LARGE FILING SEPERATOR SHEET

CASE NUMBER: 06-1358-EL-BGN

FILE DATE: 1/03/2008

SECTION: Part 4 of 5

NUMBER OF PAGES: 194

DESCRIPTION OF DOCUMENT: Transcript Volume IV and Exhibits

EXHIBIT

CITIZEN GROUPS' EX. 6

BEFORE THE
OHIO POWER SITING BOARD

In the Matter of An Application by American Municipal Power - Ohio, Inc. (AMP-Ohio) for a Certificate of Environmental Compatibility and Public Need for an Electric Generation Station and Related Facilities in Meigs County, Ohio	)	**Case No. 06-1358-EL-BGN**

DIRECT TESTIMONY OF DAVID A. SCHLISSEL
ON BEHALF OF
THE NATURAL RESOURCE DEFENSE COUNCIL, INC.
~~OHIO ENVIRONMENTAL COUNCI~~L, AND
THE SIERRA CLUB

[redacted]

Exhibit C

DECEMBER 3, 2007

Table of Contents

List of Exhibits

1. Introduction

Q. What is your name, position and business address?

A. My name is David A. Schlissel. I am a Senior Consultant at Synapse Energy Economics, Inc, 22 Pearl Street, Cambridge, MA 02139.

Q. Please describe Synapse Energy Economics.

A. Synapse Energy Economics ("Synapse") is a research and consulting firm specializing in energy and environmental issues, including electric generation, transmission and distribution system reliability, market power, electricity market prices, stranded costs, efficiency, renewable energy, environmental quality, and nuclear power.

Synapse's clients include state consumer advocates, public utilities commission staff, attorneys general, environmental organizations, federal government and utilities. A complete description of Synapse is available at our website, www.synapse-energy.com.

Q. Please summarize your educational background and recent work experience.

A. I graduated from the Massachusetts Institute of Technology in 1968 with a Bachelor of Science Degree in Engineering. In 1969, I received a Master of Science Degree in Engineering from Stanford University. In 1973, I received a Law Degree from Stanford University. In addition, I studied nuclear engineering at the Massachusetts Institute of Technology during the years 1983-1986.

Since 1983 I have been retained by governmental bodies, publicly-owned utilities, and private organizations in 28 states to prepare expert testimony and analyses on engineering and economic issues related to electric utilities. My recent clients have included the New Mexico Public Regulation Commission, the General Staff of the Arkansas Public Service Commission, the Staff of the Arizona Corporation Commission, the U.S. Department of Justice, the Commonwealth of

Massachusetts, the Attorneys General of the States of Massachusetts, Michigan, New York, and Rhode Island, the General Electric Company, cities and towns in Connecticut, New York and Virginia, state consumer advocates, and national and local environmental organizations.

I have testified before state regulatory commissions in Arizona, New Jersey, Connecticut, Kansas, Texas, New Mexico, New York, Vermont, North Carolina, South Carolina, Maine, Illinois, Indiana, Ohio, Massachusetts, Missouri, Rhode Island, Wisconsin, Iowa, South Dakota, Georgia, Minnesota, Michigan, Florida, North Dakota, Louisiana and Arkansas and before an Atomic Safety & Licensing Board of the U.S. Nuclear Regulatory Commission.

A copy of my current resume is attached as Exhibit DAS-1.

Q. On whose behalf are you testifying in this case?

A. I am testifying on behalf of the Natural Resources Defense Council, Inc., the Ohio Environmental Council, and the Sierra Club. (hereinafter "Citizen Groups")

Q. Have you testified previously before this Board?

A. No.

Q. What is the purpose of your testimony?

A. Synapse was retained by the Citizen Groups to provide technical assistance in assessing American Municipal Power's proposed 960 MW coal-fired power plant in Meigs County, Ohio, (hereinafter "AMPGS" or "the proposed plant") and in presenting arguments regarding the costs (including construction costs and the cost of CO2 regulations) of the proposed plant and alternatives to the proposed plant.

This testimony presents the results of our analyses to date.

Q. Were there other members of the Synapse staff who also assisted in the analyses undertaken by Synapse as part of its evaluation of AMP's proposed plant?

A. Yes. Dr. David White, Michael Drunsic, Robin Maslowski, Jeremy Fisher, Allison Smith and Kenji Takahashi also were members of the Synapse team for this project. Copies of their resumes are available at www.synapse-energy.com. However, I am ultimately responsible for all the conclusions and opinions presented in this testimony.

Q. Please summarize your conclusions.

A. My conclusions are as follows:

1. AMP-Ohio has not adequately considered the risks associated with building a new coal-fired power plant in the resource planning analyses that included the AMPGS Project as part of the Power Supply Plans that were prepared in early 2007 for the AMP-Ohio member communities.

2. The most significant uncertainties and risks associated with the proposed AMPGS are the potential for future federal restrictions on CO_2 emissions and further increases in the project's capital cost.

3. Increasing numbers of proposed coal-fired power plants have been cancelled, delayed and rejected by state regulatory commissions or boards because of , at least in large part, the uncertainties and risks regarding future carbon regulations and construction costs.

4. In particular, it is important for AMP-Ohio and its member communities to examine their involvement in the AMPGS Project in light of coming federal regulation of greenhouse gas emissions. It would be imprudent for AMP-Ohio and its members to continue their participation in the Project without fully considering the risk of significantly higher CO_2 prices in its resource planning process. To reflect the uncertainties and risks, AMP-

Ohio should use a broad range of possible CO_2 prices in resource planning such as the forecasts presented by Synapse in this Case.

5. Soaring power plant construction costs also will have a significant impact on the results of properly performed resource planning. Actual and estimated power plant capital costs have been strongly affected by the domestic and international competition for design and construction resources, manufacturing capacity and commodities. It would be imprudent to not allow for the possibility that these same factors which have led to the skyrocketing of power plant construction costs in recent years will continue to significantly affect project costs during the design and construction of the proposed AMPGS Project.

6. [redacted] to prepare the Power Supply Plans for AMP-Ohio's member communities appears to have considered only a single low forecast for future CO_2 prices and a year old capital cost for the AMPGS Project. Although AMP-Ohio and R.W. Beck ran sensitivity scenarios during the resource planning process to examine how capacity additions would change with changes in assumed loads, gas prices, and implied heat rates, there is no evidence that they conducted sensitivities to see what impact higher CO_2 prices or increased plant capital costs would have on the supplied-side options that would be selected as part of a least-cost, least-risk plan.

7. For this and other reasons, the Power Supply Plans prepared by AMP-Ohio and R.W. Beck for the AMP-Ohio member communities are severely flawed and biased in favor of the AMPGS Project. [redacted]

8. The *Initial Project Feasibility Study* prepared for AMP-Ohio by R.W. Beck is similarly flawed and biased in favor of the AMPGS Project. That

study is not a resource plan and also does not show that the AMPGS Project should be part of a least-cost, least risk resource plan for the participating AMP-Ohio member communities. In particular, the *Initial Project Feasibility Study* does not appropriately consider the risks associated with future federal regulation of greenhouse gas emissions and future CO_2 prices.

9. For these reasons, the Ohio State Siting Board should reject AMP-Ohio's Application for a certificate of environmental compatibility and public need to construct and operate the proposed AMPGS Project. AMP-Ohio and its member communities should conduct new resource planning that more fully reflects the potential risks posed by federal regulation of greenhouse gas emissions and soaring power plant construction costs. These new resource plans should consider the potential for demand-side options to be a part of a least-cost, least- risk portfolio of alternatives to the proposed AMPGS Project.

Q. Please explain how you conducted your investigations in this proceeding.

A. We have reviewed AMP-Ohio's filing with the Power Siting Board, the June 2007 *Initial Project Feasibility Study* prepared by R.W. Beck, and other documents prepared by AMP-Ohio for distribution to potential AMPGS Project participant communities. We also have reviewed a number of the Power Supply Plans that were prepared by R.W. Beck for AMP-Ohio's member communities. In addition, we prepared 59 Interrogatories and Document Requests which the Citizen Groups submitted to AMP-Ohio to obtain copies of support workpapers and materials for costs used and the statements made in the *Initial Project Feasibility Study* and for the workpapers for the development of the February 2007 Power Supply Plans.

Q. Has AMP-Ohio provided all of the documents necessary to conducted a full investigation in this proceeding?

A. No. AMP-Ohio has refused to provide almost all of the documents that we requested, other than providing a limited number of narrative answers and promising to provide a few documents, some of which we received on December 1, 2007 and others of which have not yet been provided as this testimony is being finalized on December 3, 2007.

2. AMP-Ohio Has Not Adequately Considered The Risks Associated With Building A New Coal-Fired Generating Unit

Q. Why is it important that AMP-Ohio consider risk when evaluating the economics of building the proposed AMPGS Project?

A. Risk and uncertainty are inherent in all enterprises. But the risks associated with any options or plans need to be balanced against the expected benefits from each such option or plan.

In particular, parties seeking to build new generating facilities and the associated transmission face of a host of major uncertainties, including, for example, the expected cost of the facility, future restrictions on emissions of carbon dioxide, and future fuel prices. The risks and uncertainties associated with each of these factors needs to be considered as part of the economic evaluation of whether to pursue the proposed facility or other alternatives.

Q. What are the most significant fossil plant-specific uncertainties and risks associated with building new coal-fired generating plants like the AMPGS Project?

