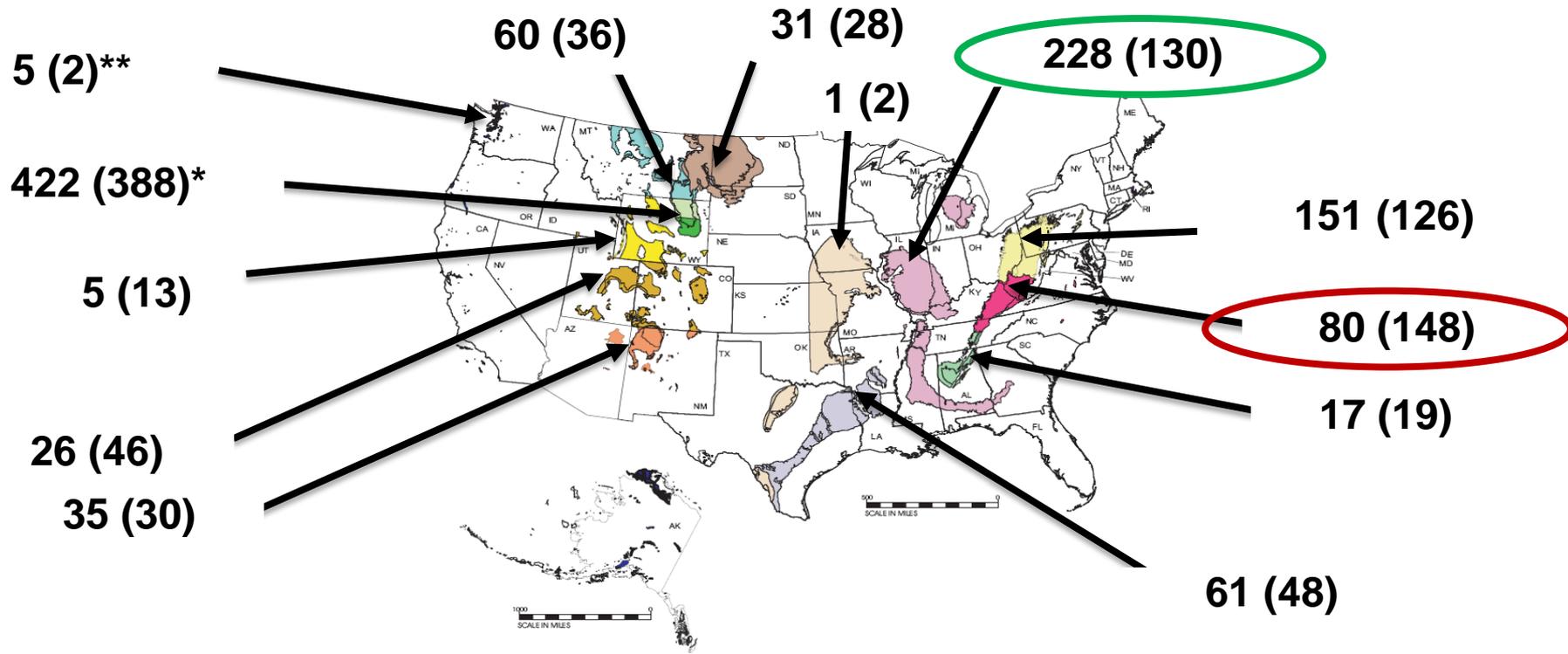
- Rocky Mountain
- Southwest
- Northwest

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

Source: 2012 Production Shares : Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine and Employment and Coal Production Report;"

**WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES.
DO NOT QUOTE OR CITE AS AEO2015 MODELING ASSUMPTIONS AND
INPUTS ARE SUBJECT TO CHANGE.**

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.

- APPALACHIA**
 - Northern Appalachia
 - Central Appalachia
 - Southern Appalachia
- INTERIOR**
 - Eastern Interior
 - Western Interior
 - Gulf Lignite
- NORTHERN GREAT PLAINS**
 - Dakota Lignite
 - Western Montana
 - Wyoming, Northern Powder River Basin
 - Wyoming, Southern Powder River Basin
 - Western Wyoming
- OTHER WEST**
 - Rocky Mountain
 - Southwest
 - Northwest

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

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

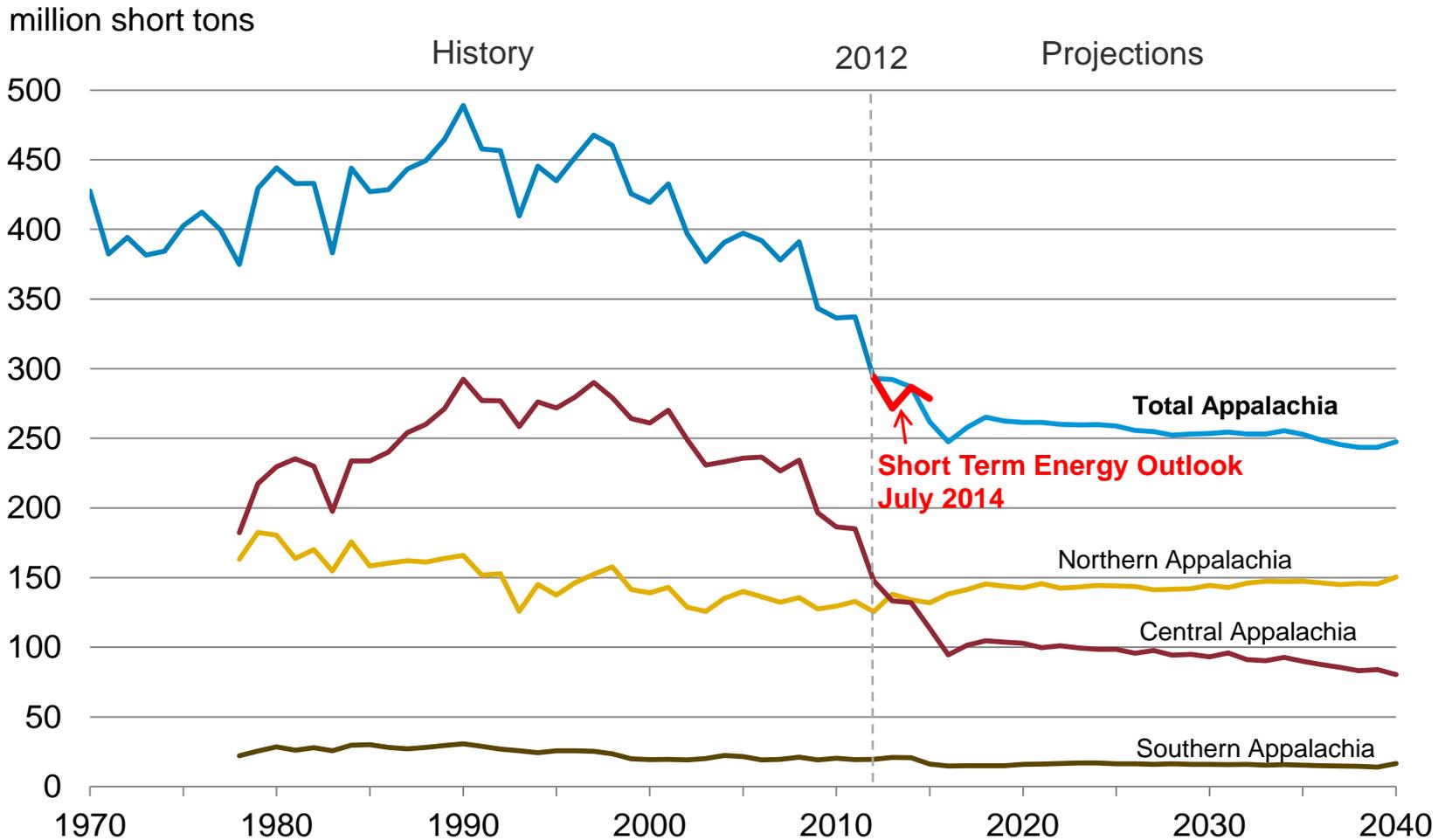
Coal Supply Region	1980-1990	1990-2000	2000-2012	2005-2012	2011-2012	2012-2040
Northern Appalachia	5.4	5.5	-2.7	-3.8	-4.9	-1.3
Central Appalachia	7.3	4.4	-5.9	-5.9	-3.8	-3.4
Eastern Interior	4.8	3.7	-0.8	-0.1	6.1	0.1
Gulf Lignite	2.6	2.4	-2.8	-4.5	-4.2	-1.0
Dakota Lignite	6.0	1.0	-3.5	-5.2	-4.8	-1.0
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).

**WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES.
DO NOT QUOTE OR CITE AS AEO2015 MODELING ASSUMPTIONS AND
INPUTS ARE SUBJECT TO CHANGE.**

