Testimony of

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before the

Committee on Energy and Natural Resources

United States Senate

January 24, 2007

Mr. Chairman, and members of the Committee, I appreciate the opportunity to appear before you today. As requested in your invitation, my testimony focuses on the Energy Information Administration's (EIA's) recent analysis of the energy and economic impacts of a cap-and-trade program for greenhouse gas (GHG) emissions. The proposal we evaluated, sent to us by Chairman Bingaman and Senators Landrieu, Lugar, Murkowski, Salazar, and Specter in September 2006, would set specific targets for the reduction of GHG emissions intensity of the U.S. economy and incorporate a safety valve to assure that allowance prices remain at or below a ceiling that rises over time.

EIA is the independent statistical and analytical agency within the Department of Energy. We are charged with providing objective, timely, and relevant data, analyses, and projections for the use of the Congress, the Administration, and the public. Although we do not take positions on policy issues, we do produce data and analyses to help inform energy policy deliberations. Because we have an element of statutory independence with respect to this work, our views are strictly those of EIA and should not be construed as representing those of the Department of Energy, the Administration, or any other organization.

EIA's analysis (*Energy Market and Economic Impacts of a Proposal to Reduce Greenhouse Gas Intensity with a Cap and Trade System* (SR/OIAF/2007-1)), released earlier this month, compares cases incorporating the cap-and-trade proposal to those in the reference case of the *Annual Energy Outlook 2006* (*AEO2006*). *AEO2006* is based on Federal and State laws and regulations in effect as of October 2005. It has recently been superseded by *AEO2007,* which updates the projections to current laws and regulations and our current analysis of market

conditions. However, given the relatively modest changes between *AEO2006* and *AEO2007*, an analysis starting from the new *Outlook* would likely produce results that are very similar to those I will review today

The projections included in EIA's reference and policy cases, which extend through 2030, are not meant to be exact predictions of the future but represent likely energy futures, given technological and demographic trends, fixed laws and regulations, and consumer behavior as derived from available data. EIA recognizes that projections of energy markets over a 25-year period are highly uncertain and subject to many events that cannot be foreseen such as supply disruptions, policy changes, and technological breakthroughs. In addition to these phenomena, long-term trends in technology development, demographics, economic growth, and energy resources may evolve along a different path than expected in the projections. For this reason, the *AEO* includes many alternative cases intended to examine these uncertainties. Generally, projected differences between cases, which are the focus of our report, are likely to be more robust than the specific projections for any one case.

EIA's complete report, which includes a description of the proposal (and its full text as an Appendix), our modeling approach and our results, as well as a discussion of uncertainties and caveats, has been provided to the Committee and is publicly available on our web site. My testimony summarizes key findings, focusing on the Phased Auction case, which provides for the direct allocation of some emissions allowances and the auctioning of others, with the share to be auctioned rising over time as specified in the proposal. It outlines projected impacts on energy prices, energy use, GHG emissions, and economic activity, as well as the sensitivity of the

results to technology and other uncertainties. It also provides some comparisons to results from other EIA analyses of policies to limit GHG emissions.

Energy Prices

The cap-and-trade proposal requires that fossil fuel suppliers submit emission allowances that reflect the carbon dioxide emitted when the fuel is burned. Fuel suppliers would presumably pass on the cost of the allowances to consumers, leading to increases in fuel prices. As a secondary effect, however, reduced demand for fossil fuels could lower their supply cost at the wellhead or the minemouth, offsetting some of the price increase due to allowances. When these effects are taken together, however, the cost of allowances tends to dominate, so the energy prices paid by end users generally rise.

Figures 1 and **2** summarize the program's impacts on energy prices, which are all expressed in real 2004 dollars and include the value of allowances. The average retail gasoline price is 6 cents per gallon (3 percent) higher in 2020 and 11 cents per gallon (5 percent) higher in 2030 than in the reference case. Because the safety valve caps the price of GHG allowances at $5.89 per metric ton of carbon dioxide (CO_2) in 2012, rising to $14.18 per metric ton in 2030, the maximum direct effect of the cap-and-trade policy on the delivered price of gasoline in 2030 is roughly 11 cents per gallon (2004 dollars).

The average delivered natural gas price is $0.41 per thousand cubic feet (6 percent) higher in 2020 and $0.88 per thousand cubic feet (11 percent) higher in 2030, largely because of the allowance price which is added to the delivered fuel costs.

The average delivered coal price to electric generators, including the cost of emissions allowances, is $0.67 per million British thermal units (Btu) (48 percent) higher in 2020 and $1.22 per million Btu (81 percent) higher in 2030 than in the reference case. The much higher percentage change in delivered coal prices compared to the other fossil fuels reflects both coal's high carbon content per unit of energy and its relatively low price in the reference case.