A. The most significant uncertainties and risks associated with building and operating new coal-fired generating plants like the proposed the AMPGS Project are the potential for future restrictions on CO_2 emissions and the potential for significant increases in the project's capital cost. However, there also are other

potential uncertainties and risks for new coal plants. These other uncertainties and risks include the potential for higher fuel prices, fuel supply disruptions that could affect plant operating performance and fuel prices, and the potential for increasing stringency of regulations of current criteria pollutants.

Q. Did R.W. Beck and AMP-Ohio adequately consider these uncertainties and risks in the resource planning analyses that led to the Power Supply Plans that were provided to each of the AMP-Member communities in February 2007?

A. No. [redacted] AMP-Ohio in February 2007 developed its Power Supply Plans in ways that favored the AMPGS Project. In particular, R.W. Beck and AMP-Ohio used a low CO_2 price forecast and what was then a year old construction cost estimate for the AMPGS in developing the Power Supply Plans. Then R.W. Beck and AMP-Ohio failed to conduct any sensitivity analyses to evaluate how the capital additions in the plans would change along with changes in these critical assumptions. R.W. Beck and AMP-Ohio failed to prepare such sensitivities for higher CO_2 prices and increased construction costs even though they had prepared similar sensitivities to see how capacity additions in the plans would change with changes in estimated loads, gas prices and what R.W. Beck called the implied heat rate (power costs divided by gas prices). The failure to conduct sensitivities for higher CO_2 prices was especially significant because of the low CO_2 price forecast that R.W. Beck used in the base case analyses in developing the Power Supply Plans.

In other words, higher CO_2 prices, on their own, or in combination with increased plant construction costs, may make the proposed AMPGS Project less economic than other available alternatives and uneconomic for AMP-Ohio's member communities. The important reason to prepare sensitivities is to determine what changes in CO_2 prices and/or construction costs would make the Project

uneconomic and then to evaluate how likely those changes are. Unfortunately, the methodology used by R.W. Beck and AMP-Ohio in preparing the Power Supply Plans appears not to have allowed for these critical analyses.

Q. Has AMP-Ohio provided the workpapers associated with the development of the CO_2 prices and the AMPGS Project construction cost estimate used in the Power Supply Plans?

A. No. AMP-Ohio refused to provide these materials.[1]

Q. Does the *Initial Project Feasibility Study* remedy or correct for the flaws in the Power Supply Plans?

A. No. The analyses in the *Initial Project Feasibility Study* do not represent resource planning studies which examine whether the proposed AMPGS Project should be part of a least-cost, least-risk capacity expansion plan by looking that the costs and benefits of a range of supply-side and demand-side options. Instead, the *Initial Project Feasibility Study* only compares what it projects will be the cost of power from the AMPGS Project against the AMP-Ohio members' current costs of power and the alternative of buying power from the market. This is a far different analysis than should have been performed during the resource planning process for determining which supply-side and demand-side alternatives will provide power for the participating AMP-Ohio member communities at the least cost and with the least risk.

---

[1] AMP-Ohio's Response to Request No. 24 of Natural Resource Defense Council, et, al, First Set of Interrogatories and Request for Production of Documents. (hereinafter "Citizen Groups"). Copies of AMP-Ohio's Responses are provided in Exhibit DAS-2.

Q. Does the risk analysis presented in the *Initial Project Feasibility Study* provide an adequate consideration of the risks and uncertainties associated with the proposed AMPGS Project?

A. No. AMP-Ohio has refused to provide any of the workpapers related to R.W. Beck's derivation of the CO_2 prices in used in *Initial Project Feasibility Study,* including the *Analysis of Potential Project Risks* that it includes.[2] However, it is clear from the documents that we have seen that the forecast CO_2 prices that R.W. Beck used in the *Initial Power Feasibility Study* are extremely low and narrow. As I will demonstrate later in this testimony, given the reductions in CO_2 emissions that will be necessary to stabilize atmospheric temperatures, the proposals that are currently under consideration in Congress, and the substantial uncertainty surrounding the ultimate timing and design of federal carbon regulations, it is necessary to use a higher and much broader range of CO_2 prices in resource planning than R.W. Beck and AMP-Ohio have considered. It also is necessary to perform sensitivities reflecting that power plant construction costs will continue to soar as they have in recent years.

Q. Have other companies provided sensitivity analyses for key input parameters in their Integrated Resource Plans or in the modeling analyses presented in support of requests to build and operate new generating facilities?

A. Yes. We have seen such sensitivity analyses for key input parameters in many of the power plant cases in which we have been involved in recent years.

---

[2] AMP-Ohio's Responses to Requests Nos. 9, 31, and 48 of the Citizen Groups (See Exhibit DAS-2).

Q. Have you seen any recent instances in which companies have decided not to undertake new coal-fired power plants because of concerns over increasing construction costs and/or the potential for federal regulation of greenhouse gas emissions?

A, Yes. In just the past few months, a number of companies have announced that they will not pursue new coal-fired generating facilities. For example, in its recently-filed Resource Plan in Colorado, Xcel Energy announced that:

> In sum, in light of the now likely regulation of CO_2 emissions in the future due to a broader interest in climate change issues, the increased costs of constructing new coal facilities, and the increased risk of timely permitting to meet planned in-service dates, Public Service does not believe it would be prudent to consider at this time any proposals for new coal plants that do not include CO_2 capture and sequestration.[3]

Idaho Power Company similarly has concluded that:

> Due to escalating construction costs, the transmission cost associated with a remotely located resource, potential permitting issues, and continued uncertainty surrounding GHG laws and regulations, IPC [Idaho Power Company] has determined that coal-fired generation is not the best technology to meet its resource needs in 2013. IPC has shifted its focus to the development of a natural gas-fired combined cycle combustion turbine located closer to its load center in southern Idaho.[4]

Minnesota Power Company also has announced that it was considering only carbon minimizing resources and would not consider a new coal resource without a carbon solution.[5] The Company also announced that in the long-term it would

---

3 Public Service Company of Colorado, *2007 Colorado Resource Plan*, Volume 2 Technical Appendix, at page 2-34.

4 U.S. Securities and Exchange Commission Form 10-Q, Third Quarter of 2007, Idaho Power Company, at pages 49-50.

5 *Petition for Approval, Minnesota Power's 2008 Resource Plan*, Minnesota Public Utilities Commission Docket No. E015/RP-07-1357, dated October 31, 2007, at page 5.

consider pulverized coal and IGGC plants with proven carbon capture and CO_2 sequestration technologies.[6]

Avista Utilities also has announced that it will not pursue coal-fired power plants in the foreseeable future.

Q. Have any proposed coal-fired generating projects been cancelled or delayed as a result of concern over increasing construction costs or the potential for federal regulation of greenhouse gas emissions?

A. Yes. According to published reports, 16 coal-fired power plant projects have been cancelled within the past year and more than three dozen others have been delayed, in part, because of concern over rising construction costs and climate change. For example:

- Tenaska Energy cancelled plans to build a coal-fired power plant in Nebraska because of rising steel and construction prices. According to the Company's general manager of business development:

  .. coal prices have gone up "dramatically" since Tenaska started planning the project more than a year ago.

  And coal plants are largely built with steel, so there's the cost of the unit that we would build has gone up a lot... At one point in our development, we had some of the steel and equipment at some very attractive prices and that equipment all of a sudden was not available.

  We went immediately trying to buy additional equipment and the pricing was so high, we looked at the price of the power that would be produced because of those higher prices and equipment and it just wouldn't be a prudent business decision to build it.[7]

- Westar Energy announced in December 2006 that it was deferring site selection for a new 600 MW coal-fired power plant due to significant increases in the facility's estimated capital cost of 20 to 40 percent, over just 18 months. This prompted Westar's Chief Executive to warn: "When

---

6 Id, at page 6.

7 Available at www.swtimes.com/articles/2007/07/09/news/news02.prt.

equipment and construction cost estimates grow by $200 million to $400 million in 18 months, it's necessary to proceed with caution."[8] As a result, Westar Energy has suspended site selection for the coal-plant and is considering other options, including building a natural gas plant, to meet growing electricity demand. The company also explained that:

> most major engineering firms and equipment manufacturers of coal-fueled power plant equipment are at full production capacity and yet are not indicating any plans to significantly increase their production capability. As a result, fewer manufacturers and suppliers are bidding on new projects and equipment prices have escalated and become unpredictable.[9]

- Xcel Energy announced in October 2007 that it was deferring indefinitely its plans to build an IGCC plant in Colorado because the development costs were higher than the utility originally expected.[10]

- TXU cancelled 8 of 11 proposed coal-fired power plants, in large part because of concern over global warming and the potential for federal legislation restricting greenhouse gas emissions.[11]

- Tampa Electric just cancelled a proposed integrated gasification combined cycle plant ("IGCC") due to uncertainty related to CO_2 regulations, particularly capture and sequestration issues, and the potential for related project cost increases. According to a press release, "Because of the economic risk of these factors to customers and investors, Tampa Electric believes it should not proceed with an IGCC project at this time," although it remains steadfast in its support of IGCC as a critical component of future fuel diversity in Florida and the nation.

- In June 2007, the Tondu Corp. announced that it was suspending plans to build a planned 600 MW IGCC facility citing high costs and other concerns related to technology and construction risks.

