

EIA Analysis of Proposed Environmental Policies

**Renewable Portfolio Standards
Clean Energy Portfolio Standards
Greenhouse Gas Cap and Trade Systems**

October 17, 2007



Energy Information Administration

- Independent statistical agency within the Department of Energy
 - www.eia.doe.gov
- Produce monthly short-term and annual long-term forecasts of U.S. and world energy markets
- Short Term Energy Outlook
 - <http://www.eia.doe.gov/emeu/steo/pub/contents.html>
- Annual Energy Outlook, 2007
 - <http://www.eia.doe.gov/oiaf/aeo/index.html>
- International Energy Outlook, 2006
 - <http://www.eia.doe.gov/oiaf/ieo/index.html>
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EIA Environmental Policy Analyses

- Proposal requiring 25 percent renewable fuels in the motor vehicle transportation and electricity markets by 2025
- Analysis of S. 280, the Climate Stewardship and Innovation Act of 2007
- Impacts of a 15-Percent Renewable Portfolio Standard, June 2007
- Energy Market Impacts of a Clean Energy Portfolio Standard – Follow-up, February 2007
- Energy Market and Economic Impacts of a Proposal to Reduce Greenhouse Gas Intensity with a Cap and Trade System, January 2007

EIA Environmental Policy Analyses, continued

- Energy and Economic Impacts of H.R. 5049, the Keep America Competitive Global Warming Policy Act, September 2006
- Energy Market Impacts of a Clean Energy Portfolio Standard, June 2006
- Energy Market Impacts of Alternative Greenhouse Gas Intensity Reduction Goals, March 2006
- Impacts of the Modeled Recommendations of the National Commission on Energy Policy, April 2005
- Analysis of Senate Amendment 2028, the Climate Stewardship Act of 2003, May 2004

EIA Environmental Policy Analyses, continued

- Analysis of S. 1844, the Clear Skies Act of 2003; S. 843, the Clear Air Planning Act of 2003; and S. 366, the Clean Power Act of 2003, May 2004
- Analysis of S. 485, the Clear Skies Act of 2003, and S. 843, the Clean Air Planning Act of 2003, September 2003
- Analysis of S.139, the Climate Stewardship Act of 2003, June 2003
- Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity, October 1998
- All available at:
 - http://www.eia.doe.gov/oiaf/service_rpts.htm
 - <http://www.eia.doe.gov/oiaf/analysis.htm>
- Ongoing studies
 - Follow-up analysis of S. 280
 - Analysis of S. 1766, Low Carbon Economy Act of 2007

Focus on Three Policy Instruments

- Renewable Portfolio Standards (RPS)
 - Requires that electricity retail sellers procure a specified share of their sales from qualified renewable generators – generally non-hydroelectric renewables. Operates as a credit trading system where sellers can generate or purchase their own qualifying renewable generation or purchase credits from others who have excess credits.
- Clean Energy Portfolio Standards (CEPS)
 - Same as an RPS but extends the list of qualifying generators to non- or low-carbon emitting technologies like nuclear and fossil technologies with carbon capture and sequestration equipment.
- Greenhouse Cap and Trade Programs
 - Sets an explicit emissions cap on covered entities and allocates or auctions emissions allowances that must be submitted by covered entities for each ton of GHG emissions they emit. Essentially operates like the existing sulfur dioxide (SO₂) emissions program that currently exists for coal power plants.

Energy Market Impacts of a Renewable Portfolio Standard

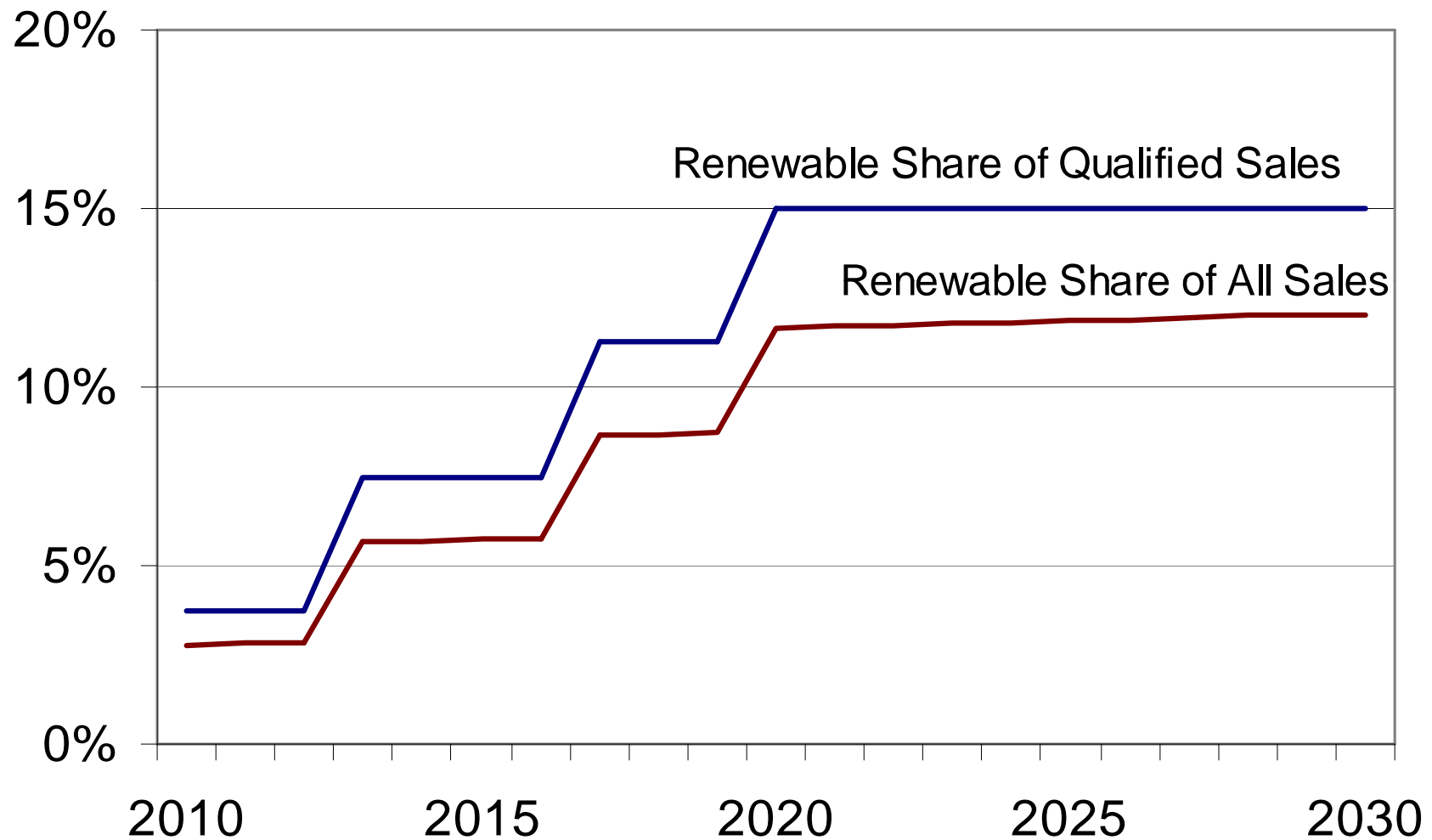
15-Percent RPS Proposal

- Requested by Senator Bingaman
- Requires 15-Percent of Sales be Derived From Renewable Generation by 2020
 - Exempts small utilities with fewer than 4,000,000 megawatthours of sales
 - Existing hydro and MSW generation does not qualify but is excluded from sales base from utilities who generate from them
- Triple credits are given for customer-sited renewables (i.e., distributed renewables like PV). Double credits for resources on Indian Lands.
- Requirement expires in 2030
- Compliance with renewable energy credits
 - Utilities may purchase credits from other generators in lieu of generating with renewable resources
 - Utilities may purchase credits from the government at 1.9 cents per kilowatthour, adjusted for inflation if they are unable to acquire qualifying generation at that price

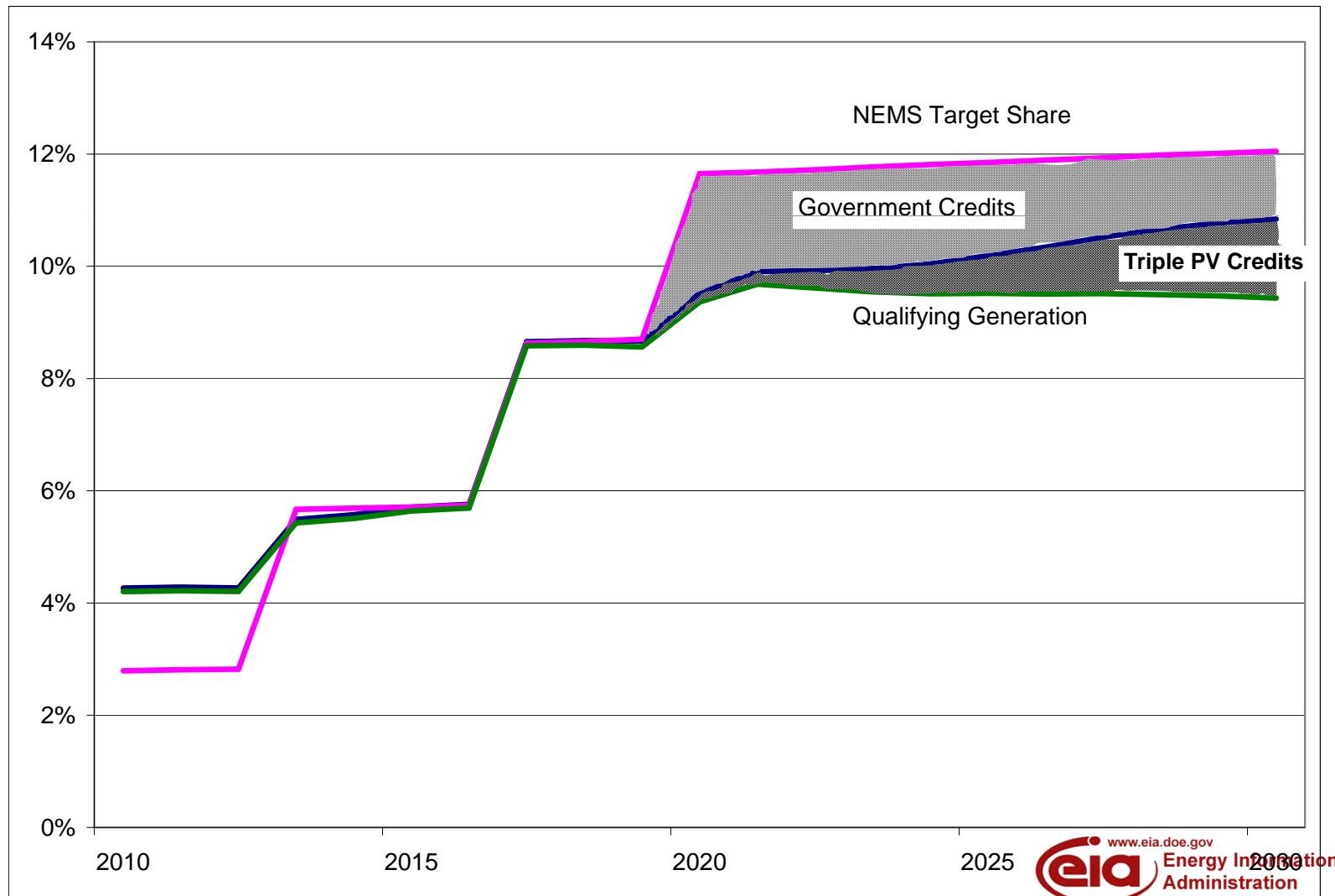
Analysis Methodology

- Analyzed using EIA's National Energy Modeling System (NEMS)
- NEMS is a comprehensive model of the U.S. energy economy through 2030
- Represents supply, demand, and conversion sectors
 - Energy price feedback to macroeconomic parameters
 - Endogenously determined energy prices and quantities
- Not able to model double credits for Indian Lands
- State RPS programs not included in reference case
- Assumes existing laws and regulations including expiration of current production tax credit for certain renewables

