Impacts of the Low Carbon Economy Act of 2007

Results of a Preliminary Analysis by the National Commission on Energy Policy

July 11, 2007

The introduction in the Senate today of the Low Carbon Economy Act of 2007 marks an important step forward in the effort to build broad, bi-partisan support for meaningful federal action to address global climate change. Having long taken the position that any responsible, long-term energy strategy for the United States must include a mandatory program to reduce greenhouse gas emissions, the National Commission on Energy Policy (NCEP) enthusiastically welcomes this development. The Commission is also pleased to note that the bill introduced today is consistent in many key respects with climate-policy recommendations first put forward by NCEP in 2004 and subsequently updated in April 2007. In particular, the proposed legislation combines substantial technology incentives with an emissions trading program that will create a consistent, economy-wide price signal for avoiding greenhouse gas emissions. This two-pronged strategy offers, in our view, the most promising and cost-effective approach for initiating the transition to a low-carbon economy.

Early debate on any climate-policy proposal is likely to focus on the environmental benefits and economic costs of action. This memorandum summarizes key findings from an initial analysis of the Low Carbon Economy Act of 2007 that builds on work the Commission undertook to explore the benefits and costs of its own recently updated recommendations. Because the basic program design contained in the Bingaman-Specter bill is quite similar to that analyzed by the Commission, the impacts of the proposed legislation could be estimated using the same approach with appropriate adjustments to certain key program parameters. Clearly, additional work will be needed to explore the specific impacts of the Bingaman-Specter approach relative to other legislative options. Nevertheless, the Commission offers these initial results by way of informing the near-term debate and suggesting areas for further analysis as Congress engages critical program design issues in the weeks and months ahead.

Parameters of the Analysis

Consistent with the Commission's long-standing emphasis on comprehensive policy approaches, our primary analysis included policy and technology changes additional to a greenhouse-gas emissions trading program. Because the Low Carbon Economy Act of 2007 includes substantial new incentives for technology development and deployment, many of these assumptions—particularly with respect to efficiency and technology improvements and advanced low-carbon options like carbon capture and storage—are directly applicable to the proposed legislation. In other areas, especially concerning automobile fuel economy and renewable energy mandates, our main analysis includes additional policies that are not covered in the Bingaman-Specter bill. (A summary of key assumptions in the policy case is provided in Table 1.) Action on these other policies within the timeframe of the analysis is, in some cases,

reasonably likely: fuel economy legislation, for example, is being actively debated in Congress at this time. In other areas, such as a national renewable portfolio standard, the present outlook is more uncertain.

Given these uncertainties, the Commission also modeled the impacts of the price signal generated by the greenhouse-gas trading program alone, without additional policies and with more conservative technology assumptions than those in the policy case described above.[1] In this case, the market price of allowances is assumed to rise to the safety valve level in the early years of program implementation and technology and efficiency improvements are driven solely by the greenhouse-gas price signal. This represents a kind of "worst-case" scenario because it relies solely on the price signal generated by the trading program to motivate emissions reductions and assumes that the substantial new R&D investments and deployment incentives provided for and funded by the proposed legislation have little or no effect on the pace of technology development.

The remainder of this memorandum summarizes key findings from both the policy case and the $12 safety valve case. The results are similar to those described in the modeling appendix to the NCEP's April 2007 recommendations, but they differ insofar as they incorporate the more stringent emissions targets and higher allowance-price caps proposed in the Low Carbon Economy Act of 2007.[2] As before, the analysis relies on the Energy Information Administration's (EIA's) National Energy Modeling System (NEMS), a detailed model of energy production and consumption; results are presented relative to EIA's Annual Energy Outlook 2006 reference-case forecast.[3]