Because electricity consumers capture the economic benefits of the allocation of GHG allowances to regulated utilities in areas of the country where electricity rates are set under cost-of-service regulation at the state level, projected impacts on the average delivered price of electricity are sensitive to decisions made regarding the allocation or auctioning of allowances. In the Phased Auction case, where significant quantities of allowances are given free of charge to electricity generators, electricity prices are estimated to be 4 percent higher than in the reference case in 2020 and 11 percent higher in 2030. In the Full Auction case, where all allowances are auctioned, electricity prices are estimated to be 6 percent higher than in the reference case in 2020 and 13 percent higher in 2030. The difference between the Phased and Full Auction cases reflects the assumed passthrough to ratepayers of the value of allowances given to electric generators who are subject to state-level cost-of-service regulation in the Phased Auction case. Electricity price impacts also vary across states and regions.

Energy Use

Impacts on energy use generally reflect both the size of the change in energy prices and the availability of substitutes and alternatives for each type of affected energy. **Figure 3**

summarizes projected impacts on energy use. Projected primary energy use is 1.7 quadrillion Btu (1 percent) lower in 2020 and 2.4 quadrillion Btu (2 percent) lower in 2030 as the cost of GHG allowances is passed through to consumers, providing an incentive to lower energy use and shift away from fossil fuels, particularly in the electric power sector. Relative to the reference case, fossil fuel energy consumption is 1.9 quadrillion Btu (2 percent) lower in 2020 and 8.1 quadrillion Btu (7 percent) lower in 2030, with almost all of the change accounted for by a reduction in the otherwise expected growth in coal use.

The reduction in petroleum use relative to the reference case projection is less than 1 percent in 2020 and about 3 percent in 2030. Over 70 percent of oil is used in the transportation sector, where alternatives are limited. With impacts on retail gasoline prices starting at 6 cents per gallon in 2012 and growing to only 11 cents per gallon by 2030, only modest changes in vehicle purchase and travel decisions are expected, and there is no significant impetus to fuel switching.

Impacts on projected natural gas use are also small. Natural gas consumption is 0.3 quadrillion Btu (1 percent) lower in 2020 and 0.3 quadrillion Btu (1 percent) higher in 2030. The electric power sector reduces its use of natural gas in 2020, but increases its gas use in 2030, reflecting the impact of the proposal in substantially reducing the switch away from gas generation over the 2020 to 2030 period, when the reference case, by comparison, projects a substantial increase in new coal-fired capacity and coal generation.

Projected coal consumption is significantly affected by the program. Relative to reference case projections, coal use is reduced by 1.2 quadrillion Btu, or 4 percent, in 2020 and more significantly reduced by 6.8 quadrillion Btu (20 percent) in 2030, due mainly to the shift in the

generation fuel mix that is driven by higher delivered coal prices. In contrast to the situation in the transportation sector, a program that places even a modest value on GHG emissions encourages a significant shift towards alternative technologies such as nuclear and renewables in the electric generation sector. The proposal also significantly impacts the economic attractiveness of coal-to-liquids (CTL) conversion. Almost all of the CTL capacity that is projected to be built and operated in the reference case is not expected to be built if the cap-and-trade proposal is implemented.

Figure 4 shows how the cap-and-trade proposal affects projected electric generation capacity additions over the 2004 to 2030 period. The projected capacity additions of conventional coal-fired technology decline to less than a third of the reference case level. Notwithstanding the decline in coal generation relative to the reference case, overall use of coal is expected to increase from its 2004 level, mainly due to increased utilization of existing coal plants. Thus, although allowance prices under the proposal are high enough to dissuade much of the construction of new coal plants that would otherwise occur in the 2015 to 2030 period, they are low enough that it is still attractive to use available coal capacity through 2030. As the program continues beyond 2030, allowance prices would likely continue to rise as the GHG emissions cap tightens and the price trigger for the safety valve increases, eventually resulting in the retirement of significant amounts of existing coal plants for economic reasons. Under such a scenario, the level of coal use beyond 2030 would likely be sensitive to the future competitiveness of coal with carbon capture and sequestration relative to other very-low-carbon or carbon-free generating technologies.

Emissions

As shown in **Figure 5**, reductions in emissions of non-CO_2 GHG emissions in the proposed program, which are not represented in a detailed fashion in the EIA National Energy Modeling System, are projected to account for 57 percent of the covered GHG emissions reductions in 2020 and 35 percent of the covered GHG emissions reductions in 2030. Estimates for non-CO_2 GHG emissions were developed using emissions baselines and abatement cost curves based on engineering cost estimates that were supplied by the U.S. Environmental Protection Agency. Real-world factors affecting the behavior of decisionmakers and the use of incomplete cost information may result in an overstatement of the actual level of non-CO_2 abatement achieved at each level of the allowance price. However, due to the safety-valve feature of the proposed cap-and-trade program, the projected energy sector and economic impacts would not change significantly even if the assumptions used regarding the supply of GHG abatement opportunities were too optimistic. Rather, such a situation would tend to drive the allowance price up to the safety-valve level earlier than projected in our analysis.