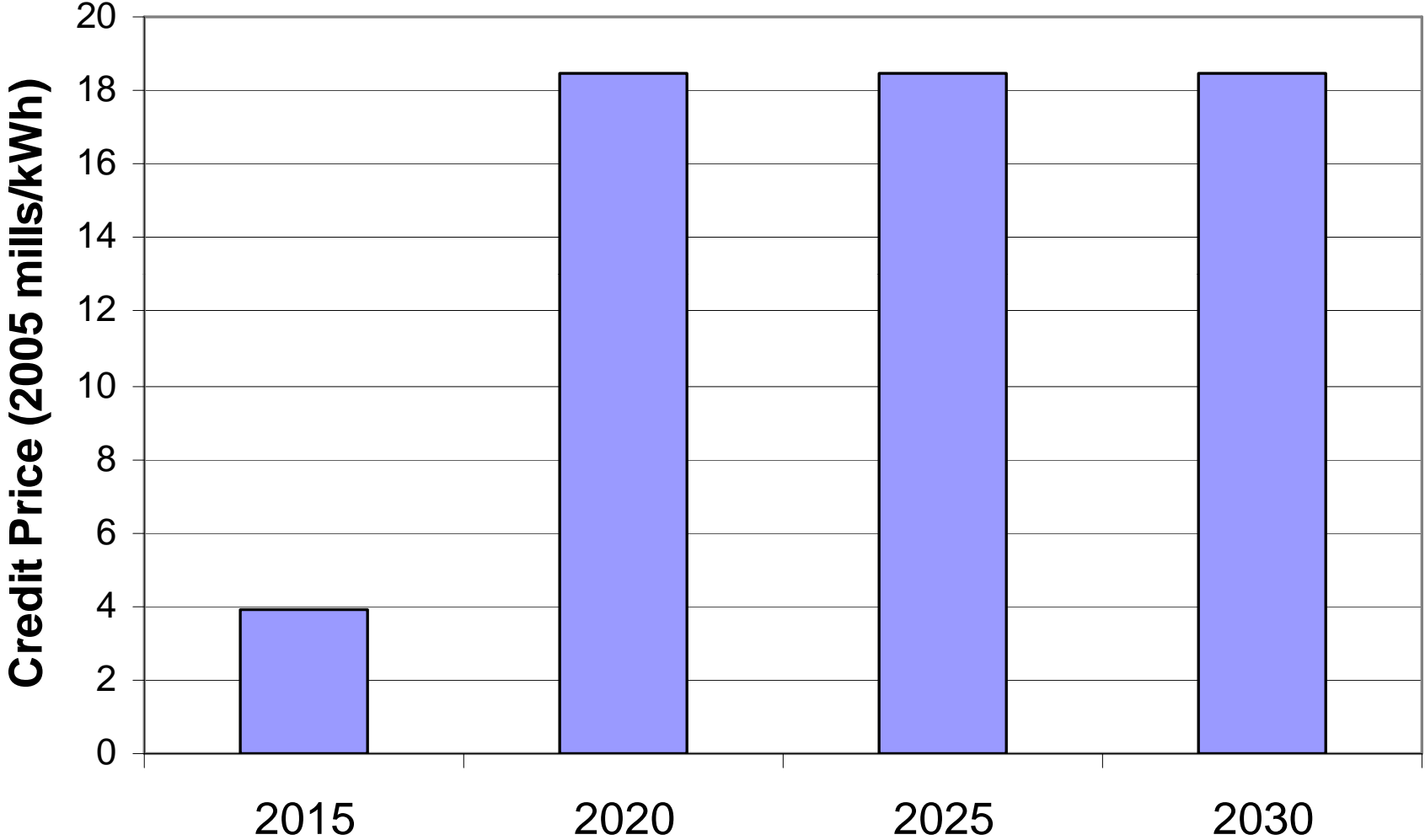
Target Share, Before and After Exclusions



The target is achieved through a combination of renewable generation, bonus credits, and government issued credits

