Synapse
Energy Economics, Inc.

Synapse 2008
CO_2 Price Forecasts

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1. INTRODUCTION

Synapse has prepared a 2008 CO_2 price forecast for use in Integrated Resource Planning (IRP) and other electricity resource planning analyses. The 2008 Synapse Low CO_2 Price Forecast starts at $10/ton[1] in 2013, in 2007 dollars, and increases to approximately $23/ton in 2030. This represents a $15/ton levelized price over the period 2013-2030, in 2007 dollars. The 2008 Synapse High CO_2 Price Forecast starts at $30/ton in 2013, in 2007 dollars, and rises to approximately $68/ton in 2030. This High Forecast represents a $45/ton levelized price over the period 2013-2030, also in 2007 dollars. Synapse also has prepared a Mid CO_2 Price Forecast that starts close to the low case, at $15/ton in 2013 in 2007 dollars, but then climbs to $53/ton by 2030. The levelized cost of this mid CO_2 price forecast is $30/ton in 2007 dollars.

In 2006, Synapse developed a set of CO_2 price forecasts for use in IRP and other electricity resource planning analyses.[2] Those forecasts ranged from a low of $10.23 levelized over the years 2013-2030, to a high of $37.11 levelized over the same period (all in 2007 dollars).

Significant developments in the past two years led Synapse to re-examine and revise its 2006 CO_2 price forecasts to ensure that these forecasts reflect an appropriate level of financial risk associated with greenhouse gas emissions. Most importantly, the political support for serious climate change legislation has expanded significantly in Federal and State governments, as well as in the public at large, as the scientific evidence of climate change has become more certain. Concurrently, the new greenhouse gas regulation bills under consideration in the 110th U.S. Congress contain emissions reductions that are significantly more stringent than would have been required by proposals introduced in earlier years. Moreover, an increasing number of states have adopted policies, either individually and/or as members of regional coalitions, to reduce greenhouse gas emissions. In addition, in the past two years, additional information has been developed regarding technology innovations in the areas of renewables, energy efficiency, and carbon capture and sequestration, leading to greater clarity about the cost of emissions mitigation; however, cost estimates for many of these technologies are still in the early stages. Taken together these developments lead to higher financial risks associated with future greenhouse gas emissions and justify the use of higher projected CO_2 emissions

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1 Throughout this paper, emission allowance prices are quoted in dollars per ton. This should be interpreted as dollars per short ton of CO_2. Prices in the economic literature and in international trading are often quoted in dollars per metric ton of CO_2 or dollars per metric ton of carbon, but the units we use are more typical of US carbon pricing schemes.

2 CO_2 price: Carbon dioxide (CO_2) is one of a cohort of six gases known to contribute to the atmospheric greenhouse effect which are collectively called greenhouse gases, or GHG. Most of the policies being designed at state, federal, and international levels propose to limit emissions of CO_2 as well as methane (CH_4), and nitrous oxide (N_2O), amongst others. Although these other gases are more potent greenhouse gases than CO_2, carbon dioxide is far more abundant and is the primary greenhouse gas emitted as a result of fossil fuel combustion. The "allowance price" is the price to emit one unit of CO_2, or more precisely, quantity of GHG equivalent to the 100-year global warming potential of one unit of CO_2. In shorthand and for simplicity, we refer to the "allowance price to emit one short ton of carbon dioxide equivalent greenhouse gas" as the "CO_2 price".

allowance prices in electricity resource planning and selection for the period 2013 to 2030.

As discussed in our earlier carbon price reports, we conclude that federal regulation of greenhouse gas emissions is certain. However, the costs of any program will be affected by important details that are still uncertain, such as the timing, goals, and design of the program that will ultimately be adopted and implemented. Therefore, it is critical to consider a reasonable range of CO_2 emissions allowance prices in resource planning to achieve decisions that are robust in an uncertain future just as resource planners normally consider a range of fuel prices. For this reason, we provide high, low and mid CO_2 allowance price forecasts.

This report discusses the specific factors and developments that we have considered in re-examining and revising the Synapse forecast of CO_2 prices for use in resource planning and selection. In general, our CO_2 price forecasts are based on:

1. Our review of the current political conditions in the U.S. concerning the issue of climate change and responses thereto;
2. The results of publicly available modeling analyses of greenhouse gas regulatory proposals in the current U.S. Congress;
3. The ranges of CO_2 prices used by utility regulatory commissions and utilities in electric resource planning;
4. Our review of the estimated costs for technological solutions to electric sector carbon emissions such as energy efficiency, renewable resources, nuclear power, and carbon capture and sequestration;
5. Our work experience and professional judgment on global climate change and electric resource planning issues.

2. NEW DEVELOPMENTS SINCE THE SPRING OF 2006

The most significant new developments since Synapse released its original CO_2 price forecasts in the spring of 2006 include the following:

Increasing Evidence of Climate Change

The Intergovernmental Panel on Climate Change (IPCC) released the IPCC Fourth Assessment Report, in 2007.[3] This report, a consensus document reflecting the views of hundreds of the world's top climate scientists, concluded in far stronger language than had any previous version that the climate of the Earth has been, and will continue to be, adversely affected by human-induced climate change. The report noted that "warming of the climate system is unequivocal", and that "Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases." The report documents increases in both surface temperature and sea level, as well as reductions in snow cover, that result directly from human activities. Finally, the report notes that "Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century."