Because the safety-valve in the cap-and-trade program is projected to be triggered in 2026, the specified GHG intensity targets in the proposal are not fully attained beyond that date. Total emission reductions in 2030 are estimated to be 654 million metric tons CO_2 equivalent short of the level that would satisfy the GHG intensity reduction goal.

Economic Impacts

Figure 6 shows the projected effect of the cap-and-trade policy on the projected level of real gross domestic product (GDP) and personal consumption for both the Phased Auction and Full Auction cases. By 2030, real GDP in the Phased Auction case is projected to be 0.26 percent ($59 billion in year-2000 dollars) below the reference case levels. The total reduction in discounted real GDP over the 2009 to 2030 period is 0.10 percent ($232 billion) relative to the reference case. Impacts on projected real consumption, also shown in **Figure 6**, are somewhat larger, reaching 0.36 percent ($55 billion) in 2030. The reduction in discounted real consumption over the 2009 to 2030 period is 0.14 percent ($236 billion).

As requested, EIA's analysis also included a Full Auction case in which 100 percent of emissions allowances are auctioned beginning from the start of the cap-and-trade program in 2012. GDP and consumption impacts for this case are larger than those for the Phased Auction case, due to the assumption that the much higher auction revenues are not re-circulated into the economy beyond the $50 billion in expenditures from the proposed Climate Change Trust Fund. This result could change under a different revenue recycling assumption, and does not imply a general conclusion that a Full Auction will necessarily have larger GDP impacts than a Phased Auction.

Technology Sensitivities

While the *AEO2006* reference case used as the baseline in our analysis incorporates significant improvements in technology cost and performance over time, it may either overstate or

understate the actual future pace of improvement, since the rate at which the characteristics of energy-using and producing technologies will change is highly uncertain.

Although the cap-and-trade program includes provisions that allocate a portion of the allowance auction revenues for increased federal funding for research, development and deployment, EIA, consistent with its established practice in other recent studies, did not attempt to estimate how increased government spending might specifically impact technology development. In previous analyses, EIA has illustrated how the use of more optimistic assumptions about the timing and cost of advanced energy technologies tends to reduce projected energy use in both baseline and policy cases. Under more optimistic technology assumptions, specified emissions reduction targets can generally be reached at lower cost, and the safety-valve is less likely to be triggered.

Relationship to Previous EIA Greenhouse Gas Analyses

In recent years, EIA has completed several other reports on policy proposals to limit or reduce GHG emissions. Our new report builds on these prior analyses (all of which are available on our web site), which taken together suggest that the economic impacts are largely determined by the *size of the energy market change* required to satisfy the policy *and the speed* with which the change must occur. From an energy and economic perspective, one key factor is the extent to which a proposed policy causes the economic obsolescence of existing energy system capital.

In April 2005, EIA analyzed of the original policy proposal made by the National Commission on Energy Policy (NCEP), a nongovernmental, privately-funded entity. That proposal included a cap-and-trade program along with other recommendations. The emission reduction targets for

the cap-and-trade program in the original NCEP proposal were less stringent than those evaluated in our new report, but the proposed program began in 2010 rather than 2012. In February 2006, EIA reported on the energy and economic impacts of several alternative cap-and-trade options, ranging from less stringent to more stringent than the one considered in our new report.

Two EIA studies issued in 2003 and 2004 considered the original version of the Climate Stewardship Act (S.139), which would cap GHG emissions at the 2000 level in 2010 and the 1990 level from 2016 on, and an amended version of that bill (S.A.2028) that removed a provision for a tightening of the emissions cap beginning in 2016. These proposals have the same 2010 start date as the original NCEP proposal but they do not have a safety valve, and emissions are capped at a lower level than in the proposal analyzed in our new study. The reference cases for all studies completed before 2006, including EIA's analyses of the Kyoto Protocol, differ significantly from the reference case for the present study, which incorporates significantly higher long-term real prices for oil and natural gas.

Finally, while all reference and policy case projections are inherently uncertain, policy design differences can significantly affect the nature of uncertainty surrounding the projected energy and economic impacts of alternative policies to limit GHG emissions. Inclusion of a safety-valve feature in a cap-and-trade program would allow GHG emissions to rise above the level projected in our report in the event that emissions reduction inside or outside the energy sector proves to be more costly than we expect, while protecting against the prospect of larger energy system and economic impacts in these circumstances. In contrast, policies that impose a "hard" cap on emissions without a safety-valve price for GHG credits would force the fixed GHG

emissions target to be met regardless of cost, reducing uncertainty surrounding the GHG emissions outcome but increasing uncertainty regarding energy and economic impacts. Policy design differences can also influence the behavior of stakeholders after a policy is implemented. For example, interests primarily focused on the achievement of GHG emissions reduction targets are more likely to support the broad availability of low-cost options to reduce emissions, rather than insist on the use of particular technologies and the avoidance of others if a safety-valve provision is included in a policy.