- Four public power agencies suspended permitting activities for the coal-fired Taylor Energy Center because of growing concerns about greenhouse gas emissions.[12]

---

8 Available at http://www.westarenergy.com/corp_com/corpcomm.nsf/F6BE1277A768F0E4862572690055581C/$file/122806%20coal%20plant%20final2.pdf.

9 Id.

10 Denver Business Journal, October 30, 2007.

11 See www.marketwatch.com/news/story/txu-reversal-coal-plant-emissions.

12 See www.taylorenergycenter.org/s_16asp?n=40.

Q. Have you seen any instance where a participant in a jointly-owned coal-fired power plant project has withdrawn because of concern over increasing construction costs or potential CO_2 emissions costs?

A. Yes. Great River Energy ("GRE") just withdrew from the proposed Big Stone II coal-fired power plant project in South Dakota. According to GRE, four factors contributed most prominently to the decision to withdraw, including uncertainty about changes in environmental requirements and new technology and that fact that "The cost of Big Stone II has increased due to inflation and project delays."[13]

Q. Have any proposed coal-fired generating projects been rejected by state regulatory commissions due to concerns over increasing construction costs or the potential for federal regulation of greenhouse gas emissions?

A. Yes. A number of power plant projects have been approved by state regulatory commissions during 2007. However, since last December, proposed coal-fired power plant projects have been rejected by the Oregon Public Utility Commission, the Florida Public Service Commission, and the Oklahoma Corporation Commission. The North Carolina Utilities Commission rejected one of the two coal-fired plants proposed by Duke Energy Carolinas for is Cliffside Project.

The decision of the Florida Public Service Commission in denying approval for the 1,960 MW Glades Power Project was based on concern over the uncertainties over plant costs, coal and natural gas prices, and future environmental costs, including carbon allowance costs.[14] In addition, the Oklahoma Corporation Commission voted in September of this year to reject Public Service of Oklahoma's application to build a new coal-fired power plant.[15]

---

[13] See ww.greatriverenergy.com/press/news/091707_big_stone_ii.html.
[14] Order No. PSC-07-0557-FOF-EI, Docket No. 070098-EI, July 2, 2007.
[15] Cause No. PUD 200700012 signed Order No. 545240, October 2007.

The Minnesota Public Utilities Commission also has refused to approve an agreement under which Xcel Energy would have purchased power from a proposed IGCC facility due to concerns over the uncertainties surrounding the plant's estimated construction and operating costs and operating and financial risks.[16]

On October 18, 2007, the Kansas Department of Health and Environment rejected an application to build two 700 MW coal-fired units at an existing power plant site. In a prepared statement explaining the basis for this decision, Rod Bremby, Kansas's secretary of health and environment noted that "I believe it would be irresponsible to ignore emerging information about the contribution of carbon dioxide and other greenhouse gases to climate change and the potential harm to our environment and health if we do nothing."[17]

Q. Is it important to evaluate the uncertainties and risks associated with alternatives to the AMPGS Project as well?

A. Yes. The risks associated with building natural gas-fired alternatives include potential CO_2 emissions costs, possible capital cost escalation and fuel price uncertainty and volatility.

Renewable alternatives and energy efficiency also have some uncertainties and risks. These include potential capital cost escalation, contract uncertainty and customer participation uncertainty.

---

[16] Order in Docket No. E-6472/M-05-1993, dated August 30, 2007, at pages 16-19.
[17] See www.kansascity.com/105/story/323833.html.

3. AMP-Ohio Has Not Adequately Considered The Risks Associated With Future Federally Mandated Greenhouse Gas Reductions

Q. Is it prudent to expect that a policy to address climate change will be implemented in the U.S. in a way that should be of concern to coal-dependent utilities in the Midwest?

A. Yes. The prospect of global warming and the resultant widespread climate changes has spurred international efforts to work towards a sustainable level of greenhouse gas emissions. These international efforts are embodied in the United Nations Framework Convention on Climate Change ("UNFCCC"), a treaty that the U.S. ratified in 1992, along with almost every other country in the world. The Kyoto Protocol, a supplement to the UNFCCC, establishes legally binding limits on the greenhouse gas emissions of industrialized nations and economies in transition.

Despite being the single largest contributor to global emissions of greenhouse gases, the United States remains one of a very few industrialized nations that have not signed the Kyoto Protocol.[18] Nevertheless, individual states, regional groups of states, shareholders and corporations are making serious efforts and taking significant steps towards reducing greenhouse gas emissions in the United States. Efforts to pass federal legislation addressing carbon, though not yet successful, have gained ground in recent years. These developments, combined with the growing scientific understanding of, and evidence of, climate change mean that establishing federal policy requiring greenhouse gas emission reductions is just a matter of time. The question is not whether the United States will develop a

---

[18] As I use the terms "carbon dioxide regulation" and "greenhouse gas regulation" throughout our testimony, there is no difference. While I believe that the future regulation we discuss here will govern emissions of all types of greenhouse gases, not just carbon dioxide ("CO_2"), for the purposes of our discussion we are chiefly concerned with emissions of carbon dioxide. Therefore, we use the terms "carbon dioxide regulation" and "greenhouse gas regulation" interchangeably. Similarly, the terms "carbon dioxide price," "greenhouse gas price" and "carbon price" are interchangeable.

national policy addressing climate change, but when and how. The electric sector will be a key component of any regulatory or legislative approach to reducing greenhouse gas emissions both because of this sector's contribution to national emissions and the comparative ease of regulating large point sources.

There are, of course, important uncertainties with regard to the timing, the emission limits, and many other details of what a carbon policy in the United States will look like.

Q. If there are uncertainties with regard to such important details as timing, emission limits and other details, why should a utility engage in the exercise of forecasting greenhouse gas prices?

A. First of all, utilities are implicitly assuming a value for carbon allowance prices whether they go to the effort of collecting all the relevant information and create a price forecast, or whether they simply ignore future carbon regulation. In other words, a utility that ignores future carbon regulations is implicitly assuming that the allowance value will be zero. The question is whether it's appropriate to assume zero or some other number. There is uncertainty in any type of utility forecasting and to write off the need to forecast carbon allowance prices because of the uncertainties is not prudent.

For example, there are myriad uncertainties that utility planners have learned to address in planning. These include randomly occurring generating unit outages, load forecast error and demand fluctuations, and fuel price volatility and uncertainty. These various uncertainties can be addressed through techniques such as sensitivity and scenario analyses.

Q. If the AMPGS Project were to be built, is carbon regulation an issue that definitely could be addressed in the future, and at a reasonable cost, once the timing and stringency of the regulation is known?

A. No. Unlike for other power plant air emissions like sulfur dioxide and oxides of nitrogen, there currently is no commercial or economical method for post-combustion removal of carbon dioxide from pulverized coal plants. Some technologies, such as the Powerspan technology discussed by AMP-Ohio are starting to be tested. However, it is expected to be years, if not decades, before there will be viable post-combustion technology for the removal and sequestration of greenhouse gas emissions from pulverized coal-fired power plants.

Q. Does AMP-Ohio agree with this assessment that there is currently no technically and commercially viable technology for carbon capture and sequestration for pulverized coal-fired power plants?

A. Yes.[19]

Q. Is this a generally accepted view in the industry?

A. Yes. For example, a witness for Dominion Virginia Power has recently testified that:

> carbon capture technology is not commercially viable or available at the present time. Furthermore, the successful integration of all of the technologies needed for a commercial-scale carbon capture and sequestration system has yet even to be demonstrated. As a result, it is not currently feasible to construct a power plant with technology that can capture and store carbon emissions.[20]

This conclusion is consistent with the general view in the electric industry.

---

[19] AMP-Ohio's Response to Response to Request No. 41 of the Citizen Groups (provided in Exhibit DAS-2)

[20] Direct Testimony of Dominion Virginia Power witness James K. Martin in Virginia State Corporation Commission Case No. PUE-2007-00066, at page 7, line 11.

Even if such technology were available, retrofitting an existing coal plant with the technology for carbon capture and sequestration is expected to be very expensive, increasing the cost of generating power at the plant by perhaps as much as 68 to 80 percent or higher.

Q. Do utilities have opinions about whether and when greenhouse gas regulation will come?

A. Yes. A increasing number of utility executives are agreeing that mandatory federal regulation of the emissions of greenhouse gases is inevitable.

For example, in April 2006, the Chairman of Duke Energy, Paul Anderson, stated:

> From a business perspective, the need for mandatory federal policy in the United States to manage greenhouse gases is both urgent and real. In my view, voluntary actions will not get us where we need to be. Until business leaders know what the rules will be – which actions will be penalized and which will be rewarded – we will be unable to take the significant actions the issue requires.[21]

Similarly, James Rogers, who was the CEO of Cinergy and is currently CEO of Duke Energy, has publicly said "[I]n private, 80-85% of my peers think carbon regulation is coming within ten years, but most sure don't want it now."[22] Mr. Rogers also was quoted in a December 2005 *Business Week* article, as saying to his utility colleagues, "If we stonewall this thing [carbon dioxide regulation] to five years out, all of a sudden the cost to us and ultimately to our consumers can be gigantic."[23]

---

21 Paul Anderson, Chairman, Duke Energy, "Being (and Staying in Business): Sustainability from a Corporate Leadership Perspective," April 6, 2006 speech to CERES Annual Conference, at: http://www.duke-energy.com/news/mediainfo/viewpoint/PAnderson_CERES.pdf

22 "The Greening of General Electric: A Lean, Clean Electric Machine," *The Economist*, December 10, 2005, at page 79.