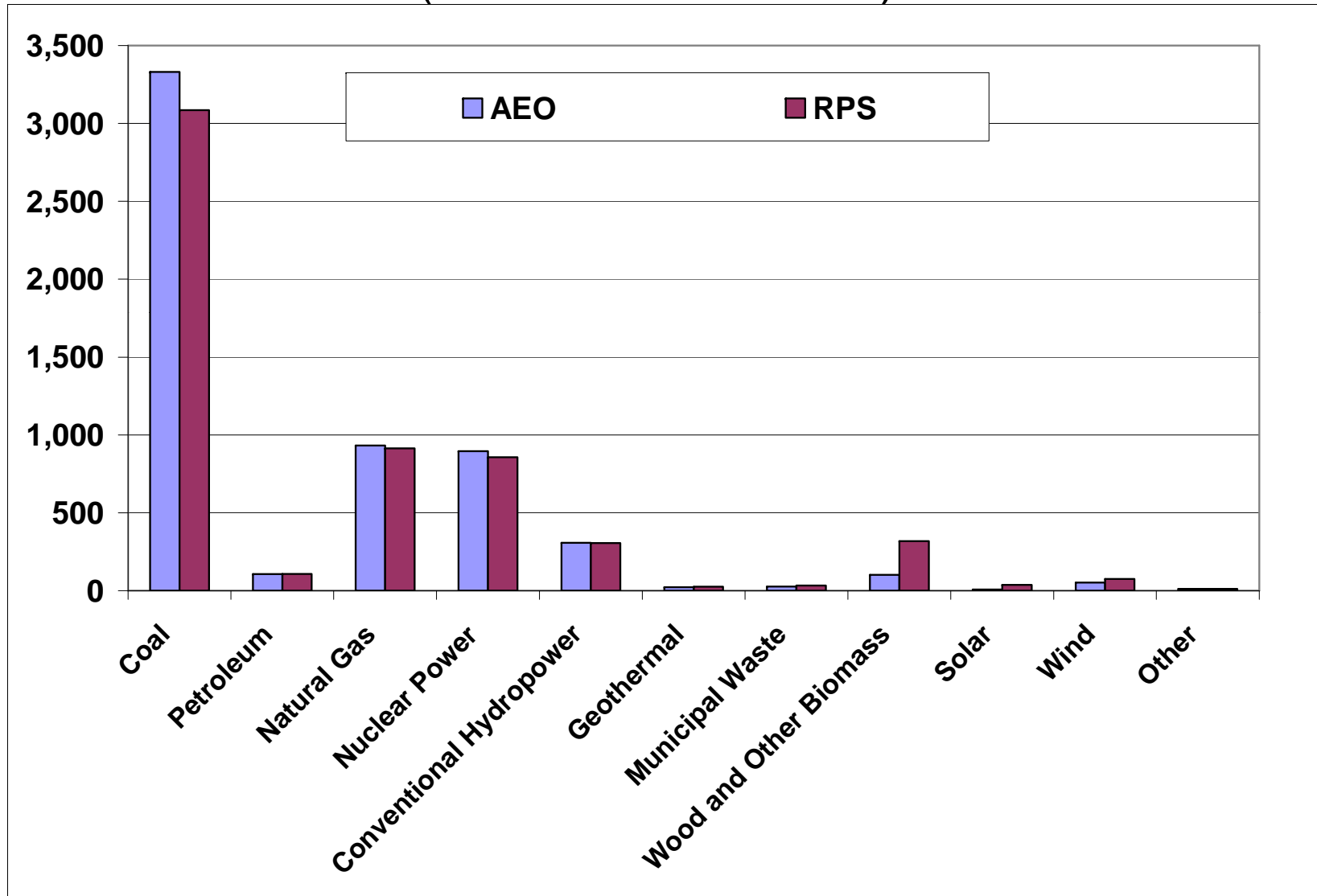


Renewable Credit Prices Limited by Price Cap

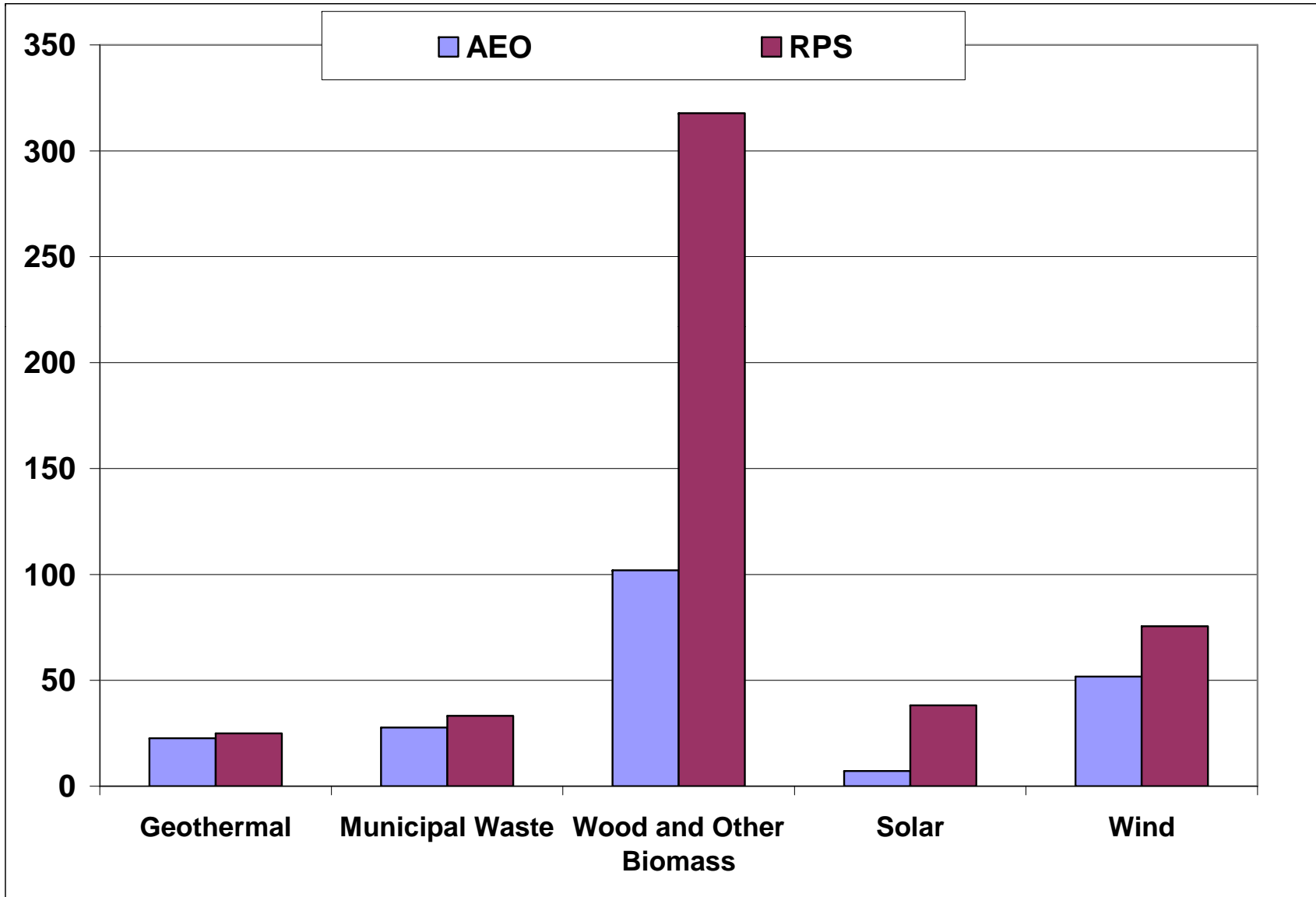


2030 Generation by Fuel

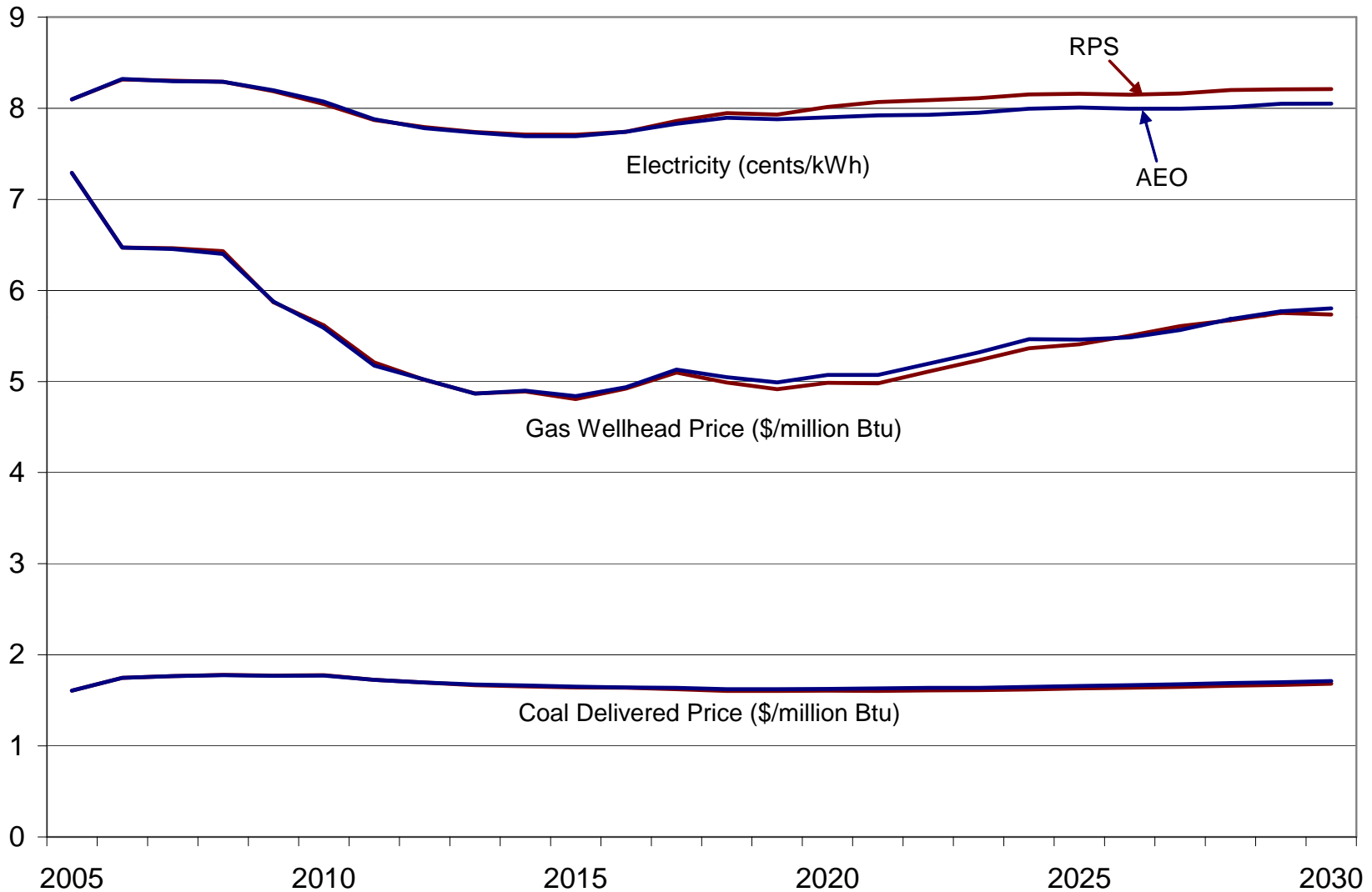
(billion kilowatthours)



2030 Renewable Generation (billion kilowatthour)

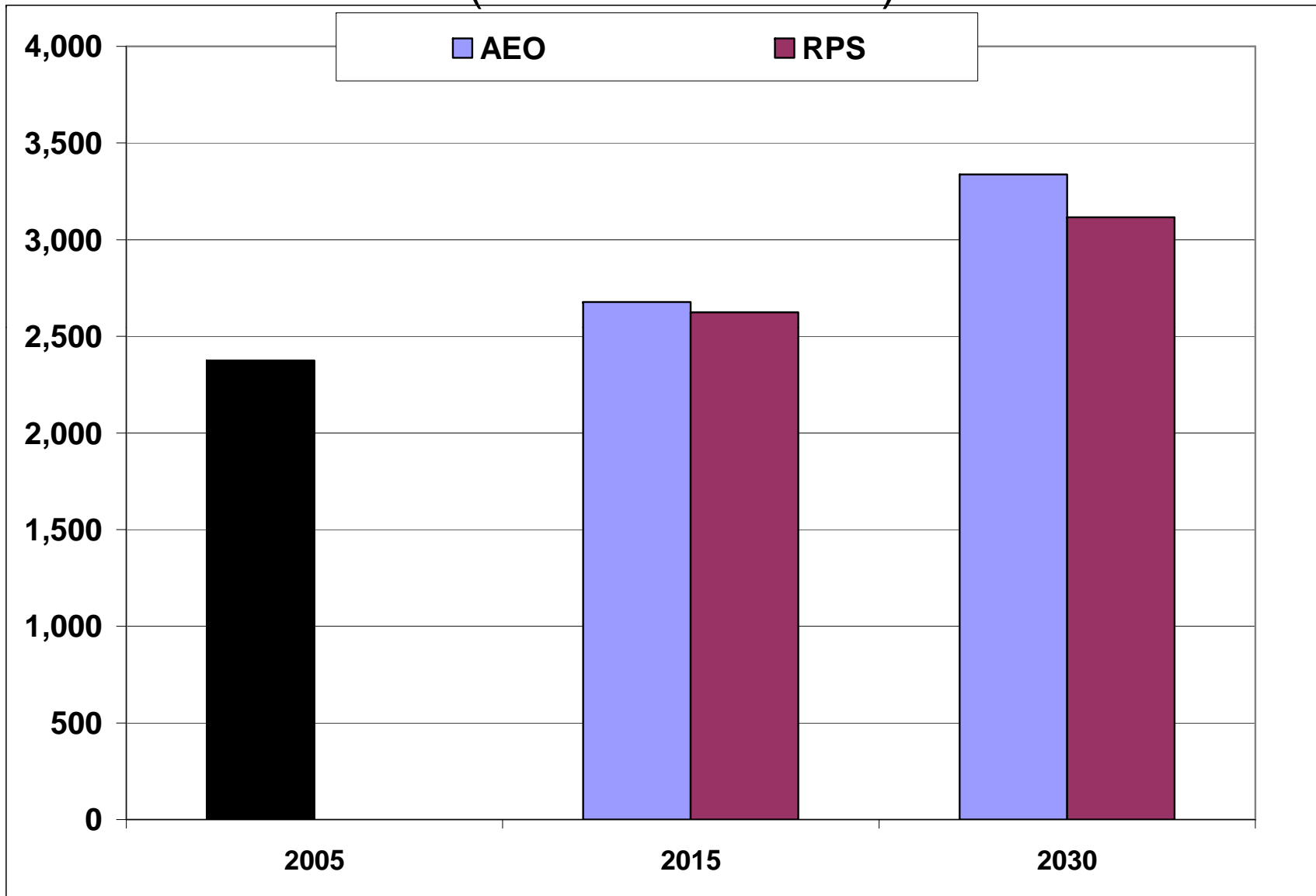


Electricity, Coal and Natural Gas Prices



Carbon Dioxide Emissions

(million metric tons)



