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AEO2022 First Coal Working Group Meeting



For

Coal Working Group

May 26, 2021 | Washington, D.C.

By

Electricity, Coal, and Renewables Modeling Team

AEO2022 First Coal Working Group Meeting Agenda

- What we're working on for AEO2022
- Update on legislation and regulations affecting coal use
- Summary of AEO2021 projections with emphasis on coal
- **Meeting protocols**
 - This presentation and accompanying meeting minutes will be made available within the next few weeks on the EIA Working Group website
 - Please mute yourself and enter questions using the WebEx chat feature—we will pause at points during the presentation to address them.
 - Select the raised-hand button if you want to speak
 - The meeting will follow Chatham-house rules and will be recorded for note taking purposes only
 - You were required to register with your email address, but if other people and listening with you or you wish to add or remove someone from the working group list, please send an email to David.Fritsch@eia.gov

Overview of *Annual Energy Outlook 2022* (AEO2022)

- What will be included in the AEO2022 release posted on the EIA website?
 - Working group presentations and minutes
 - Flip-book covering the Reference and core side cases
 - Assumptions reports, including costs for new and existing electric plants and levelized costs
 - Issues in Focus (IIF) paper on international coal trade is planned as part of the International Energy Outlook 2021 release and several IIF papers are likely as part of AEO2022
 - Model documentation update in early 2022 after the official release of AEO2022
- AEO2022 schedule
 - Coal Market Module (CMM) model development: Jun-Sep 2021
 - Second Working Group Session: Sep 2021
 - Expected AEO release (event): Jan 2022

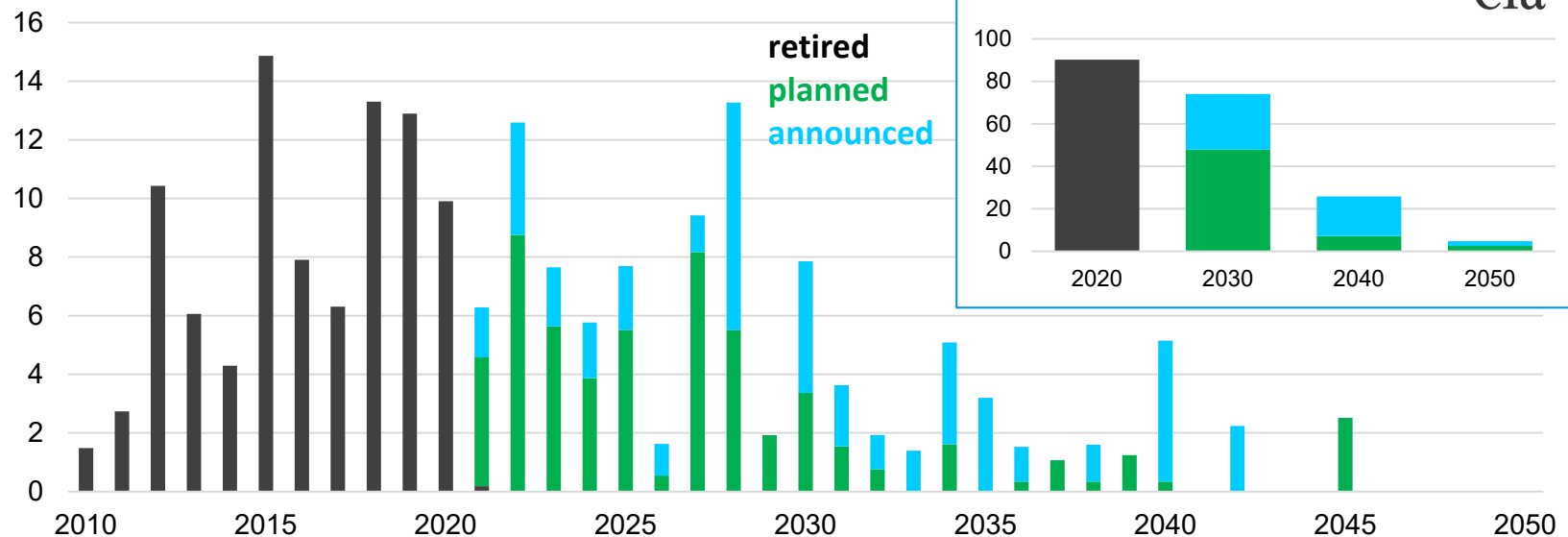
Coal Model Development for AEO2022

- **Upgrade or modify CMM code to use AIMMS v4.76 (64 bit) or later (completed)**
- **Implemented a new coal transportation rate escalation methodology (completed for AEO2021)**
- Evaluate utility Integrated Resource Plans (IRP) and implications for coal retirement. Working on IIF paper based on AEO2021
- Update historical coal input data in the CMM to base year 2020
- Update base year coal transportation rates based on 2018 and 2019 data
- Integrate the coal trade projections from new International Coal Market Module (ICMM) into the CMM

Wave of coal retirements is expected to continue based on review of already planned or announced retirements

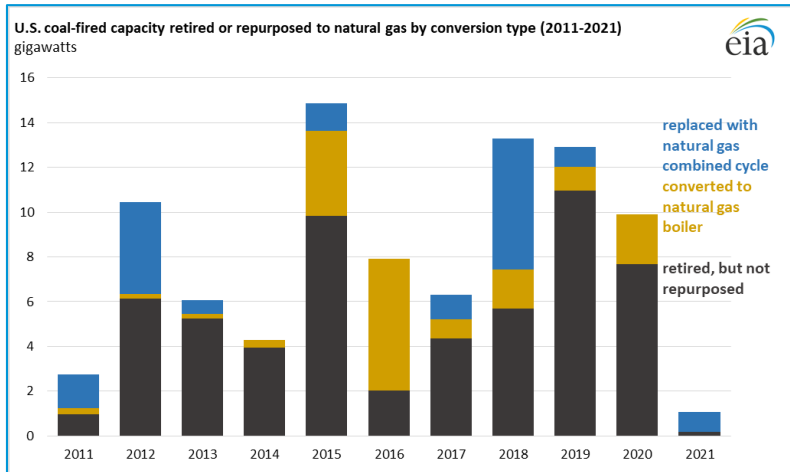
Coal plants retirements

gigawatts (GW) of net summer capacity

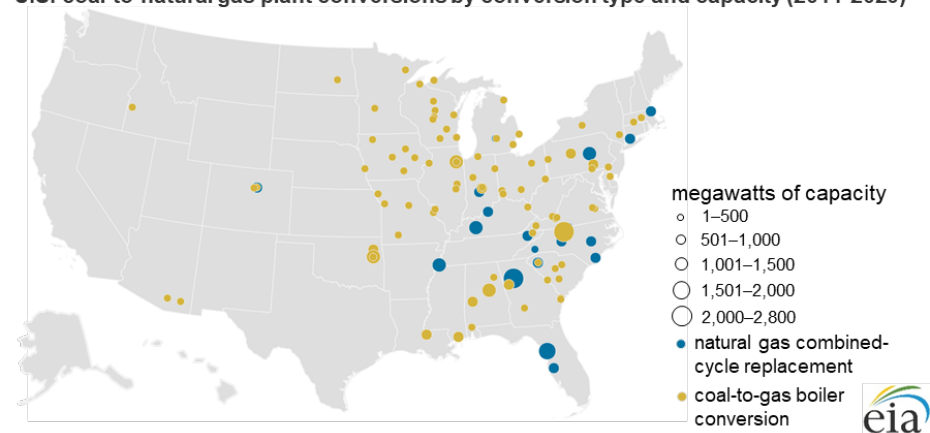


Source for actual and planned retirements: Survey Form EIA 860-M data as of Feb 2021 and analyst research on specific announcements. Announced retirements are based on analyst research and have not been classified as a planned retirement for inclusion in the AEO2022 Reference case.

More than 100 coal-fired plants have been replaced or converted to natural gas since 2011



U.S. coal-to-natural gas plant conversions by conversion type and capacity (2011-2020)



- From 2011 to 2021, 121 U.S. coal-fired power plants were repurposed to burn other types of fuels, 107 of which were converted to or replaced by natural gas-fired plants
- Among the natural gas-fired conversions, 16.5 gigawatts (GW) had the boiler converted to burn natural gas, and 16.1 GW were replaced with natural gas combined cycle
- Motives behind these transitions include: stricter emissions standards, low natural gas prices, and more efficient new natural gas turbine technology.

Source: U.S. Energy Information Administration, *Today in Energy*, “[More than 100 coal-fired plants have been replaced or converted to natural gas since 2011](#)”, Principal Contributor: Lindsay Aramayo, August 5, 2020. Updated with Feb 2021 data from Form EIA 860-M.

Update on other coal-related development and communication efforts

- Developing an International Coal Market Module (ICMM) in the World Energy Protection System Plus (WEPS+)
 - Developed a linear programming-based approach using our Global Hydrocarbon Supply Model (GHySMo) platform in AIMMS and Python
 - Created supply curves by WEPS region and sub-region for four coal types based on world historical coal production as compiled and estimated by our International Energy Statistics.
 - Modeled world coal trade for both thermal and metallurgical coal for both seaborne and land based transportation of coal between regions and within regions based on estimated cost to move coal by land and sea. Inland costs are based on historical rate and price data, and seaborne costs are determined by vessel size, fuel cost and shipping distance between regions.
 - Implemented new model in the upcoming *International Energy Outlook (IEO2021)*

Legislation and regulations update

EPA CO₂ regulations included in AEO

- Affordable Clean Energy (ACE) rule vacated in January 2021 will not be represented in AEO2022
 - In AEO2021 with ACE in place, the NEMS Electricity Markets Module (EMM) required existing coal units to either upgrade to a heat rate improvement (HRI) option identified in EIA's CPP study or retire by 2025; this approach relies on the [2015 EIA study of heat rate improvement](#) (HRI) potential and costs for existing coal units
 - As of May 2021, a replacement rule has not been proposed (and the Clean Power Plan (CPP) is not back in effect). EPA put out a memorandum explicitly stating that no CAA 111(d) regulation is currently in place: “Because the court vacated ACE and did not expressly reinstate the CPP, EPA understands the decision as leaving neither of those rules, and thus no CAA section 111(d) regulation, in place with respect to greenhouse gas (GHG) emissions from electric generating units (EGUs).”
- New Source Performance Standards (NSPS) limit CO₂ emissions from new plants
 - The [EPA released proposed revisions](#) that would eliminate the Carbon Capture and Sequestration (CCS) requirement and specify CO₂ emission rates of 2,000 lb CO₂/MWh-gross for large units (super-critical), 1,900 lb for small units (sub-critical), and 2,200 lb for new coal refuse-fired units. EPA would also adjust the rules for modified units
- A 3% adder is applied to the cost of capital for new coal across all AEO cases
 - The adder applies to new coal units or upgrades to existing units without maximum sequestration options (90% removal) to account for risk of future tightening of CO₂ emissions standards and other policies affecting coal use