This concludes my testimony, Mr. Chairman and members of the Committee. I would be pleased to answer any questions you may have.

Figure 1. Projected Coal and Natural Gas Prices in Two Cases, 2004, 2020 and 2030 (2004 dollars per million Btu)

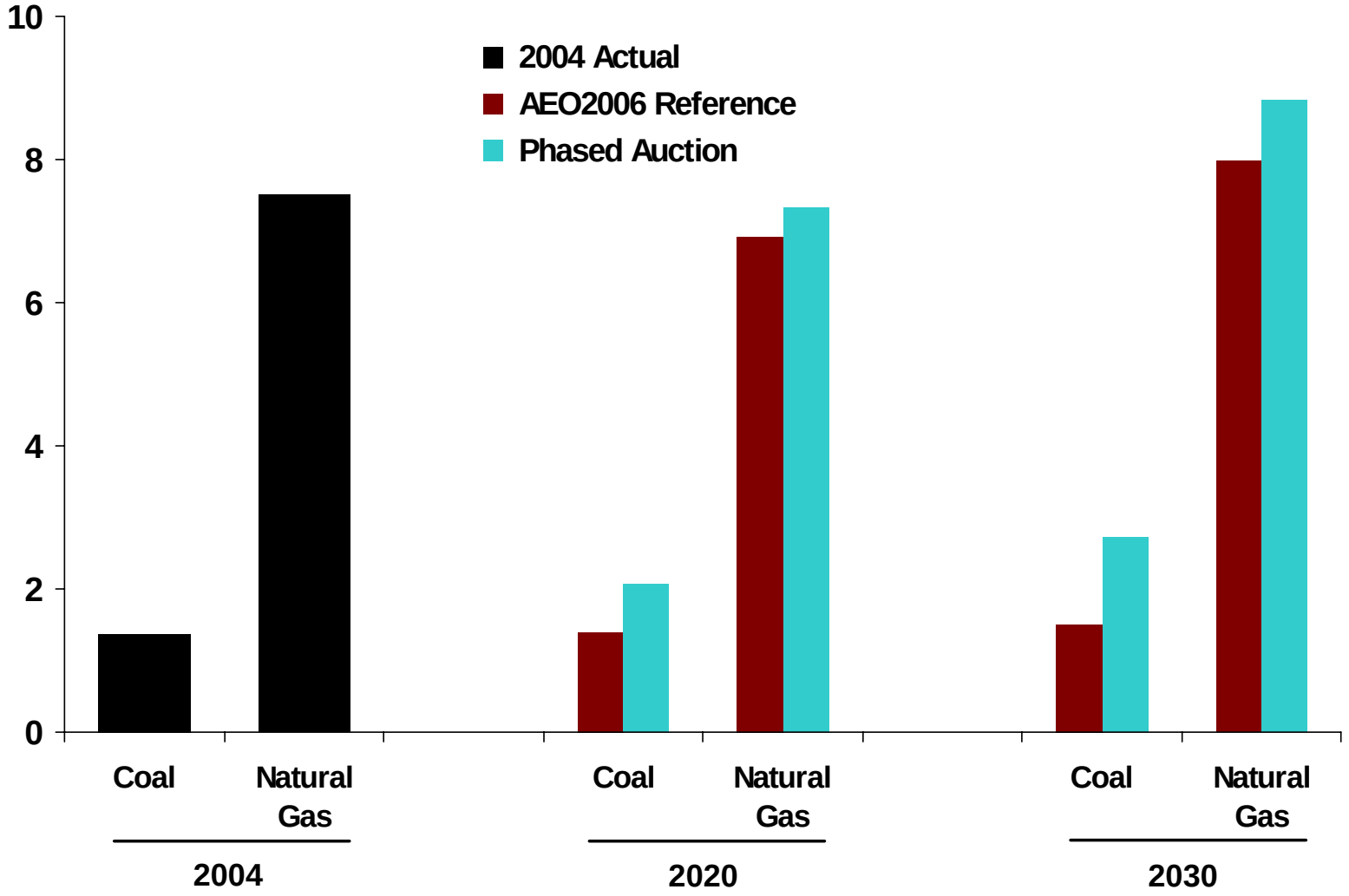


Figure 2. Projected Motor Gasoline and Electricity Prices in Two Cases, 2004, 2020 and 2030