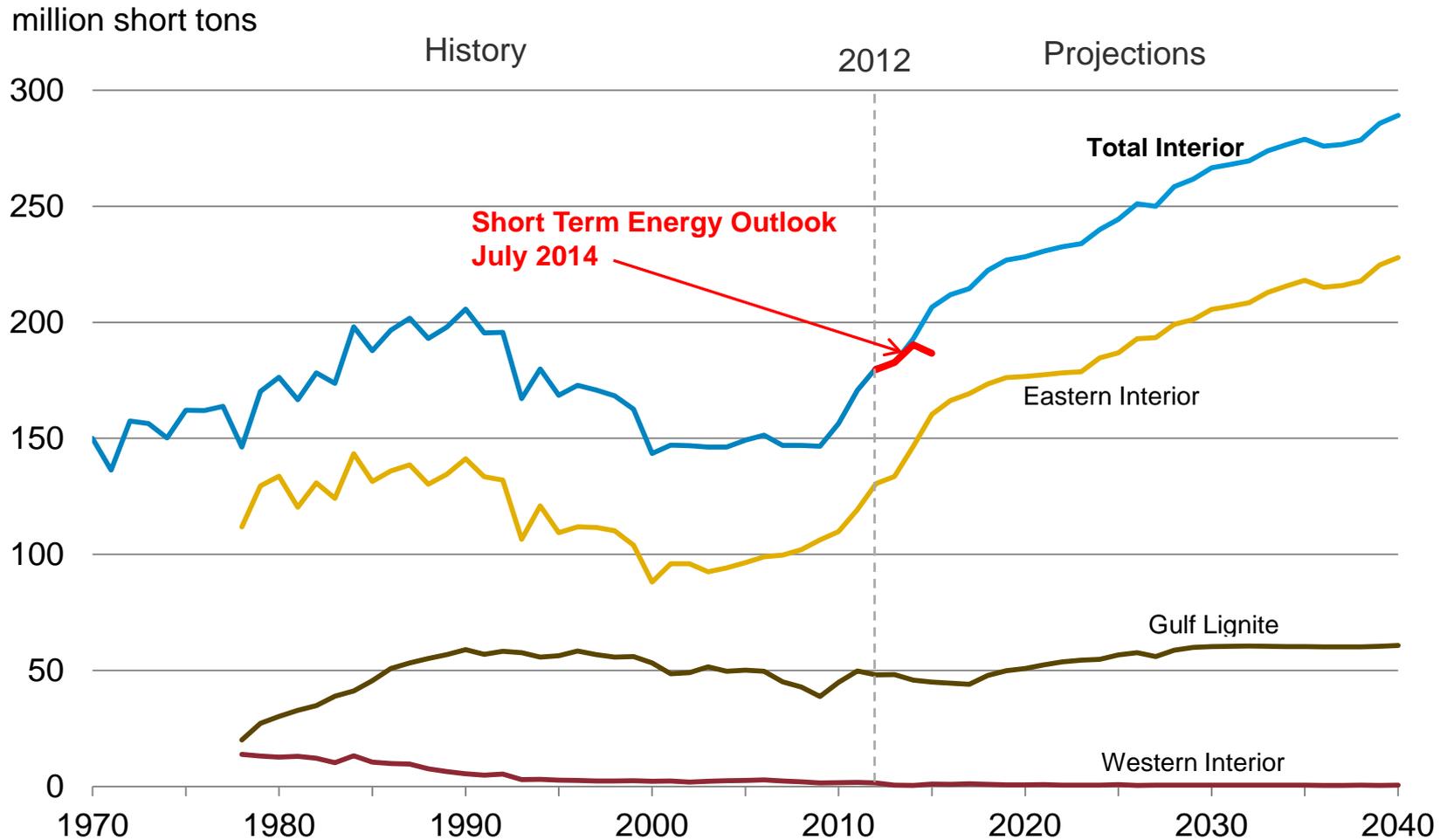
Appalachian coal production, 1970-2040



Source: AEO2014 Reference Case (April 2014)

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

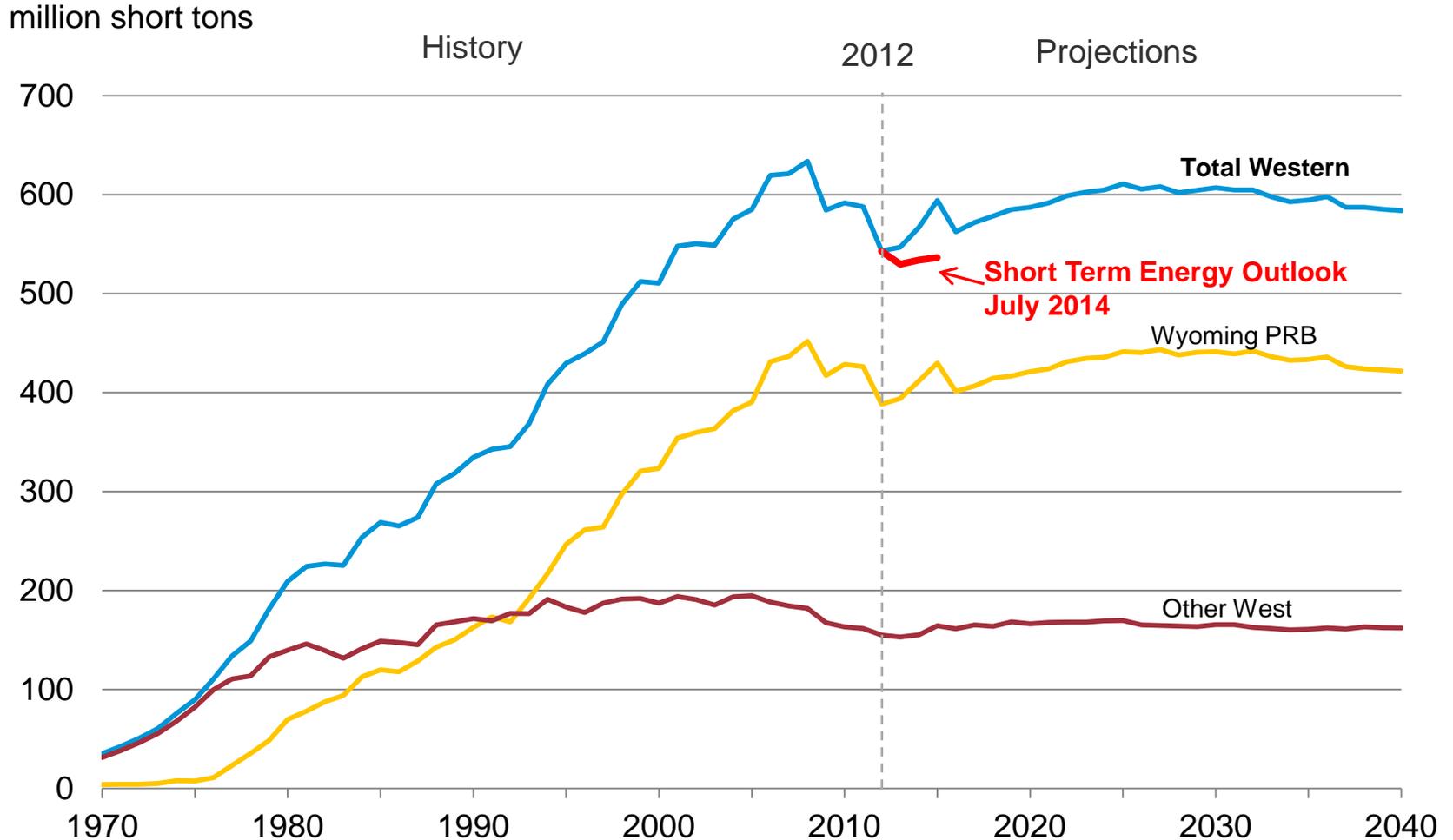
Interior coal production, 1970-2040



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

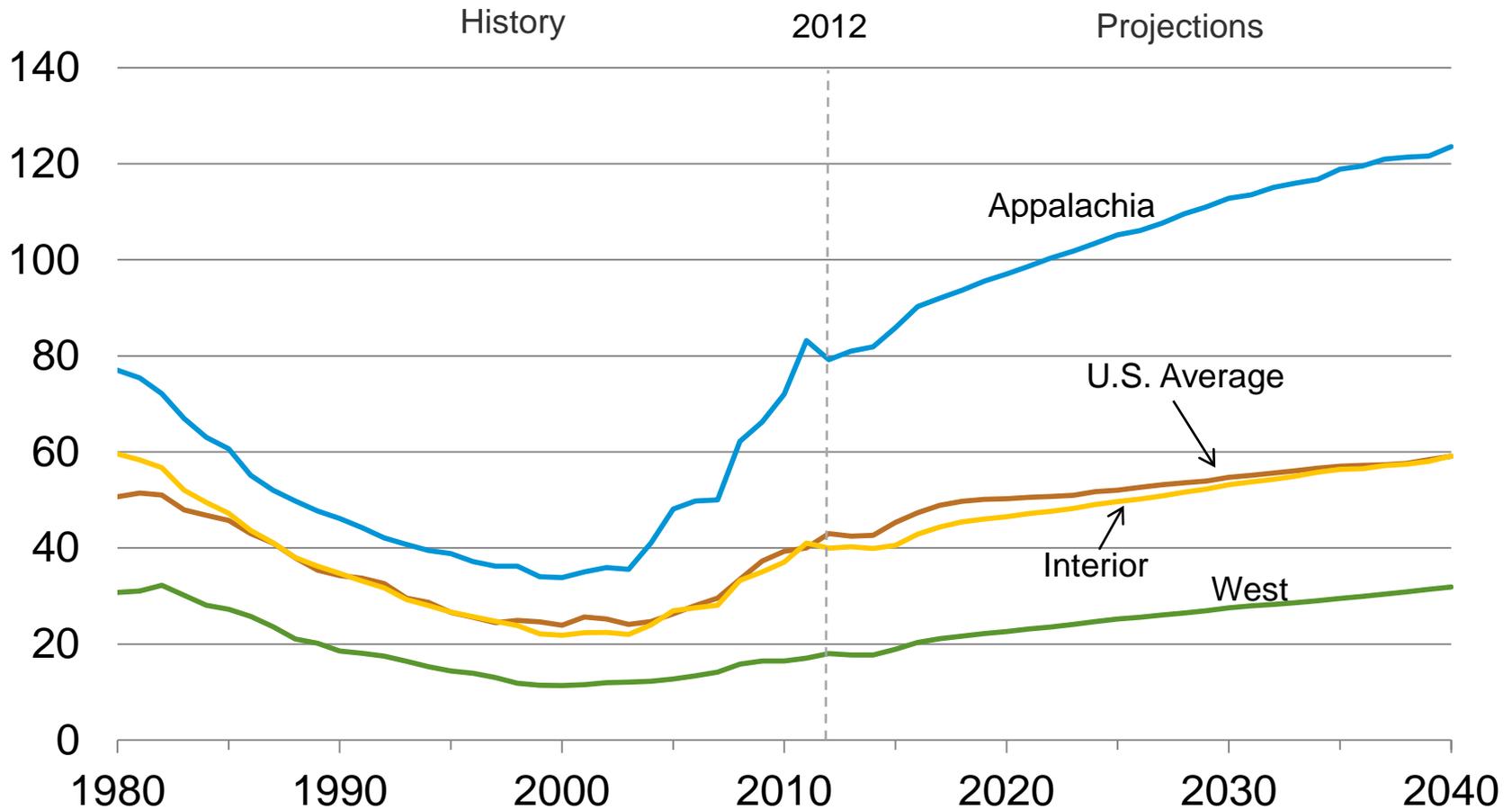


Source: AEO2014 Reference Case (April 2014)