The IPCC report, and numerous related scientific studies and reports, continue to corroborate and strengthen a consistent message: while uncertainties remain in the nature and timing of certain specific *impacts* of climate change, human-caused climate change is now established beyond any credible scientific doubt. The social and economic costs of climate change will be large and detrimental to societies all over the world, although those in less-developed regions are more likely to suffer greater damages in the short term. Importantly, the expected damages and costs associated with climate change rise with increasing levels of greenhouse gases in the atmosphere, as do the risks of crossing dangerous thresholds into cataclysmic impacts, such as the loss of the largest Antarctic glaciers and the resulting inundation of coastal regions around the world. Actions taken by governments and societies today will make an enormous difference in the ultimate economic and societal costs and dislocations associated with climate change.

Increased Political Support for Serious Government Action on Climate Change

A number of developments demonstrate growing political support for, and anticipation of, serious action by federal and state governments in the U.S. to mitigate climate change. These developments include:

- Bipartisan support for climate change legislation – Senators and representatives of both major parties support the climate change legislation introduced in the

[3] http://www.ipcc.ch/

current Congress, and the presumptive nominees for President from both major parties also support some form of aggressive climate change legislation.

- Carbon Principles issued by three leading financial institutions – Citi, JPMorgan Chase, and Morgan Stanley developed climate change guidelines for advisors and lenders to power companies in the United States. These Principles create an approach to evaluating and addressing carbon risks in the financing of electric power projects.[4] Several other financial institutions, such as Bank of America and Credit Suisse, have adopted the Principles.
- State and Regional Actions to reduce greenhouse gas emissions – More than 30 states have developed or are developing climate change plans. Some states, like California, Montana, Oregon and Washington, have adopted explicit performance based standards regarding long-term investments in baseload generation. The California Energy Commission requires that new investments in baseload generation comply with a standard of 1,100 lbs of CO_2 per MWh. The Northeast states are implementing a regional cap on carbon emissions. States in the upper Midwest and the West are also acting regionally to address CO_2 emissions. As of Dec. 2007, 25 states had adopted Renewable Portfolio Standards that require certain percentages of energy consumption be supplied by renewable resources.
- Judicial decisions regarding greenhouse gases– In April 2007, the U.S. Supreme Court found in Massachusetts v. EPA that CO_2 is an air pollutant under the Clean Air Act.5 For this reason the EPA has statutory authority to regulate emissions of CO_2. The court found that EPA's refusal to do so or to provide a reasonable explanation of why it could not regulate was arbitrary, capricious and otherwise not in accordance with law. The Supreme Court also found that the "harms associated with climate change are serious and well recognized."
- A state court in Georgia has subsequently ruled that an air permit cannot be issued for a new coal-fired power plant without CO_2 emission limitations based on a Best Available Control Technology ("BACT") analysis.[6]
- Increasingly stringent federal legislative proposals that would require much more substantial reductions in greenhouse gas emissions than the proposals introduced in earlier sessions of Congress (see below).
- A 2007 resolution adopted by the National Association of Regulatory Utility Commissioners (NARUC) encouraged utility requirements to "assess and incorporate carbon-related risks in their planning and decision-making processes."[7]

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4 Carbon Principles adopted February 8, 2008. For more information see: http://www.carbonprinciples.com/

5 127 S. Ct. 1438 (2007)

6 *Friends of the Chattahoochie, Inc. and Sierra Club v. Dr. Carol Couch, Direct Environmental Protection Division, Georgia Department of Natural Resources and Longleaf Energy Associates,* LLC, Final Order in the Superior Court of Fulton County, State of Georgia, Docket No. 2008CV146398, issued on June 30, 2008.

7 NARUC, *Resolution on State Regulatory Policies Toward Climate Change,* adopted November 2007.

Federal Legislative Proposals

To date, the U.S. government has not required greenhouse gas emission reductions in the private sector. However, a number of legislative initiatives for mandatory emissions reduction proposals have been introduced in Congress. These proposals establish carbon dioxide emission trajectories below the projected business-as-usual emission trajectories, and they generally rely on market-based mechanisms, such as cap and trade programs, for achieving the targets. The proposals also include various provisions to spur technology innovation, as well as various details pertaining to offsets, allowance allocation, “safety valve” maximum allowance prices and other issues. The major federal proposals that would require greenhouse gas emission reductions that had been submitted in the 110th U.S. Congress are summarized in Table 1 below.

Table 1. Summary of Mandatory Emissions Targets in Proposals Discussed in the current U.S. Congress