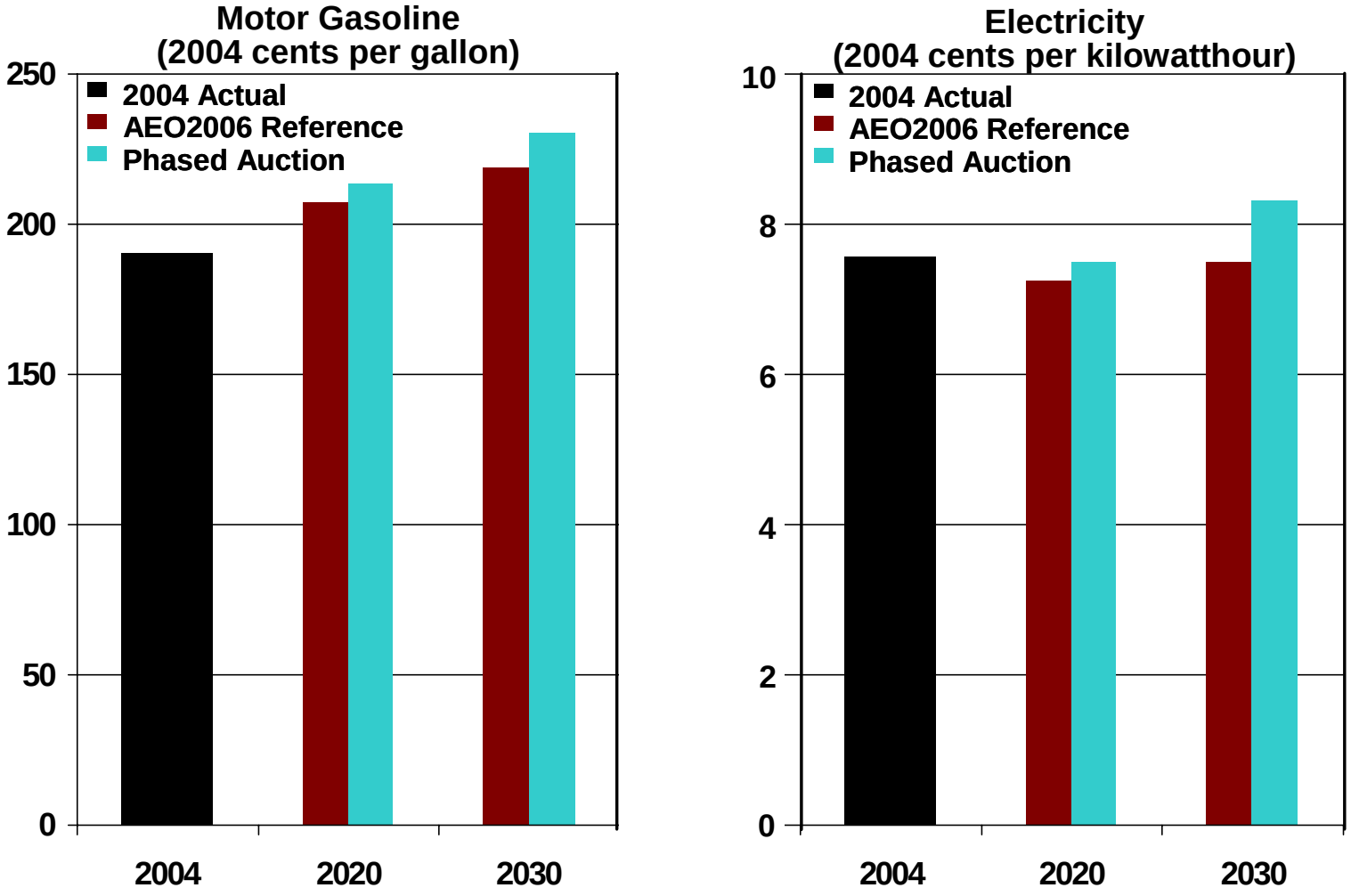


Figure 3. Primary Energy Consumption in Two Cases, 2004-2030 (quadrillion Btu)