Uncertainties

- Indian lands provision
 - Extensive use of Indian lands with double credits could decrease compliance costs, reduce renewable generation stimulated
- Future cost and performance
 - Current costs for all power-sector construction is higher than historical trend
 - Some renewables have little commercial experience
 - Costs tend to be location-specific, and depend on uncertain resource cost and quality
- Natural gas price will affect competitiveness of renewable resources
 - However, the impact may not be intuitive
 - Higher gas prices may make coal the resource of comparison
- Changes in laws and regulations or continuation of existing regulations such as the renewable production tax credit could significantly alter results
- Potential credit price volatility
- Individual utility impacts could be larger

Energy Market Impacts of a Clean Energy Portfolio Standard

CEPS Proposals Analyzed

- Sen. Coleman requested that EIA analyze a proposal requiring an increasing share of carbon-free generation (aka “clean energy”)
- EIA published an analysis of the Senator’s original proposal in June 2006
- The revised analysis was published in January 2007

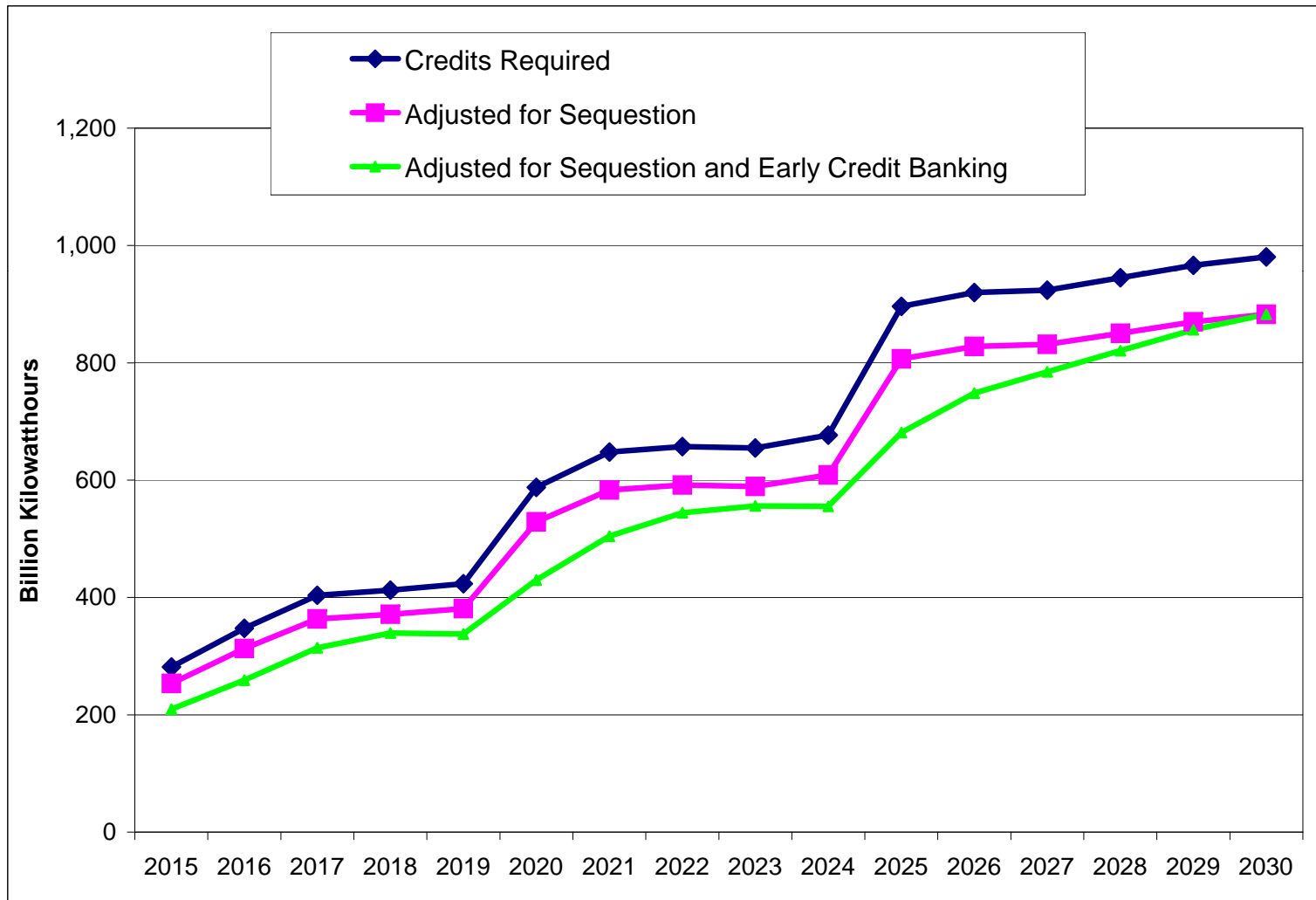
Revised Proposal Details

- Uses total sales as basis for compliance percentages
 - Share required grows from 10% in 2015, to 15% in 2020, and 20% in 2025 and beyond
 - No sunset (20% is “forever after”)
 - Total credits required by a retailer cannot exceed sales growth from baseline (2008-2011)
- Credit value varies by resource
 - Full credit for qualifying renewables
 - Half credit for nuclear generation
 - Credit to plants with carbon capture and sequestration is proportional to carbon removal efficiency
 - Double credit for qualifying generation on Indian lands

Additional Proposal Details

- “Early Action” period allows retailers to “bank” credits for qualifying generation from 2010 to 2014
 - This includes qualifying generation from plants in service prior to 2010
- 2.5 cent per kWh credit price cap (inflation adjusted)
- State RPS credits only count if generation also qualifies for Federal program
 - Does not preempt state requirements or compliance fees/penalties
- Provisions not addressed in analysis
 - Indian lands credit
 - Future credit borrowing
 - Interaction with state programs

Clean Energy Required

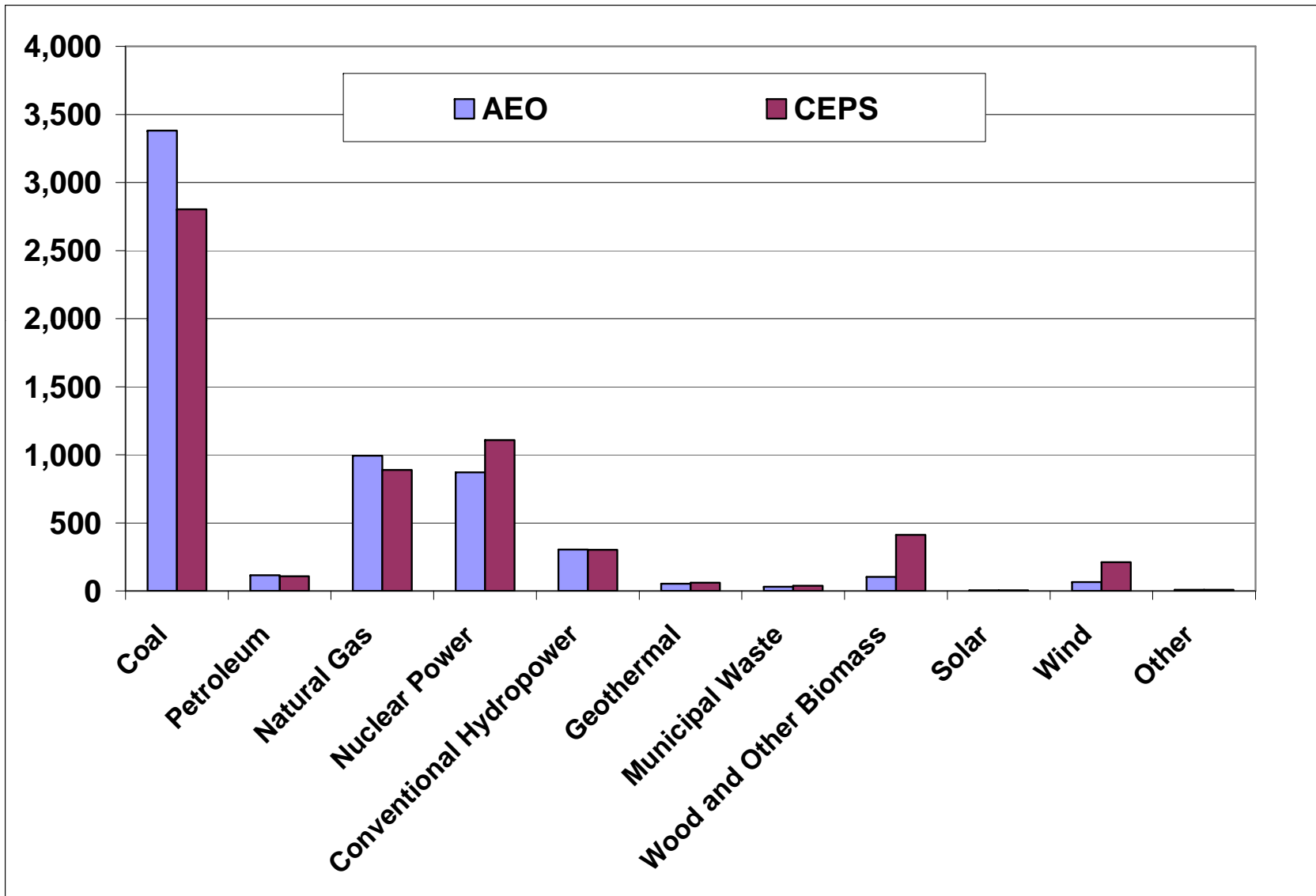


CEPS Results Summary

- Program achieves targeted share of total sales in all but the first year of mandatory compliance
- Leads to significant growth in nuclear and renewable generation
 - 2030 renewable generation is 466 billion kilowatthours (83 percent higher) with the CEPS proposal than in the reference case
 - 2030 nuclear generation is 238 billion kilowatthours (27 percent higher) with the CEPS proposal than in the reference case. 36 gigawatts of new nuclear capacity is added with CEPS, compared to 6 gigawatts added in the reference case.
- Power sector GHG emissions rise 23 percent from 2004 levels with the CEPS proposal, compared to 44 percent in the reference case
- Average end-use electricity prices increase with the proposal requirements, but the impact is small and it varies over time. The largest increases are in 2020 through 2022 and in 2029, when annual electricity prices are slightly more than 1 percent (nearly 0.1 cent) above reference case levels. By 2030 end-use electricity prices are only 0.02 cents (0.3 percent) higher.
- Natural gas wellhead prices in 2030 are \$5.78 with CEPS, compared to \$5.92 in the reference case.