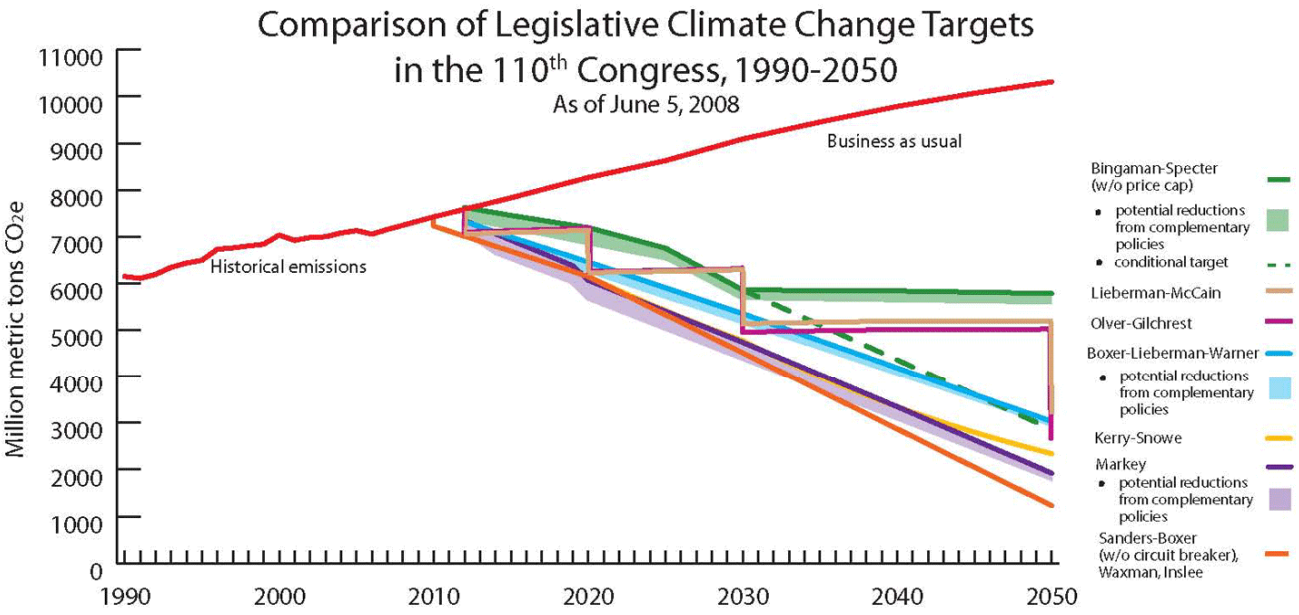
Proposed National Policy	Title or Description	Year Proposed	Emission Targets	Sectors Covered
Feinstein-Carper S.317	Electric Utility Cap & Trade Act	2007	▪ 2006 level by 2011 ▪ 2001 level by 2015 ▪ 1%/year reduction from 2016-2019 ▪ 1.5%/year reduction starting in 2020	Electricity sector
Kerry-Snowe S.485	Global Warming Reduction Act	2007	▪ 2010 level from 2010-2019 ▪ 1990 level from 2020-2029 ▪ 2.5%/year reductions from 2020-2029 ▪ 3.5%/year reduction from 2030-2050 ▪ 65% below 2000 level in 2050	Economy-wide
McCain-Lieberman S.280	Climate Stewardship and Innovation Act	2007	▪ 2004 level in 2012 ▪ 1990 level in 2020 ▪ 20% below 1990 level in 2030 ▪ 60% below 1990 level in 2050	Economy-wide
Sanders-Boxer S.309	Global Warming Pollution Reduction Act	2007	▪ 2%/year reduction from 2010 to 2020 ▪ 1990 level in 2020 ▪ 27% below 1990 level in 2030 ▪ 53% below 1990 level in 2040 ▪ 80% below 1990 level in 2050	Economy-wide
Olver, et al HR 620	Climate Stewardship Act	2007	▪ Cap at 2006 level by 2012 ▪ 1%/year reduction from 2013-2020 ▪ 3%/year reduction from 2021-2030 ▪ 5%/year reduction from 2031-2050 ▪ equivalent to 70% below 1990 level by 2050	US national
Bingaman–Specter S.1766	Low Carbon Economy Act	2007	▪ 2012 levels in 2012 ▪ 2006 levels in 2020 ▪ 1990 levels by 2030 ▪ President may set further goals $\geq$60% below 2006 levels by 2050 contingent upon international effort	Economy-wide
Lieberman-Warner S. 2191	America's Climate Security Act	2007	▪ 2005 level in 2012 ▪ 1990 level in 2020 ▪ 65% below 1990 level in 2050	U.S. electric power, transportation, and manufacturing sources.
Boxer-Lieberman-Warner S. 3036	Substitute for S. 2191	2008	▪ 4% below 2005 level in 2012 ▪ 19% below 2005 level in 2020 ▪ 71% below 2005 level in 2050	Economy-wide
Markey HR. 6186	The Investing in Climate Action and Protection Act	2008	▪ 2005 level in 2012 ▪ 20% below 2005 level by 2020 ▪ 80% below 2005 level by 2050	Economy-wide

The emissions levels that would be mandated by these bills that are shown in Figure 1 below, reproduced from a recent World Resources Institute analysis.[8]

[8] Version as of June 2008, available at http://pdf.wri.org/usclimatetargets_2008-06-18.pdf.

Each of the major legislative proposals that have been introduced in the 110th Congress would require far more substantial reductions in greenhouse gas emissions than would have been required by the proposals that had been introduced in Congress by the spring of 2006. For example, Figure 2 compares the emissions caps that would have been required by Senate Bill S. 2028 in the 109th Congress with the emissions levels that would be mandated under Senate Bills S. 2191 and S. 3036.