EPA air quality regulations affecting electricity generation

- The Mercury and Air Toxics Standards (MATS) are included in all AEO cases
 - On July 17, 2020, EPA finalized a revision to the 2012 MATS rule based on its determination that it is not “appropriate and necessary” to regulate hazardous air pollutants (HAP) emissions from power plants under Section 112 of the Clean Air Act.
 - EPA also determined that “emissions of HAP have been reduced such that residual risk is at acceptable levels, that there are no developments in HAP emissions controls to achieve further cost-effective reductions beyond the current standards, and, therefore, **no changes to the MATS rule are warranted.**” (quoted from [EPA website](#); emphasis added).
- EPA’s Cross-State Air Pollution Rule (CSAPR) is included in all AEO cases
 - On March 15, 2021, EPA finalized the Revised Cross-State Air Pollution Rule Update for the 2008 ozone National Ambient Air Quality Standards (NAAQS). Starting in the 2021 ozone season, the rule will require additional emissions reductions of nitrogen oxides (NOX) from power plants in 12 states. These reductions will be included in AEO2022, but minimal impact is expected because many EMM regions are solving well below the NOX limits.
- Regional Haze compliance is reflected in survey Form EIA-860 filings as each coal plant complies
 - Compliance follows from State Implementation Plans due on July 31, 2021 and implemented by 2028; [Regional Haze Reform Roadmap](#) dated September 11, 2018
 - On June 30, 2020, EPA reaffirmed a 2017 determination that participation in CSAPR qualifies as a best available retrofit technology alternative to satisfy Regional Haze requirements (for example, Texas)

Other EPA regulations affecting coal generating units but not explicitly modeled in NEMS

- EPA's Effluent Limitation Guidelines (ELG) compliance is reflected in survey Form EIA-860 filings as each coal plant takes action to comply
 - EPA's Proposed Rule was published November 22, 2019 to:
 - Extend compliance deadlines for up to two years
 - Expand technology options for achieving compliance
 - Provide flexibility in managing ELG systems under a voluntary incentives program that allows facilities until 2028 to implement new limits if they adopt additional measures to achieve stricter limitations on specific pollutants
 - Impose less-stringent requirements for high-flow facilities, low-utilization units, and facilities retiring by 2028
- EPA and the Department of the Army published the Navigable Water Protection Rule on April 21, 2020 after repealing the Waters of the U.S. (WOTUS) rule in September 2019
 - Under the final Navigable Waters Protection Rule, **Jurisdictional Waters** consists of four clear categories that are federally regulated:
 - The territorial seas and traditional navigable waters
 - Perennial and intermittent tributaries to those waters
 - Certain lakes, ponds, and impoundments,
 - Wetlands adjacent to jurisdictional waters
 - **Non-Jurisdictional Waters:** The final rule also details 12 categories of exclusions (in other words features that are not “waters of the United States”), such as features that only contain water in direct response to rainfall (that is, ephemeral features), groundwater, many ditches, prior converted cropland, and waste treatment systems.

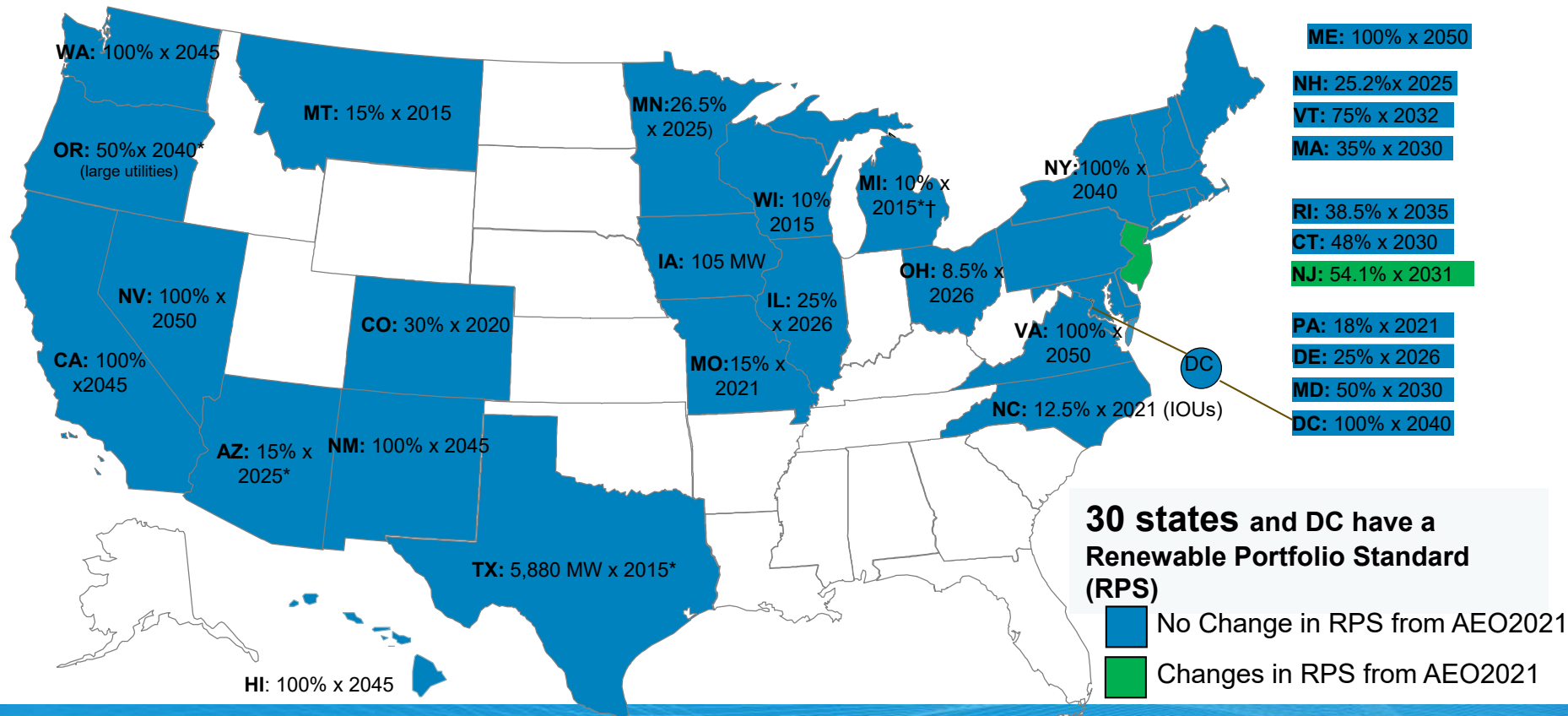
Other EPA regulations affecting coal generating units but not explicitly modeled in NEMS (continued)

- [EPA issued a rule](#) on August 28, 2020 to update 2015 Coal Combustion Residual (CCR) regulations in response to a August 2018 court ruling that certain provisions were insufficiently protective of public health
 - The final rule defines clay-lined impoundments as “lined” and allow unlined surface implements to continue to receive coal ash unless they leak. It set revised date of April 11, 2021 by which unlined surface impoundments and units that failed the aquifer location restriction must cease receiving waste and initiate closure or retrofit
 - Revisions to the alternative closure provisions that would grant certain facilities additional time to develop alternative capacity to manage their waste streams (including additional waste - primarily non-CCR wastewater - generated at the facility) before they must stop receiving waste and initiate closure of their surface impoundments.
 - The final rule defines clay-lined impoundments as “lined” and allows unlined surface implements to continue to receive coal ash unless they leak. It set a revised date of April 11, 2021, by which unlined surface impoundments and units that failed the aquifer location restriction must stop receiving waste and either close or retrofit unit

State policies affecting U.S. coal use

- Regional Greenhouse Gas Initiative expanding to include Virginia in AEO2022
 - Virginia Clean Economy Act (Senate Bill 851/House Bill 1526)
 - 2021: CO₂ allowance of 27.16/metric ton (mt)
 - Allocation decreases each year through 2030 by 0.84/mt CO₂, and remains at 19.6/mt of CO₂ thereafter
 - Dominion Energy and Appalachian Power required to retire carbon-emitting electric generating units by Dec. 31, 2045
- Oregon [passed S.B. 1547](#) in 2016 that requires utilities to exit out-of-state coal contracts by 2030
 - Potential implications for coal holdings by PacifiCorp, including Jim Bridger (WY; 2/3 owner), Hunter, Huntington, Dave Johnston, Naughton, Wyodak, Craig (partial owner), Colstrip (partial owner), and Hayden (partial owner)
 - Wyoming passed [Senate File 159](#) requiring utilities to make a good faith attempt to sell coal plants purchased under an agreement approved by the state's commission. The ruling also specified [ratepayers](#) in Wyoming would assume the costs of buying the coal plant in operation
- U.S. Pacific-Northwest coal terminal development unlikely to move forward
 - [Lawsuit](#) is ongoing by the proposed, 44-MMtpy Millennium terminal's stakeholders to challenge Washington state's 2017 denial of the Clean Water Act Section 401 certification
 - [Army Corps revived its environmental review](#) of the project in October 2018, 2019, although it cannot issue a permit for the project unless the Washington State's certification denial is reversed or set aside
 - State board's shoreline decision to deny construction permits was affirmed by state appeals court in March 2020.
 - Lighthouse Resources, the Millennium project sponsors have filed for Chapter 11 bankruptcy and have been unable to find a buyer for the port during bankruptcy reorganization.
 - Ridley expansion could free up some capacity at Westshore for U.S. exports through Canada

State RPS policies will be finalized toward the end of the AEO cycle



Recent coal protection attempts by western US states

- Montana:
 - Two new laws
 - Disputes among the Colstrip power plant's six owners must be settled through Montana courts, instead of Washington as currently required by the Colstrip Ownership and Operation Agreement. The law invalidates contracts that don't settle disputes through Montana courts.
 - If a company refuses to share in the operating costs or takes actions that bring about the closure of a facility (Colstrip) without obtaining the consent of all the co-owners, it would be considered an "unfair or deceptive trade practice." Montana's attorney general could issue fines of up to \$100,000 per day.
- Wyoming:
 - A law signed on April 6, 2021 creates a \$1.2 million fund to support litigation to protect Wyoming's coal interests. What these interest include is unclear, but it might support litigation against the State of Washington for prohibiting construction of a coal export terminal.