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

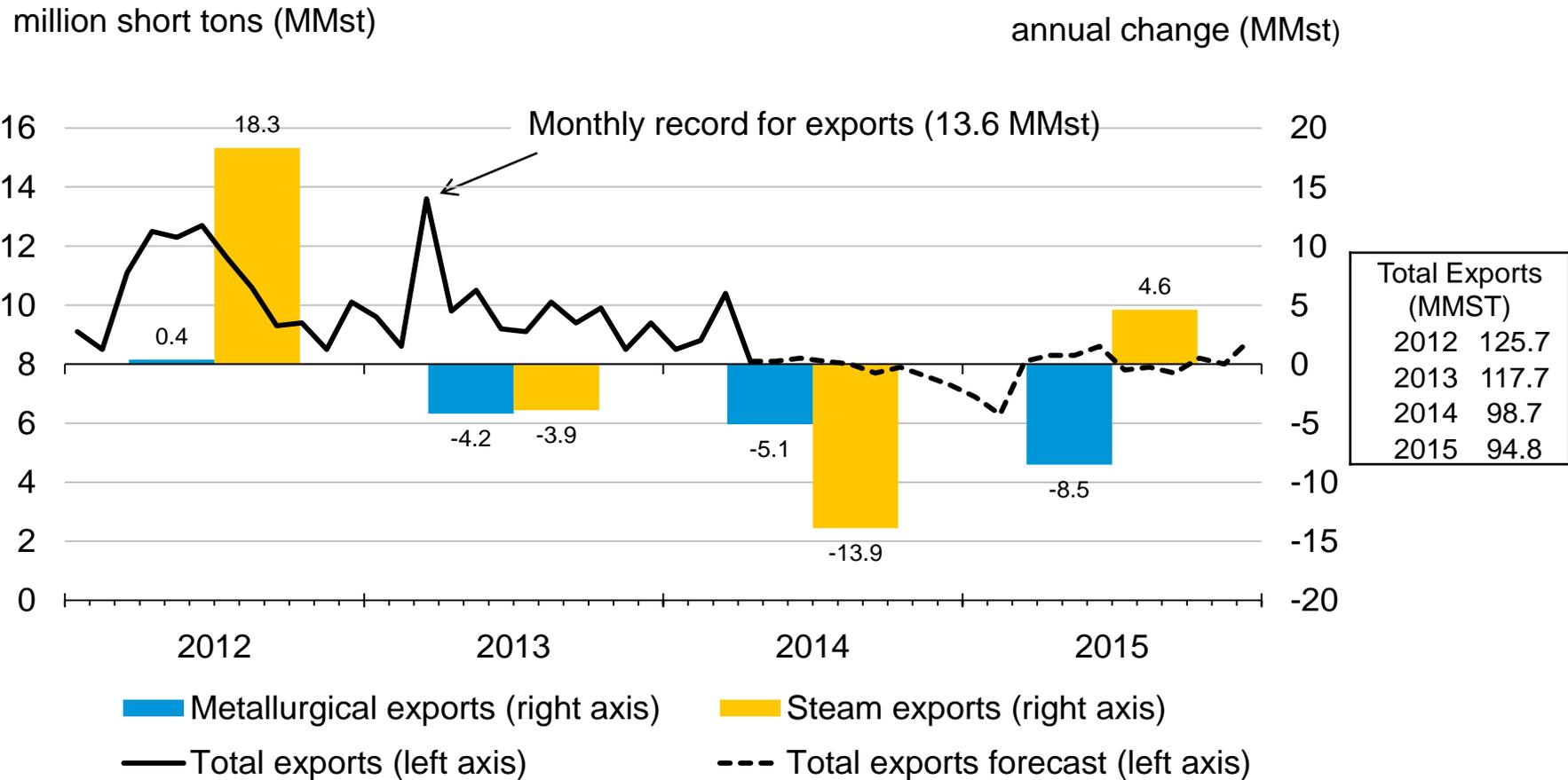
Average minemouth coal prices by region, 1980-2040

2012 dollars per short ton



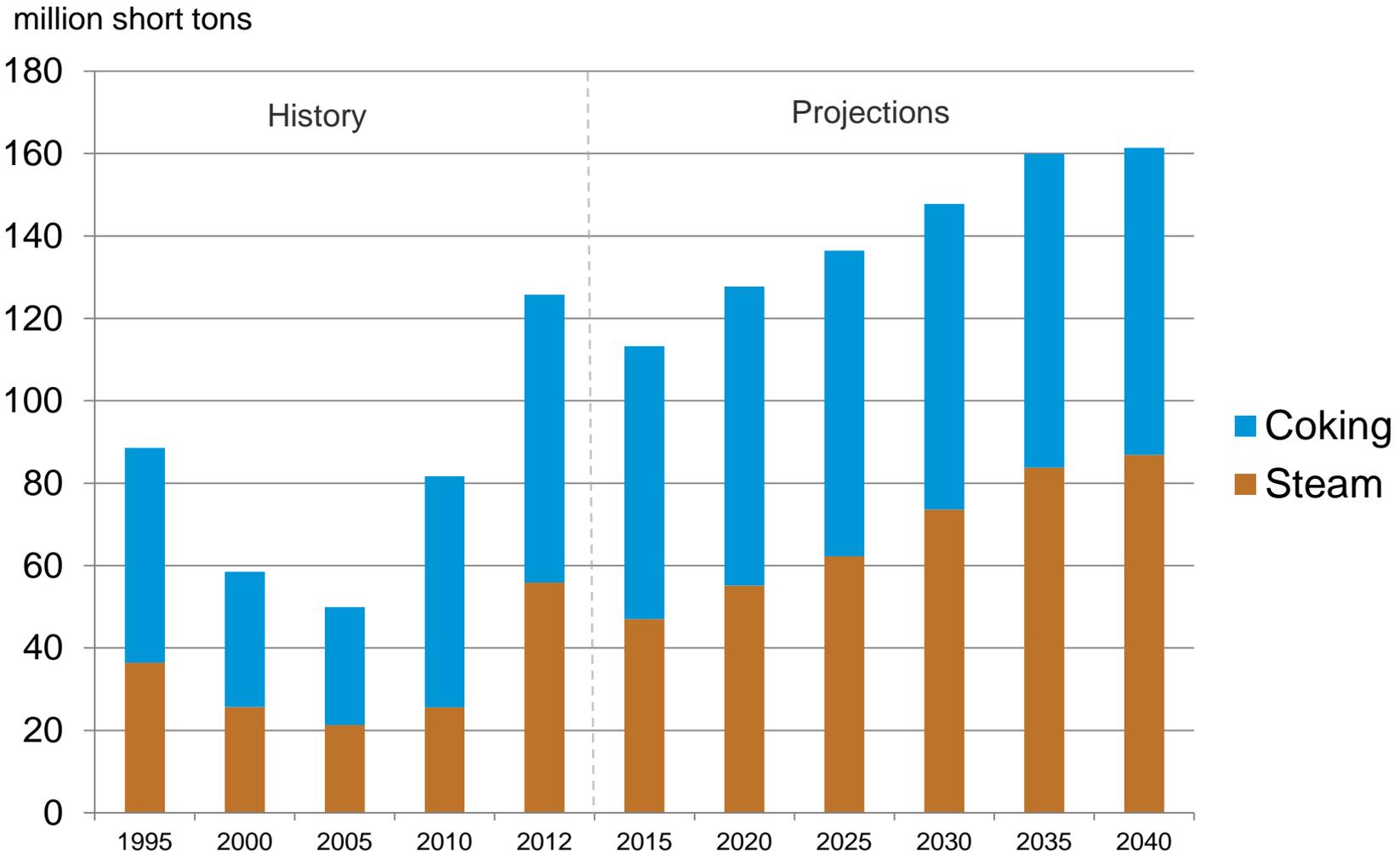
Source: AEO2014 Reference Case (April 2014)

U.S. Coal Exports, Short-Term Energy Outlook, July 2014



Source: 2012-2013: U.S. Energy Information Administration (EIA), Monthly Energy Review;
 2014-2015: STEO (July 2014)

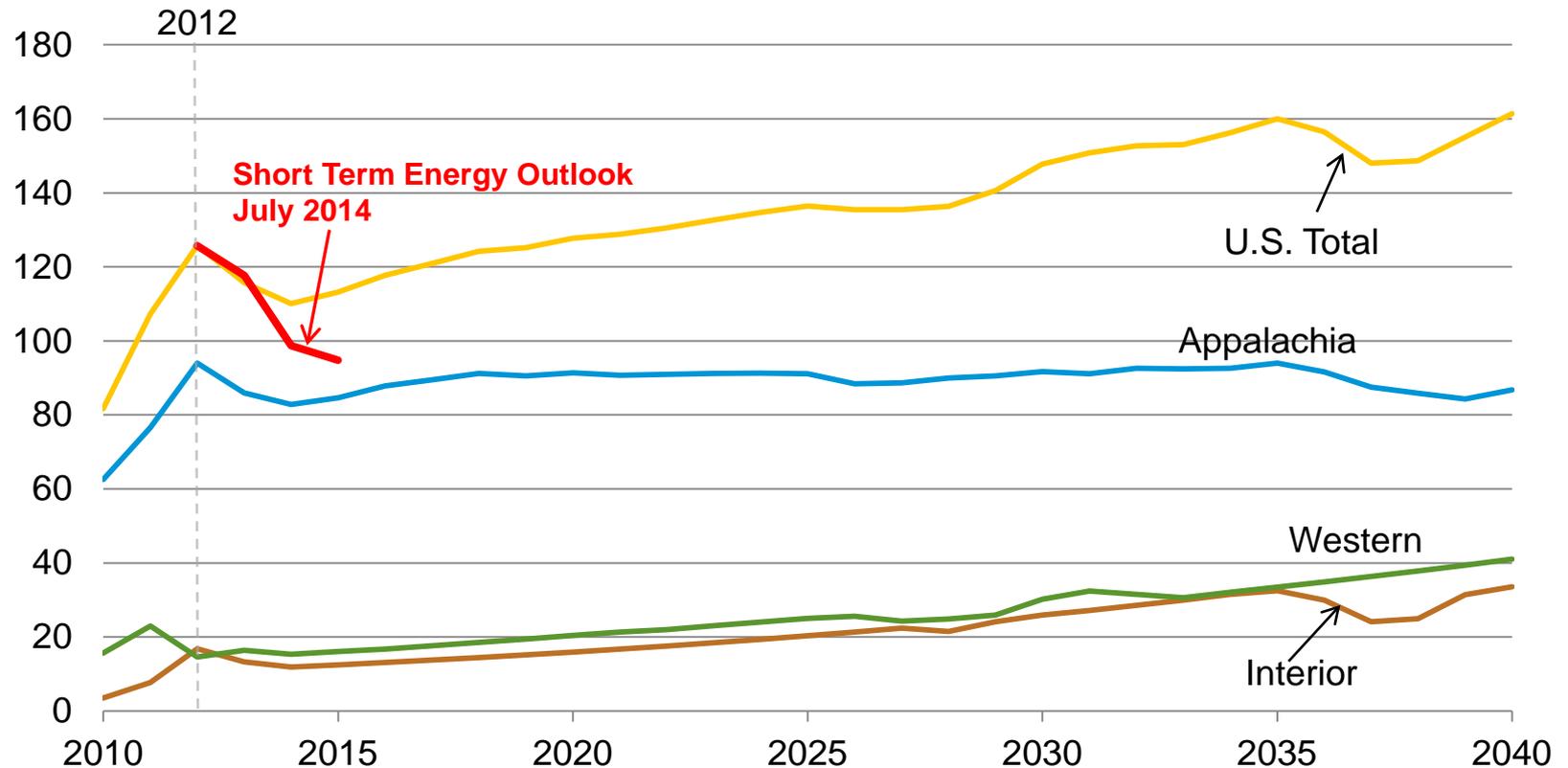
U.S. Coal Exports, 1995-2040



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

million short tons



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

Current Major North American Coal Export Terminals with annual capacity and 2013 export volumes (million short tons)



<u>Port</u>	<u>Capacity</u>	<u>2013 Exports</u>
Baltimore	23	15.1
Norfolk	79	49.7
Mobile	18	12.6
New Orleans	63	19.8
Houston	16	3.3
Vancouver	54	42.1
Ridley	13	13.0
Total	266	155.6

Source: Port Capacities: Wood Mackenzie; **U.S. Exports:** U.S. Energy Information Administration (EIA), Quarterly Coal Report; **Vancouver Exports:** Port of Vancouver 2013 Statistics Overview; **Ridley Exports:** Ridley Terminal 2013 Financial Report

Other North American Coal Export Terminals & Proposed Capacity Expansions (million short tons)



<u>Port</u>	<u>Capacity</u>	<u>Capacity Expansion</u>
Baltimore	23	0
Norfolk	79	0
Charleston	2	8
Mobile	18	9
New Orleans	63	36
Houston	16	18
Corpus Christi	2	0
Altamira	4	0
Lázaro Cárdenas	7	0
Guyamas	7	26
Los Angeles	3	0
San Francisco	1	3
Oregon	0	52
Washington	0	48
Vancouver	54	11
Ridley	13	13
Total	291	225

Source: Port Capacities: Wood Mackenzie; **Capacity Expansion:** Wood Mackenzie, Ridley Terminal website, Ambre Energy website, Gateway Pacific Terminal website, Port of Vancouver website, SNL Energy.