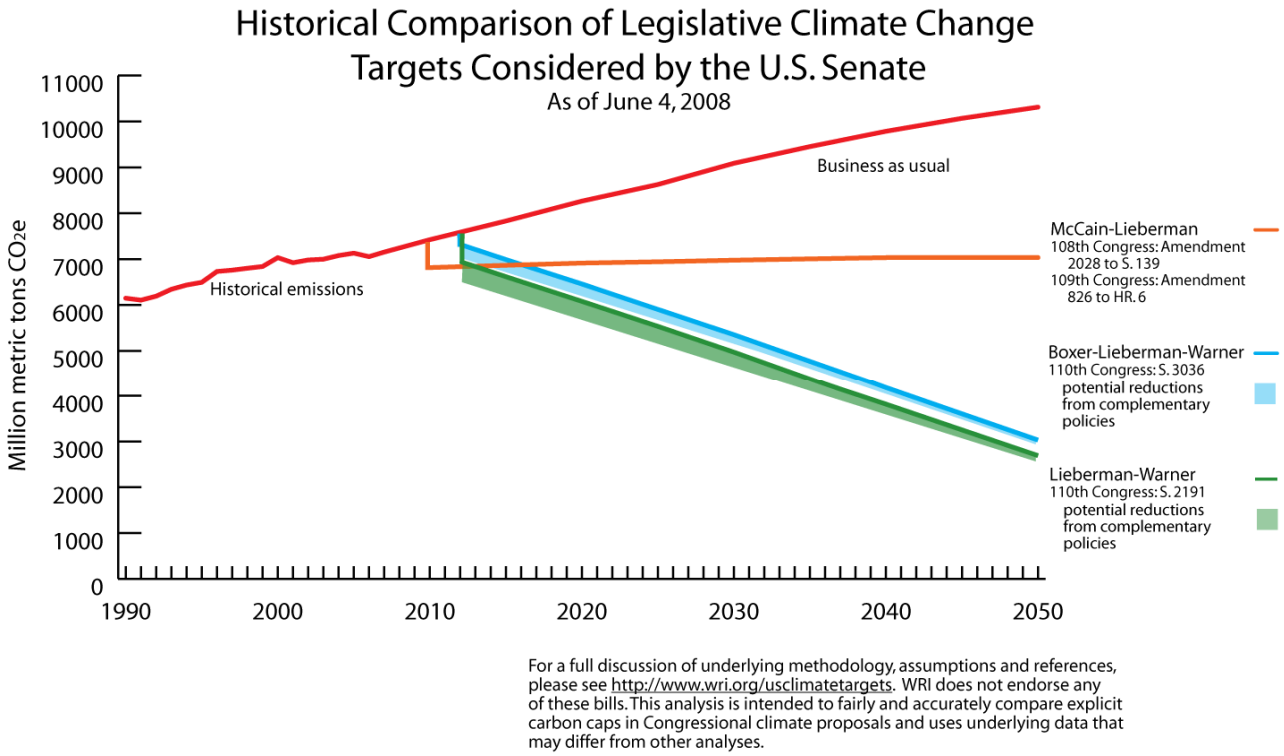
Figure 1: Comparison of Legislative Climate Change Targets in the Current 110th U.S. Congress



WORLD RESOURCES INSTITUTE

For a full discussion of underlying methodology, assumptions and references, please see http://www.wri.org/usclimatetargets. WRI does not endorse any of these bills. This analysis is intended to fairly and accurately compare explicit carbon caps in Congressional climate proposals and uses underlying data that may differ from other analyses. Price caps, circuit breakers and other cost-containment mechanisms contained in some bills may allow emissions to deviate from the pathways depicted in this analysis.

Figure 2: Historical Comparison of Legislative Climate Change Proposals in U.S. Congress



It is uncertain which, if any, of the specific climate change bills that have been introduced to date in the Congress will be adopted. The general trend is clear, however, and it would be a mistake to ignore it in long-term decisions concerning electric resources: over time the proposals in Congress are becoming more stringent as evidence of climate change accumulates and as the political support for serious governmental action grows.

3. FACTORS THAT INFLUENCE CO_2 PRICES

A large number of modeling analyses have been undertaken to evaluate the CO_2 allowance prices that would result from the major climate change bills introduced in the current Congress. It is not possible to compare the results of all of these analyses directly because the specific models and the key assumptions vary. However, the results of these analyses do provide important insights into the ranges of possible future CO_2 allowance prices under a range of potential scenarios.

These analyses included the following:

- The Energy Information Administration of the U.S. Department of Energy's ("EIA") assessment of the *Energy Market and Economic Impacts of S. 280, the Climate Stewardship and Innovation Act of 2007* (July 2007).[9]
- The October 2007 Supplement to the EIA's assessment of the *Energy Market and Economic Impacts of S. 280, the Climate Stewardship and Innovation Act of 2007*.[10]
- The EIA's assessment of the *Energy Market and Economic Impacts of S. 1766, the Low Carbon Economy Act of 2007* (January 2008).[11]
- The EIA's assessment of the *Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007* (April 2008).[12]
- The U.S. Environmental Protection Agency's ("EPA") *Analysis of the Climate Stewardship and Innovation Act of 2007 – S. 280 in 110th Congress* (July 2007).[13]
- The EPA's *Analysis of the Low Carbon Economy Act of 2007 – S. 1766 in 110th Congress* (January 2008).[14]
- The EPA's *Analysis of the Lieberman-Warner Climate Security Act of 2008 – S. 2191 in 110th Congress* (March 2008).[15]
- *Assessment of U.S. Cap-and-Trade Proposals* by the Joint Program at the Massachusetts Institute of Technology ("MIT") on the Science and Policy of Global Change (April 2007).[16]
- *Analysis of the Cap and Trade Features of the Lieberman-Warner Climate Security Act – S. 2191* by the Joint Program at MIT on the Science and Policy of Global Change (April 2008).[17]

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9 Available at http://www.eia.doe.gov/oiaf/servicerpt/csia/pdf/sroiaf(2007)04.pdf.
10 Available at http://www.eia.doe.gov/oiaf/servicerpt/biv/pdf/s280_1007.pdf
11 Available at http://www.eia.doe.gov/oiaf/servicerpt/lcea/pdf/sroiaf(2007)06.pdf
12 Available at http://www.eia.doe.gov/oiaf/servicerpt/s2191/pdf/sroiaf(2008)01.pdf.
13 Available at http://www.epa.gov/climatechange/economics/economicanalyses.html.
14 Available at http://www.epa.gov/climatechange/economics/economicanalyses.html.
15 Available at http://www.epa.gov/climatechange/economics/economicanalyses.html.
16 Available at http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt146.pdf
17 Available at http://mit.edu/globalchange/www/MITJPSPGC_Rpt146_AppendixD.pdf.