23 "The Race Against Climate Change," *Business Week*, December 12, 2005, online at http://businessweek.com/magazine/content/05_50/b3963401.htm.

Similarly, American Electric Power anticipates that the momentum in Congress is moving toward a mandatory federal greenhouse gas program that will set targets and timelines for future CO_2 emission reductions.[24]

Not wanting carbon regulation from a utility perspective is understandable because carbon price forecasting is not simple and easy, it makes resource planning more difficult and is likely to change "business as usual." For many parties, including AMP-Ohio, that means that it is much more difficult to justify building a pulverized coal plant. Regardless, it is imprudent to ignore the risk.

In fact, electric utilities and generation companies are increasingly incorporating assumptions about carbon regulation and costs into their long term planning, and have set specific agendas to mitigate shareholder risks associated with future U.S. carbon regulation policy. These utilities cite a variety of reasons for incorporating risk of future carbon regulation as a risk factor in their resource planning and evaluation, including scientific evidence of human-induced climate change, the U.S. electric sector's contribution to emissions, and the magnitude of the financial risk of future greenhouse gas regulation.

Q. Why would electric utilities, in particular, be concerned about future carbon regulation?

A. Electricity generation is very carbon-intensive. Electric utilities are likely to be one of the first, if not the first, industries subject to carbon regulation because of the relative ease in regulating stationary sources as opposed to mobile sources (automobiles) and because electricity generation represents a significant portion of total U.S. greenhouse gas emissions. A new generating facility may have a book life of twenty to forty years, but in practice, the utility may expect that that

[24] For example, see the Testimony of Appalachian Power Company witness Dana E. Waldo in West Virginia Public Service Commission Case No. 06-0033-E-CN, at page 7, lines 15-18, and the Testimony of Appalachian Power Company witness Michael W. Renchek in West Virginia Public Service Commission Case No. 06-0033-E-CN, at page 6, lines 1-2, and page 9, lines 12-16.

asset will have an operating life of 50 years or more. By adding new plants, especially new coal plants, a utility is essentially locking-in a large quantity of carbon dioxide emissions for decades to come. In general, electric utilities are increasingly aware that the fact that we do not currently have federal greenhouse gas regulation is irrelevant to the issue of whether we will in the future, and that new plant investment decisions are extremely sensitive to the expected cost of greenhouse gas regulation throughout the life of the facility.

Q. What is your assessment of the potential for federal regulation of greenhouse gas emissions?

A. We at Synapse believe that it is not a question of "if" with regards to federal regulation of greenhouse gas emissions but rather a question of "when." However, we also agree that there are uncertainties as to the design, timing and details of the CO_2 regulations that ultimately will be adopted and implemented.

Q. What mandatory greenhouse gas emissions reductions programs have begun to be examined in the U.S. federal government?

A. To date, the U.S. government has not required greenhouse gas emission reductions. 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 details pertaining to offsets, allowance allocation, restrictions on allowance prices and other issues. The federal proposals that would require greenhouse gas emission reductions that

had been submitted in the current U.S. Congress are summarized in Table 1 below.[25]

Table 1. Summary of Mandatory Emissions Targets in Proposals Discussed in the current U.S. Congress[26]

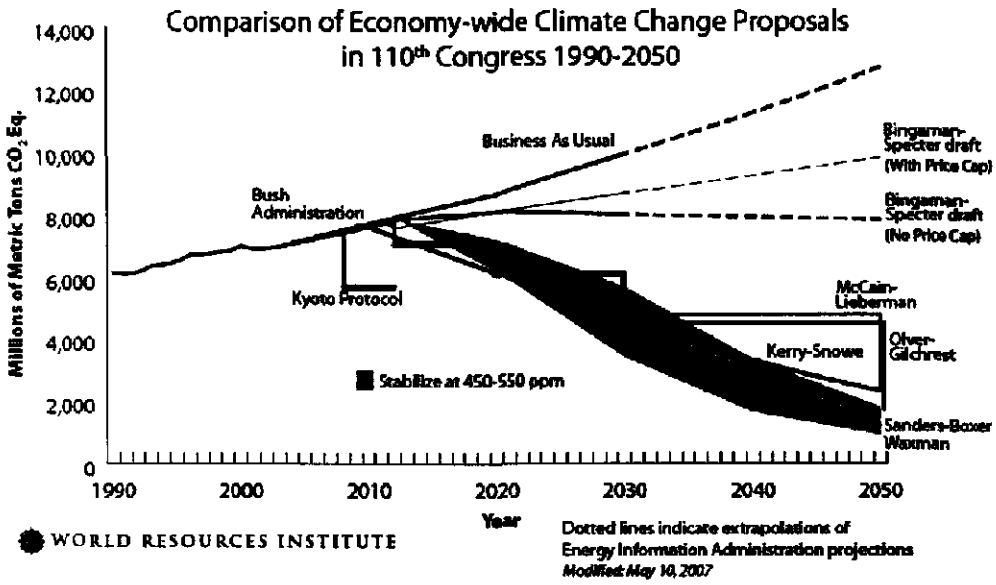
Proposed National Policy	Title or Description	Year Proposed	Emission Targets	Sectors Covered
Feinstein- Carper S.317	Electric Utility Cap & Trade Act	2007	2006 level by 2011, 2001 level by 2015, 1%/year reduction from 2016-2019, 1.5%/year reduction starting in 2020	Electricity sector
Kerry-Snowe	Global 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 ≥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.

[25] Table 1 is an updated version of Table ES-1 on page 5 of Exhibit DAS-4.

[26] More detailed summaries of the bills that have been introduced in the U.S. Senate in the 110th Congress are presented in Exhibit DAS-3.

The emissions levels that would be mandated by the bills that have been introduced in the current Congress are shown in Figure 1 below:

Figure 1: Emissions Reductions Required under Climate Change Bills in Current US Congress



The shaded area in Figure 1 above represents the 60% to 80% range of emission reductions from current levels that many now believe will be necessary to stabilize atmospheric CO_2 concentrations by the middle of this century.

Q. Is it reasonable to believe that the prospects for passage of federal legislation for the regulation of greenhouse gas emissions have improved as a result of last November's federal elections?

A. Yes. As shown by the number of proposals being introduced in Congress and public statements of support for taking action, there certainly are an increasing numbers of legislators who are inclined to support passage of legislation to regulate the emissions of greenhouse gases.

Nevertheless, my conclusion that significant greenhouse gas regulation in the U.S. is inevitable is not based on the results of any single election or on the fate of any single bill introduced in Congress.

Q. Are individual states also taking actions to reduce greenhouse gas emissions?

A. Yes. A number of states are taking significant actions to reduce greenhouse gas emissions.

For example, Table 2 below lists the emission reduction goals that have been adopted by states in the U.S. Regional action also has been taken in the Northeast and Western regions of the nation.

Table 2: Announced State and Regional Greenhouse Gas Emission Reduction Goals

State	GHG Reduction Goal	Western Climate Initiative member (15% below 2005 levels by 2020)	Regional Greenhouse Gas Initiative member (Cap at current levels 2009-2015, reduce this by 10% by 2019)
Arizona	2000 levels by 2020; 50% below 2000 levels by 2040	yes	
California	2000 levels by 2010; 1990 levels by 2020; 80% below 1990 levels by 2050	yes	
Connecticut	1990 levels by 2010; 10% below 1990 levels by 2020; 75-85% below 2001 levels in the long term		yes
Delaware			yes
Florida	2000 levels by 2017, 1990 levels by 2025, and 80 percent below 1990 levels by 2050		
Hawaii	1990 levels by 2020		
Illinois	1990 levels by 2020; 60% below 1990 levels by 2050		
Maine	1990 levels by 2010; 10% below 1990 levels by 2020; 75-80% below 2003 levels in the long term		yes
Maryland			yes
Massachusetts	1990 levels by 2010; 10% below 1990 levels by 2020; 75-85% below 1990 levels in the long term		yes
Minnesota	15% by 2015, 30% by 2025, 80% by 2050		
New Hampshire	1990 levels by 2010; 10% below 1990 levels by 2020; 75-85% below 2001 levels in the long term		yes
New Jersey	1990 levels by 2020; 80% below 2006 levels by 2050		yes
New Mexico	2000 levels by 2012; 10% below 2000 levels by 2020; 75% below 2000 levels by 2050	yes	
New York	5% below 1990 levels by 2010; 10% below 1990 levels by 2020		yes
Oregon	Stabilize by 2010; 10% below 1990 levels by 2020; 75% below 1990 levels by 2050	yes	
Rhode Island	1990 levels by 2010; 10% below 1990 levels by 2020; 75-80% below 2001 levels in the long term		yes
Utah		yes	
Vermont	1990 levels by 2010; 10% below 1990 levels by 2020; 75-85% below 2001 levels in the long term		yes
Washington	1990 levels by 2020; 25% below 1990 levels by 2035; 50% below 1990 levels by 2050	yes	

Q. Have recent polls indicated that the American people are increasingly in favor of government action to address global warming concerns?