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/>

For more information

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

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

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

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

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.

Assessing Uncertainty: Accelerated Coal and Nuclear Retirement Side Cases

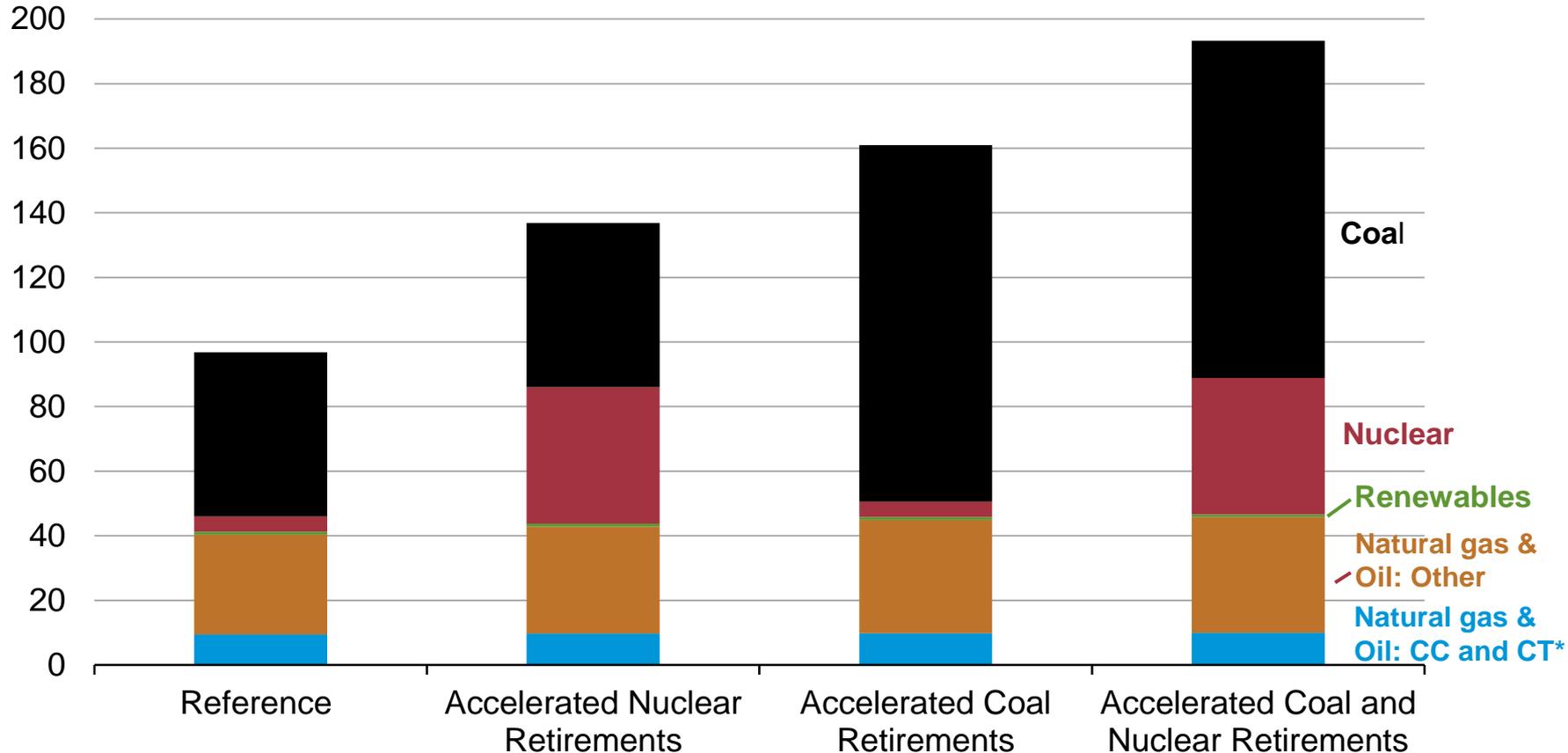
Accelerated power plant retirements and nuclear side case assumptions

- Accelerated Coal Retirements case
 - Starts from AEO2014 High Coal Cost case, with coal prices 68% above Reference case in 2040
 - Annual O&M increase of 3% in real terms from 2012 to 2040, compared to no increase in the Reference case
- Accelerated Nuclear Retirements case
 - No subsequent license renewals for nuclear units past 60 years compared to the Reference case assumption that license renewals allow units to operate beyond 60 years
 - Annual O&M increase of 3% in real terms from 2012 to 2040, compared to no increase in the Reference case
- Accelerated Coal and Nuclear Retirements case
 - Combines assumptions from the previous two cases

Rising costs for coal lead to 60 GW of additional retirements in the Accelerated Coal Retirement case, while 37 GW of additional nuclear capacity would occur between 2030 and 2040 if licenses are not extended beyond 60 years

cumulative capacity additions

gigawatts

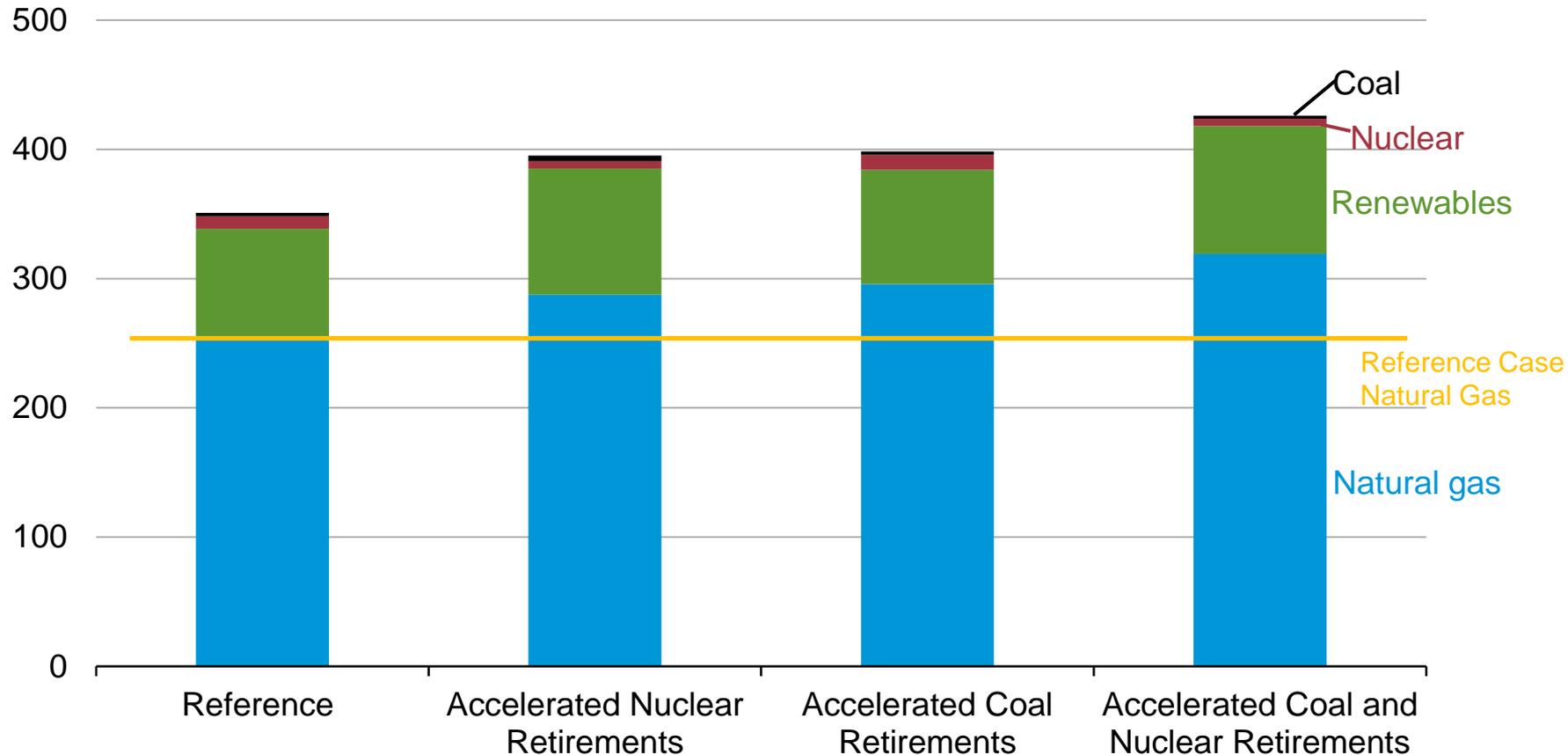


*Excludes retirements of natural gas and oil CC /CT capacity in the end-use sectors

Source: U.S. Energy Information Administration, Annual Energy Outlook 2014 National Energy Modeling System runs REF2014.D102413A, LOWNUC14.D012314B, HCCSTOM.D012314A, and HCLONUC.D012314A

