



Annual Energy Outlook 2025 Working Group Meeting for Electricity, Renewables, Coal, and Nuclear

Preliminary Results

*EIA Electricity, Coal, and Renewables Long-Term Modeling Team
November 12, 2024 | Washington, DC*

Meeting Overview

- Review of current laws and regulations and key model developments
- Discussion of preliminary results for *Annual Energy Outlook 2025* (AEO2025) Reference case, which includes partial impacts of the U.S. Environmental Protection Agency's (EPA) final Clean Air Act Section 111 ruling
- Additional core side cases to be published (not discussed today):
 - High and Low Oil Prices
 - High and Low Economic Growth
 - High and Low Resource and Supply
 - High and Low Zero-carbon Technology Cost, including electrolyzer
 - Side cases for Issues in Focus articles (to be determined)

Review of current laws and regulations and key model developments

Updated Legislation and Regulations (as of October 1, 2024)

- Inclusion of energy communities for zero-emission capacity additions (part of the Inflation Reduction Act [IRA])
- EPA's Clean Air Act Section 111 for greenhouse gas emissions regulation as finalized in May 2024
- Clean Energy Standards update, with additional 12.4 gigawatts (GW) of mandated battery storage capacity and 21.5 GW of offshore wind capacity through 2050
 - Michigan: 100% CES by 2040, changed from 1.5% annual increase in renewable generation
 - Minnesota: 100% clean energy by 2040 with interim goal of 55% renewables by 2035
 - Illinois: 100% clean energy set as executive order
 - Delaware: inclusion of 100% reduction GHG emissions from power sector
 - Pennsylvania: 100% clean energy by 2050 executive order

EPA's Clean Air Act Section 111 Final Ruling

111(d) Existing Source Performance Standards

- Existing coal-fired steam generators:
 - Convert to natural gas by Jan 1, 2030, or retire
 - Retrofit remaining units with carbon capture and storage (CCS) by 2032
 - *Represent coal/gas cofiring compliance option by identifying current cofiring units and allowing option to retrofit (in progress)*
- Existing oil/natural gas-fired steam generators:
 - Assume no change in operation necessary

111(b) New Source Performance Standards

- New natural gas combined-cycle (NGCC) starting in 2029 and beyond:
 - Restrict new NGCC units without CCS built after 2025 to 40% maximum capacity factor, or
 - Must have CCS to operate above 40%
 - Model NGCC with hydrogen as a compliance option (future development)
- New natural gas simple-cycle combustion turbines:
 - As of 2029, units built after 2024 will have a 20% capacity factor limit

Key Data Updates and Model Developments for AEO2025 in Electric Power Sector

- Updated capital cost and performance characteristics for electric power generating technologies
 - Includes technologies with significant historical and recent additions (combined cycle, wind, solar), as well as technologies with few installations (nuclear, CCS)
- Updated CCS retrofit costs for coal and natural gas combined-cycle power plants and conversion cost for coal-to-gas power plant
- Wind and solar resource supply curves reassessment of available land and resources with the Energy Communities analysis
- Updated end-use load shapes using NREL's 2018 ResStock and ComStock
- Inclusion of new load shapes for and accounting of consumption for electric vehicles at point of charging
- Restructured/reduced coal supply region

Key Data Updates and Model Developments for AEO2025 (cont'd)

- Addition of biomass energy with carbon capture and sequestration (BECCS) technology to capacity expansion technology options
- Inclusion of Palisades Nuclear Plant restart
- Endogenous phase-out of IRA tax credits when emissions reduced to 25% of 2022 level
- Updated interactions with the new Hydrogen Market Module (HMM) and Carbon Capture Allocation Transportation and Sequestration (CCATS) Module
 - Provide data inputs needed by the other modules to calculate IRA Section 45V and 45Q tax credits