A. Yes. A summer 2006 poll by Zogby International showed that an overwhelming majority of Americans are more convinced that global warming is happening than they were even two years ago. In addition, Americans also are connecting intense weather events like Hurricane Katrina and heat waves to global warming.[27] Indeed, the poll found that 74% of all respondents, including 87% of Democrats, 56% of Republicans and 82% of Independents, believe that we are experiencing the effects of global warming.

The poll also indicated that there is strong support for measures to require major industries to reduce their greenhouse gas emissions to improve the environment without harming the economy – 72% of likely voters agreed such measures should be taken.[28]

Other recent polls reported similar results. For example, a recent Stanford University/Associated Press poll found that 84 percent of Americans believe that global warming is occurring, with 52 percent expecting the world's natural environment to be in worse shape in ten years than it is now.[29] Eighty-four percent of Americans want a great deal or a lot to be done to help the environment during the next year by President Bush, the Congress, American businesses and/or the American public. This represents ninety-two percent of Democrats and seventy-seven percent of Republicans.

At the same time, according to a recent public opinion survey for the Massachusetts Institute of Technology, Americans now rank climate change as

---

27 "Americans Link Hurricane Katrina and Heat Wave to Global Warming," Zogby International, August 21, 2006, available at www.zogby.com/news.

28 Id.

29 *The Second Annual "America's Report Card on the Environment" Survey by the Woods Institute for the Environment at Stanford University in collaboration with The Associated Press,* September 25, 2007.

the country's most pressing environmental problem—a dramatic shift from three years ago, when they ranked climate change sixth out of 10 environmental concerns.[30] Almost three-quarters of the respondents felt the government should do more to deal with global warming, and individuals were willing to spend their own money to help.

Q. Has AMP-Ohio developed any projection of future CO_2 emissions allowance prices for use in its resource planning for the AMPGS Project?

A. Yes. It appears that R.W. Beck used two slightly different CO_2 forecasts in its development of the February 2007 Power Supply Plans for the AMP-Ohio members and in the June 2007 Initial Project Feasibility Study. These forecasts are presented in Table 3 below:

30 *MIT Carbon Sequestration Initiative, 2006 Survey,* http://sequestration.mit.edu/research/survey2006.html

Table 3: CO_2 Price Forecasts in R.W. Beck Power Supply Plans and AMPGS Project *Initial Project Feasibility Study*[31]

	Expected CO_2 Prices *Initial Project Feasibility Study*	CO_2 Prices Power Supply Plans
	(Nom$	(Nom$
2010	$0.00	
2011	$0.00	
2012	$0.00	
2013	$3.36	
2014	$5.19	
2015	$7.08	
2016	$9.06	
2017	$11.14	
2018	$13.29	
2019	$13.61	
2020	$13.94	
2021	$14.27	
2022	$14.62	
2023	$14.97	
2024	$15.33	
2025	$15.69	
2026	$16.07	
2027	$16.46	
2028	$16.85	
2029	$17.26	
2030	$17.67	

Thus, the CO_2 prices used in the Development of the Power Supply Plans were higher in the years 2013-2017 than the prices used in the June 2007 *Initial Project Feasibility Study*.

[31] The CO_2 prices shown in Table 3 are taken from the Assumptions Document for Developing Member Power Supply Plans in the February 17, 2007 *Power Supply Plan for City of Oberlin* and Table 4-7 of the *Initial Project Feasibility Study*.

Q. Have AMP-Ohio or R.W. Beck explained the differences between the CO_2 price forecast that was used in the Power Supply Plans and the one used in *Initial Project Feasibility Study*?

A. No. The Citizen Groups submitted a number of interrogatories and document requests seeking the workpapers and source documents which underlay the CO_2 price forecasts used by R.W. Beck in both the February 2007 Power Supply Plans and the June 2007 Initial Project Feasibility Study. AMP-Ohio refused to provide any of the requested materials except to refer us back to the June 2007 Initial Project Feasibility Study.[32] Instead of providing the requested supporting data and materials for the CO_2 price forecasts, AMP-Ohio only gave the following narrative answer:

> R.W. Beck developed the $5 - $15/ton range (in 2006$) in preparation for the AMP-Ohio Power Supply Study that began in the fall of 2006. The range was based on R.W. Beck's review of historical prices in Europe and certain studies and analysis available at that time including a study by the National Commission on Energy Policy (December 2004). The ultimate costs for CO_2 control will be influenced by several factors including the stringency of potential legislation, whether offsets from other sectors of the economy would be allowed to offset emissions from the power industry, the method of regulation (a cap and trade system or a tax), etc. Additionally, costs for Powerspan ECO_2 carbon dioxide capture technology has been estimated at approximately $20 per ton.[33]

Q. Did AMP-Ohio even identify the "historical prices in Europe" or the "certain studies and analysis" on which R.W. Beck relied beyond the December 2004 National Commission on Energy Policy study?

A. No.[34]

---

32 See AMP-Ohio's responses to Requests 9, 24, 31a, 31, c, and 48a in Exhibit DAS-2.
33 AMP-Ohio's response to Request 9 in Exhibit DAS-2.
34 Id.

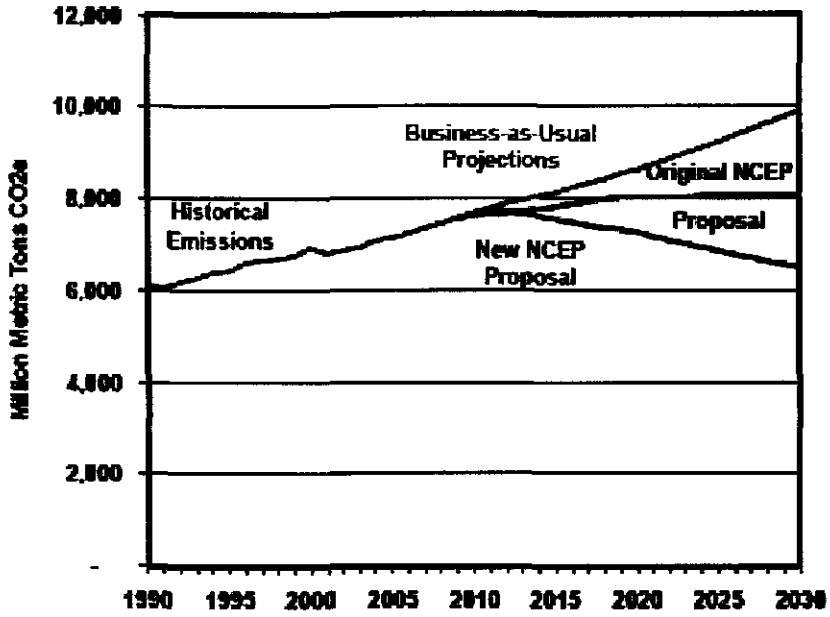
Q. Is the December 2004 National Commission on Energy Policy study on which AMP-Ohio says R.W. Beck relied still relevant today?

A. No. The proposal discussed in the December 2004 National Commission on Energy Policy ("NCEP") study upon which R.W. Beck says it relied no longer exists. The bills that have been introduced in the current Congress would mandate significantly larger reductions in CO_2 emissions than would have resulted from proposal that the National Commission studied in December 2004. Indeed, the National Commission itself has revised, and strengthened considerably, its own proposal for reducing CO_2 emissions.[35]

A graphical version of the difference between the April 2007 NCEP proposal and the proposal cited in the Commission's December 2004 study is shown in Figure 2 below.

[35] *Energy Policy Recommendations to the President and the 110th Congress*, National Commission on Energy Policy, April 2007, available on the Commission's website.

Figure 2: Original and Current NCEP Proposals[36]



For example, the original NCEP proposal included a safety valve price of $7/ton of CO_2, escalating at 5 percent per year, in nominal terms. This safety valve would represent a cap on CO_2 allowance prices. In April 2007, the NCEP revised its proposal, raising the safety valve price to $10/ton, escalating at 5 percent per year, in real not nominal terms. The actual legislation that Senator Bingaman introduced in July 2007 further increased raised the proposed safety value figure to $12/ton in 2012, escalating thereafter at 5 percent per year, in real terms.

Q. Has AMP-Ohio provided any assessments of the global warming legislation that has been proposed in the current 110th Congress?

A. No. AMP-Ohio refused to provide any such assessments.[37] AMP-Ohio also was unwilling or unable to provide any other assessments, evaluations or projections

[36] From the National Commission on Energy Policy, www.energycommission.org.
[37] AMP-Ohio's Response to Request No. 1 in Exhibit DAS-2.

of future CO2 allowance prices other than the R.W. Beck Initial Project Feasibility Study.[38]

Q. AMP-Ohio claims, in support of the CO_2 costs used by R.W. Beck, that the "costs for [the] Powerspan ECO_2 carbon dioxide capture technology has been estimated at approximately $20 per ton."[39] Is this claim credible?

A. No. The Powerspan ECO_2 carbon dioxide capture technology has not been tested on any scale beyond the laboratory. Indeed, a 1 MW test of the technology at an operating power plant, producing 20 tons of CO_2 per day, will not even be started until 2008. It will be years before it is known whether the Powerspan ECO_2 carbon dioxide technology will even be technically and commercially viable. The $20/ton cost figure cited by AMP-Ohio appears to be based solely on unproven extrapolations from lab tests and not real world experience. AMP-Ohio does not even cite in what year's dollars this $20/ton figure is supposed to be. If the $20/ton figure only reflects the cost of capturing CO_2 at the plant even this low cost should be increased by perhaps another $5-$10/ton to reflect the estimated costs of transportation and sequestration.