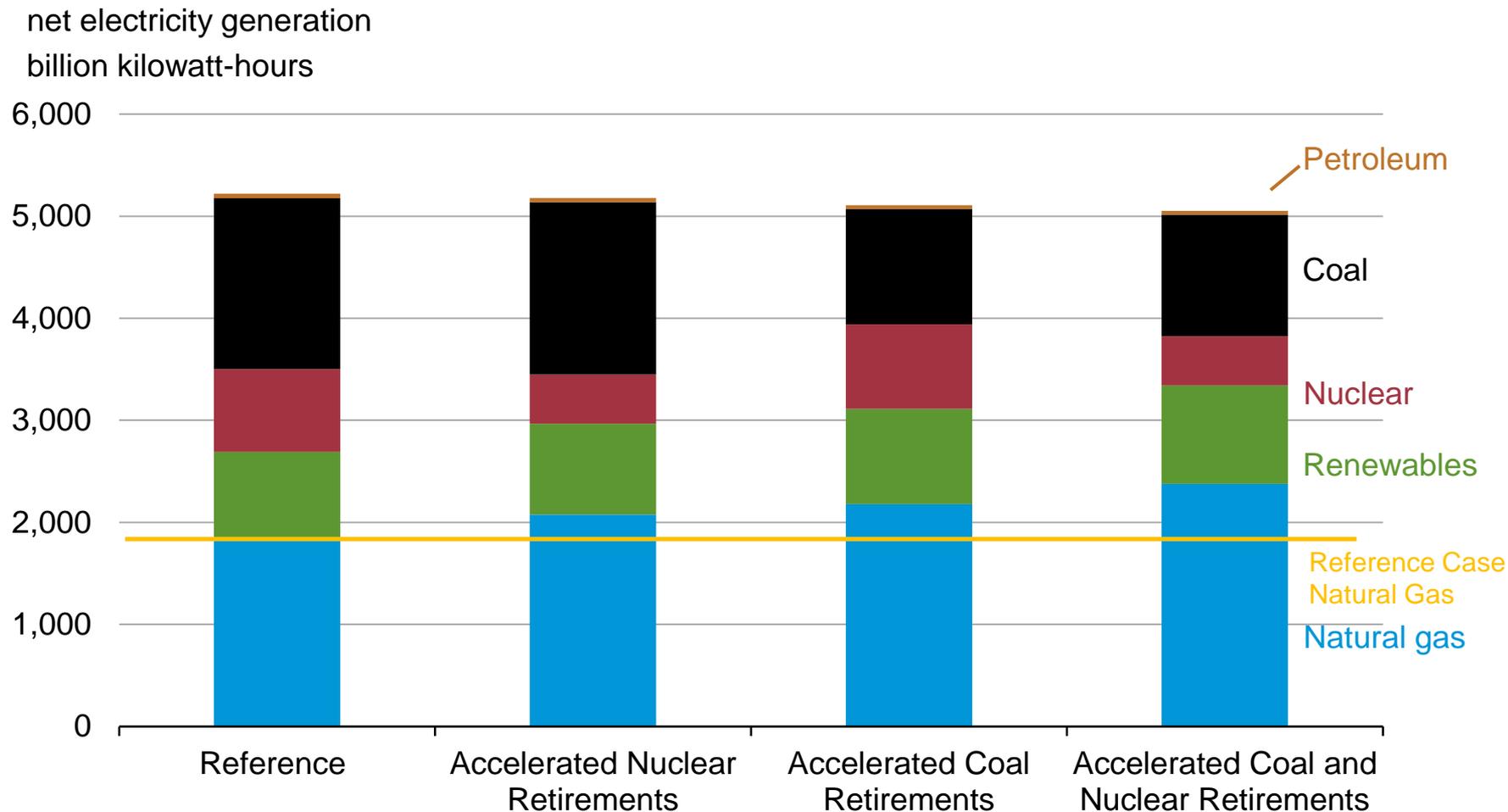
Natural gas and renewables capacity additions are expected to fill the void left by accelerated coal and nuclear retirements through 2040

cumulative capacity additions
gigawatts



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2014* National Energy Modeling System runs REF2014.D102413A, LOWNUC14.D012314B, HCCSTOM.D012314A, and HCLONUC.D012314A

Natural gas and renewables generation share increases through 2040 in accelerated retirement cases but overall electricity demand decreases slightly due to higher natural gas prices



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2014* National Energy Modeling System runs REF2014.D102413A, LOWNUC14.D012314B, HCCSTOM.D012314A, and HCLONUC.D012314A

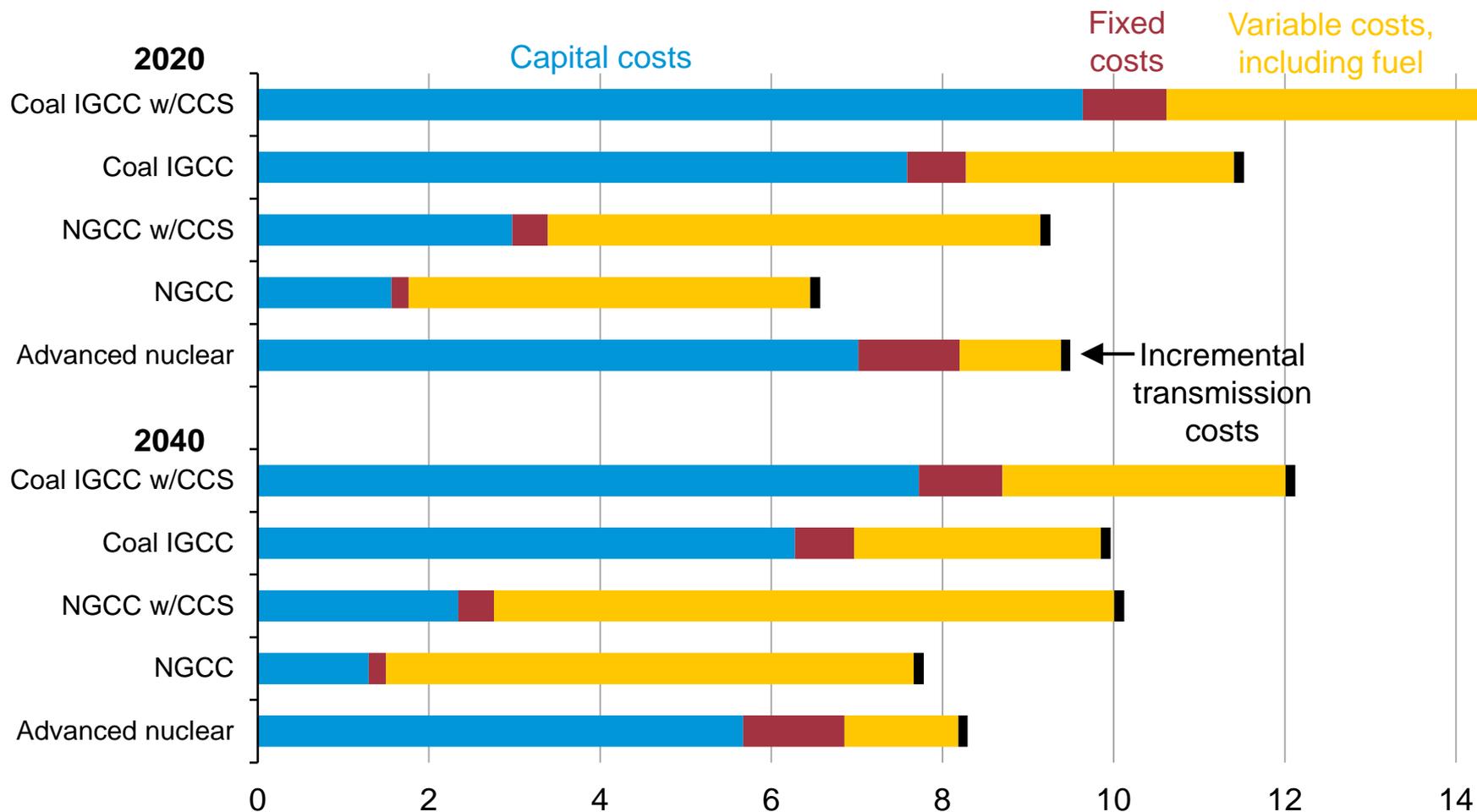
Assessing Uncertainty: CO₂ Policy Side Cases

CO₂ policy side case assumptions

- Greenhouse Gas \$10 case (GHG 10)
 - CO₂ fee of \$10 per metric ton starting in 2015
 - Increasing by 5% in real terms to \$34 per metric ton CO₂ by 2040
 - Results in an approximately 35% reduction in CO₂ emissions compared to the Reference case
- Greenhouse Gas \$25 case (GHG 25)
 - CO₂ fee of \$25 per metric ton starting in 2015
 - Increasing by 5% in real terms to \$85 per metric ton CO₂ by 2040
 - Results in an approximately 80% reduction in CO₂ emissions compared to the Reference case

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

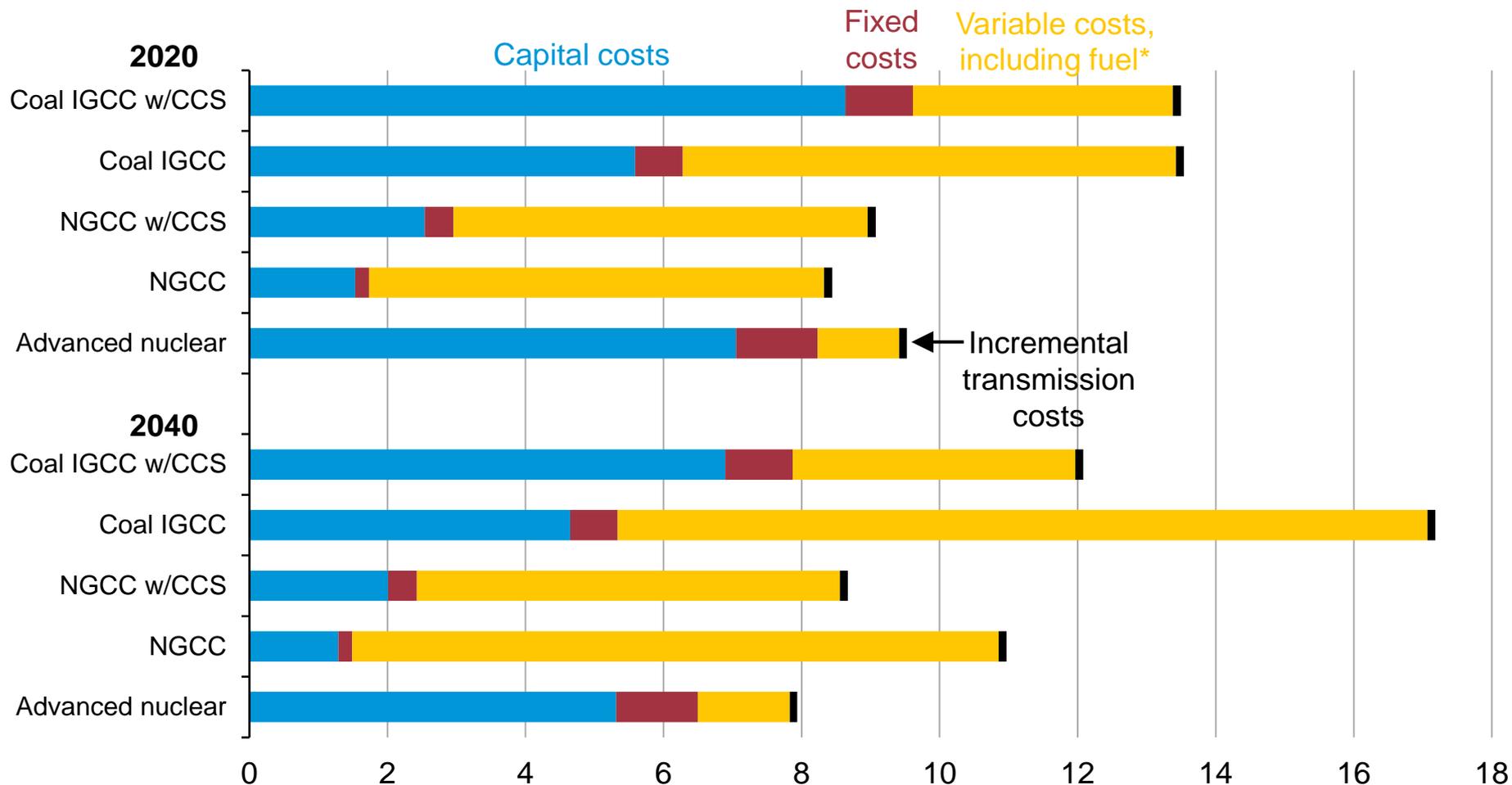
new power plant costs, 2012 cents per kilowatthour