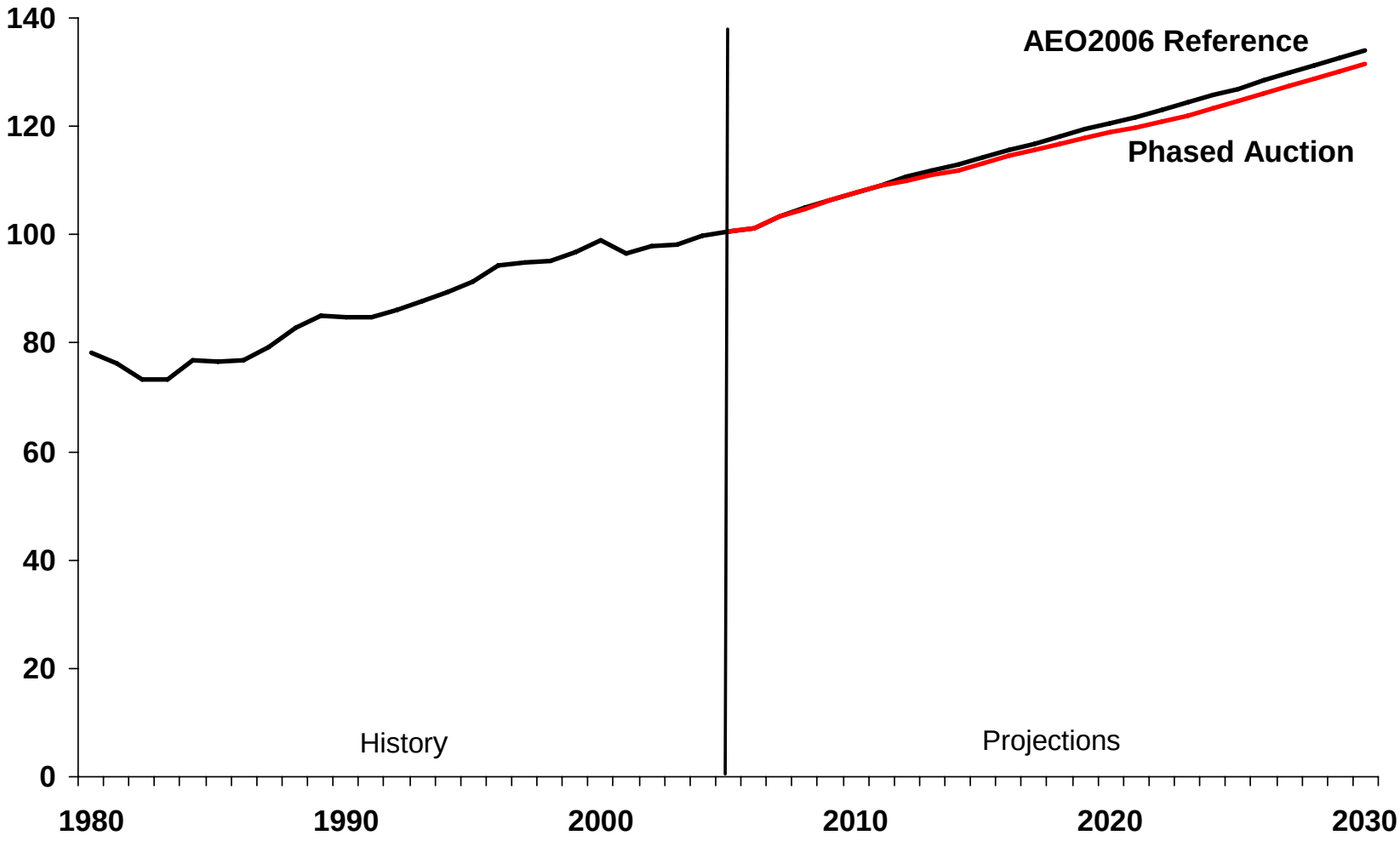


Figure 4. Generating Capacity Additions by Type in Two Cases, 2004-2030 (gigawatts)