Q. Are there significant uncertainties associated with the Powerspan ECO_2 carbon dioxide capture technology?

A. Yes. The engineering firm of Burns and Roe Enterprises, Inc, conducted an independent due diligence review of the proposed AMPGS Project for the City of Cleveland, Division of Cleveland Public Power. Burns and Roe's October 17, 2007 Consulting Engineer's Report noted that the use of the Powerspan's ECO-SO2 on the AMPGS Project would require scaling it up by a factor of ten from the Commercial Demonstration Unit that had been successfully operated at a power

[38] AMP-Ohio's Response to Request No. 2 in Exhibit DAS-2.
[39] AMP-Ohio's Response to Request No. 9 in Exhibit DAS-2.

plant.[40] Burns and Roe also expressed concern that there are a number of significant risks associated with Powerspan's ECO-SO_2 process and concluded that

> The scale-up of the ECO-SO_2 process and its operation is a major unknown risk. This is recognized in the RW Beck report, and it is noted that presently unknown issues can be accommodated by adjustments in the field and modifications to the equipment. However, the design and operational changes that may ultimately be needed can increase the capital cost and O&M cost to the point where this system is not as economic as the conventional wet FGD system.[41]

These same conclusions are even more applicable to the Powerspan ECO_2 carbon capture system which has only been tested in laboratory conditions and is not scheduled for a test on even a 1 MW scale at an operating power plant until sometime in 2008. Indeed, in its discussion of CO_2 control, Burns and Roe noted that the proposed Post-Combustion CO_2 capture technologies such as the ammonia absorption process being investigated by Powerspan, "need to be demonstrated at large scales before they can be recommended for retrofit or implementation."[42]

The amount of power that the ammonia absorption processes being investigated by Powerspan and Alstom will require (i.e., the parasitic loads they will create) also represent major uncertainties.

---

40 *Consulting Engineer's Report for the American Municipal Power Generating Station located in Meigs County, Ohio*, prepared for the Division of Cleveland Public Power, City of Cleveland, dated October 16, 2007, at pages 2-8 and 2-9.

41 Id, at pages 1-2 and 2-13.

42 Id, at page 5-4.

Q. Did AMP-Ohio provide any documents to support the claimed $20/ton cost for the Powerspan ECO_2 carbon dioxide capture technology?

A. No. The Citizen Groups asked AMP-Ohio several interrogatories and document requests seeking information with which we could evaluate the claimed $20/ton cost for the Powerspan ECO_2 carbon dioxide capture technology:

> Question 43: Please provide copies of any assessments or estimates, prepared by or for AMP-Ohio, of the potential costs of retrofitting the proposed plant for carbon capture and sequestration equipment (including all aspects of such retrofit, such as the need to increase generating capacity to account for parasitic load loss) when that technology becomes commercially viable.
>
> Question 44: Please provide copies of any assessments or estimates, prepared by or for AMP-Ohio, which have addressed or examined the operating costs, performance penalties, and/or additional fuel needs that can be expected to be experienced as a result of the addition and use of carbon capture and sequestration equipment.

AMP-Ohio either was unwilling or unable to provide the requested documentation. Instead, it provided the following narrative response and referred back to two earlier narrative responses that also contained absolutely no calculations, engineering or economic information supporting or justifying the $20/ton carbon dioxide capture cost estimate:

> See Responses to Requests 38 and 40. Legislation/regulations for CCS are not in effect. However, AMPGS has given consideration of the potential savings that could materialize with Powerspan. Based on estimates presented by Powerspan, the cost of an ammonia absorption system on a power plant equipped with the Powerspan SO_2 process comparable to AMPGS is estimated at approximately $20/ton.[43]

[43] AMP-Ohio's Response to Request 43 in Exhibit DAS-2.

Q. Have you seen any other estimates for the cost of carbon capture and sequestration at proposed pulverized coal plants such as the proposed AMPGS Project?

A. Yes. Hope has been expressed concerning potential technological improvements and learning curve effects that might reduce the estimated cost of carbon capture and sequestration. However, I have seen recent studies by objective sources that estimate that the cost of carbon capture and sequestration could increase the cost of producing electricity at pulverized coal-fired power plants by 60-80 percent, on a $/MWh basis.

For example, a very recent study by the National Energy Technology Laboratory ("NETL") projects that the cost of carbon capture and sequestration would be $75/tonne[44] of CO_2 avoided, in 2007 dollars, for pulverized coal plants.[45] This translates in to $65/ton of CO_2 avoided, in 2005 dollars.

The March 2007 "Future of Coal Study" from the Massachusetts Institute of Technology estimated that the cost of carbon capture and sequestration would be about $28/ton although it also acknowledged that there was uncertainty in that figure.[46] The tables in that study also indicated significantly higher costs for carbon capture for pulverized coal facilities, in the range of about $40/ton and higher.[47]

Similarly, in a recent proceeding at the West Virginia Public Service Commission, Appalachian Power Company has estimated the costs of electricity from a number of coal-fired technologies with and without carbon capture and

---

44 A tonne or metric ton is a measurement of mass equal to 1,000 kilograms or 1.1 tons.

45 *Cost and Performance Baseline for Fossil Energy Plants*, National Energy Technology Laboratory, Revised August 2007, at page 27.

46 *The Future of Coal, Options for a Carbon-Constrained World*, Massachusetts Institute of Technology, March 2007, at page xi.

47 Id, at page 19.

sequestration.[48] Appalachian Power estimates that the cost of just capturing the CO_2 emissions from a new pulverized coal plant would be approximately $43-$46/MWh on a levelized basis.

Also, in its Consulting Engineer's Report for the Division of Cleveland Public Power, Burns and Roe cited estimated costs of capture of CO_2 at between $20 and $60/ton of CO_2 avoided.[49] This is within the general range of estimates that I have seen from the industry.

However, even when the technology for CO_2 capture matures, there will always be significant regional variations in the cost of storage due to the proximity and quality of storage sites.

Q. Is there any consensus when carbon capture and sequestration technology will become commercially viable for pulverized coal plants like the AMPGS Project?

A. No. I have seen estimates that carbon capture and sequestration technology may be proven and commercially viable from as early as 2015 to 2030 or later, if, indeed, it is ever proven to be technically and commercially viable.

For example, the February 2007 *Future of Coal* study from the Massachusetts Institute of Technology:

> Many years of development and demonstration will be required to prepare for its successful, large scale adoption in the U.S. and elsewhere. A rushed attempt at CCS [carbon capture and sequestration] implementation in the face of urgent climate concerns could lead to excess cost and heightened local

---

[48] Appalachian Power Company witness Renchek's Exhibit MWR-4, revised, in West Virginia Case No. 06-0033-E-CN.

[49] *Consulting Engineer's Report for the American Municipal Power Generating Station located in Meigs County, Ohio*, prepared for the Division of Cleveland Public Power, City of Cleveland, dated October 16, 2007, at page 5-4.

environmental concerns, potentially lead to long delays in implementation of this important option.[50]

Q. Has AMP-Ohio provided any assessments of the potential or the feasibility of sequestering the CO_2 from the proposed AMPGS Project?

A. No. The Citizen Groups requested that information. However, AMP-Ohio was unwilling or unable to provide any such assessments of the potential for or feasibility of sequestering the CO_2 that would be produced at the proposed AMPGS Project.[51]

Q. Are the CO_2 price forecasts used by R.W. Beck in developing the Power Supply Plans for AMP-Ohio member communities and in the *Initial Project Feasibility Study* reasonable in light of the uncertainty surrounding future CO_2 costs and the stringent reductions in CO_2 emissions that would be required under the global warming bills that have been introduced in the current U.S. Congress?

A. No. First, the CO_2 price forecasts used in the February 2007 Power Supply Plans and in the *Initial Project Feasibility Study* are too low considering the proposals that are currently under review in Congress. In addition, given all of the uncertainties it would be prudent to review a wide range of forecasts in resource planning, not just a single price trajectory or a narrow range of forecasts.

Q. Has Synapse developed a carbon price forecast that would assist the Power Siting Board in evaluating the proposed the AMPGS?