Source: AEO2014 Reference Case (April 2014)

Average levelized electricity costs for new power plants, excluding subsidies, in the GHG 25 case, 2020 and 2040

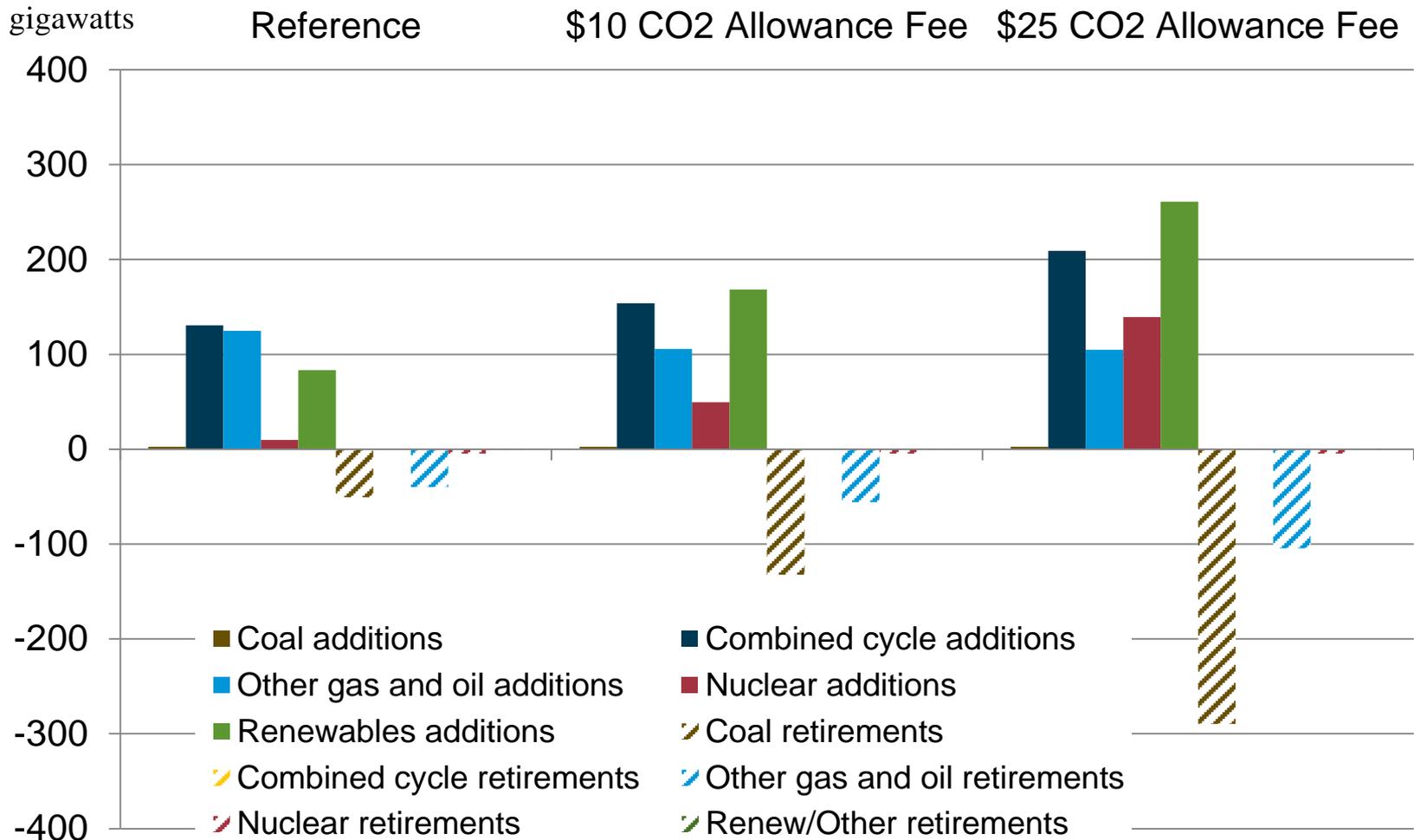
new power plant costs, 2012 cents per kilowatthour



*Fuel cost includes CO₂ fee.

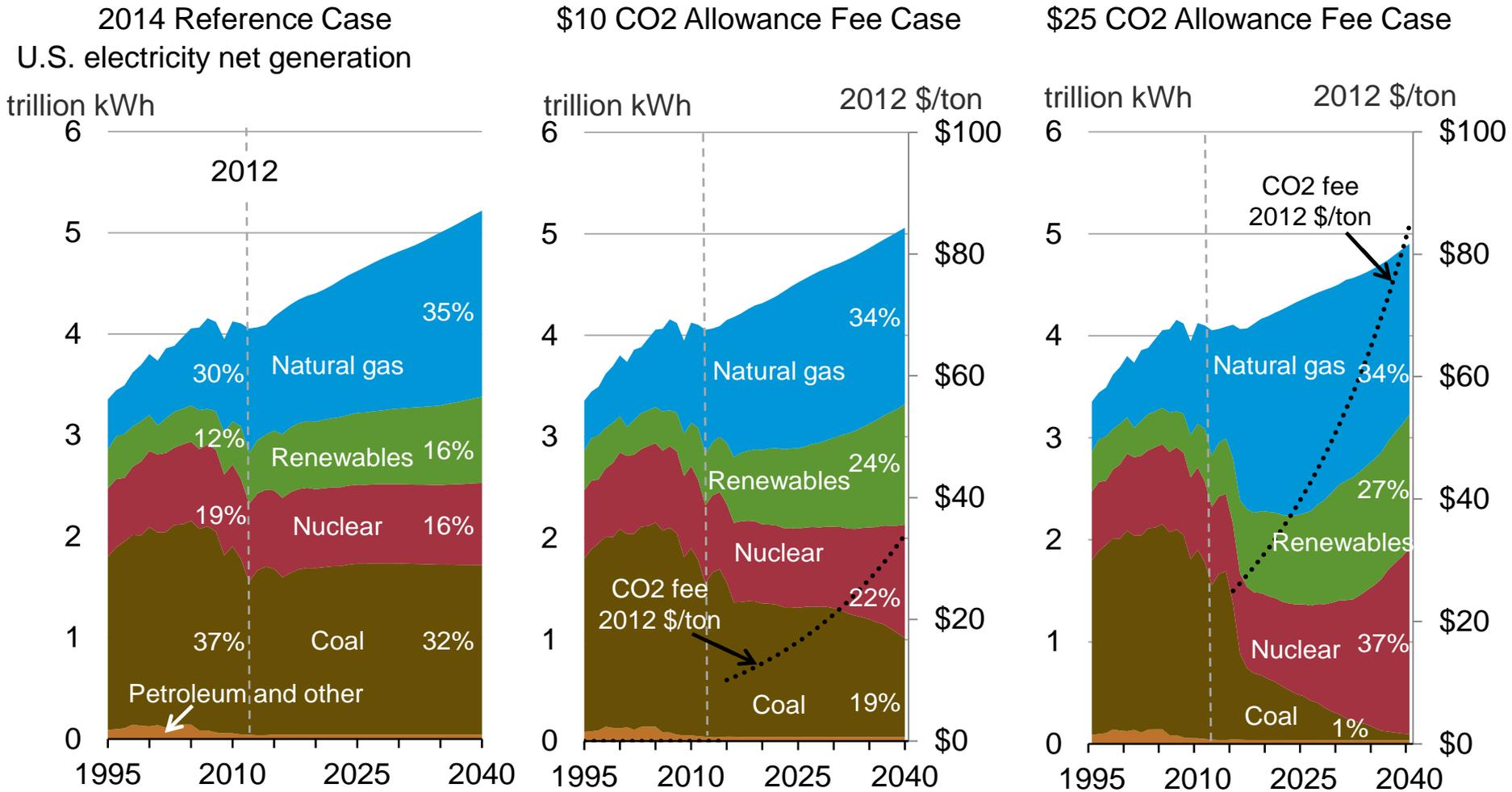
Source: AEO2014 GHG 25 Case (April 2014).

Generating capacity additions and retirements in reference and carbon dioxide allowance fee side cases (cumulative through 2040)



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2014* National Energy Modeling System runs REF2014.D102413A, CO2FEE10.D011614A, and CO2FEE25.D011614A

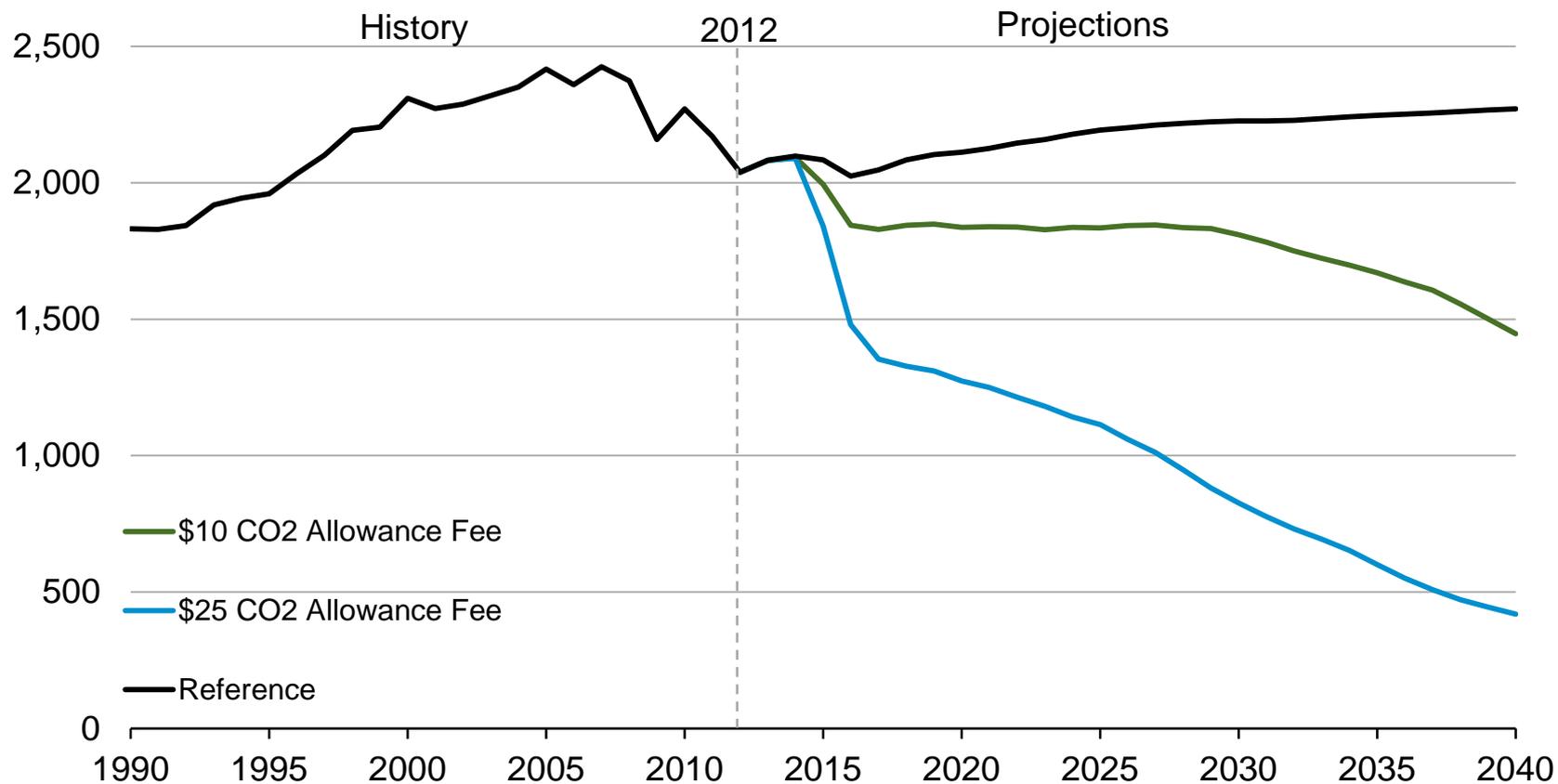
Changing electricity generation mix in Reference case and carbon dioxide fee allowance side cases