[1] This case uses EIA's Annual Energy Outlook 2006 reference case assumptions regarding technology.
[2] The Commission's April 2007 updated recommendations called for program targets that would stabilize U.S. greenhouse gas emissions at current (2006) levels by 2020 and reduce emissions 15 percent below current levels by 2030. By comparison, the Bingaman-Specter legislation calls for reducing greenhouse gas emissions to 2006 levels by 2020 and to 1990 levels (approximately 20 percent below 2006 levels) by 2030. Similarly, the allowance price cap the Commission recommended starts at $10 per metric ton of carbon-dioxide equivalent emissions in 2012, whereas the Bingaman-Specter bill proposes a starting price of $12 per ton. Under both proposals, the price cap escalates at a rate of 5 percent per year, after inflation.
[3] A detailed description of the NEMS model can be found at http://www.eia.doe.gov/oiaf/aeo/overview/index.html. The model was used to forecast impacts to 2030, consistent with the forecasting period used in EIA's Annual Energy Outlook.

Table 1: Key Modeling Assumptions

Vehicle Fuel Economy	Average combined new car and light-truck fuel economy increases gradually to reach 41 miles per gallon by 2027. This is just slightly below the President's current recommendation for a presumptive 4 percent per year (approx. 1 mpg per year) rate of improvement in average light-duty vehicle fuel economy.
Greenhouse Gas Trading Program	Mandatory economy-wide greenhouse gas trading program implemented in 2012 with the following features: • Annual program targets defined to reduce emissions to 1990 levels (approximately 20 percent below 2006 levels) by 2030. • "Safety valve" price starts at $12 per ton CO_2-equivalent in 2012 and escalates 5% per year in real terms thereafter.
Energy Efficiency	Uses assumptions in EIA's "High Technology" side case from the Annual Energy Outlook 2006 for the residential, commercial, industrial, and transportation sectors.
Advanced Coal	Carbon capture and storage projects receive production incentives similar to the renewable production tax credit.
Renewable Electricity	A federal renewable portfolio standard is adopted to increase the nation's share of renewable electricity sales to at least 15% by 2020. Consistent with recent legislative proposals, the standard includes a 1.5 cent price cap on the cost of renewable energy credits.
Technology RD&D	Uses EIA's "High Technology" side case from the Annual Energy Outlook 2006 for the electric sector (which includes high technology assumptions for fossil fuel, nuclear, and renewable energy systems).

Emissions and Allowance Prices

- Relative to the reference case, covered greenhouse gas emissions less offsets[4] in the policy case are 1,605 million metric tons of carbon-dioxide equivalent ($MMTCO_2e$) (21 percent) lower in 2020 and 2,988 $MMTCO_2e$ (34 percent) lower in 2030. Allowance banking allows these emission reductions to be spread out over the forecast period, with regulated entities over-complying in the early years of program implementation when allowance prices are lower. Over 3,718 $MMTCO_2e$ allowances are banked by 2025. Emissions then begin to rise above the target as banked allowances are used for compliance. Even with the use of banked allowances, however, emissions in 2030 are 7 percent below current (2006) levels, and cumulative greenhouse gas emissions from covered sources over the 2012–2030 period analyzed are 24 percent below reference-case emissions.

[4] Covered sources include sources of energy-related CO_2 emissions, nitrous oxide emissions from adipic acid and nitric acid production, and industrial gases (HFCs, PFCs, and SF6). Eligible offset projects include only those listed in Section 303(b)(2) of the Bingaman-Specter bill: landfill methane use projects; animal waste or municipal wastewater methane use projects; projects to reduce sulfur hexafluoride emissions from transformers; and coal mine methane use projects.

- Allowance prices in the policy case rise from roughly $5.40 (real 2004 dollars) per metric ton of carbon-dioxide-equivalent in 2012 to just under $24 per metric ton in 2030 and remain below the safety valve price throughout the forecast period. Overall, program targets are met and no additional allowances are purchased through the safety valve mechanism.