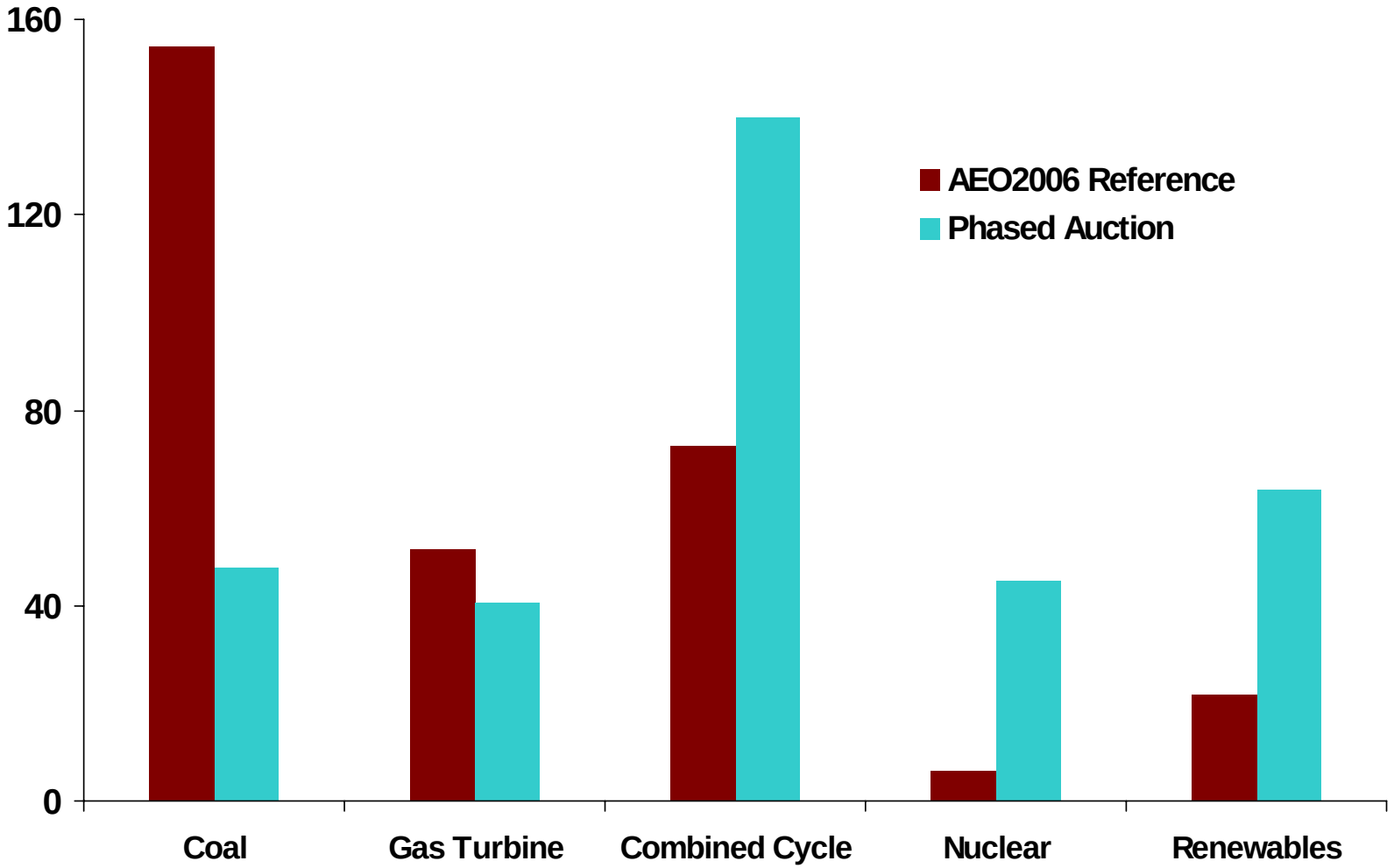


Figure 5. Greenhouse Gas Reductions from the AEO2006 Reference Case in the Phased Auction Case, 2020 and 2030 (million metric tons of carbon dioxide equivalent)