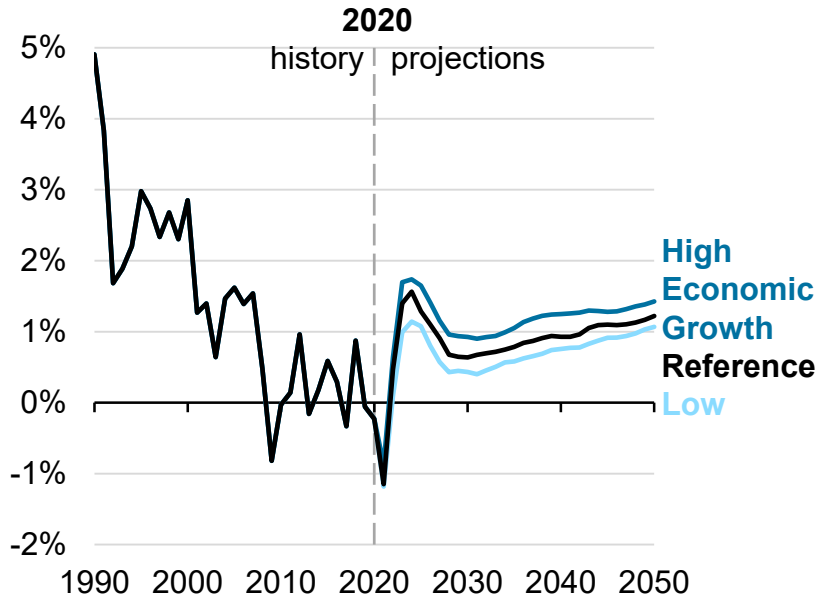
AEO2021 assumptions and trends

What is the Reference case?

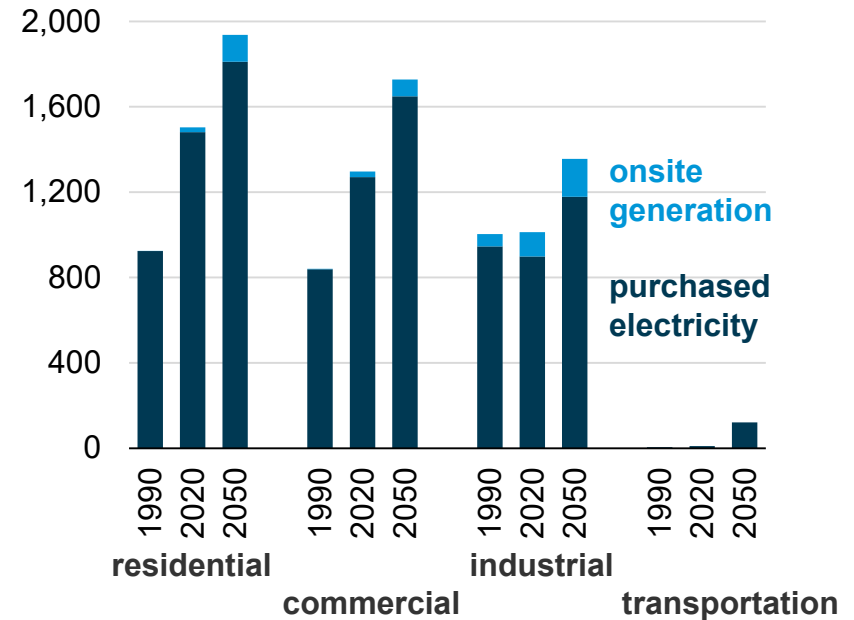
- The Reference case projection assumes trend improvement in known technologies along with a view of economic and demographic trends reflecting the current views of leading economic forecasters and demographers.
- The Reference case generally assumes that current laws and regulations affecting the energy sector, including sunset dates for laws that have them, are unchanged throughout the projection period.
- The potential impacts of proposed legislation, regulations, and standards are not included.
- We address the uncertainty inherent in energy projections by developing side sensitivity cases with different assumptions of macroeconomic growth, world oil prices, technological progress, and energy policies.
- Projections in the AEO should be interpreted with a clear understanding of the assumptions that inform them and the limitations inherent in any modeling effort.

Electricity demand grows modestly throughout the projection period

U.S. electricity use growth rate, three-year rolling average
AEO2021 economic growth cases
 percentage growth



U.S. electricity use by end-use sector
AEO2021 Reference case
 billion kilowatthours



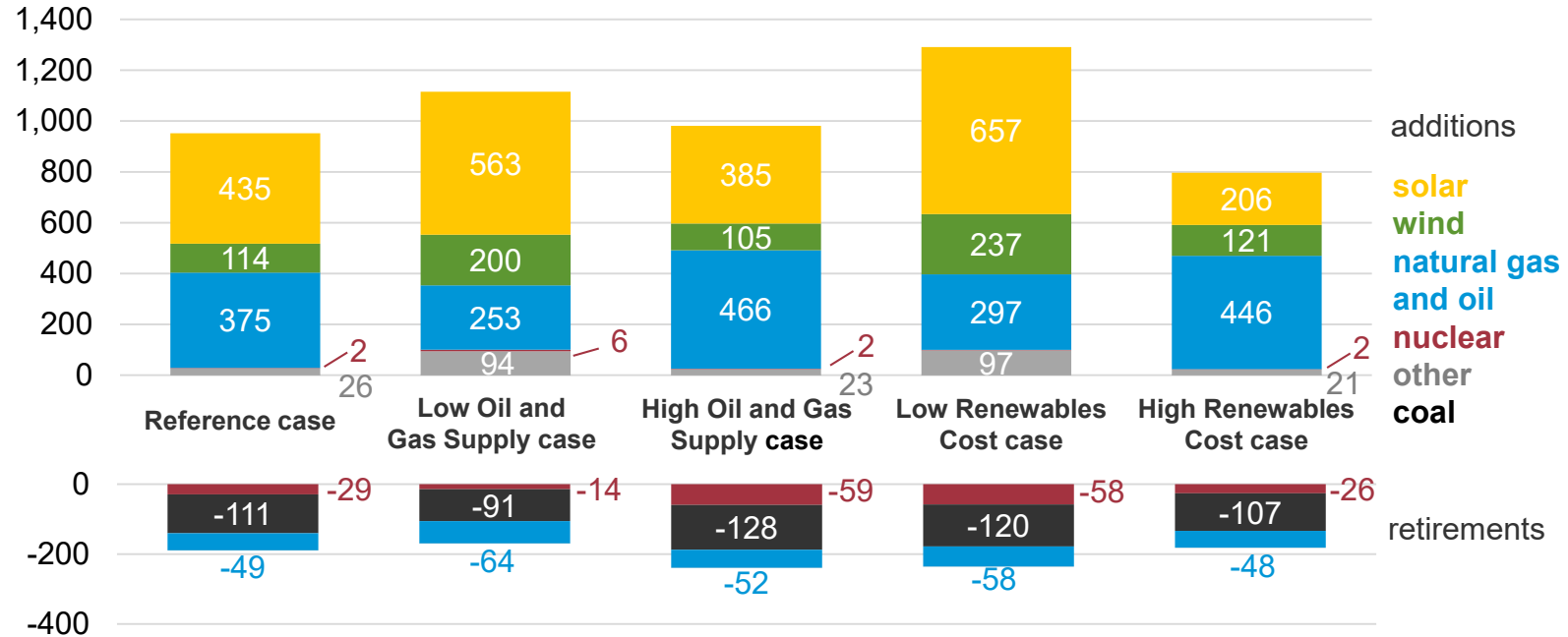
Note: Onsite generation is electricity produced onsite for own use.

Electricity generating capacity increases 52% to 84% across AEO cases; additions come mostly from solar, wind, and natural gas

Cumulative electricity generating capacity additions and retirements (2021–2050)

AEO2021 selected cases

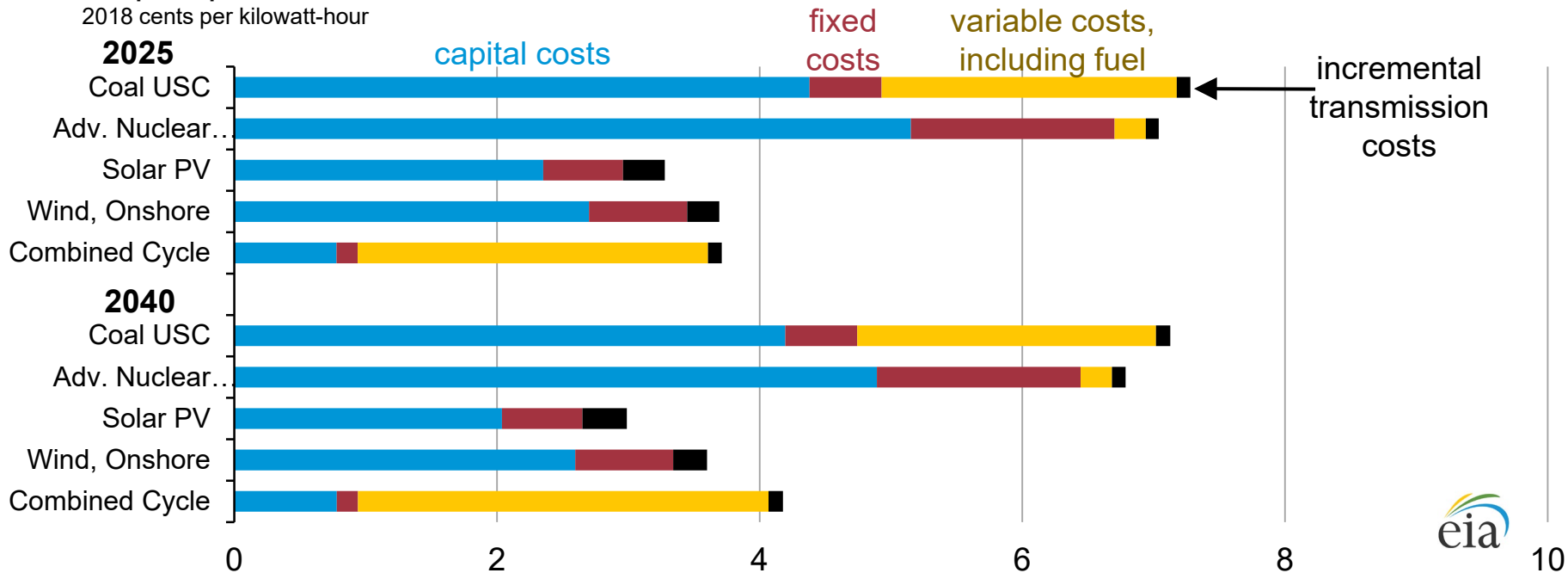
gigawatts



Relatively high levelized cost of electricity for coal prohibits the addition of coal in any case evaluated in AEO2021