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2014* National Energy Modeling System runs REF2014.D102413A, CO2FEE10.D011614A, and CO2FEE25.D011614A

Carbon dioxide emissions from the electric power sector in the GHG cases compared to the Reference case

carbon dioxide emissions
million metric tons



Source: EIA, Annual Energy Outlook 2014

Assessing Uncertainty: Other Side Cases

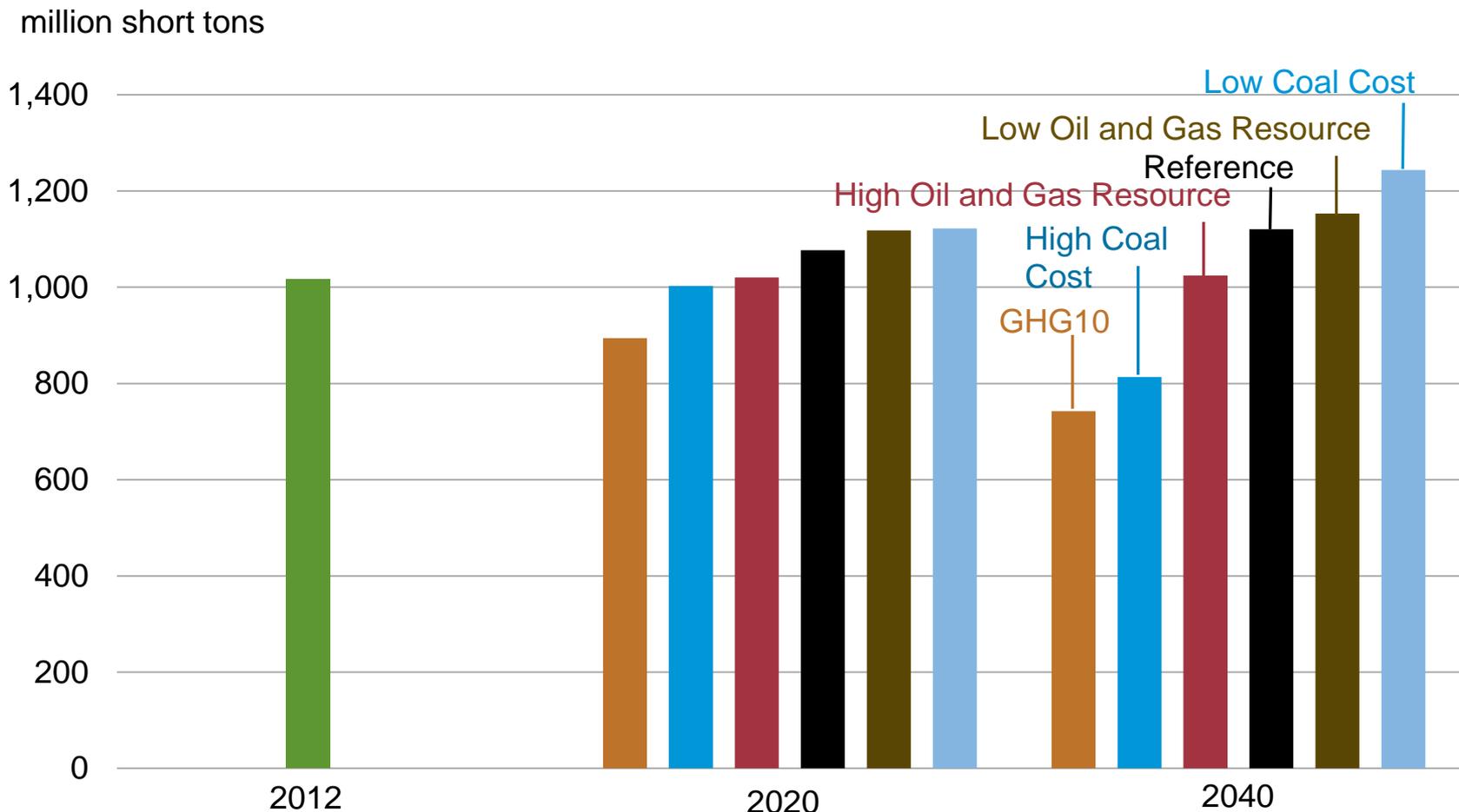
Key differences between alternate cases

	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

**WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES.
DO NOT QUOTE OR CITE AS AEO2015 MODELING ASSUMPTIONS AND
INPUTS ARE SUBJECT TO CHANGE.**

*Includes CO₂ fee

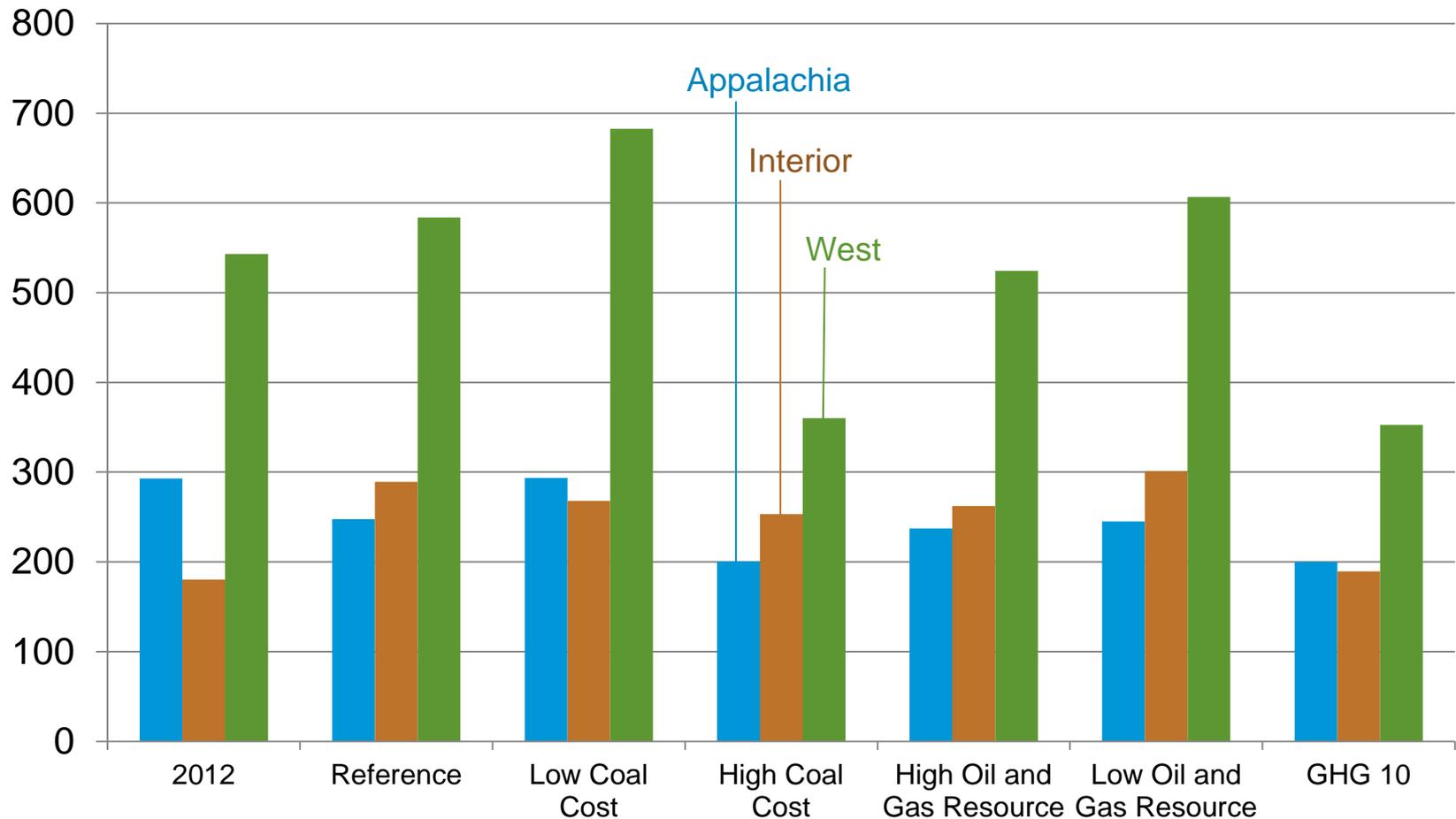
U.S. Coal Production, 2020 and 2040



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.