Preliminary Results for AEO2025

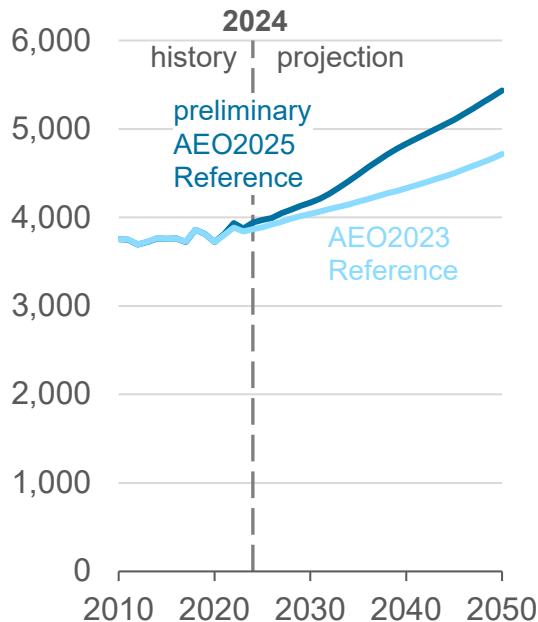
Summary of Preliminary Results

- Current laws and regulations drive growing shares of renewables in the generation mix to above 60% in 2050, as coal and natural gas shares decline over time
 - Higher demand compared with AEO2023
 - Increased projection of wind capacity expansion with updated wind resource
 - Higher natural gas price projection than AEO2023 in addition to lower capital cost assumptions
- Implementation of 111 results in coal power plants retiring completely by 2033
 - Low coal CCS retrofit expected in the preliminary Reference case
 - Some CCS capacity for natural gas combined-cycle
- Average all-sector electricity prices expected to be similar to AEO2023 as the impact of higher natural gas prices are offset by higher generation from renewables in the mix
- Additional model developments in other modules, particularly in the Transportation Demand Module, could have sizeable impact on the results discussed here

Demand higher compared with AEO2023 and includes consumption for electric vehicle at point of charging