- *The Lieberman-Warner America's Climate Security Act: A Preliminary Assessment of Potential Economic Impacts, prepared by the Nicholas Institute for Environmental Policy Solutions, Duke University and RTI International, (*October 2007)[18]
- *U.S. Technology Choices, Costs and Opportunities under the Lieberman-Warner Climate Security Act: Assessing Compliance Pathways,* prepared by the International Resources Group for the Natural Resources Defense Council, *NRDC (May 2008)*[19]
- *The Lieberman-Warner Climate Security Act – S. 2191, Modeling Results from the National Energy Modeling System – Preliminary Results,* Clean Air Task Force, (January 2008).[20]
- *Economic Analysis of the Lieberman-Warner Climate Security Act of 2007 Using CRA's MRN-NEEM Model*, CRA International, (April 2008).[21]
- *Analysis of the Lieberman-Warner Climate Security Act (S. 2191) using the National Energy Modeling System (NEMS/ACCF/NAM),* a report by the American Council for Capital Formation and the National Association of Manufacturers, NMA, (March 2008).[22]

The results of these and other analyses show that there are a number of factors that affect projections of allowance prices under federal greenhouse gas regulation. These include: the base case emissions forecast; the reduction targets in each proposal; whether complementary policies such as aggressive investments in energy efficiency and renewable energy are implemented, independent of the emissions allowance market; the policy implementation timeline; program flexibility regarding emissions offsets (perhaps international) and allowance banking; assumptions about technological progress; the presence or absence of a "safety valve" price; and emissions co-benefits.[23]

Based on our review of the more than 75 scenarios examined in the modeling analyses listed above we conclude that:

1. Other things being equal, more aggressive emissions reductions will lead to higher allowance prices than less aggressive emissions reductions.
2. Greater program flexibility decreases the expected allowance prices, while less flexibility increases prices. This flexibility can be achieved through increasing the percentage of emissions that can be offset, by allowing banking of allowances or by allowing international trading.[24]

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18 Available at http://www.nicholas.duke.edu/institute/econsummary.pdf

19 Available at http://docs.nrdc.org/globalwarming/glo_08051401A.pdf

20 Available at http://lieberman.senate.gov/documents/catflwcsa.pdf .

21 Available at http://www.nma.org/pdf/040808_crai_presentation.pdf ….

22 Available at http://www.accf.org/pdf/NAM/fullstudy031208.pdf.

23 Discussed in more detail in *Climate Change and Power: Carbon Dioxide Emissions Costs and Electricity Resource Planning* Synapse Energy Economics, May 2006

24 One drawback to programs with higher flexibility is that they are much more complex to administer, monitor, and verify. Emissions reductions must be credited only once, and offsets and trades must be associated with verifiable actions to reduce atmospheric CO_2. A generally accepted standard is the "five-point" test: "at a minimum, eligible offsets shall consist of actions that are real, surplus,

3. The rate of improvement in emissions mitigation technology is a crucial assumption in predicting future emissions costs. For CO_2, looming questions include the future feasibility and cost of carbon capture and sequestration, and cost improvements in integrating carbon-free generation technologies. Improvements in the efficiency of coal burning technologies and in the costs of nuclear power plants could also be a factor.

   In general, those scenarios in the modeling analyses with lesser availability of low-carbon alternatives have the higher CO_2 allowance prices. When low carbon technologies are widely available, CO_2 allowance prices tend to be lower.

4. Complementary energy policies, such as direct investments in energy efficiency or policies that foster renewable energy resources are a very effective way to reduce the demand for emissions allowances and thereby lower their market prices. A policy scenario which includes aggressive energy efficiency and/or renewable resource development along with carbon emissions limits will result in lower allowance prices than one in which these resources are not directly addressed.

5. Most technologies which reduce carbon emissions also reduce emissions of other criteria pollutants, such as NO_x, SO_2 and mercury. Adopting carbon reduction technology results not only in cost savings to the generators who no longer need criteria pollutant permits, but also in broader economic benefits in the form of reduced permit costs and consequently lower priced electricity. In addition, there are a number of co-benefits such as improved public health, reduced premature mortality, and cleaner air associated with overall reductions in power plant emissions which have a high economic value to society. Models which include these co-benefits will predict a lower overall cost impact from carbon regulations, as the cost of reducing carbon emissions will be offset by savings in these other areas.

6. Projected emissions under a business-as-usual scenario (in the absence of greenhouse gas emission restrictions) have a significant bearing on projected allowance costs. The higher the projected emissions, the higher the projected cost of allowance to achieve a given reduction target.

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verifiable, permanent and enforceable." Still, there appears to be a benefit in terms of overall mitigation costs to aim for as much flexibility as possible, especially as it is impossible to predict with certainty what the most cost-effective mitigation strategies will be in the future. Models which assume greater program flexibility are likely to predict lower compliance costs for reaching any specified goal.

4. THE SYNAPSE 2008 CO_2 ALLOWANCE PRICE FORECASTS

The Synapse 2008 CO_2 price forecasts begin in 2013. This is a reasonable assumption since it is likely that climate change legislation will be passed by the next Congress and that the implementation of the regulatory scheme may take two years.

The Synapse Low CO_2 Price Forecast starts at $10/ton[25] in 2013, in 2007 dollars, and increases to approximately $23/ton in 2030. This represents a $15/ton levelized price over the period 2013-2030, in 2007 dollars.

This Low Forecast is consistent with the coincidence of one or more of the factors discussed above that have the effect of lowering prices. For example, this price trajectory may represent a scenario in which Congress begins regulation of greenhouse gas emissions slowly by either:

1. including a very modest or loose cap, especially in the initial years,
2. including a safety valve price similar to the Technology Accelerator Payment in the current Bingaman-Specter Legislation (S. 1766), or
3. allowing for significant offset flexibility, including the use of substantial numbers of international offsets.