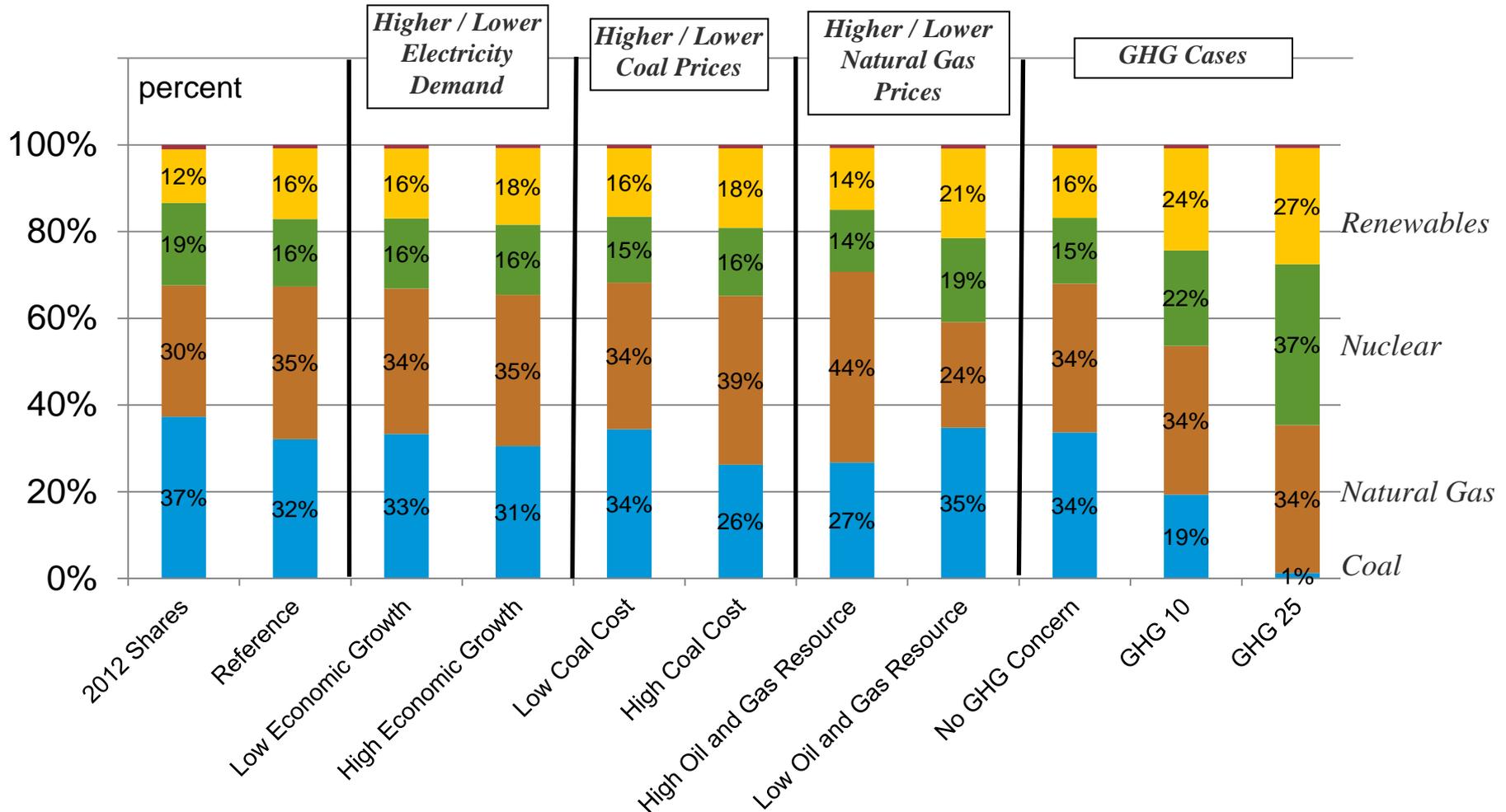
Coal production by region, 2040

Million short tons



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.

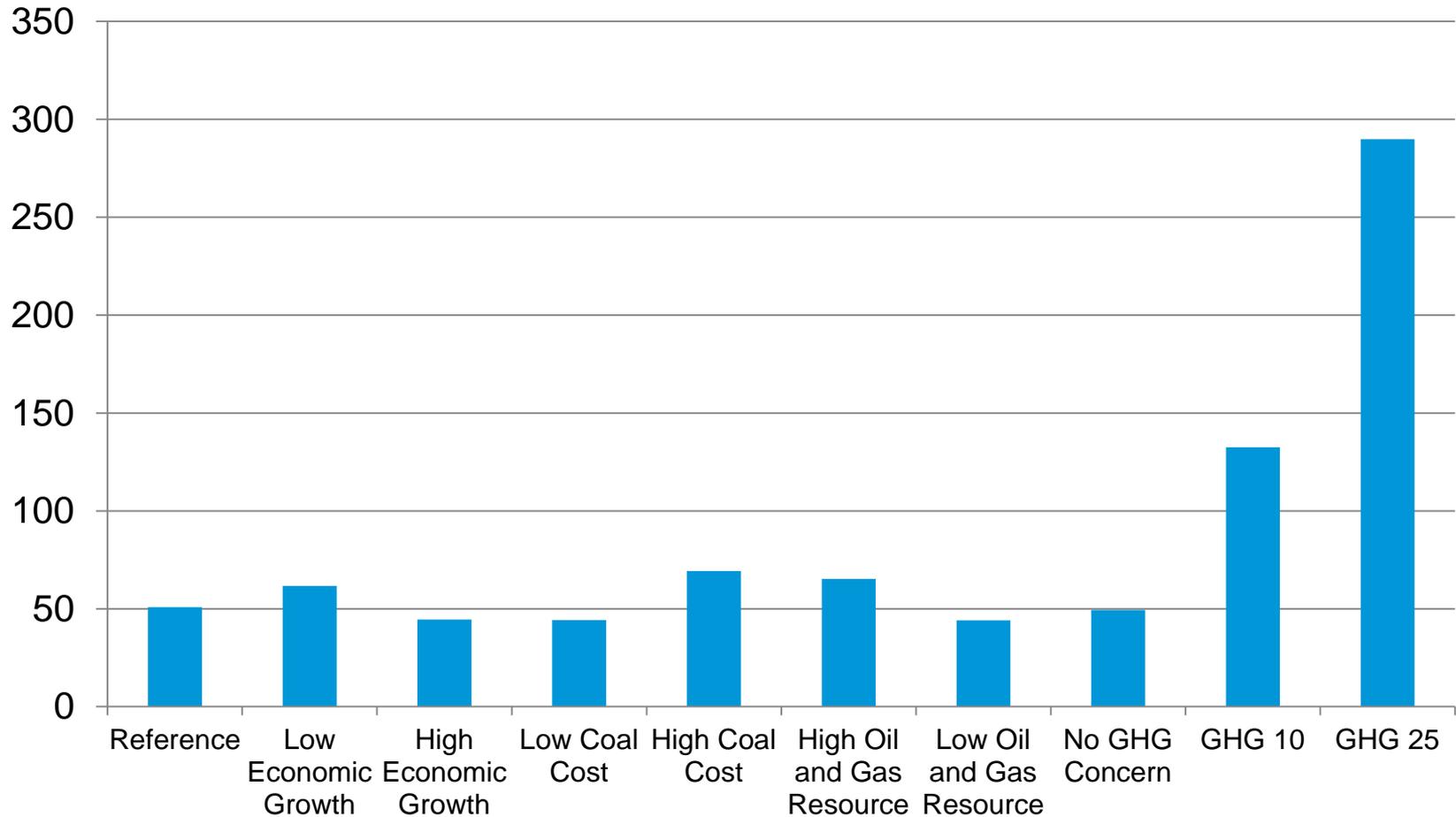
2040 electricity generation shares



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

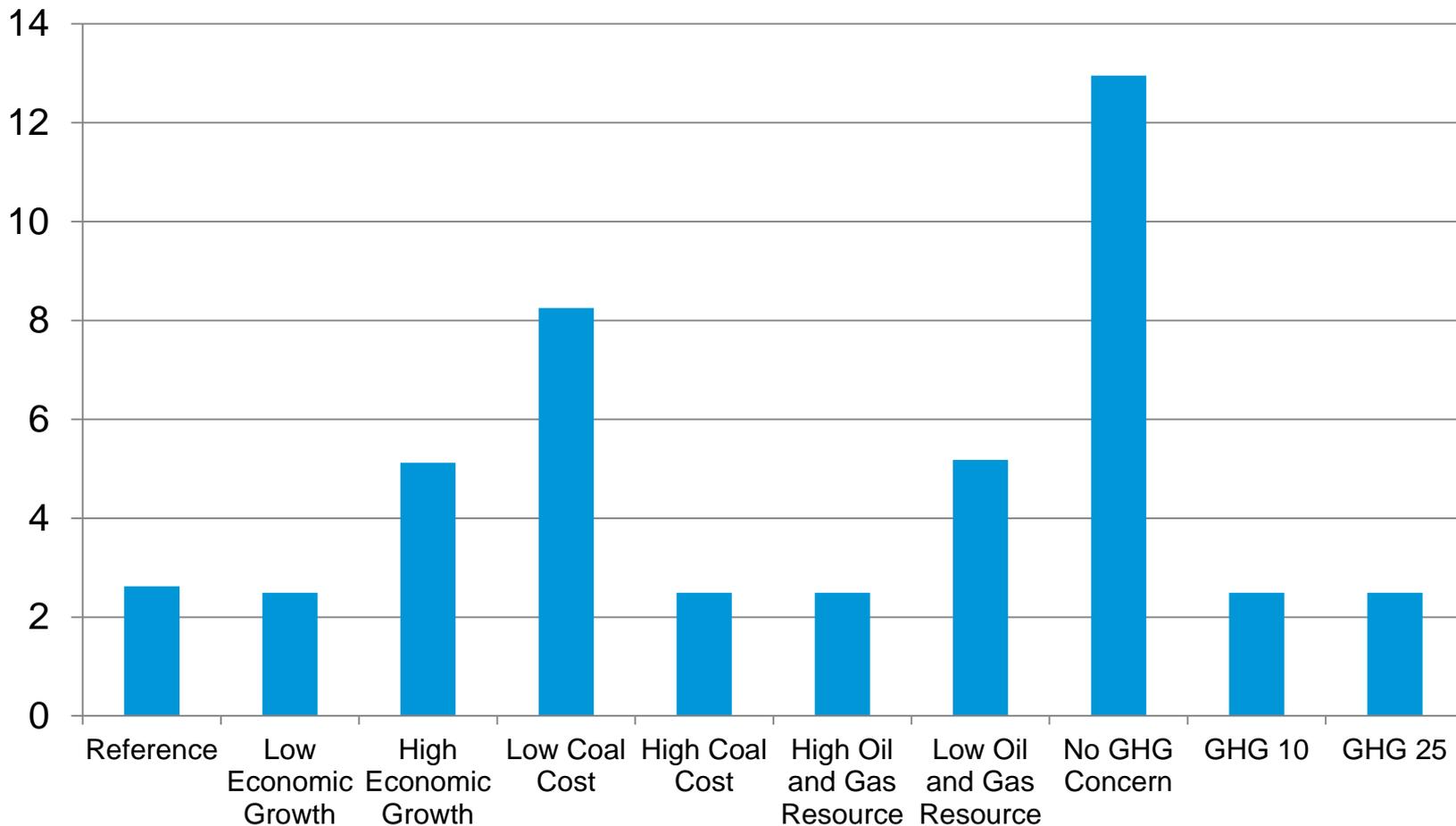
gigawatts



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

gigawatts



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