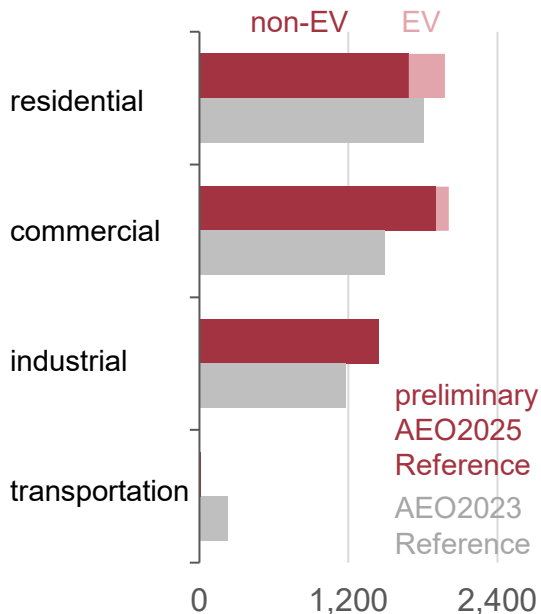
Electricity sales, all sectors

billion kilowatthours



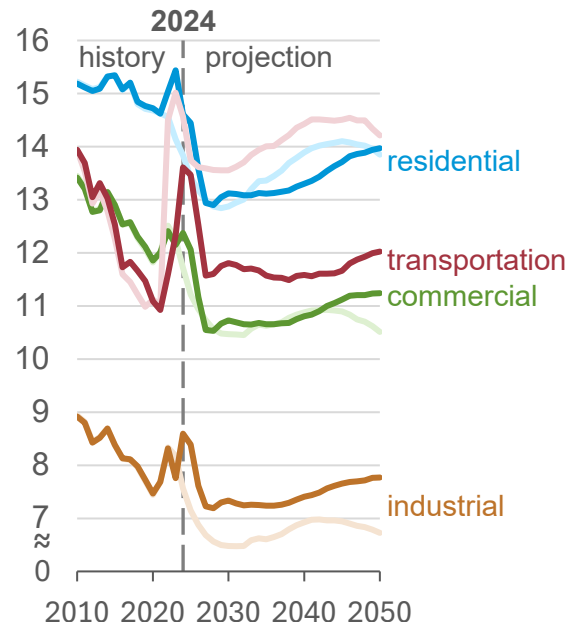
Electricity sales by sector, 2050

billion kilowatthours



Electricity prices by sector

2022 cents per kilowatthour

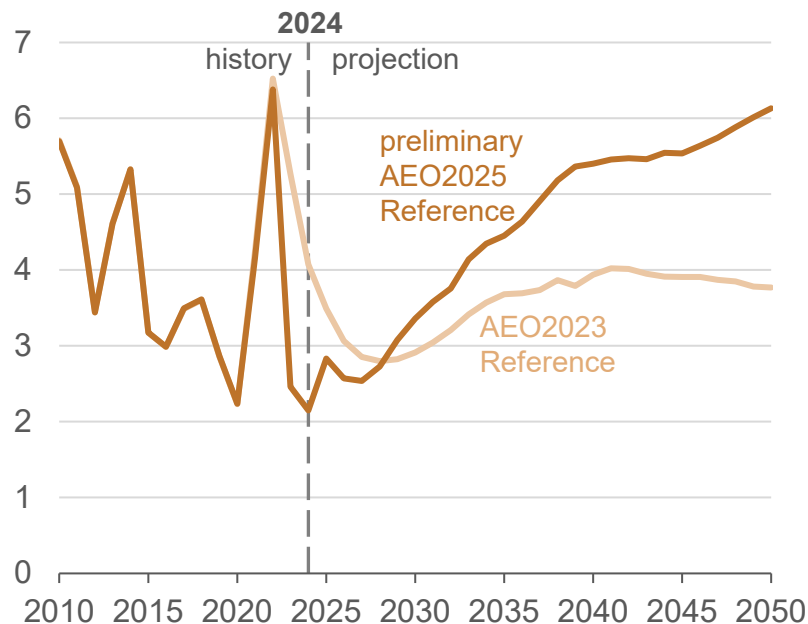


Data source: U.S. Energy Information Administration, Annual Energy Outlook 2023 and ref_clgs111.3.1030a

Natural gas price expected to be lower in near-term but trend higher in long-term; coal price stays consistently higher