The factors could also include a decision by Congress to adopt a set of aggressive complementary policies as part of a package to reduce CO_2 emissions. These complementary policies could include an aggressive federal Renewable Portfolio Standard, more stringent automobile CAFE mileage standards (in an economy-wide regulation scenario), and/or substantial energy efficiency investments. Such complementary policies would lead directly to a reduction in CO_2 emissions independent of federal cap-and-trade or carbon tax policies, and would lower the expected allowance prices associated with the achievement of any particular federally-mandated goal.

The 2008 Synapse High CO_2 Price Forecast starts at $30/ton in 2013, in 2007 dollars, and rises to approximately $68/ton in 2030. This High Forecast represents a $45/ton levelized price over the period 2013-2030, also in 2007 dollars.

This High CO_2 Price Forecast is consistent with the occurrence of one or more of the factors identified above that have the effect of raising prices. These factors include somewhat more aggressive emissions reduction targets, greater restrictions on the use of offsets, some restrictions on the availability of or the high cost of technology alternatives such as nuclear, biomass and carbon capture and sequestration, and more aggressive international actions (thereby resulting in fewer inexpensive international offsets available for purchase by U.S. emitters).

There are some CO_2 price scenarios identified in recent analyses that are significantly higher than our Synapse High Price Forecast. These scenarios represent situations with

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[25] Throughout this paper, emission allowance prices are quoted in dollars per ton. This should be interpreted as dollars per short ton of CO_2. Prices in the economic literature and in international trading are often quoted in dollars per metric ton of CO_2 or dollars per metric ton of carbon, but the units we use are more typical of US carbon pricing schemes.

limited availability of alternatives to carbon-emitting technologies and/or limited use of international and domestic offsets. We do not believe that the CO_2 prices characteristic of such scenarios are likely in the current political environment, given that there may potentially be avenues available for meeting likely emissions goals that would mitigate the costs to below these levels. This may change over time due to changes in technical, economic, and political circumstances, more stringent CO_2 emissions targets, and/or developments in scientific evidence and of the impacts of a changing climate.

Synapse also has prepared a Mid CO_2 Price Forecast that starts close to the low case, at $15/ton in 2013 in 2007 dollars, but then climbs to $53/ton by 2030. The levelized cost of this mid CO_2 price forecast is $30/ton in 2007 dollars, which is the midpoint between the $15/ton Low CO_2 Price Forecast and the $45/ton High CO_2 Price Forecast. The Mid CO_2 price forecast represents a scenario in which CO_2 allowance prices begin rather low, perhaps reflecting the hesitance of the U.S. Congress to impose high costs in the short run, but then climb significantly over time as federal regulation of CO_2 emissions becomes progressively more stringent.

The 2008 Synapse High, Mid and Low CO_2 Price Forecasts are shown in Figure 3 and Table 2 below:

Figure 3: Synapse 2008 CO_2 Price Forecasts

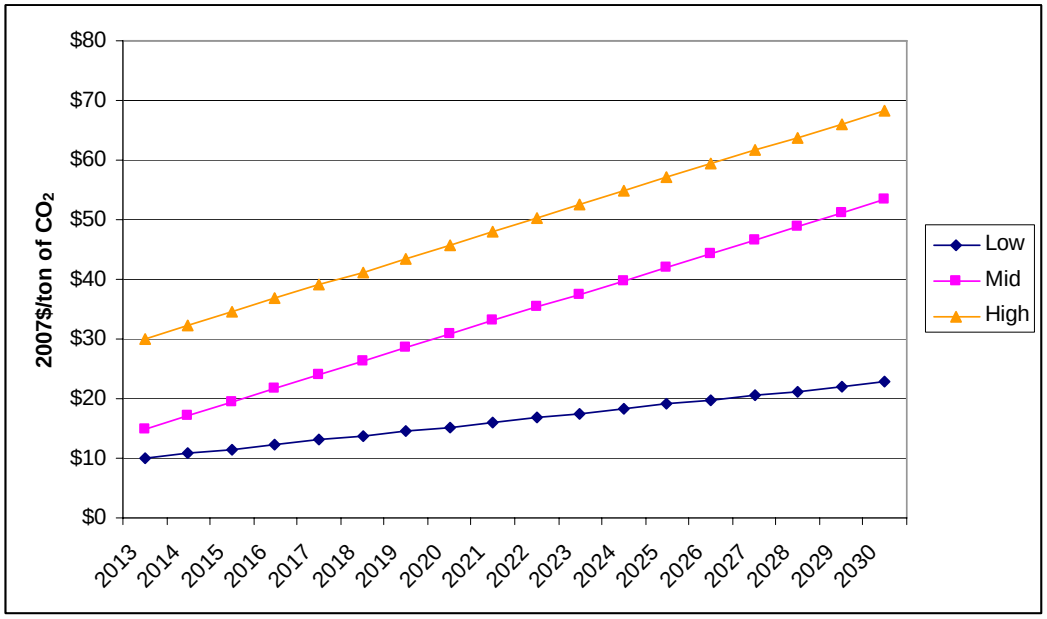

Table 2: Synapse 2008 CO_2 Price Forecasts (in 2007 dollars)

Year	Low	Mid	High
2013	$10.00	$15.00	$30.00
2014	$10.80	$17.30	$32.30
2015	$11.50	$19.50	$34.50
2016	$12.30	$21.80	$36.80
2017	$13.00	$24.00	$39.00
2018	$13.80	$26.30	$41.30
2019	$14.50	$28.50	$43.50
2020	$15.30	$30.80	$45.80
2021	$16.00	$33.10	$48.10
2022	$16.80	$35.30	$50.30
2023	$17.50	$37.60	$52.60
2024	$18.30	$39.80	$54.80
2025	$19.00	$42.10	$57.10
2026	$19.80	$44.30	$59.30
2027	$20.50	$46.60	$61.60
2028	$21.30	$48.80	$63.80
2029	$22.00	$51.10	$66.10
2030	$22.80	$53.40	$68.40

Given the significant uncertainty in the timing and design of CO_2 regulatory programs, we believe that the use of a range of CO_2 prices, such as that represented by the Synapse Low and High CO_2 Price Forecasts ($15/ton to $45/ton on a levelized basis between 2013 and 2030) is appropriate in utility resource planning.