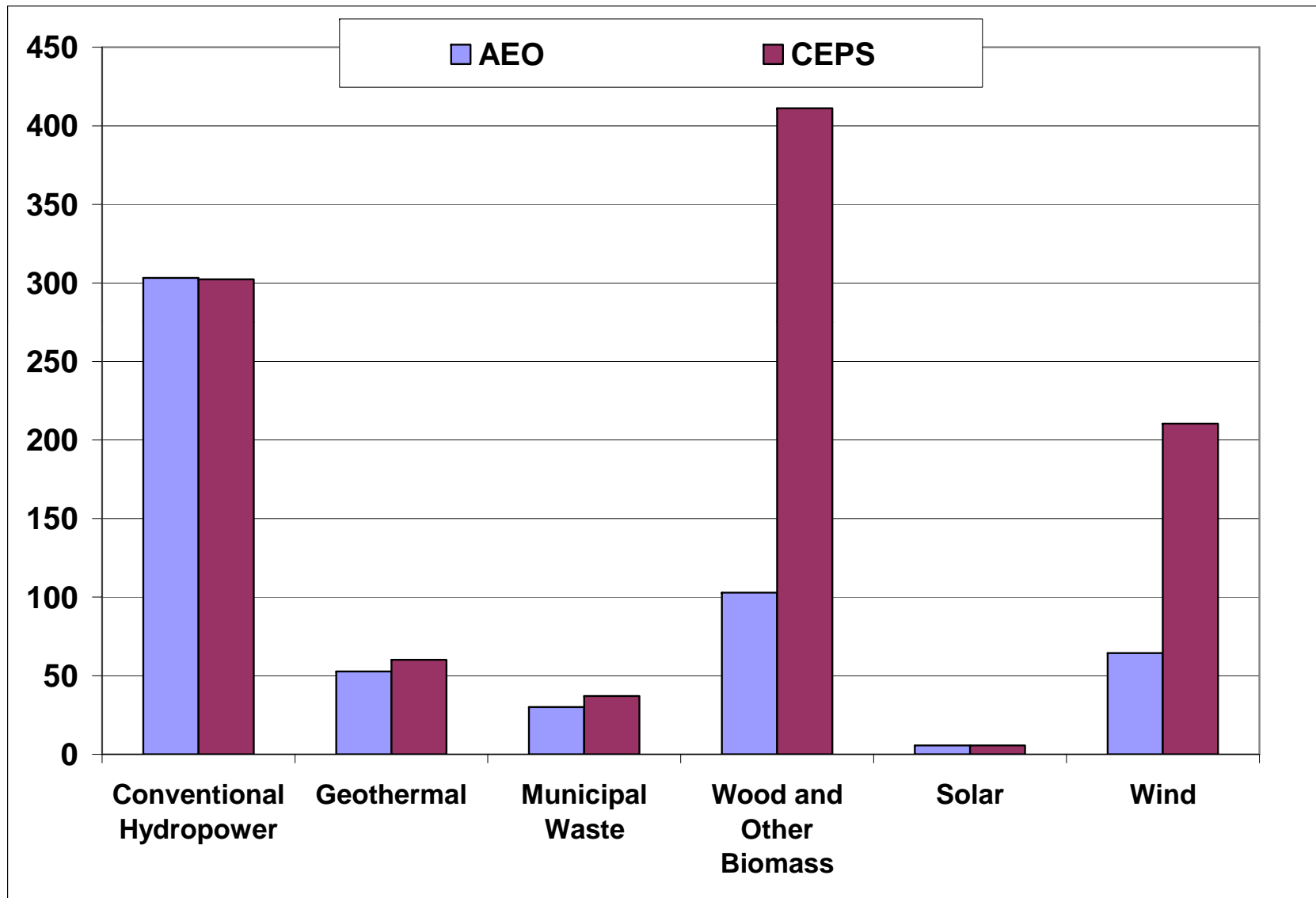
2030 Generation By Fuel

(billion kilowatthours)



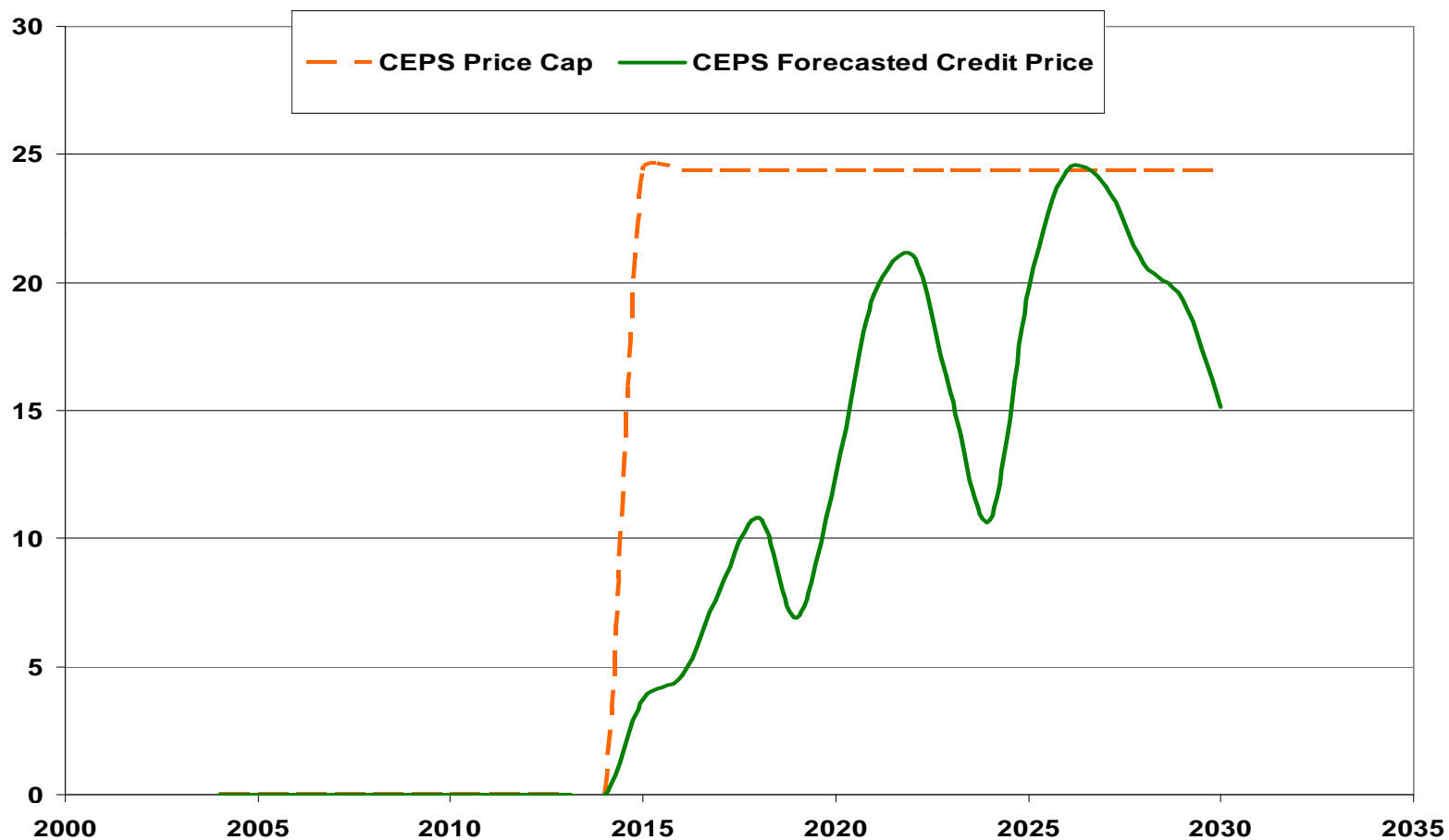
2030 Renewable Generation

(billion kilowatthours)



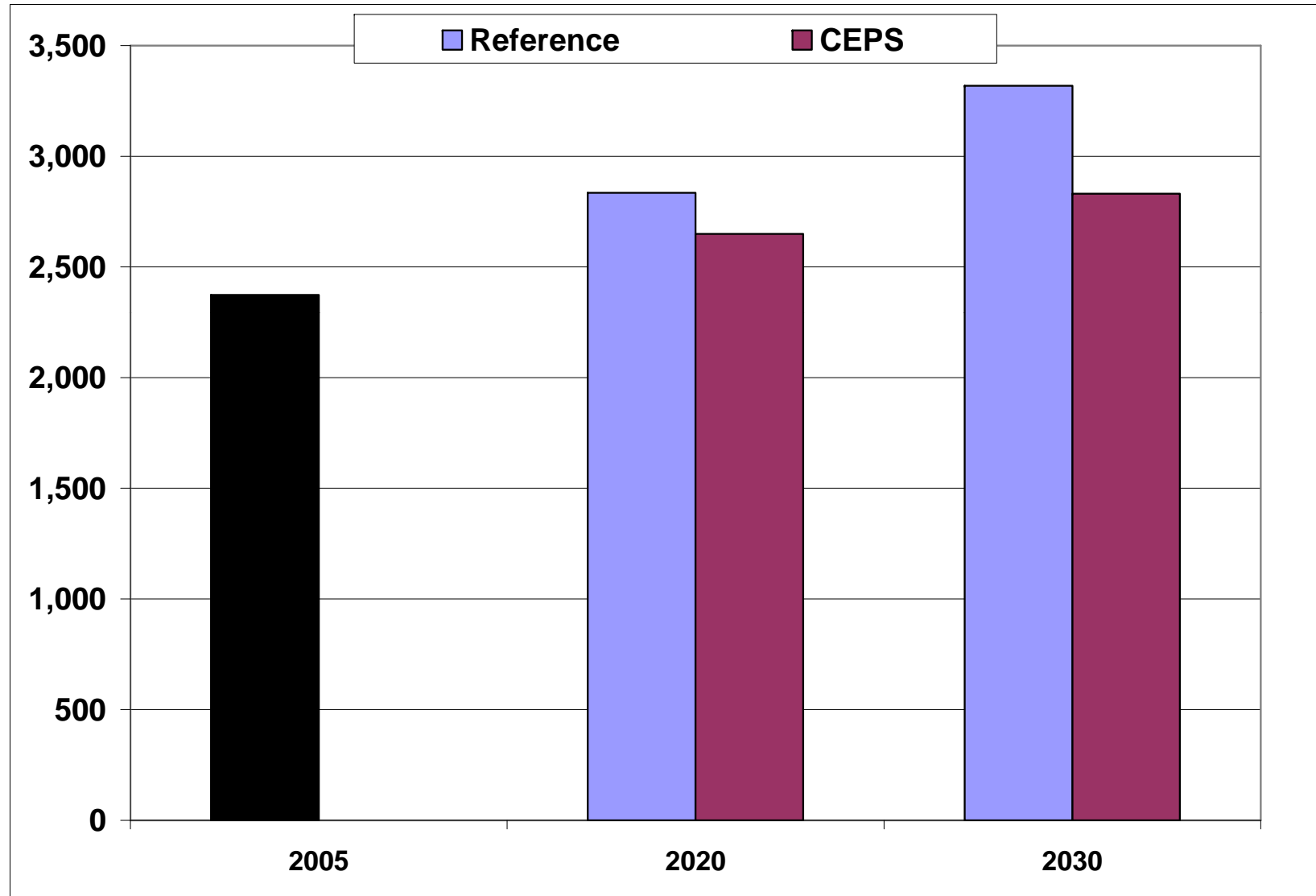
Credit Prices

2004 Mills/kWh



Carbon Dioxide Emissions

(million metric tons)