- Reductions from energy-related carbon dioxide emissions account for roughly 75 percent of predicted reductions under the policy case in the 2020–2030 timeframe. The largest emissions reductions are forecast in the electric power and transportation sectors as a result of the greenhouse gas trading program and more stringent CAFE requirements. These two sectors account for 47 percent and 15 percent, respectively, of total cumulative emissions reductions over the forecast period In contrast, primary energy consumption in the residential, commercial, and industrial sectors combined accounts for a much smaller percentage (6–11 percent) of annual emissions reductions over the forecast period, although emissions within the industrial sector are nearly 21 percent below the reference case by 2030. Remaining reductions come from other covered greenhouse gases, the bulk of which involve industrial emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur-hexafluoride (SF6).

- An allowance allocation incentive for carbon capture and storage projects is estimated to result in additional emissions reductions of 340 $MMTCO_2e$ in 2020 and 369 $MMTCO_2e$ in 2030, or about 11 percent of the overall emissions reduction achieved by 2030.

- In the $12 safety valve case, the use of the safety valve allows emissions to rise above program targets. Nonetheless, substantial reductions are achieved. From 2012 through 2030, emission reductions total nearly 20 billion metric tons, and cumulative emissions are 13 percent below the reference case.

GDP Impacts

- Because of the efficiency gains and energy demand reductions that occur in the policy case, along with the positive economic benefits generated by the recycling of allowance auction revenues, the policy case actually shows small GDP gains by 2030. Specifically, projected U.S. GDP in 2030 is 0.12 percent higher in the policy case than in the reference case and there is a cumulative GDP gain of 0.23 percent over the entire modeling period (2006–2030).[5] In other words, overall GDP increases 101 percent between 2006 and 2030 in the policy case, compared to 100.8 percent over the same time period in the reference case.

- In the more conservative $12 safety valve case, overall GDP impacts turn negative but remain very small. Specifically, projected GDP in 2030 is 0.3 percent below the reference case and cumulative GDP losses over the entire modeling period (2006–2030) amount to 0.6 percent. In other words, overall GDP grows by 100.2 percent between 2006 and 2030 in the $12 safety valve case, compared to 100.8 percent in the reference case.

[5] Overall, EIA's reference-case forecast predicts that annual U.S. GDP will increase from $11.51 trillion at present to $23.11 trillion in 2030.

Energy Price Impacts

- Much of the cost of greenhouse gas allowances is passed through to consumers in both cases, raising the delivered price of fossil fuels and electricity and creating incentives to reduce energy consumption and shift to lower-carbon technologies, particularly in the electric power sector.

- In the policy case, the average delivered price of coal in the electric sector increases from $1.39 per million Btu to $2.32 per million Btu in 2020, an increase of 66 percent. By 2030 coal prices rise from $1.51 per million Btu in the reference case to $3.56 per million Btu in the policy case, an increase of 136 percent.

- Significant improvements in end-use efficiency and reduced electricity and natural gas demand in the policy case mitigate the impact of higher coal prices on the electric sector. As a result, electricity prices in this case do not rise above reference-case levels until after 2020. In 2030, electricity prices are 7 percent above the reference case level. Electricity price impacts are likely to vary across states and regions due to differences in regulatory regimes and in the fuel mix used for power generation.

- Price increases for other forms of delivered energy in the policy case are likewise moderate: retail gasoline prices in 2030 are 5 percent higher than in the reference case (equivalent to an 11 cent-per-gallon increase) while natural gas prices are 10 percent higher than in the reference case.

- Energy prices rise more dramatically in the $12 safety valve case because this case does not assume the efficiency gains, technology improvements, and demand reductions included in the policy case. Under these more conservative assumptions, price increases for gasoline, delivered natural gas, and electricity range from 6 percent to 12 percent in 2020, and 9 percent to 16 percent in 2030. Coal prices rise by 99 percent in 2020 and 139 percent in 2030.

Other Impacts

- Despite a significant increase in coal prices, coal use in both scenarios is projected to stay roughly constant in absolute terms, declining by just 2–3 percent from current (2005) levels by 2030.