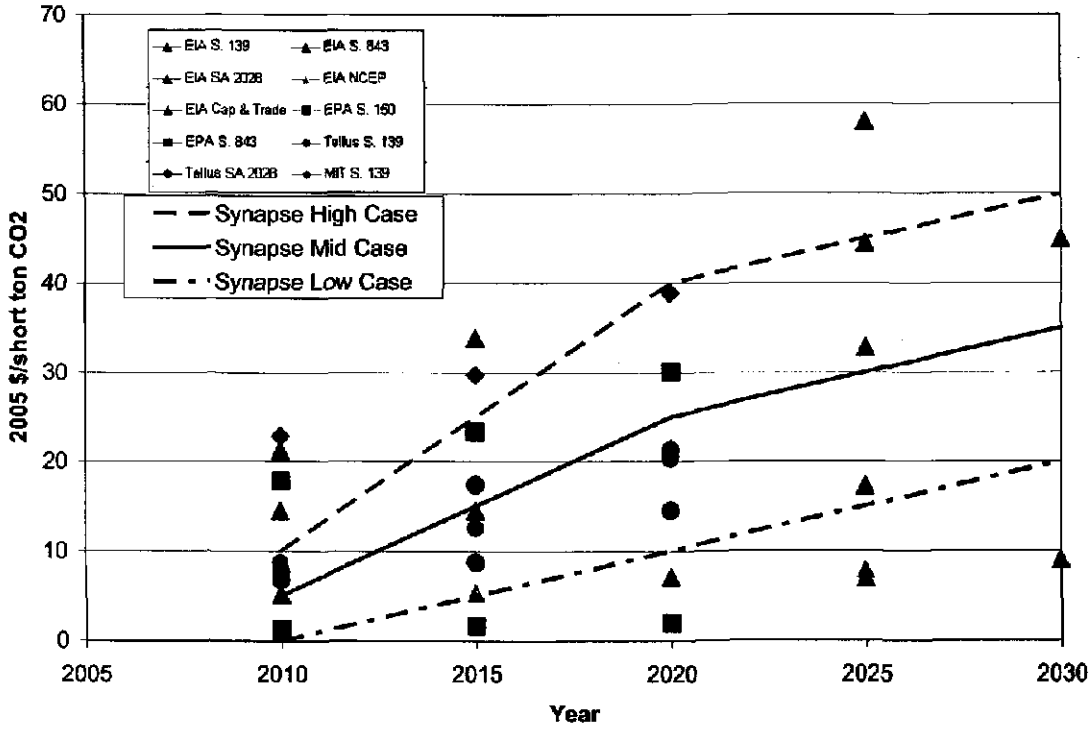
A. Yes. Synapse's forecast of future carbon dioxide emissions prices are presented in Figure 3 below.

---

50 *The Future of Coal, Options for a Carbon-Constrained World, an Interdisciplinary MIT Study*, February 2007, at page 15.

51 AMP-Ohio's Response to Request No. 38 in Exhibit DAS-2.

Figure 3. Synapse Carbon Dioxide Prices



Q. What is Synapse's carbon price forecast on a levelized basis?

A. Synapse's forecast, levelized[52] over 20 years, 2011 – 2030, is provided in Table 4 below.

Table 4: Synapse's Levelized Carbon Price Forecast (2005$/ton of CO_2)

Low Case	Mid Case	High Case
$8.23	$19.83	$31.43

[52] A value that is "levelized" is the present value of the total cost converted to equal annual payments. Costs are levelized in real dollars (i.e., adjusted to remove the impact of inflation).

Q. When were the Synapse CO_2 emission allowance price forecasts shown in Figure 3 developed?

A. The Synapse CO_2 emission allowance price forecasts were developed in the Spring of 2006.

Q. How were these CO_2 price forecasts developed?

A. The basis for the Synapse CO_2 price forecasts is described in detail in Exhibit DAS-4, starting on page 41 of 63.

In general, the price forecasts were based, in part, on the results of economic analyses of individual bills that had been submitted in the 108th and 109th Congresses. We also considered the likely impacts of state, regional and international actions, the potential for offsets and credits, and the likely future trajectories of both emissions constraints and technological program.

Q. Are the Synapse CO_2 price forecasts shown in Figure 3 based on any independent modeling?

A. Yes. Although Synapse did not perform any new modeling to develop our CO_2 price forecasts, our CO_2 price forecasts were based on the results of independent modeling prepared at the Massachusetts Institute of Technology ("MIT"), the Energy Information Administration of the Department of Energy ("EIA"), Tellus, and the U.S. Environmental Protection Agency ("EPA").[53]

[53] See Table 6.2 on page 42 of 63 of Exhibit DAS-4.

Q. Do the triangles, squares, circles and diamond shapes in Figure 3 above reflect the results of all of the scenarios examined in the MIT, EIA, EPA and Tellus analyses upon which Synapse relied?

A. As a general rule, Synapse focused our attention either on the modeler's primary scenario or on the presented high and low scenarios to bracket the range of results.

For example, the blue triangles in Figure 3 represent the results from EIA's modeling of the 2003 McCain-Lieberman bill, S.139. Synapse used the results from EIA's primary case which reflected the bill's provisions that allowed: (a) allowance banking; (b) use of up to 15 percent offsets in Phase I (2010-2015) and up to 10 percent offsets in Phase II (2016 and later years). The S.139 case also assumed commercial availability of advanced nuclear plants and of geological carbon sequestration technologies in the electric power industry.

Similarly, the blue diamonds in Figure 3 represent the results from MIT's modeling of the same 2003 McCain-Lieberman bill, S.139. MIT examined 14 scenarios which considered the impact of factors such as the tightening of the cap in Phase II, allowance banking, availability of outside credits, and assumptions about GDP and emissions growth. Synapse included the results from Scenario 7 which included allowance banking and zero-cost credits, which effectively relaxed the cap by 15% and 10% in Phase I and Phase II, respectively. Synapse selected this scenario as the closest to the S.139 legislative proposal since it assumed that the cap was tightened in a second phase, as in Senate Bill 139.

At the same time, some of the studies only included a single scenario representing the specific features of the legislative proposal being analyzed. For example, the Amended 2003 McCain Lieberman bill (SA 2028) set the emissions cap at constant 2000 levels and allowed for 15 percent of the carbon emission reductions to be met through offsets from non-covered sectors, carbon sequestration and qualified international sources. EIA presented one scenario in its table for this

policy. The results from this scenario are presented in the green triangles in Figure 3.

Q. What factors will affect the cost of CO_2 emissions allowances?

A. Exhibit DAS-4 identifies a number of factors that will affect projected allowance prices. These factors include: the base case emissions forecast; whether there are complementary policies such as aggressive investments in energy efficiency and renewable energy independent of the emissions allowance market; the policy implementation timeline; the reduction targets in a proposal; program flexibility involving the inclusion of offsets (perhaps international) and allowance banking; technological progress; and emissions co-benefits.[54] In particular, Synapse anticipates that technological innovation will temper allowance prices in the out years of our forecast.

Q. Could carbon capture and sequestration be a technological innovation that might temper or even put a ceiling on CO_2 emissions allowance prices?

A. Yes.

Q. Do the Synapse CO_2 price forecasts reflect the potential for the inclusion of domestic offsets and, perhaps, international offsets in U.S. carbon regulation policy?

A. Yes. Even the Synapse high CO_2 price forecast is consistent with, and in some cases lower than, the results of studies that assume the use of some levels of offsets to meet mandated emission limits. For example, as shown in Figure 6 the highest price scenarios in the years 2015, 2020 and 2025 were taken from the EIA and MIT modeling of the original and the amended McCain-Lieberman proposals. Each of the prices for these scenarios shown in Figure 3 reflects the allowed use of offsets.

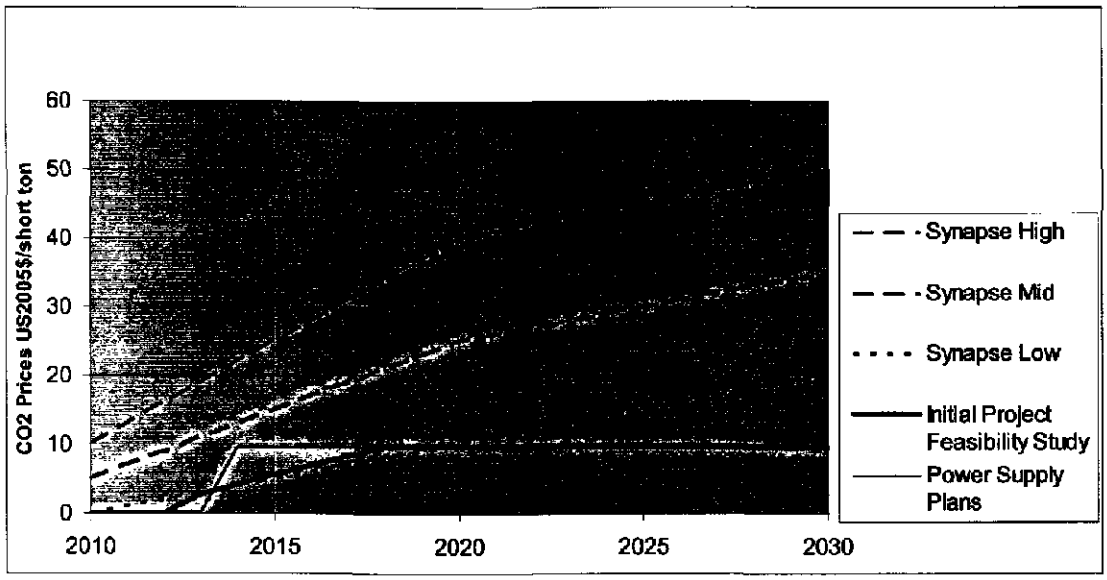
---

[54] Exhibit DAS-4, at pages 46 to 49 of 63.

Q. How do the Synapse CO_2 price forecasts compare to AMP-Ohio's CO_2 price forecast?

A. The Synapse CO_2 price forecasts and the long-term CO_2 price forecast used in the June 2007 *Initial Project Feasibility Study* are shown in Figure 3 below:

Figure 4: Synapse and AMP-Ohio CO_2 Price Forecasts



Thus, the term CO_2 price forecasts used in both [redacted] Plans and the June 2007 *Initial Project Feasibility Study* are very low compared to the Synapse forecasts.