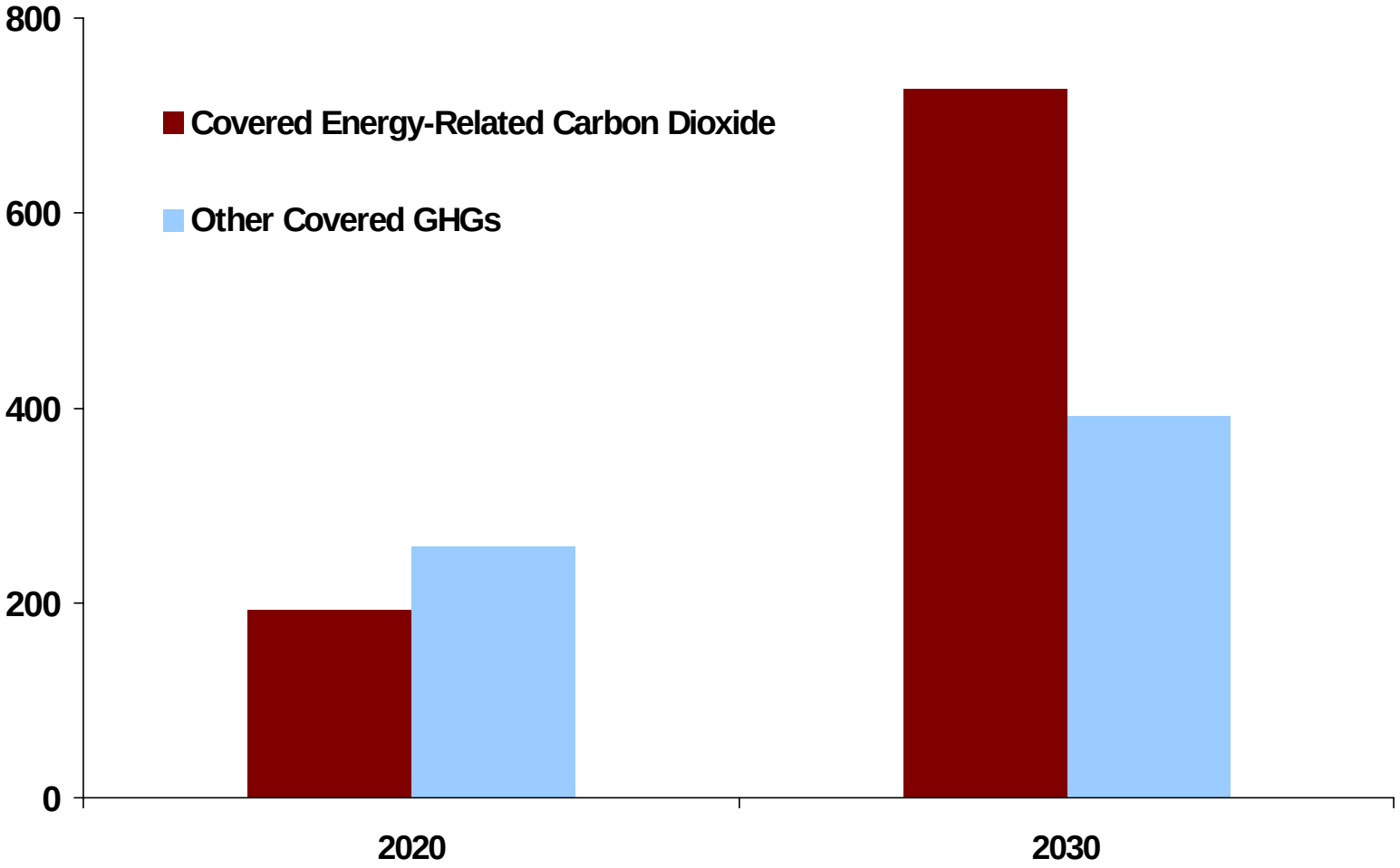
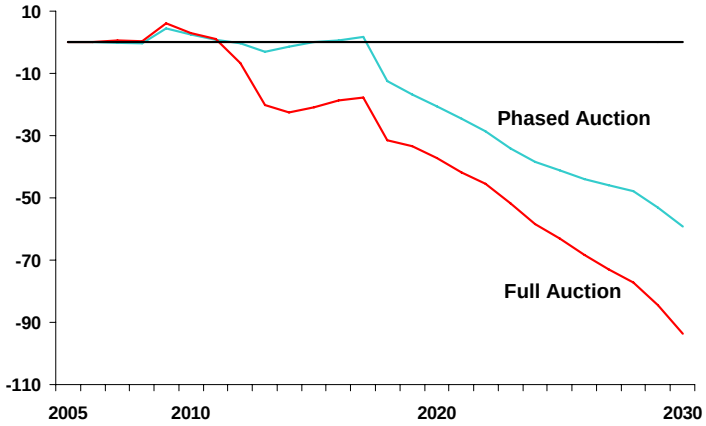
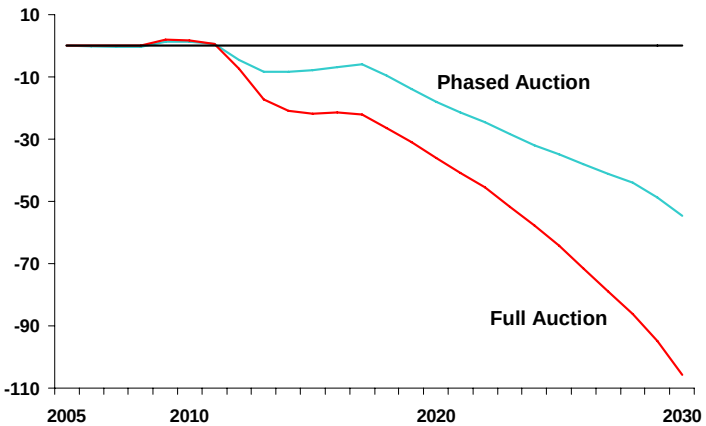


Figure 6. Impacts on Real Gross Domestic Product and Real Consumption Expenditures (billion 2000 dollars)

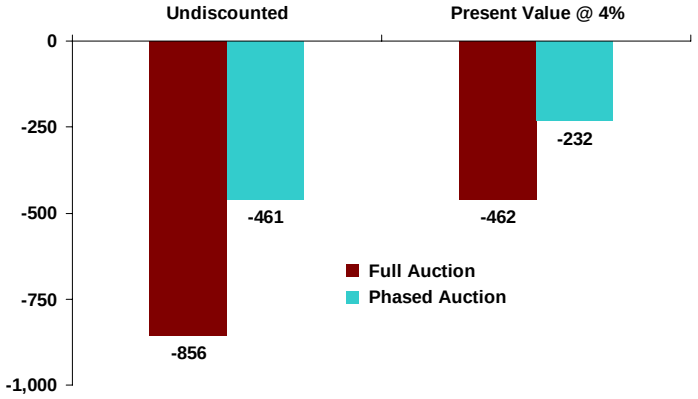
Impacts on Real Gross Domestic Product



Impacts on Real Consumption Expenditures



Cumulative Impact on Real Gross Domestic Product from 2009-2030



Cumulative Impact on Consumption from 2009-2030