RPS and CEPS Summary

- Proposal details matter
 - What technologies qualify?
 - What if any technologies get special treatment?
 - Technology and/or utility exemptions
 - Credit price cap
 - Policy sunset date
- Analyses suggests that 15 to 20 % RPS/CEPS – after adjustment – would have modest price and fuel savings impacts
- Emissions impacts also are modest

Energy and Economic Impact of a Greenhouse Cap and Trade System

Key Factors in GHG Policy Analyses

- Stringency of emission limits
- Coverage
 - What gases?
 - What sectors?
- Timing
- Treatment of offsets
 - Foreign and domestic
 - Agricultural and forestry
- Safety Valve / Technology Accelerator Payment
- Allowance allocation methodology
- Use of allowance revenue

S.280 Cap and Trade Provisions

- Establishes a GHG emissions cap on covered entities in the electric generation, commercial, and industrial sectors, together with producers and importers of hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, and petroleum refiners and product importers.
- Covered entities include all entities in covered sectors that own or control a single facility with emissions of 10,000 metric tons or more.
 - Emissions of covered entities accounted for an estimated 78 percent of total U.S. GHG emissions in 2004.
 - As emissions by covered entities are subject to limits that tighten over time under S.280, their share in total U.S. GHG emissions falls.

- Covered Entity Emission Limits

<u>Time Period</u>	<u>Limit Description</u>
2012 through 2019	2004 level
2020 through 2029	1990 level
2030 through 2049	18 percent below 1990 level
2050 and beyond	60 percent below 1990 level

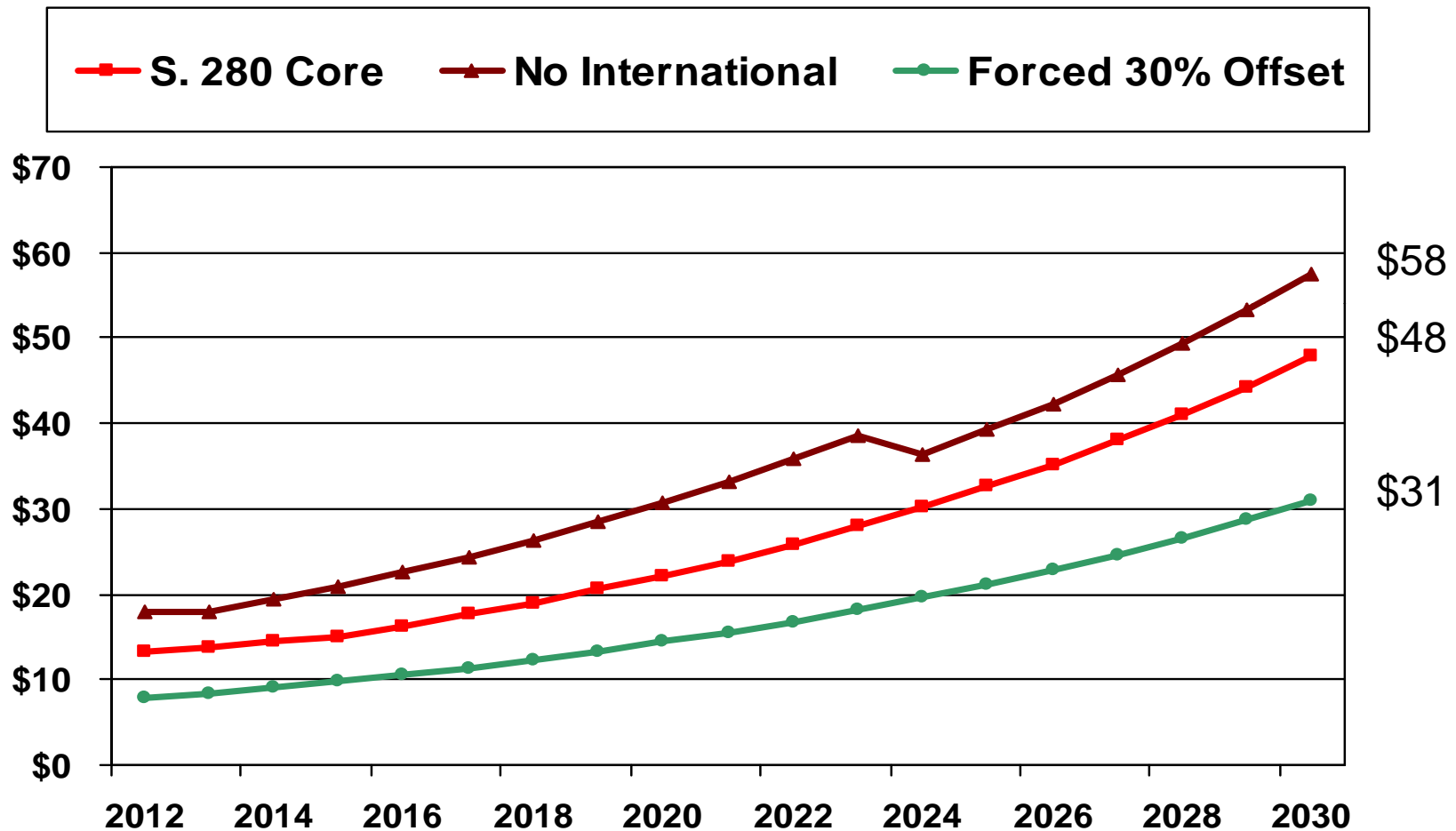
- Offsets (domestic or international) can be used in an amount equivalent to up to 30 percent of the allowance obligation

Key Insights

- **The effects of the proposal for greenhouse gases (GHG) reductions on the energy sector and the U.S. economy through 2030 depend on:**
 - the size of the reduction from baseline and the time over which the change occurs
 - the state of energy technology
 - the availability of emissions reductions or offsets outside the U.S. energy sector
- **The delivered price of coal, and its use, would be impacted far more than the price and use of other fuels.**
- **Electricity generation, which relies heavily on coal, is the easiest place to reduce energy-related carbon dioxide (CO₂) emissions within the U.S. energy system.**
 - Significant increases in generation from nuclear and renewables, together with some reductions in electricity demand growth, back out substantial amounts of conventional coal-fired generation by 2030. If nuclear power could not expand freely, coal with carbon capture and sequestration (CCS) could play a significant role after 2025 if it is available, but costs would likely be higher.
- **Given the overall size and expected growth of the U.S. economy, small changes in growth rates of consumption or output translate into large absolute dollar changes. In EIA's Core Case, projected GDP in 2030 is 0.35 percent below its baseline level. The present value of the cumulative reduction in GDP over the 2010 to 2030 period is \$553 billion.**
- **EIA's analysis only runs through the year 2030. Therefore, it does not address the energy and economic implications of the reductions in the S.280 emissions caps that occur in 2030 and 2050. Compliance beyond 2030 could pose significant challenges.**
- **Energy security is primarily about oil; efficient GHG reduction within the US is primarily about coal. GHG and energy security goals involve synergies and conflicts.**

Projected Allowance Prices

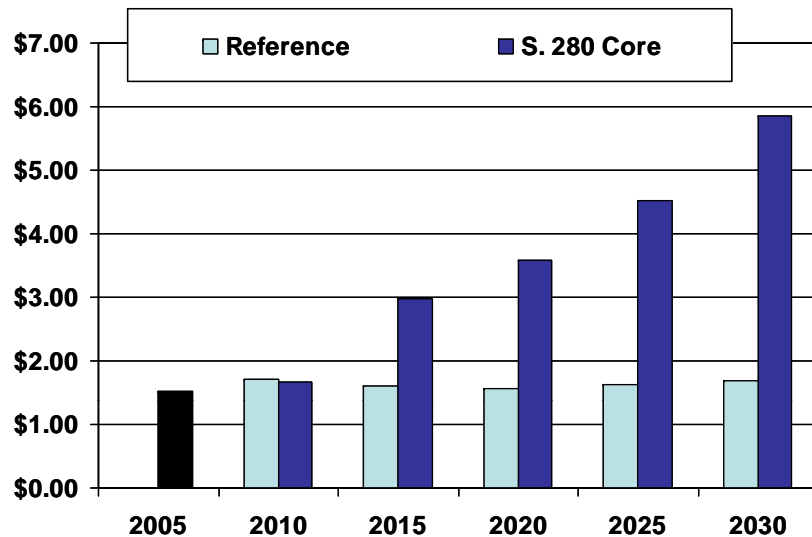
(2005 dollars per metric ton carbon dioxide equivalent)



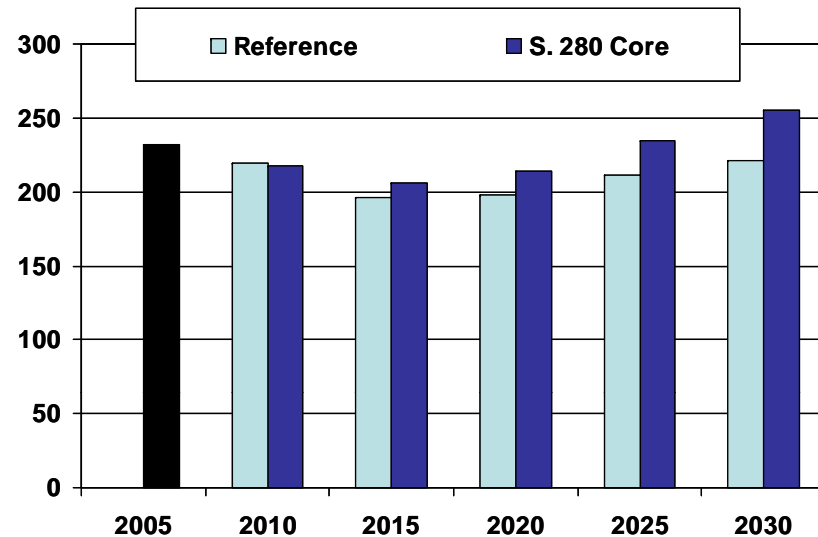
Energy price impacts are sensitive to assumptions about the cost and availability of international emissions offsets.