New power plant costs

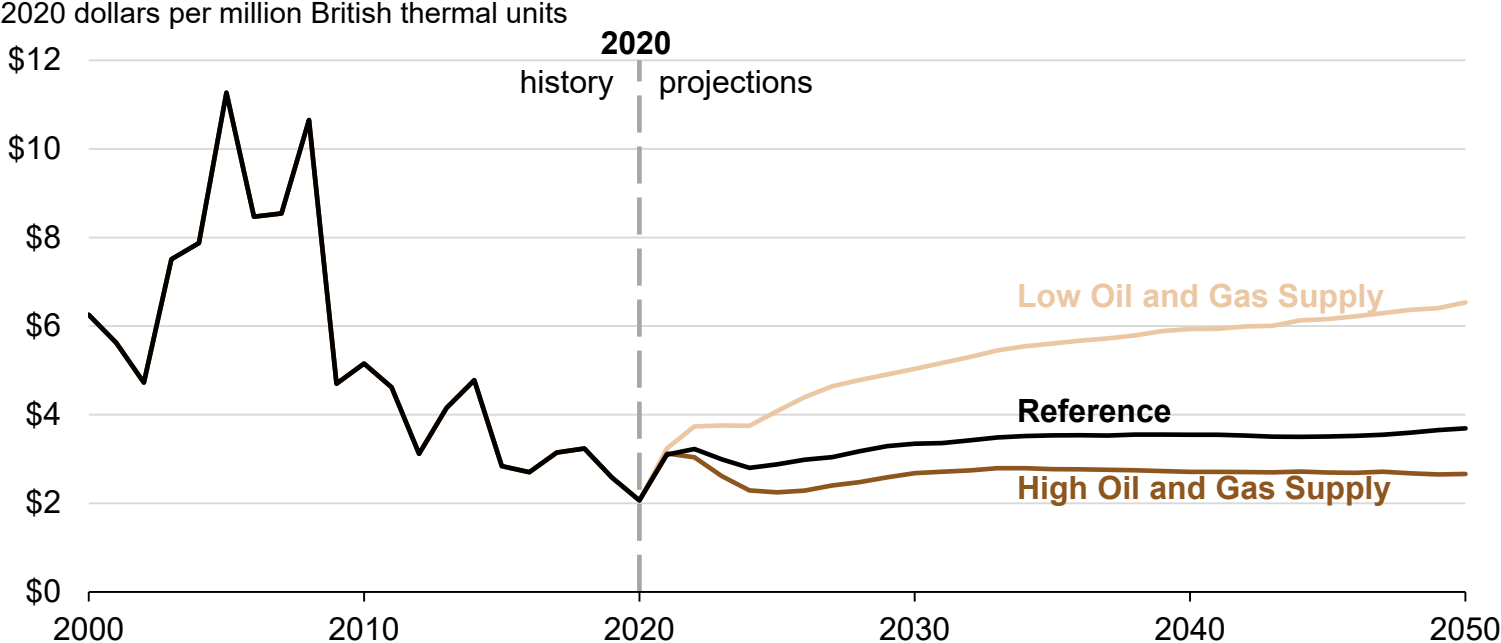
2018 cents per kilowatt-hour



Source: U.S. Energy Information Administration, "Levelized Cost of New Generation Resources in the Annual Energy Outlook 2021", February 2020, excerpted from Table 1b (2026) and Table B1b (2040)

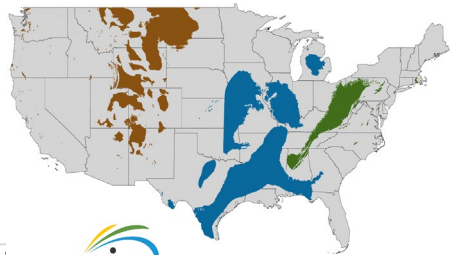
Natural gas prices continue to range between \$3.50 and \$4.00 per million British thermal units

Natural gas spot price at Henry Hub AEO2021 oil and gas supply cases

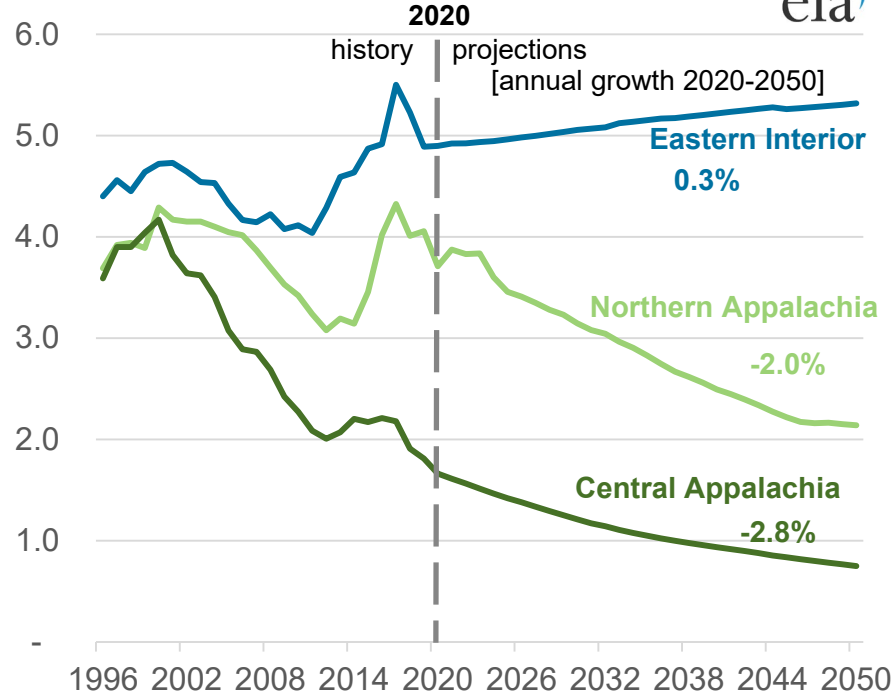


Source: U.S. Energy Information Administration, Annual Energy Outlook 2021

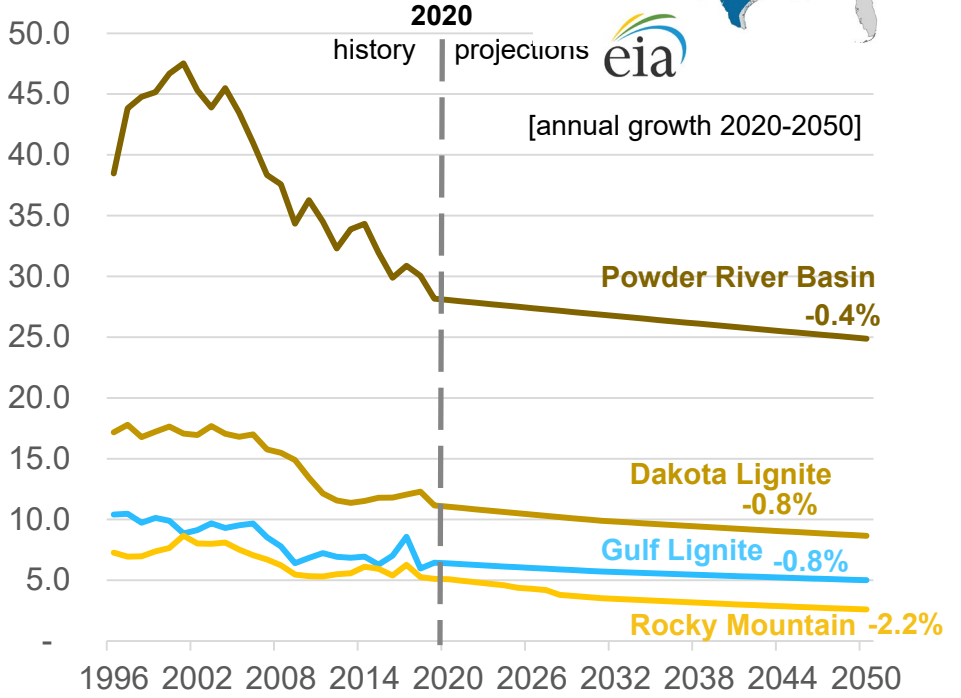
Coal productivity projected to continue declining, except in the Eastern Interior



Major eastern producing regions
short tons per miner hour



Major western producing regions
short tons per miner hour

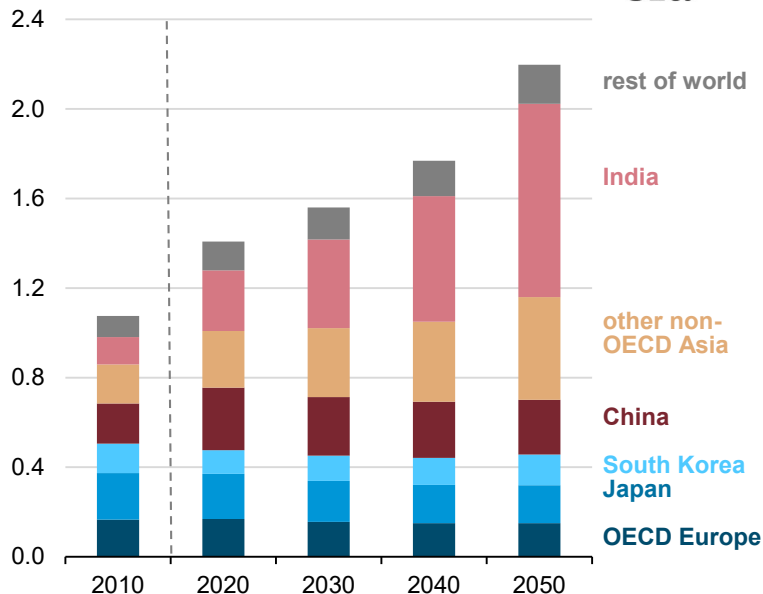


Source: U.S. Energy Information Administration, Annual Energy Outlook 2021.