- In the policy case, deployment incentives for carbon capture and storage (CCS) similar to those proposed in the Bingaman-Specter bill result in the addition of more than 84,000 megawatts of advanced coal capacity with CCS.[6]

[6] To simulate the bonus allowance program for CCS, all advanced coal generation with CCS built by 2030 receives a 1.7 cent per kilowatt-hour production tax credit. This is slightly below the current 1.9 cent per kilowatt-hour tax credit for renewables to reflect the fact that CCS systems would likely capture 90 percent (rather than 100 percent) of carbon emissions. As with the renewable production tax credit, plants receive the credit for the first 10 years of operation.

- The contribution from renewable energy resources increases substantially in both cases. In the policy case, which includes a national renewable portfolio standard, renewable generation increases to 1,016 billion kilowatt-hours by 2020 and to 1,349 billion kilowatt-hours by 2030. By comparison, EIA's reference case projects just 559 billion kilowatt-hours of renewable generation in 2030. The $12 safety valve case does not assume a renewable portfolio standard, but still shows significant gains in renewable generation (to 1,173 billion kilowatt-hours by 2030) compared to the reference case. In both scenarios, most of the increase in renewable generation is expected to be from non-hydroelectric renewable generators, mainly biomass and wind.

- The price signal generated by the trading program alone is unlikely to produce significant emissions reduction from the transport sector. This is because demand for gasoline is relatively inelastic at the level of the price signal contemplated in the Bingaman-Specter bill. Significant reductions in transport emissions and oil consumption are seen only in the policy case, which includes separate assumptions concerning a significant increase in fuel economy requirements for new light-duty vehicles.

Table 2: Summary Energy Market Results for the Reference and Policy Case

Projection	2005	2020		2030	
		AEO2006 Reference	$12 Policy Case	AEO2006 Reference	$12 Policy Case
Emissions of Greenhouse Gases (million metric tons CO2 equivalent)					
Energy-Related Carbon Dioxide	5,967	7,119	5,990	8,114	5,788
Other Covered Emissions	269	452	147	627	177
Total Greenhouse Gases	6,236	7,571	6,137	8,741	5,965
Emissions Reduction from Reference Case (million metric tons CO2 equivalent)					
Energy-Related Carbon Dioxide	-	-	1,129	-	2,327
Other Covered Emissions	-	-	305	-	450
Non-Energy Offset Credits	-	-	170	-	211
Carbon Sequestration	-	-	340	-	369
Total Emissions Reduction	-	-	1,605	-	2,988
Total (including sequestration)	-	-	1,945	-	3,357
Allowance Price (2004 Dollars per metric ton CO2 equivalent)	-	-	$10.40	-	$23.52
Delivered Energy Prices (2004 dollars per unit indicated) (includes allowance costs)					
Motor Gasoline (per gallon)	$2.31	$2.08	$2.06	$2.19	$2.29
Jet Fuel (per gallon)	$1.71	$1.42	$1.45	$1.56	$1.73
Distillate (per gallon)	$2.11	$1.93	$1.99	$2.06	$2.38
Natural Gas (per thousand cubic feet)	$9.89	$7.14	$7.39	$8.22	$9.00
Residential	$12.68	$10.48	$10.61	$11.67	$12.45
Electric Power	$8.29	$5.53	$5.44	$6.41	$6.96
Coal, Electric Power (per million Btu)	$1.50	$1.39	$2.32	$1.51	$3.56
Electricity (cents per kilowatthour)	8.3 ¢	7.2 ¢	7.2 ¢	7.5 ¢	8.0 ¢
Fossil Energy Consumption (quadrillion Btu)					
Petroleum	40.2	48.1	42.7	53.6	44.5
Natural Gas	22.9	27.7	23.8	27.7	24.2
Coal	23.4	27.6	23.2	34.5	22.7
Electricity Generation (billion kilowatthours)					
Petroleum	115	107	39	115	37
Natural Gas	752	1,102	820	990	864
Coal	2,041	2,505	2,108	3,381	2,178
Nuclear	774	871	865	871	1,039
Conventional Hydropower	267	303	307	303	308
All Other Renewable	109	212	708	256	1,041
Total	4,058	5,099	4,848	5,915	5,467