The Synapse CO_2 price forecasts are consistent with the results of the analyses of current legislative proposals and recent forecasts by regulatory commissions and utilities. For example, Figure 4 compares the annual CO_2 prices in the Synapse Low, Mid and High Forecasts with the CO_2 prices in the scenarios examined by the EIA, EPA, MIT, and Duke University in their assessments of the proposals that have been introduced in the current U.S. Congress. The Synapse forecasts are shown in the solid red lines. A number of the analyses resulted in allowance price trajectories that were significantly higher than the Synapse forecasts. As noted earlier, however, we do not believe that the highest scenarios are realistic given the current political environment and the options available for mitigating high price impacts from carbon regulation.

Figure 4: Synapse 2008 CO_2 Price Forecasts vs. Results of Modeling Analyses Major Bills in Current U.S. Congress – Annual CO_2 Prices (in 2007 dollars)

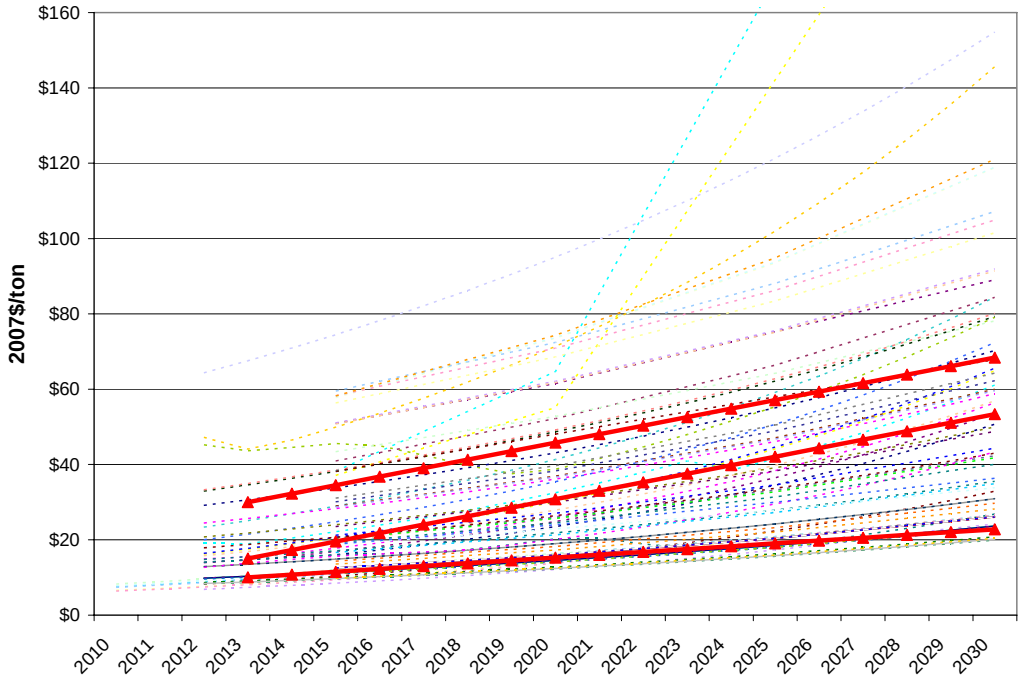

Figure 5 presents a similar comparison but in a simplified format. In Figure 5, rather than annual costs, the comparison is in terms of levelized costs for the years 2013 through 2030, also in 2007 dollars.[26] Also, in Figure 5 only the high, low, and median cases for each study are presented.

[26] Synapse used a real discount rate of 7.32% for calculating levelized values. This is equivalent to 10% nominal and 2.5% inflation. We used the CPI to convert past year dollars to 2007 dollars. At the same time, we used a 2.5% inflation rate to convert future year dollars back to 2007 dollars.

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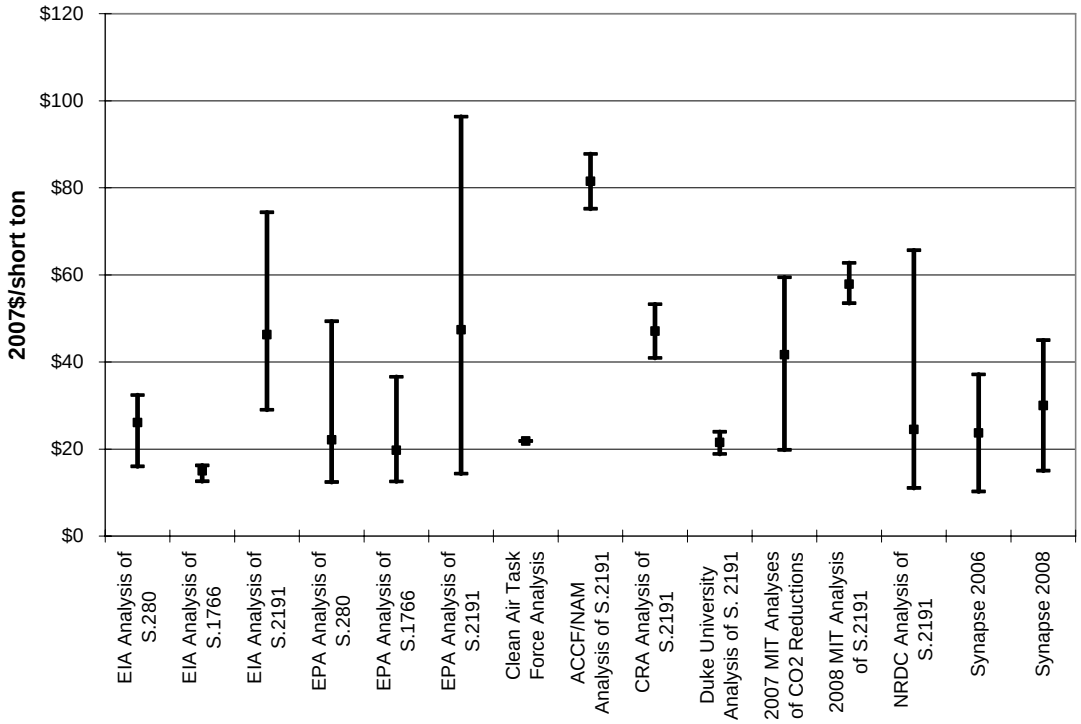
Figure 5: Synapse 2008 CO_2 Price Forecasts vs. Results of Modeling Analyses Major Bills in Current U.S. Congress – Levelized CO_2 Prices (2013-2030, in 2007 dollars)