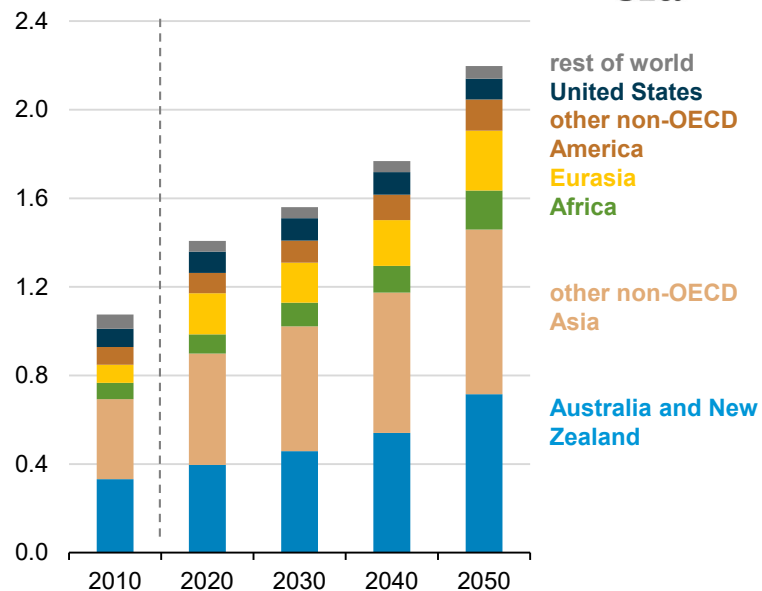


International seaborne coal trade projected in AEO2021

Coal imports
billion short tons



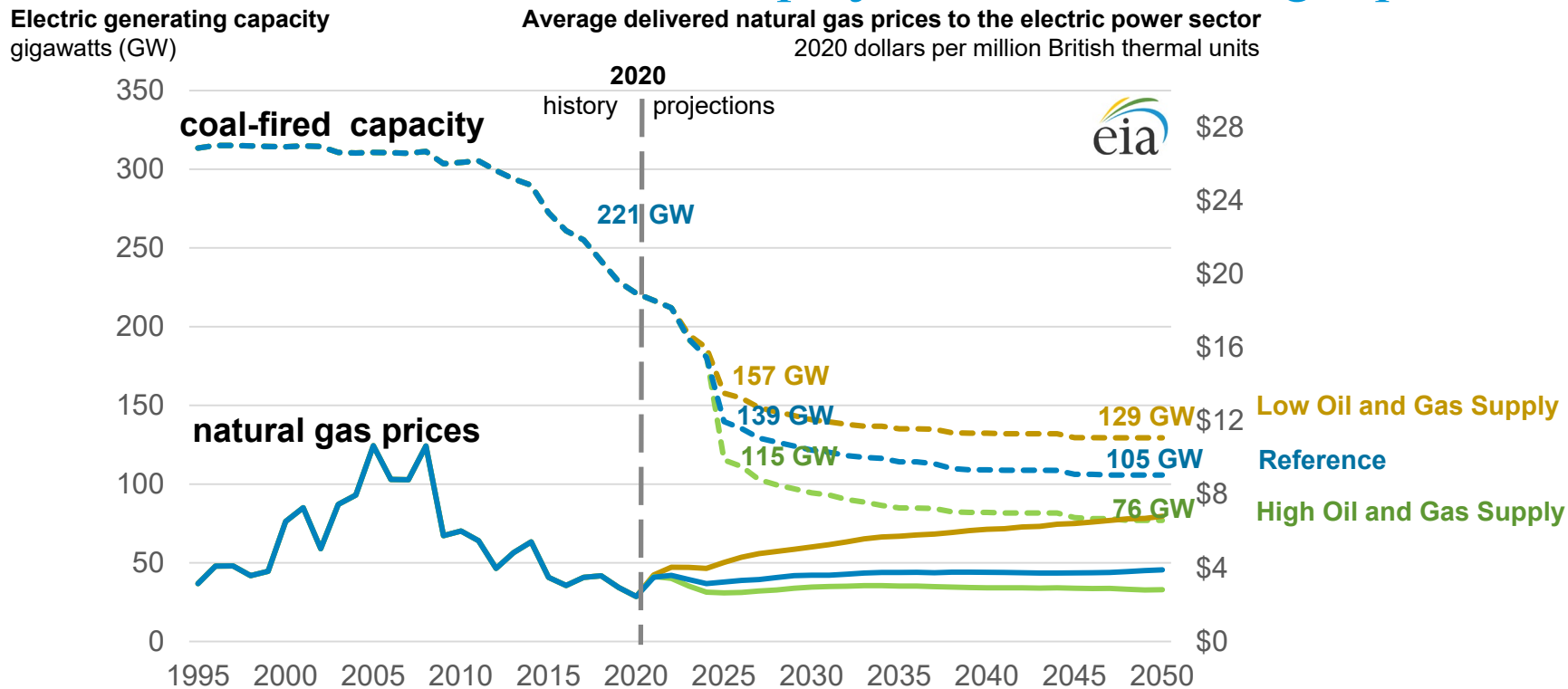
Coal exports
billion short tons



Source: U.S. Energy Information Administration, International Energy Outlook 2019.

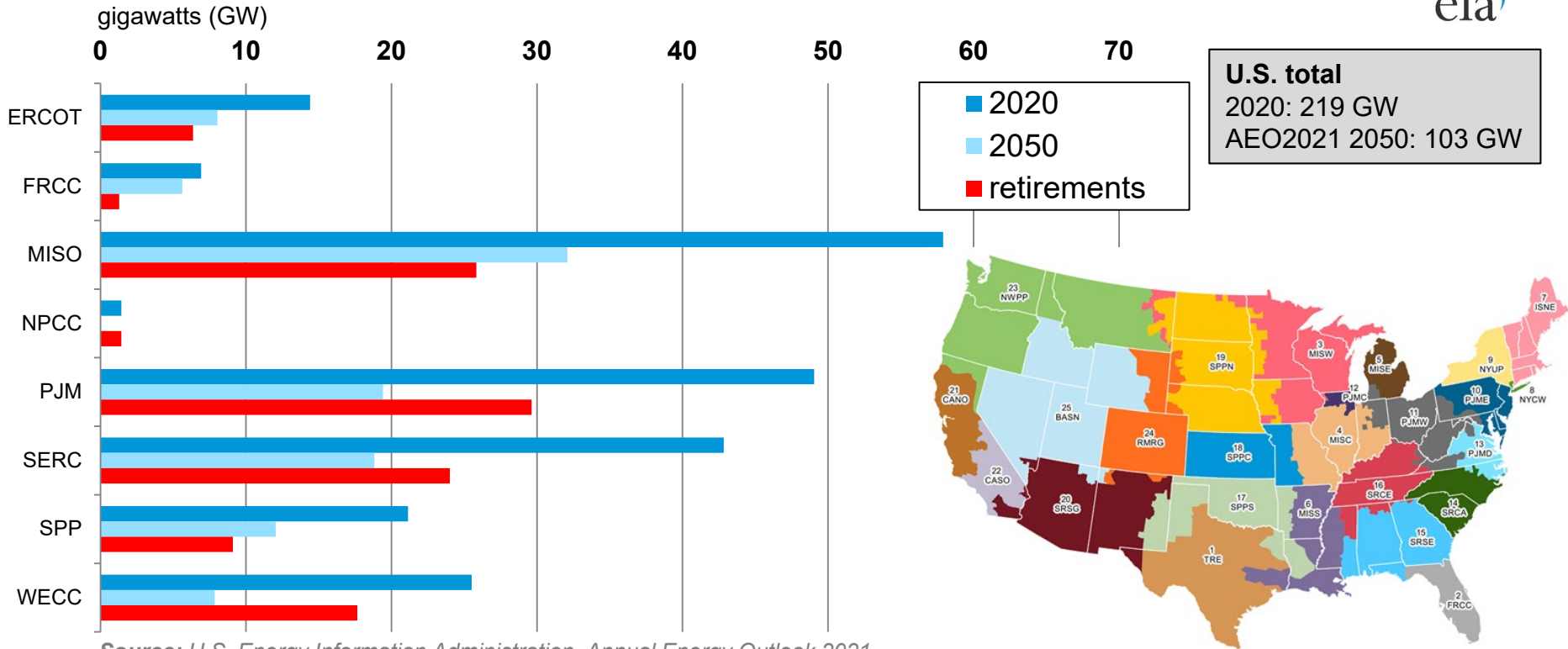
AEO2021 results with emphasis on coal

Coal-fired generating capacity decreases through 2025 in all AEO side cases and is sensitive to the projection for natural gas prices



Source: U.S. Energy Information Administration, Annual Energy Outlook 2021.