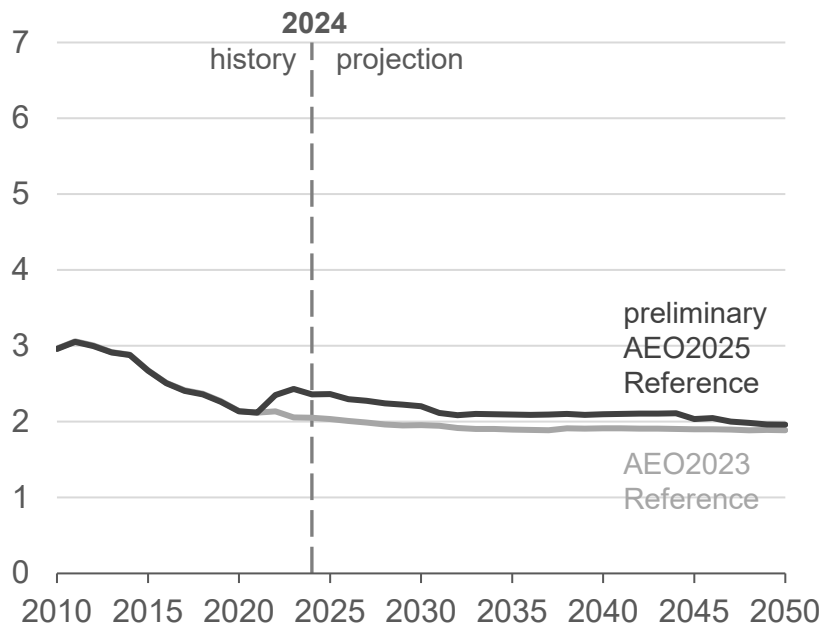
Natural gas spot price at Henry Hub

2022 dollars per million British thermal units



Delivered coal prices to power sector

2022 dollars per million British thermal units

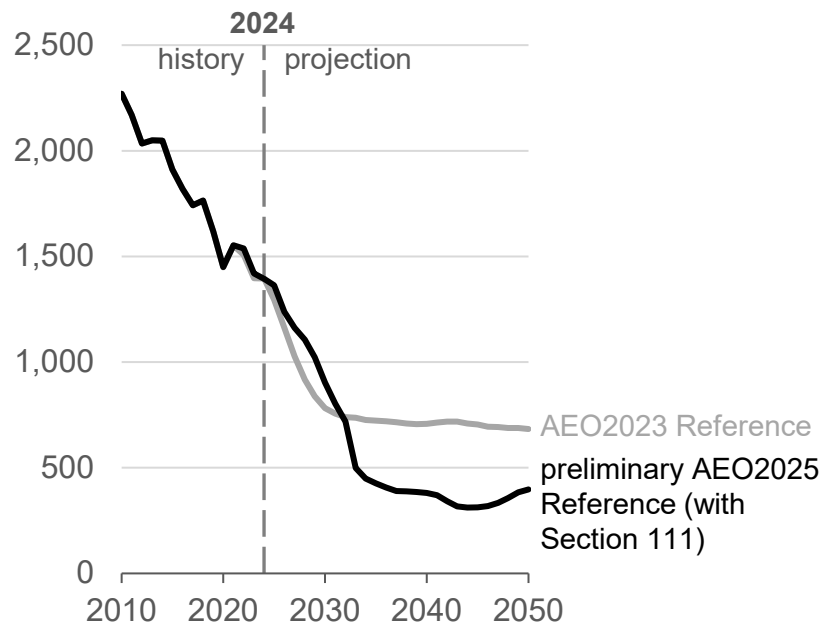


Data source: U.S. Energy Information Administration, Annual Energy Outlook 2023 and ref_clgs111.3.1030a

Energy-related CO₂ emissions continue to decline but reach 75% reduction from 2022 level with Section 111

Energy-related carbon dioxide emissions (power sector)

billion metric tons of carbon dioxide



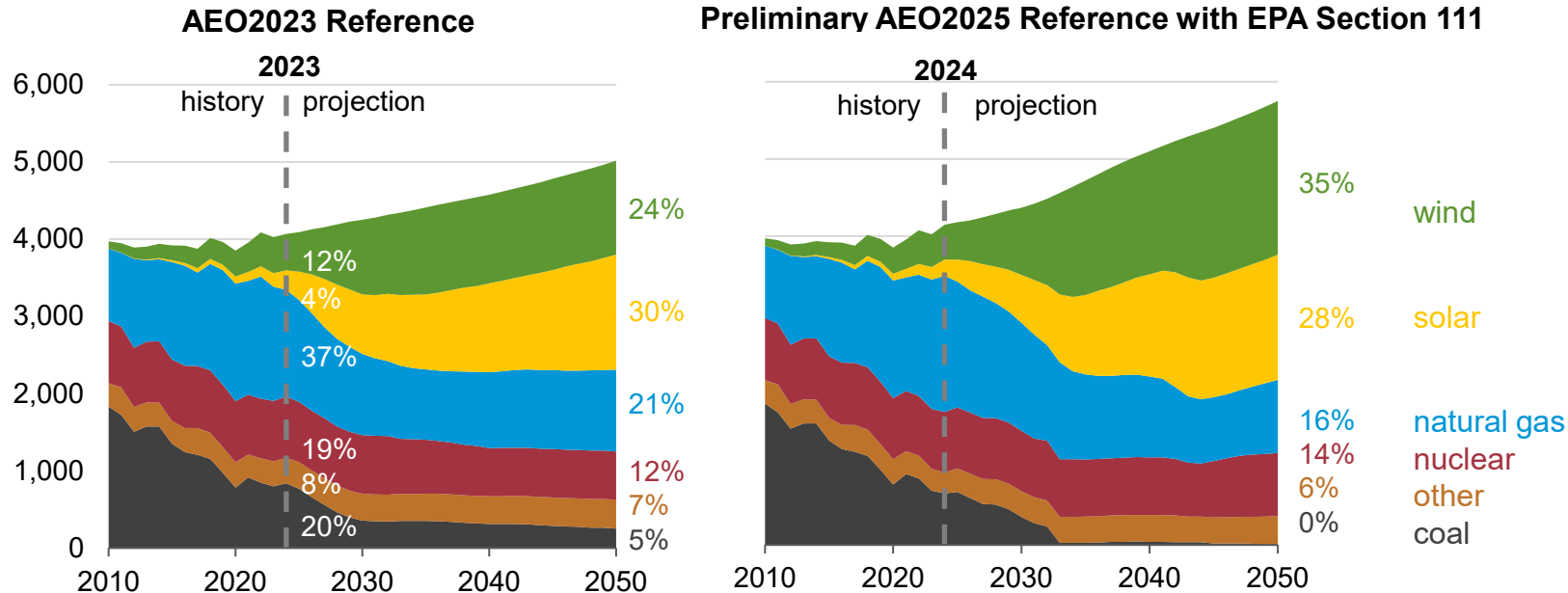
- Energy-related CO₂ emissions from the power sector in 2022 are 1,539 MMmt.
- Reduction to 25% of the 2022 level projected to occur with Section 111.
- Preliminary results still pending additional model changes, particularly in consumption from electric vehicles.