As shown in Figure 6, the 2008 Synapse CO_2 Price Forecasts also are consistent with the ranges of CO_2 prices that an increasing number of regulatory commissions and utilities are using in electric resource planning analyses. [27]

[27] Synapse used a real discount rate of 7.32% for calculating levelized values. This is equivalent to 10% nominal and 2.5% inflation. We used the CPI to convert past year dollars to 2007 dollars. At the same time, we used a 2.5% inflation rate to convert future year dollars back to 2007 dollars.

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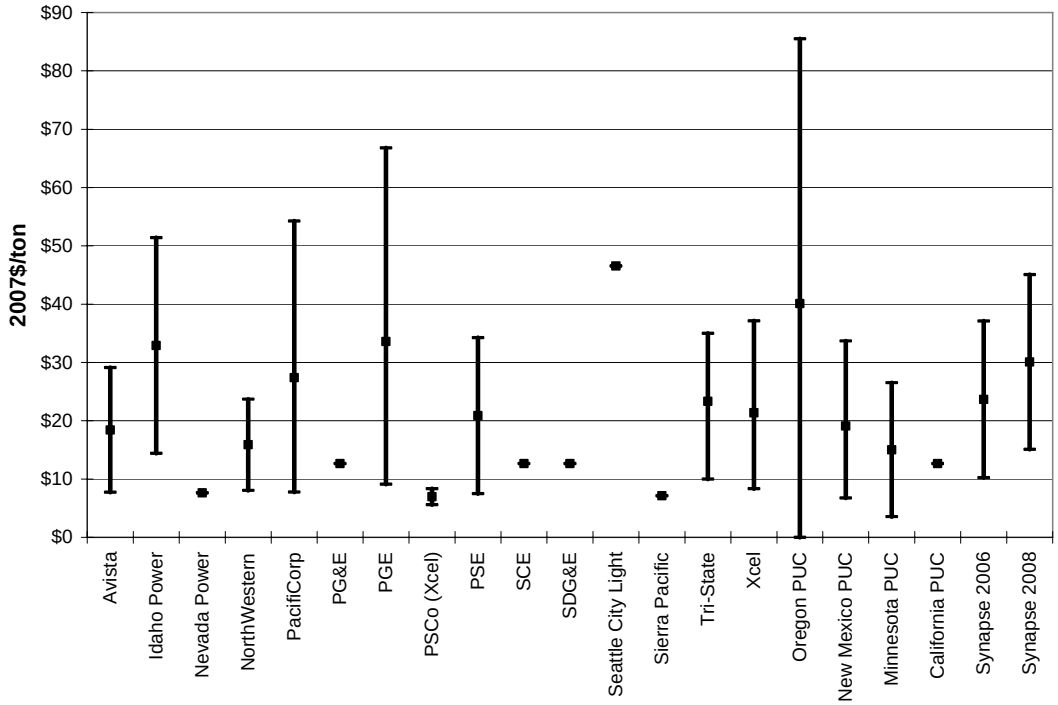
Figure 6: Synapse 2008 CO_2 Price Forecasts vs. CO_2 Prices Used by Regulatory Commissions and Utilities in Resource Planning Analyses (2013-2030, in 2007 dollars)



5. CONCLUSION

In 2006, Synapse developed an initial forecast of CO_2 allowance prices for use in electricity resource planning. In the past two years, we have seen a number of developments that have caused us to refine our expectations for the likely emission allowance costs under federal greenhouse gas regulation. More recent legislative proposals reveal a greater understanding, in Congress and among the pubic, of climate change and the emissions reductions that will be necessary to avoid dangerous climate change. As a result, long-term emission reduction targets contained in current federal proposals are more stringent than those from prior sessions, approaching the reduction levels identified by the scientific community as necessary to avoid dangerous climate change. This trend leads us to conclude that allowance prices will be higher than we projected back in 2006.

Simultaneously, today's legislative proposals reveal a more sophisticated understanding of the advantages and value of a comprehensive approach to achieving emission reductions. These proposals incorporate complementary energy policies, such as incentives for technology innovation, funds targeted to energy efficiency, restrictions on non-CCS new coal, and/or emissions performance standards, which are likely to mitigate the cost of achieving aggressive emissions goals. Further, provisions for program flexibility and trends in technological innovation hold promise to limit the price impact in the long term. Based on all of these factors, we believe our allowance price projections for the period 2013 to 2030 represent an appropriate range of values to facilitate robust decision-making for an uncertain future, in which carbon emissions will be regulated by some as-yet undefined federal regime.