Net summer coal-fired generating capacity in the electric power sector declines disproportionately by region in the AEO2021 Reference case

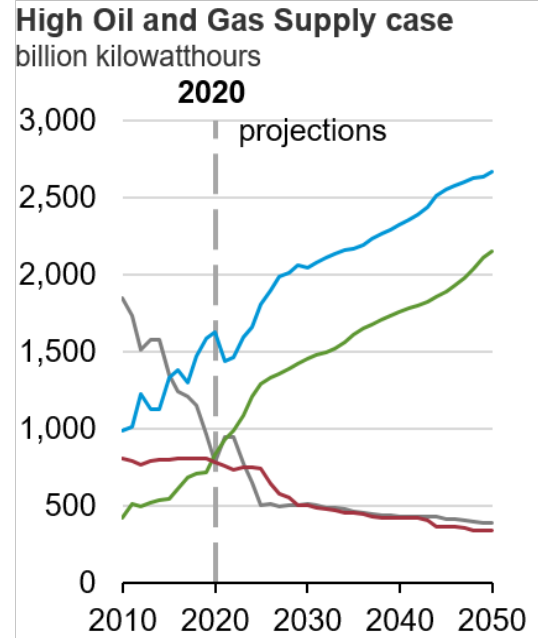
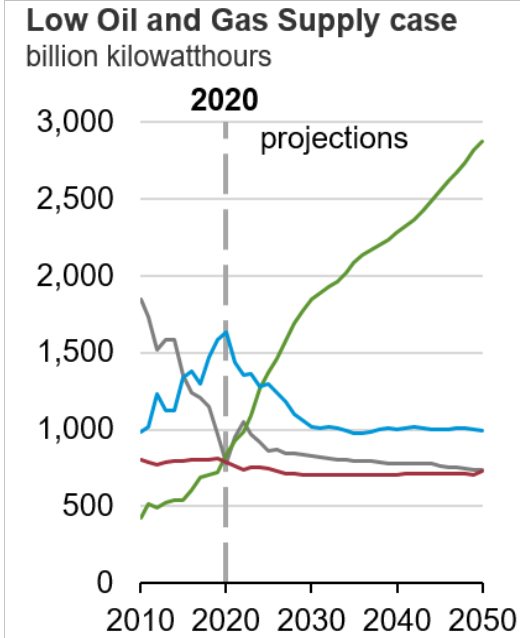
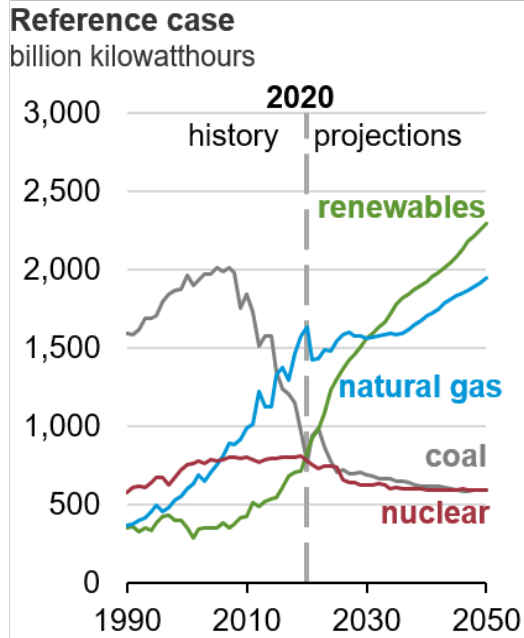


Source: U.S. Energy Information Administration, Annual Energy Outlook 2021.

Electricity generation increases by one-third; natural gas prices influence competition with renewables



U.S. electricity generation, AEO2021 oil and gas supply cases



Source: U.S. Energy Information Administration, Annual Energy Outlook 2021.



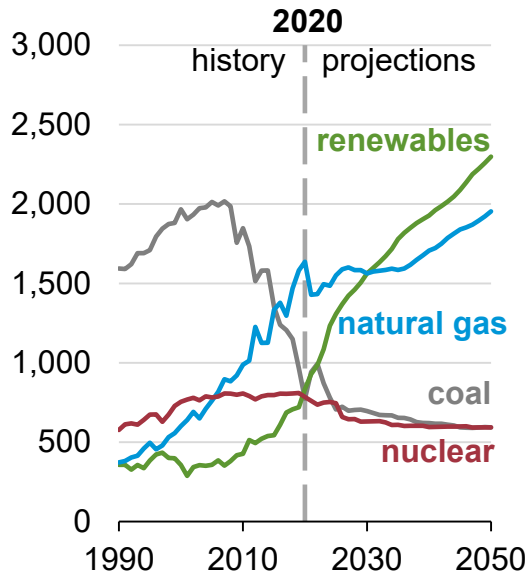
Natural gas-fired generation and renewables substitute for each other; coal and nuclear generation declines in Low Renewables Cost case

All-sector electricity generation from selected fuel by case, 2010–50

billion kilowatthours

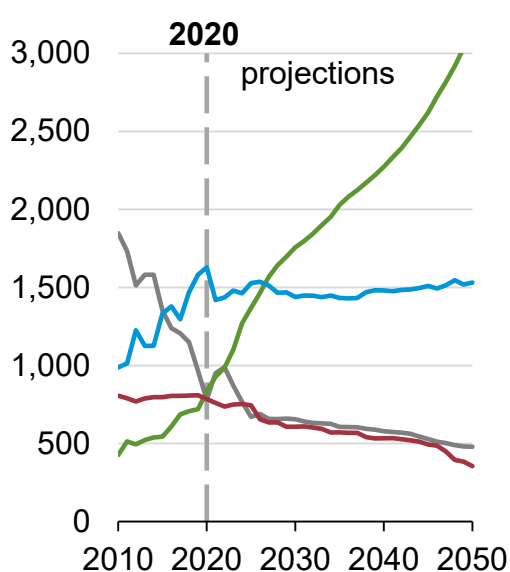
Reference case

billion kilowatthours



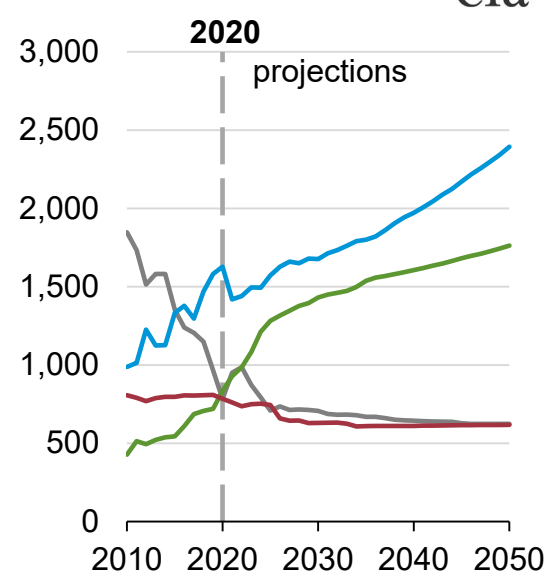
Low Renewables Cost case

billion kilowatthours



High Renewables Cost case

billion kilowatthours



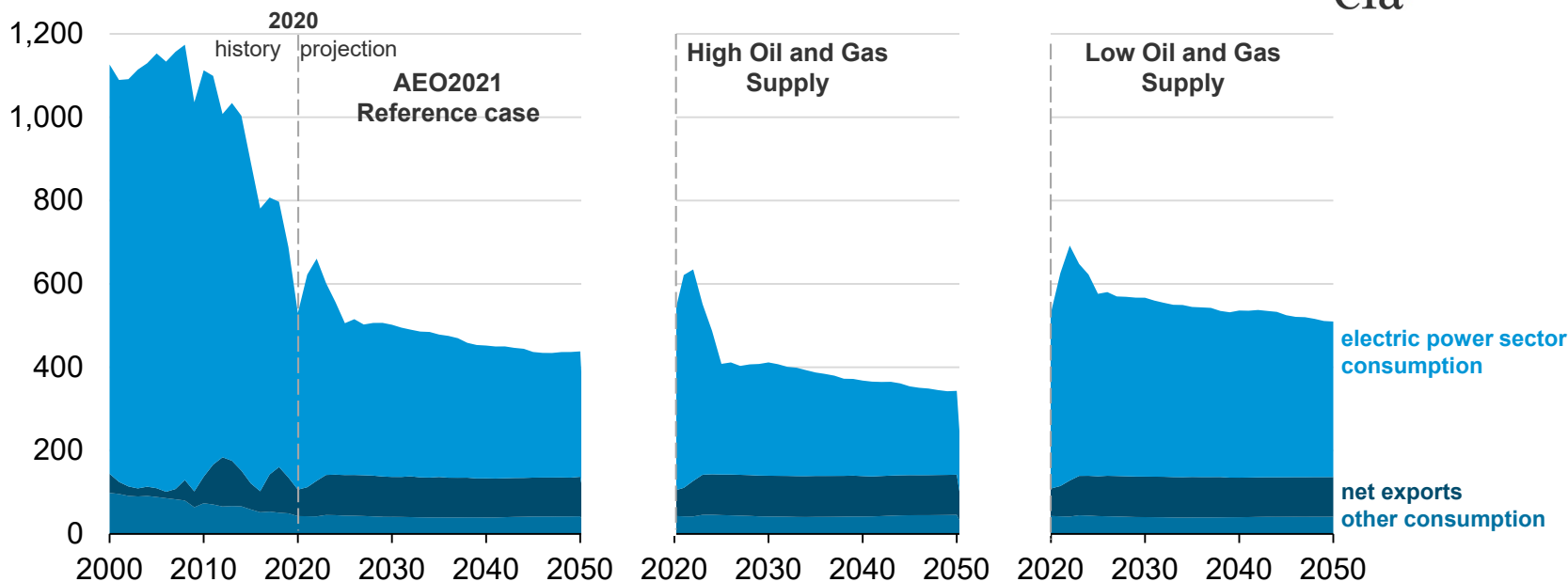
Source: U.S. Energy Information Administration, Annual Energy Outlook 2021

Electricity sector consumption drives total U.S. coal disposition with stable industrial demand and slowly increasing export demand