Data source: U.S. Energy Information Administration, [Monthly Energy Review \(October 2024\)](#)

Solar, wind, and nuclear generation increases to offset loss in coal generation under Section 111

Power sector generation

billion kilowatthours



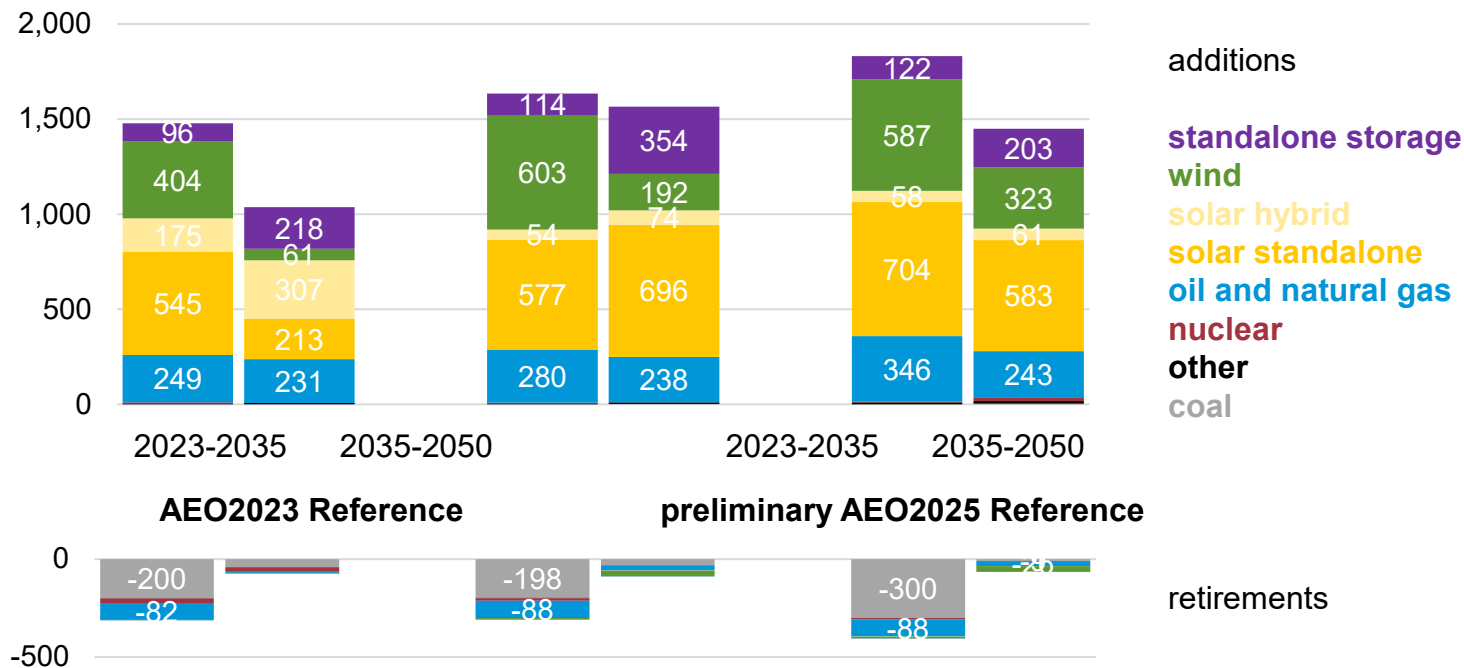
Data source: U.S. Energy Information Administration, Annual Energy Outlook 2023 and ref_clgs111.3.1030a

Note: EPA=U.S. Environmental Protection Agency

Higher capacity additions in the near- to mid-term to mostly offset coal retirements; later additions to meet incremental demand