Energy Prices

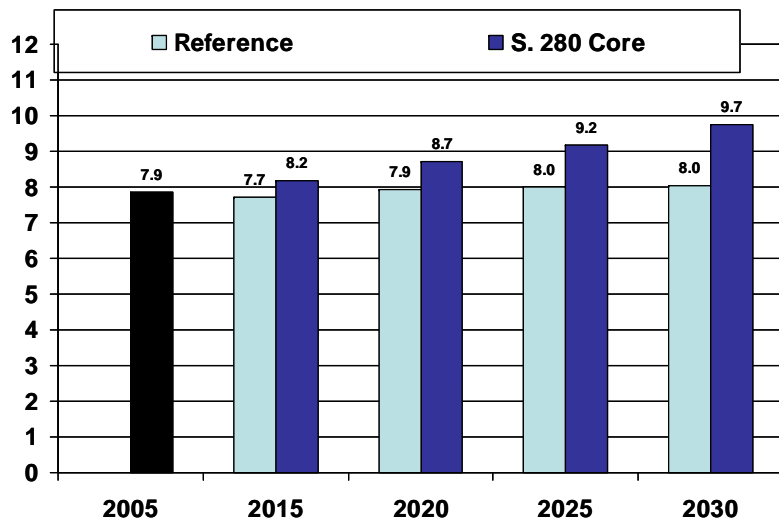
Coal Prices (real \$ per million Btu)



Motor Gasoline Prices (real cents per gallon)



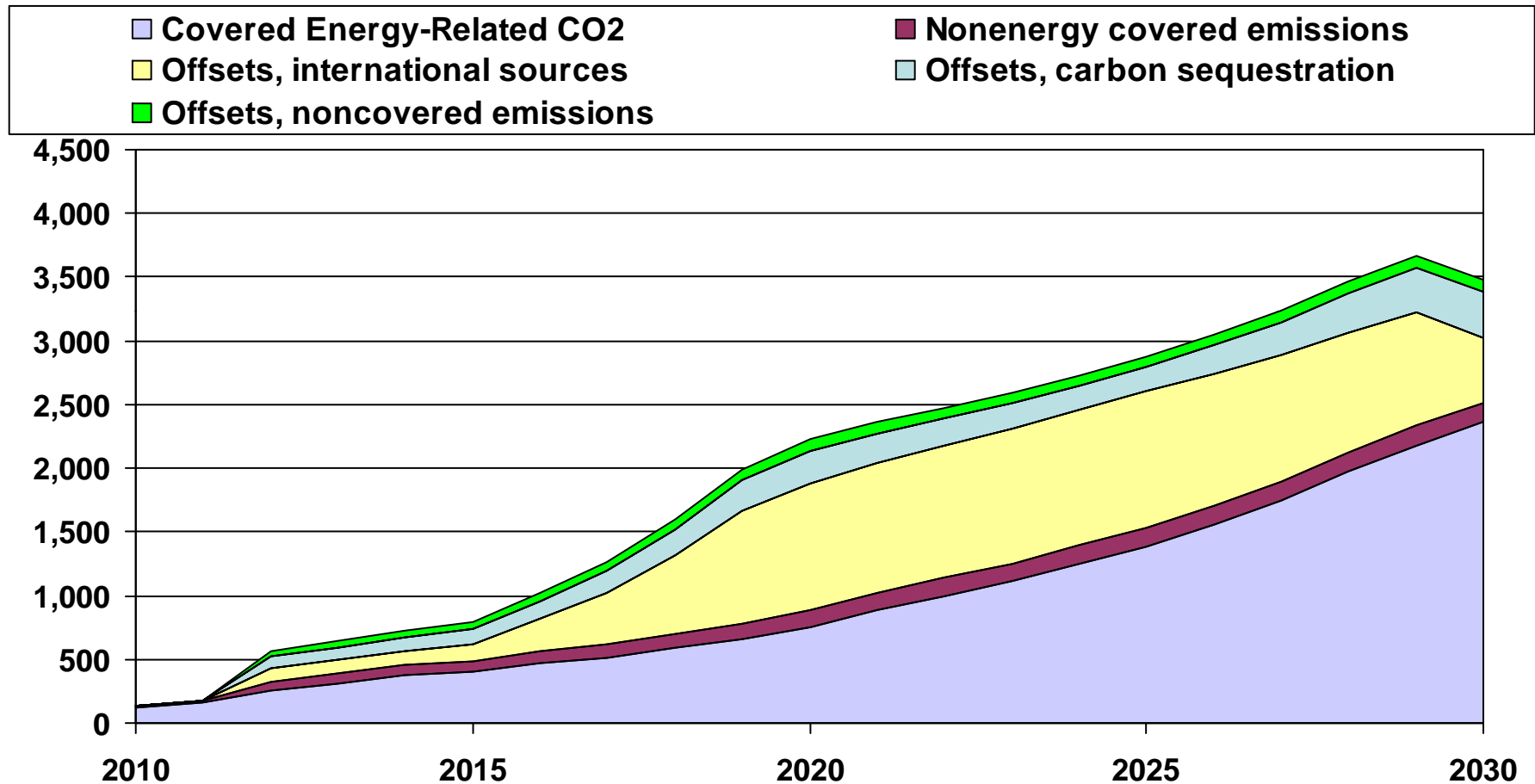
Electricity Prices, (real cents per kilowatthour)



- In EIA's S.280 Core Case, the delivered price of coal in 2030 in 2005 dollars, more than triples relative to the projected baseline level (\$1.70 to \$5.85).
- The retail price of gasoline in 2030 is 16 percent (34 cents per gallon) above baseline, while the average delivered electricity price is 21 percent higher (1.7 cents per kilowatt hour).
- Electricity price impacts differ widely by region, reflecting differences in the generation mix.

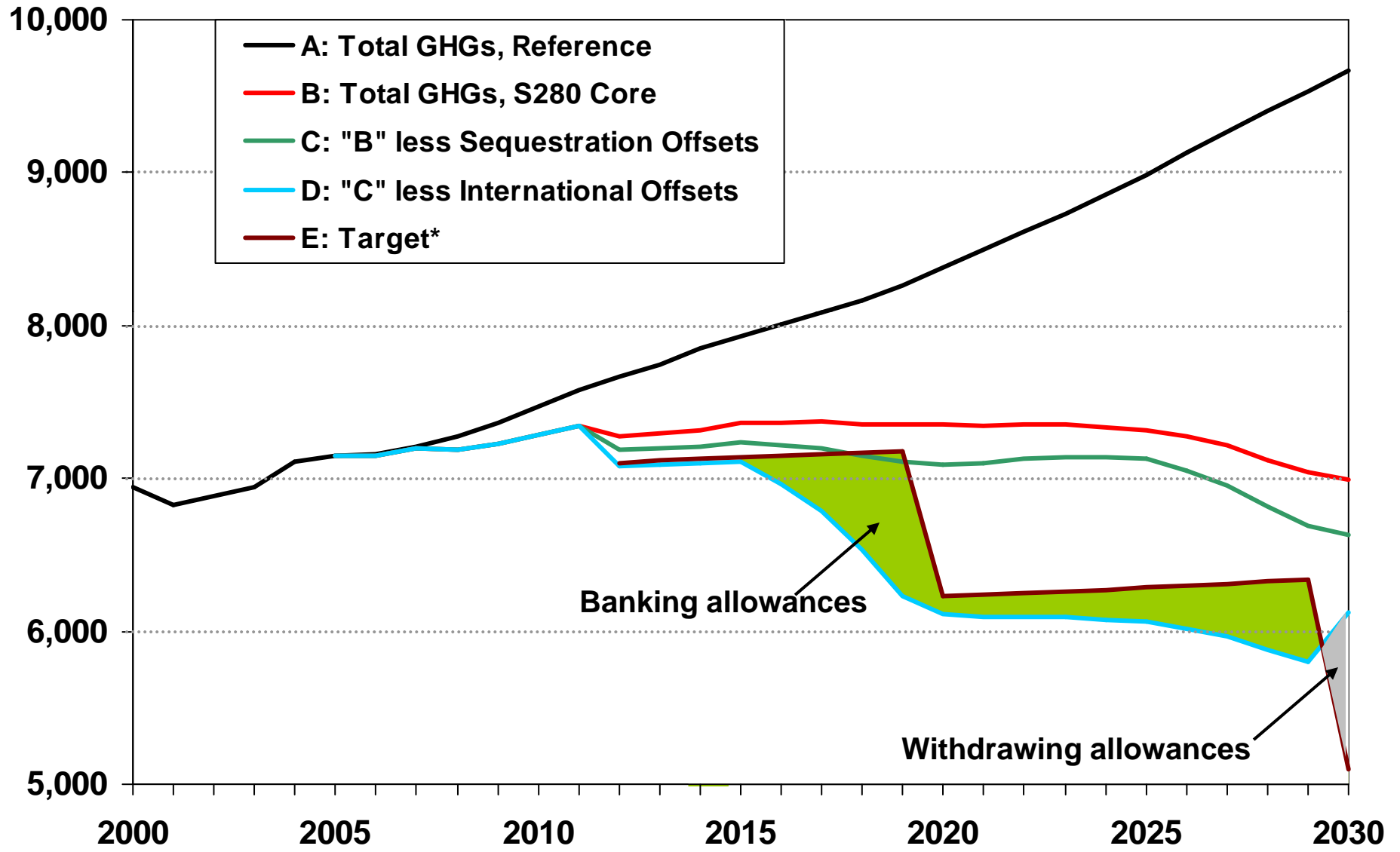
Sources of Compliance

(million metric tons CO₂ equivalent)