U.S. coal consumption and net exports

million short tons



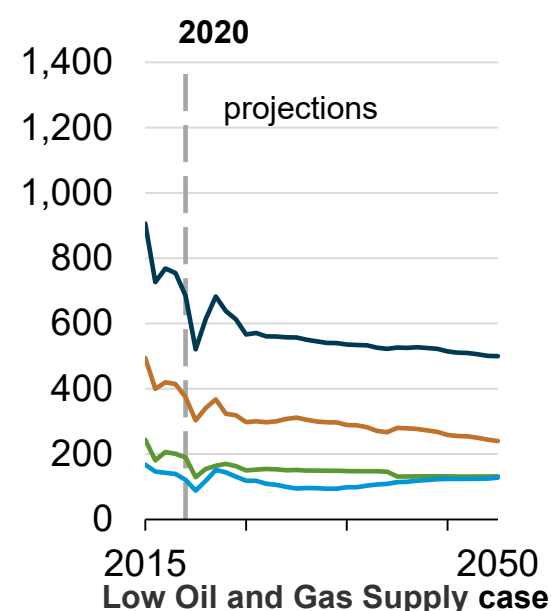
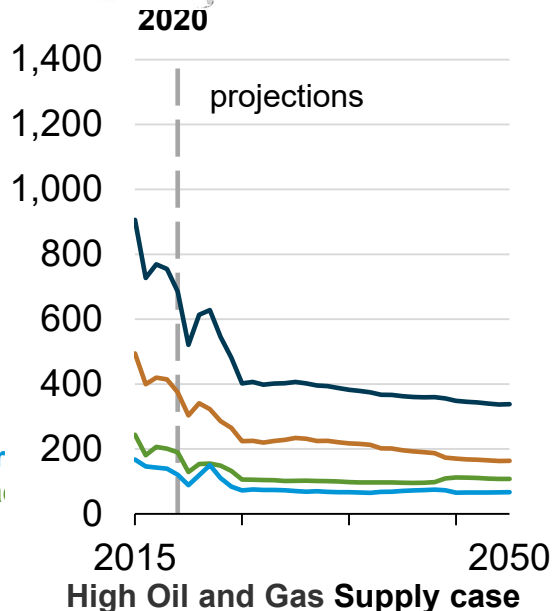
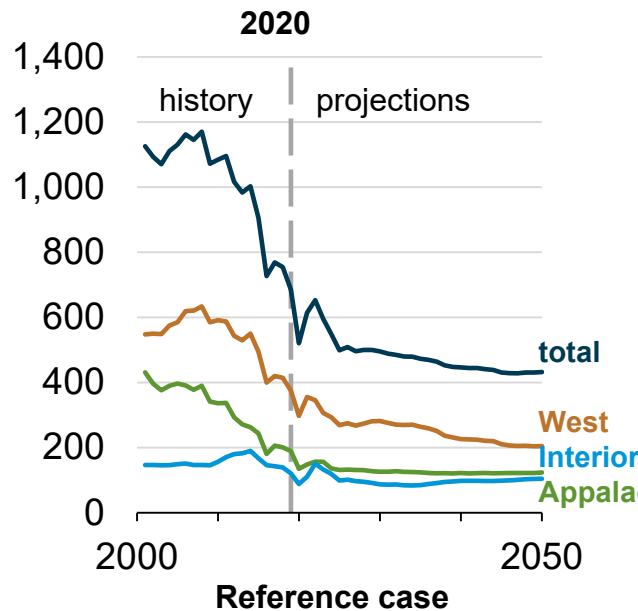
• Source: U.S. Energy Information Administration, Annual Energy Outlook 2021.



Coal production decreases through 2025 as a result of retiring coal-fired electric generating capacity, but federal rule compliance and higher natural gas prices lead to coal production leveling off

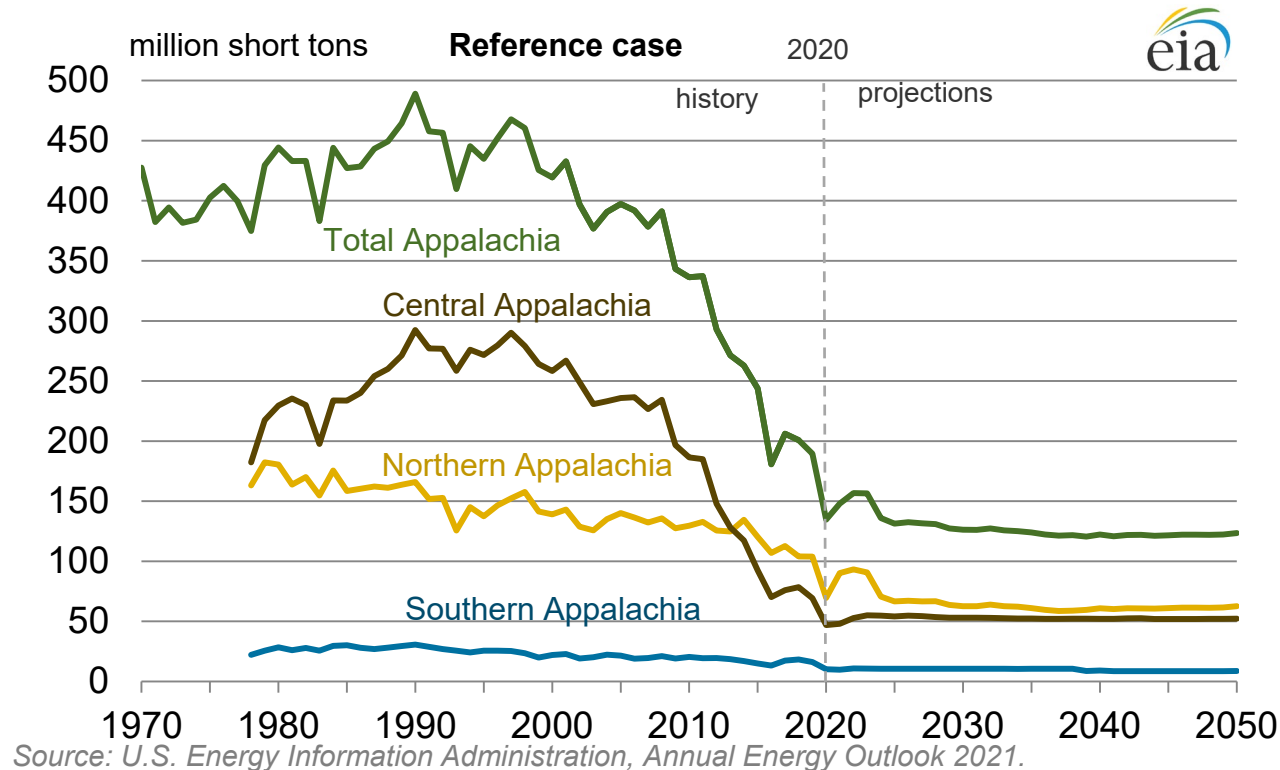


AEO2020 coal production by region
million short tons



Source: U.S. Energy Information Administration, Annual Energy Outlook 2021.

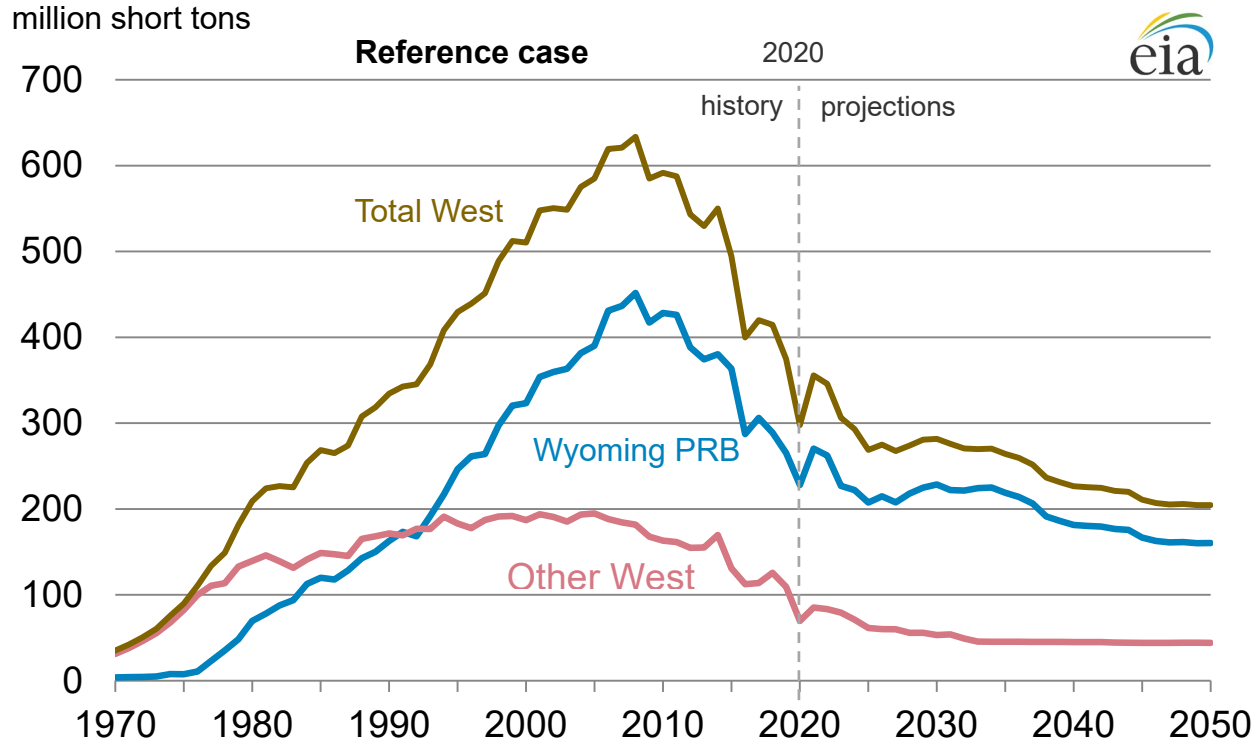
Appalachian coal production significantly declines through 2020, although eastern coal exports provide some support through 2050



Source: U.S. Energy Information Administration, Annual Energy Outlook 2021.