U.S. cumulative electricity generating capacity additions and retirements (2023–2050)

gigawatts

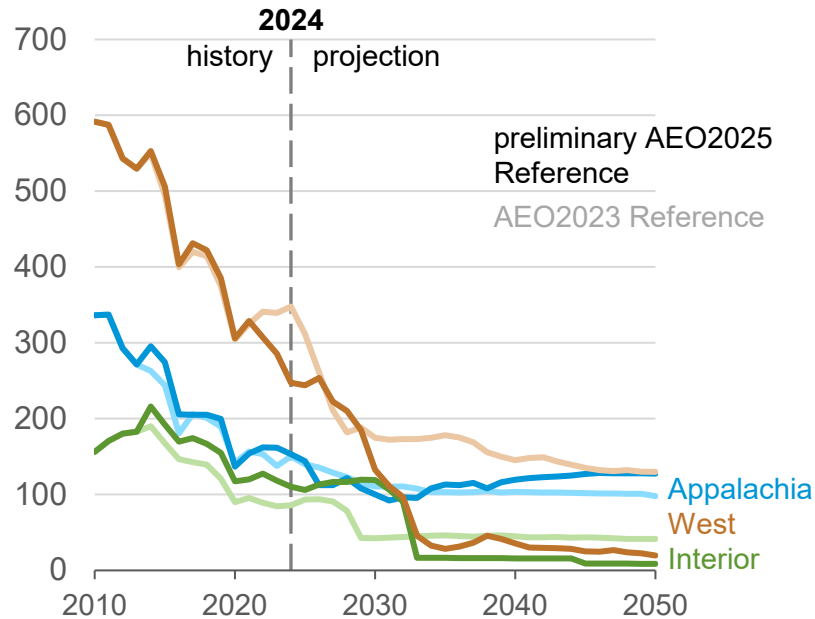


Data source: U.S. Energy Information Administration, Annual Energy Outlook 2023 and ref_clgs111.3.1030a

Coal production declines primarily in West region; exports pick up in long-term from higher international demand

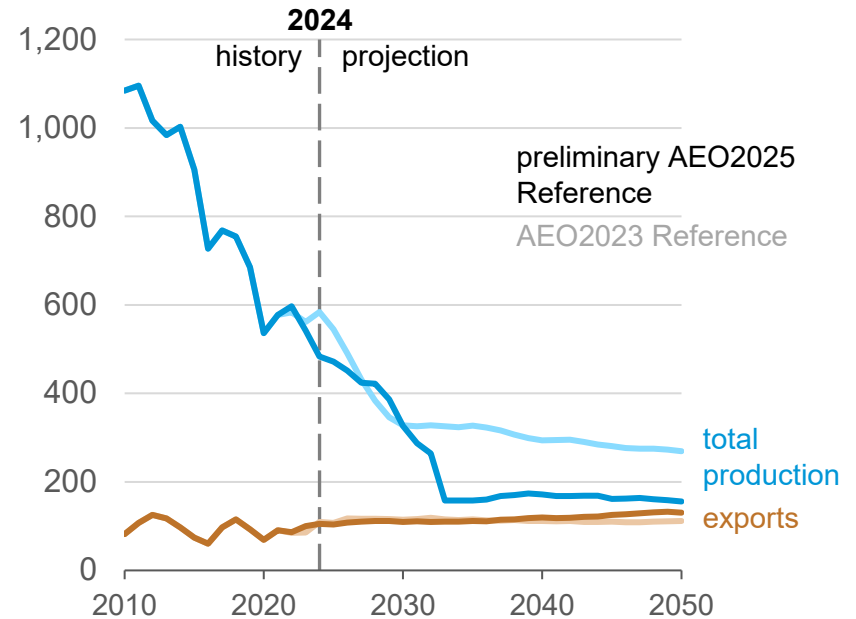
Coal production by region

million short tons



Coal total production and exports

million short tons



Data source: U.S. Energy Information Administration, Annual Energy Outlook 2023 and ref_clgs111.3.1030a

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For more information

U.S. Energy Information Administration home page | www.eia.gov

Annual Energy Outlook | www.eia.gov/aeo

- previous working group information www.eia.gov/outlooks/aeo/workinggroup/

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

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

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International Energy Portal | <http://www.eia.gov/international/overview/world>