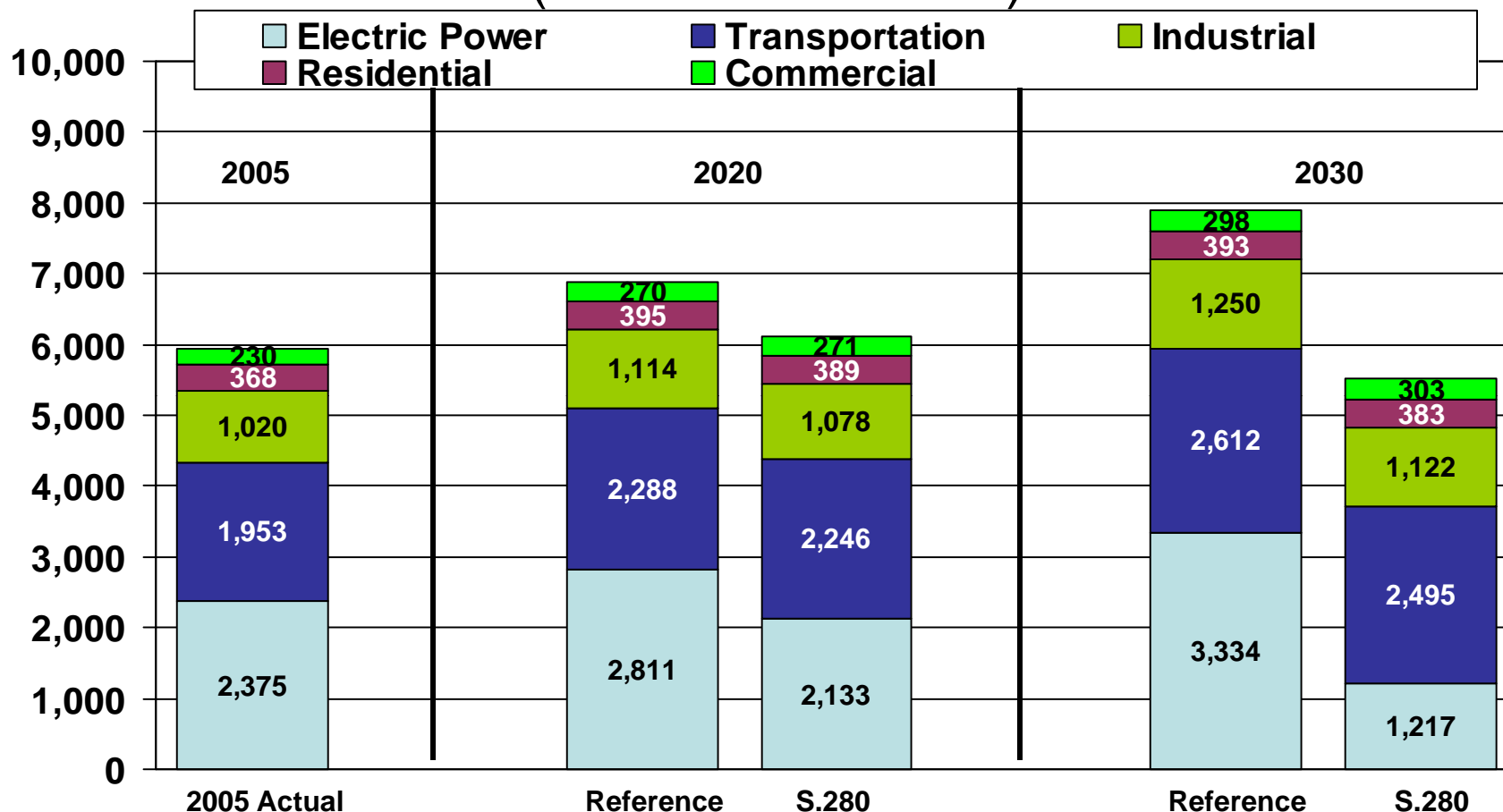


- Reductions in energy-related CO₂ emission grow steadily over time.
- International offsets play a major role in the S.280 Core case during the 2015 to 2029 period.

Projected Compliance Path



Energy-Related CO₂ Emissions (million metric tons)

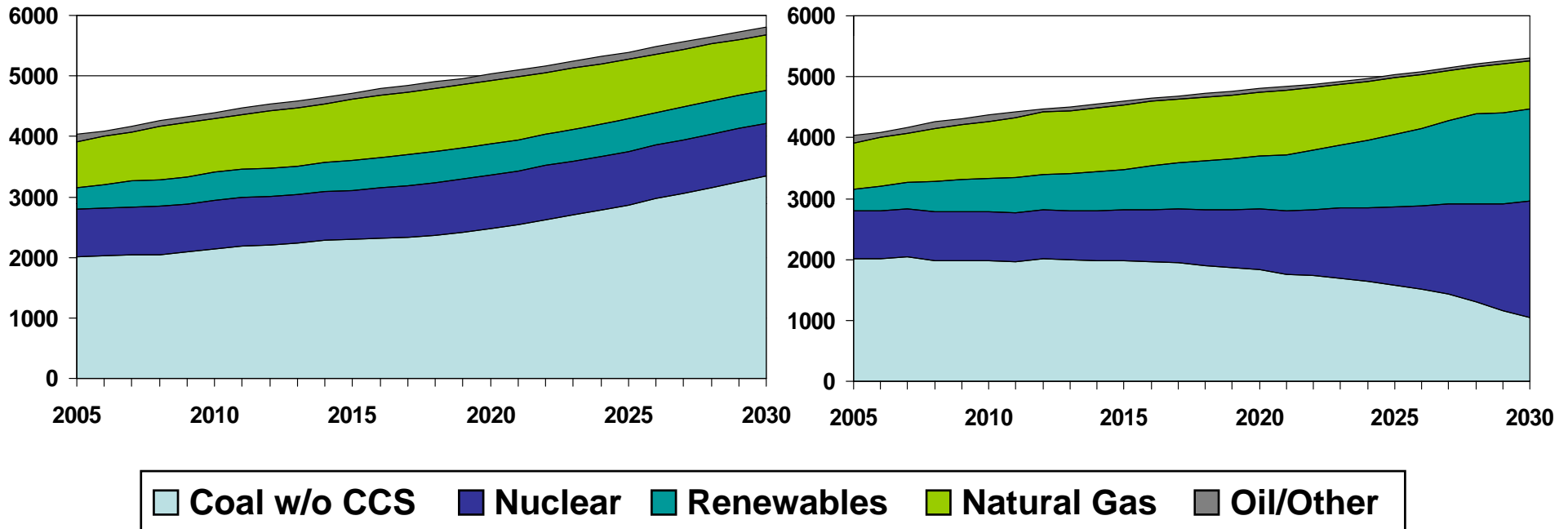


- The electric power sector dominates energy-related CO₂ emission reductions.
- Although the S.280 GHG target for covered entity emissions in 2030 is 18 percent below the 1990 level (equivalent to 34 percent below the 2005 level), total energy-related CO₂ emissions in the S.280 Core Case are only about 7% below the 2005 level in 2030 due to the use of offsets and banked allowances, partial coverage and greater reduction of other GHGs. If more (less) international offsets were available, projected 2030 energy-related emissions under S.280 would be higher (lower).

Electricity Generation by Fuel (billion kilowatthours)

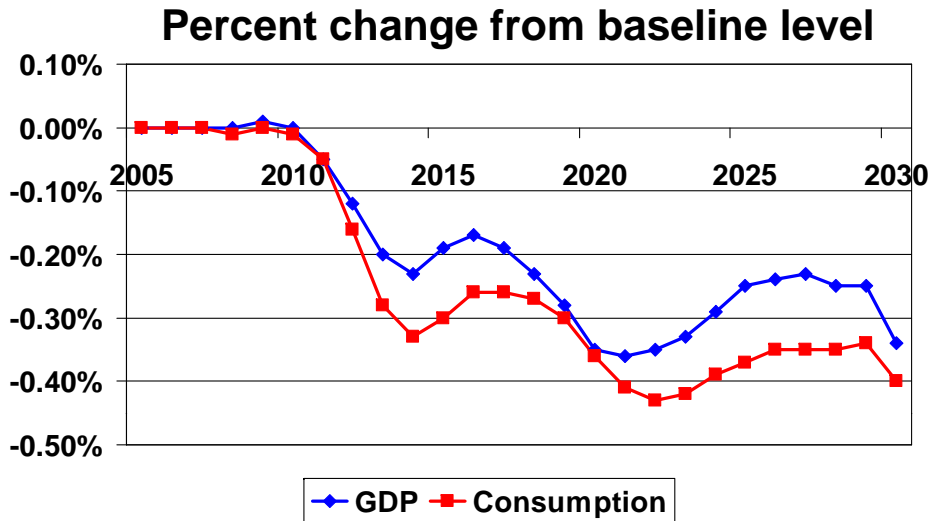
Reference Case

S. 280 Core Case



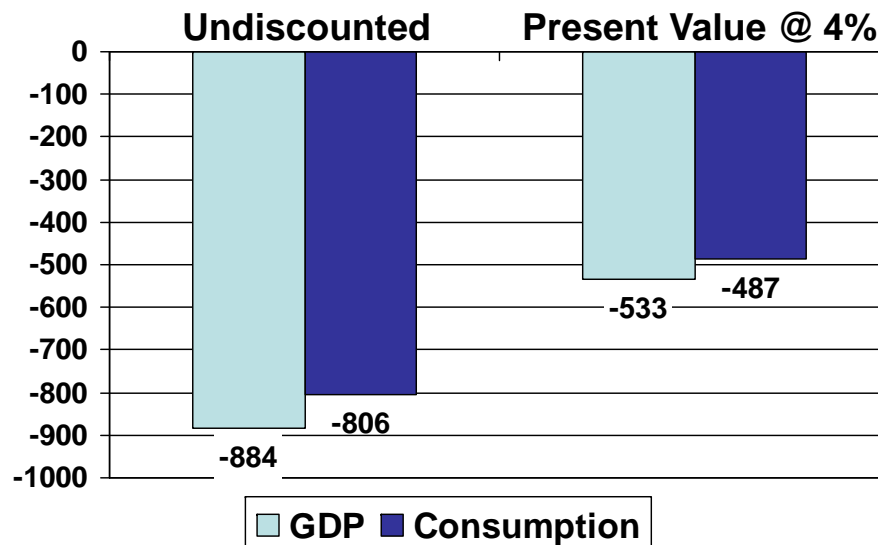
- The projected role of nuclear and renewable generation grows substantially under S.280, displacing coal-fired generation. Nuclear and renewables are less expensive than coal with carbon capture and sequestration (CCS). In a side case (not illustrated) where the expansion of nuclear power is constrained, coal with CCS starts to play a role after 2025.
- S.280 is also projected to reduce electricity demand growth, reflecting both higher electricity prices and targeted support of high-efficiency equipment

Change in Real GDP and Consumption



- Transitional effects on the economy increase when GHG limits are made more stringent and/or are phased in more rapidly
- While Gross Domestic Product (GDP) is often used as a shorthand measure of economic impacts, consumption is more directly related to well-being.
- The rules for handing out or auctioning emissions allowances are very important in determining both overall economic impacts and their distribution. EIA's analysis reflected a significant distribution of auction proceeds to business as specified by Senate staff, but S.280 itself allows considerable discretion in this area.

Cumulative Change 2010–2030, Billion 2000 Dollars



Contact Information

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Energy Information Administration

Official Energy Statistics from the U.S. Government

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