[Hyperlink to detailed regional coal production in the AEO Interactive browser.](#)

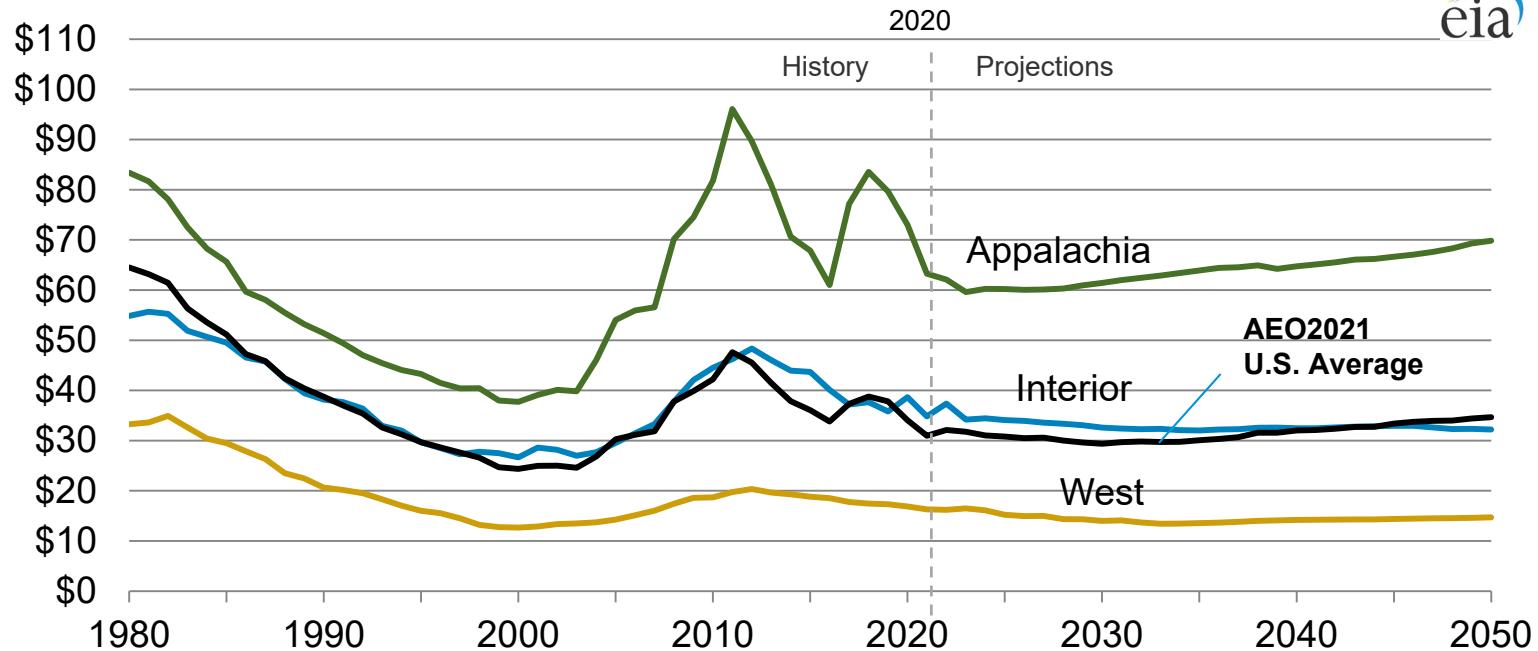
Western coal production has declined at its fastest rate since 2009



Source: U.S. Energy Information Administration, Annual Energy Outlook 2021.

Average U.S. minemouth coal prices remain relatively stable in light of declining production volumes

2019 dollars per short ton

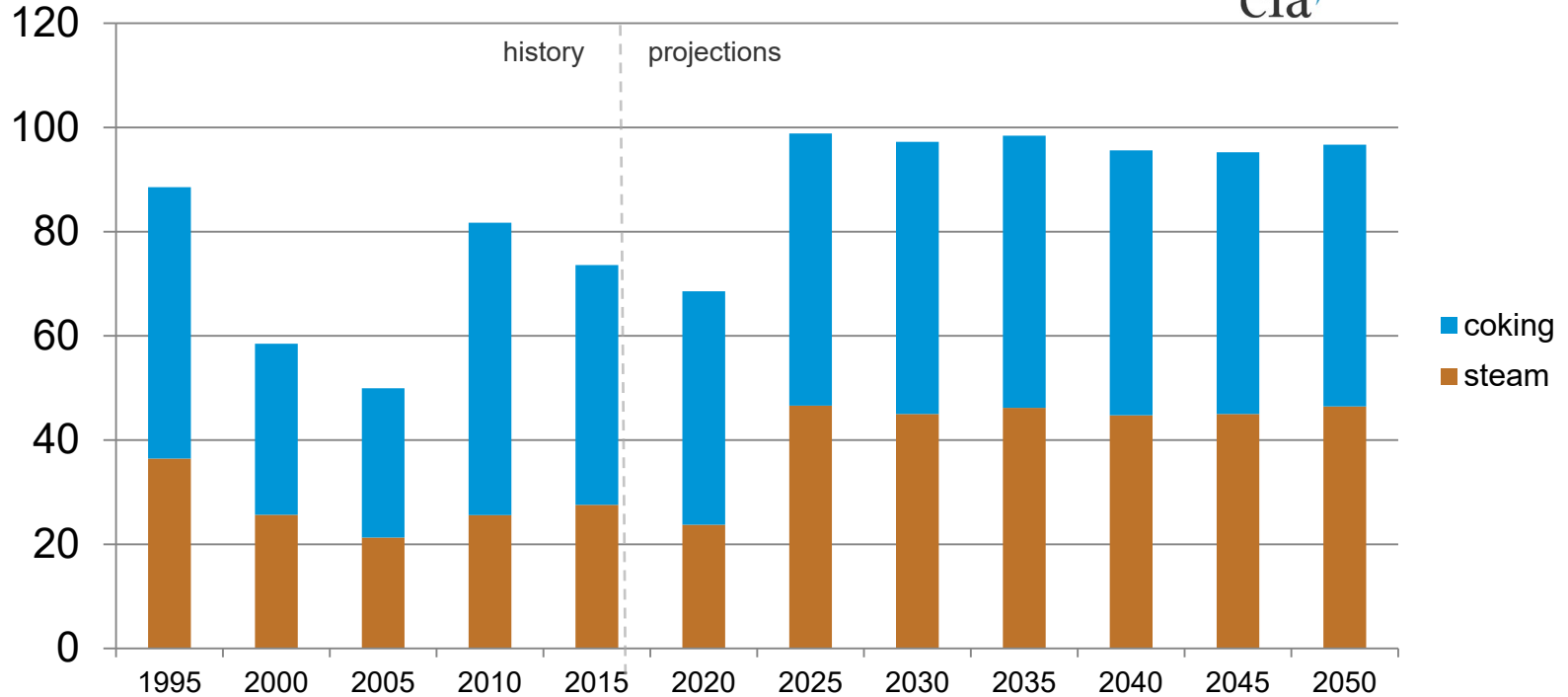


Source: U.S. Energy Information Administration, Annual Energy Outlook 2021.

[Hyperlink to EIA Interactive AEO Table Browser](#)

U.S. coal exports driven by strong demand for coking coal for steel production

million short tons



Sources: U.S. Energy Information Administration (EIA); Projections – U.S. Energy Information Administration, Annual Energy Outlook 2021; History – Quarterly Coal Report.

For more information

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U.S. Energy Information Administration homepage | www.eia.gov

Annual Energy Outlook | www.eia.gov/aeo

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

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

Today in Energy | www.eia.gov/todayinenergy

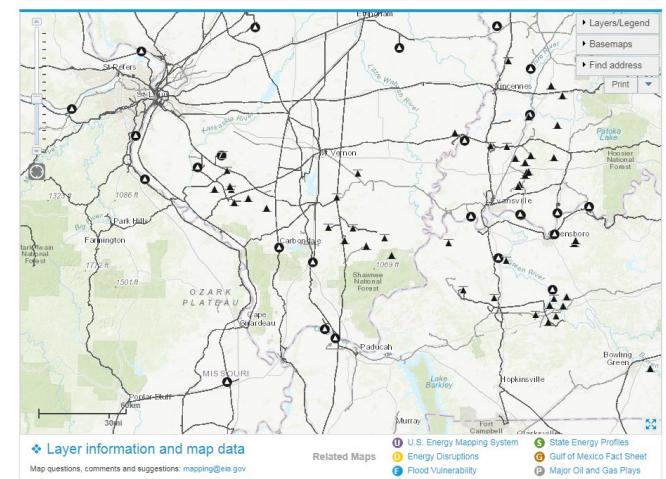
State Energy Profiles | www.eia.gov/state

Coal Data Browser | www.eia.gov/coal/data/browser

U.S. Energy Mapping System | www.eia.gov/state/maps.php?v=Coal

International Energy Portal | www.eia.gov/beta/international/?src=home-b1

U.S. Energy Mapping System



Supplemental Slides

Addressing voluntary commitments to decarbonization and implications for coal retirements

- **No change in EIA precedent:** “current laws and regulations” will remain the basis for input assumptions to Reference Case
- Common question in preceding working groups: How does EIA account for utility plans/commitments to de-carbonize?
 - We view Integrated Resource Plans (IRPs) as more aspirational and thus not appropriate to model
 - Increasing number and specificity of decarbonization announcements may indicate a move toward implementation
- We are considering different approaches to if and how to incorporate IRP statements into modeling
- We completed supplemental research on announced coal retirements during the past year to supplement IRP reviews and help identify additional coal retirements to include in the Reference case

Other federal legislation affecting coal

- [Coal excise tax rates for the Black Lung Disability Trust Fund](#) increased as of January 1, 2020 to \$1.10 per ton for underground, and to \$0.55 for surface-mined coal, or 4.4% of the sales price, whichever is lower (not applicable to lignite coal and coal intended for export). These rates expired on December 31, 2020 and returned to \$0.55 and \$0.25 per ton, or 2% of the sales price, whichever is lower.
- Section 45Q tax credit for Carbon Capture and Storage (CCS) is included in the AEO, which may have indirect implications for coal under certain market conditions
 - Per the Bipartisan Budget Act of 2018, rates are \$50 per metric ton of CO₂ for secure geologic storage, and \$35 per metric ton of CO₂ for enhanced oil or gas Recovery (EOR/EGR) or utilization projects initiated before January 1, 2024, and for the first 12 years of operation
 - The modeling of CCS and 45Q occurs in the Electricity Market Module (EMM); Capture, Transport, Utilization and Storage Module (CTUS); and the Oil and Gas Supply Module (OGSM)