Q. Do you believe that the Synapse CO_2 price forecasts remain valid despite being based, in part, on analyses from 2003-2005 which examined legislation that was proposed in past Congresses?

A. Yes. Synapse believes it is important for the Power Siting Board to rely on the most current information available about future CO_2 emission allowance prices, as long as that information is objective and credible. The analyses upon which Synapse relied when we developed our CO_2 price forecasts were the most recent analyses and technical information available when Synapse developed its CO_2

price forecasts in the Spring of 2006. However, new information shows that our CO_2 prices remain valid even though the original bills that comprised part of the basis for the forecasts expired at the end of the Congress in which they were introduced.

Most importantly, many of the new greenhouse gas regulation bills that have been introduced in Congress are significantly more stringent than the bills that were being considered prior to the spring of 2006. This increased stringency of current bills can be expected to lead to higher CO_2 emission allowance prices. The higher forecast natural gas prices that are being forecast today, as compared to the natural gas price forecasts from 2003 or 2004, also can be expected to lead to higher CO_2 emissions allowance prices.

Q. Do the Synapse carbon price forecasts presented in Figure 3 reflect the emission reduction targets in the bills that have been introduced in the current Congress?

A. No. Synapse developed our price forecasts late last spring and relied upon bills that had been introduced in Congress through that time. The bills that have been introduced in the current US Congress generally would mandate much more substantial reductions in greenhouse gas emissions than the bills that we considered when we developed our carbon price forecasts. Consequently, we believe that our forecasts are conservative but consistent with the climate change legislation that has been introduced in the current Congress.

Q. How do the Synapse and AMP-Ohio CO_2 price forecasts compare to the expected prices of CO_2 emissions allowances under the legislation currently being considered in the U.S. Congress?

A. Figure 5 below compares the Synapse and AMP-Ohio CO_2 price forecast used in the February 2007 Power Supply Plans to the projected prices of CO_2 emissions allowances developed in recent studies of the prices that would be needed to

achieve the emissions reduction targets in global warming legislation that has been introduced in the current Congress. These studies include:

- Analyses of Senate Bill S.280, the current McCain-Lieberman proposal, by the U.S. Environmental Protection Agency ("EPA") and the Energy Information Administration of the U.S. Department of Energy ("EIA").[55] The EPA examined seven different scenarios reflecting a range of assumptions concerning such important factors as the levels of offsets that would be allowed and the assumed levels of nuclear generation. The EIA examined eight different scenarios. Figure 5 shows the range of levelized costs in the scenarios studied by the EPA and the EIA.
- An Assessment of U.S. Cap-and-Trade Proposals was recently issued by the MIT Joint Program on the Science and Policy of Global Change. This Assessment evaluated the impact of the greenhouse gas regulation bills that are being considered in the current Congress. [56] The range of CO_2 costs for the three core scenarios studied by MIT are shown in Figure 5. These three scenarios analyzed (1) a reduction of greenhouse gas emissions of 80 percent from current levels by 2050; (2) a reduction of greenhouse gas emissions of 50 percent from current levels by 2050; and (3) stabilization of CO_2 emissions at year 2008 levels.

Figure 5 also includes the following:

- The safety valve prices in Senate Bill S. 1766, the Low Carbon Economy Act, which is the global warming legislation submitted in July by Senators Bingaman and Specter. The safety valve price in this proposal starts at $12/ton in 2012 and escalates at a real rate of 5 percent per year.

---

55 *Energy Market and Economic Impacts of S. 280, the Climate Stewardship and Innovation Act of 2007,* Energy Information Administration, July 2007, Supplement to the Energy and Markets Impacts of S. 280, Energy Information Administration, October 2007, and *EPA Analysis of the Climate Stewardship and Innovation Act of 2007, S. 280 in 110th Congress*, July 16, 2007.

56 Twenty nine scenarios were modeled in the April 2007 MIT Assessment. These scenarios reflected differences in such factors as emission reduction targets (that is, reduce CO_2 emissions 80% from 1990 levels by 2050, reduce CO_2 emissions 50% from 1990 levels by 2050, or stabilize CO_2 emissions at 2008 levels), whether banking of allowances would be allowed, whether international trading of allowances would be allowed, whether only developed countries or the U.S. would pursue greenhouse gas reductions, whether there would be safety valve prices adopted as part of greenhouse gas regulations, and other factors.

In general, the ranges of the projected CO_2 prices in these scenarios were higher than the range of CO_2 prices in the Synapse forecast. For example, twelve of the 29 scenarios modeled by MIT projected higher CO_2 prices in 2020 than the high Synapse forecast. Fourteen of the 29 scenarios (almost half) projected higher CO_2 prices in 2030 than the high Synapse forecast. The full results of the MIT study are presented in Exhibit DAS-6.

- The range of CO_2 prices that the New Mexico Public Regulation Commission has ordered that utilities should consider a range of CO_2 prices in their resource planning.[57] This range runs from $8 to $40 per metric ton, beginning in 2010 and increasing at the overall 2.5 percent rate of inflation.

- The range of CO_2 prices that Xcel Energy has recently announced that it would use in its resource planning.[58]

- A CO_2 price forecast that the Indiana Utility Regulatory Commission recently found were reasonable for Duke Energy Indiana to use in its resource planning for a proposed IGCC power plant.[59]

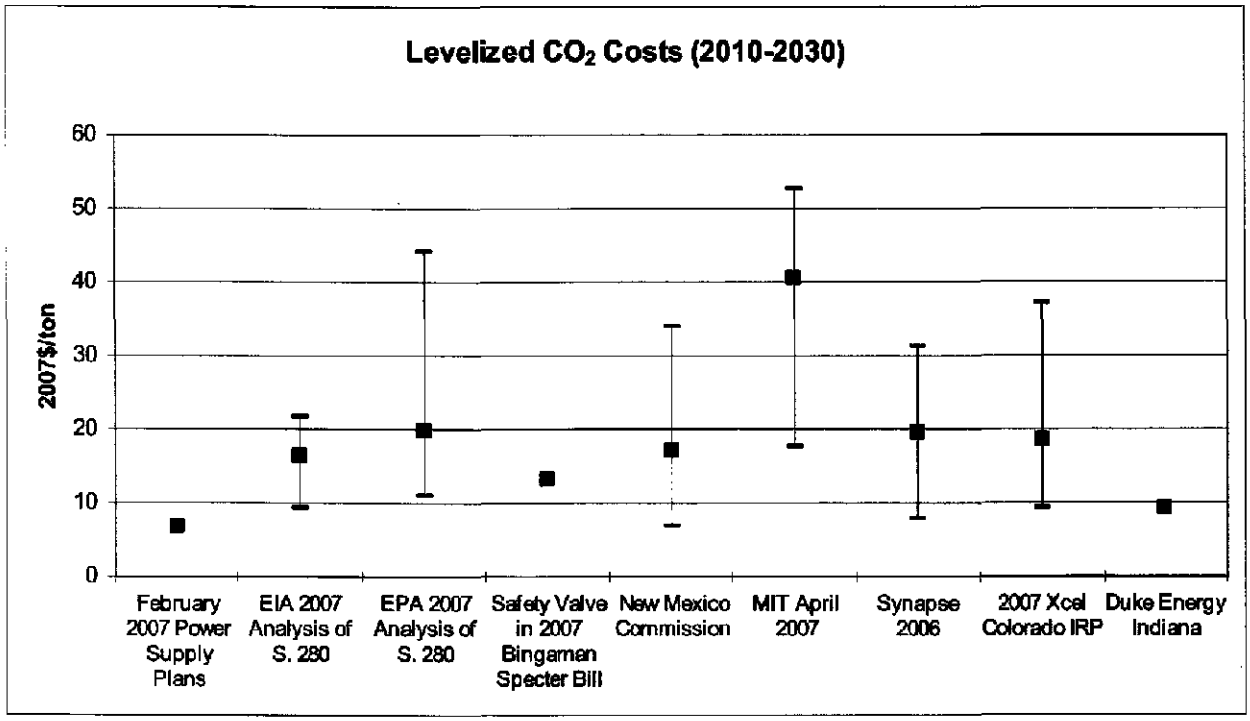
---

57 A copy of the New Mexico Commission's June 2007 Order is included as Exhibit DAS-5.

58 Public Service Company of Colorado, *2007 Colorado Resource Plan*, Volume 2 Technical Appendix, at page 2-30.

59 Order of the Indiana Utility Regulatory Commission in Cause 43114, dated November 20, 2007, at page 30.

Figure 5: Synapse and AMP-Ohio CO_2 Price Forecasts Used to Develop Power Supply Plans Compared to Other Recent Forecasts



Thus, on a levelized basis, the AMP-Ohio and R.W. Beck CO_2 price forecast used to develop the February 2007 Power Supply Plans for AMP-Ohio member communities is significantly lower than the ranges of CO_2 prices forecast by the EPA, EIA and MIT based on the legislative proposals in the current U.S. Congress and also is lower than recent forecasts of the New Mexico Public Regulation Commission and Xcel Energy. The AMP-Ohio and R.W. Beck CO_2 price forecast used to develop the Power Supply Plans also is lower than the recent Duke Energy Indiana forecast accepted by the Indiana Utility Regulatory Commission and the safety valve prices in Senate Bill S. 1766, the Bingaman-Specter global warming legislation.

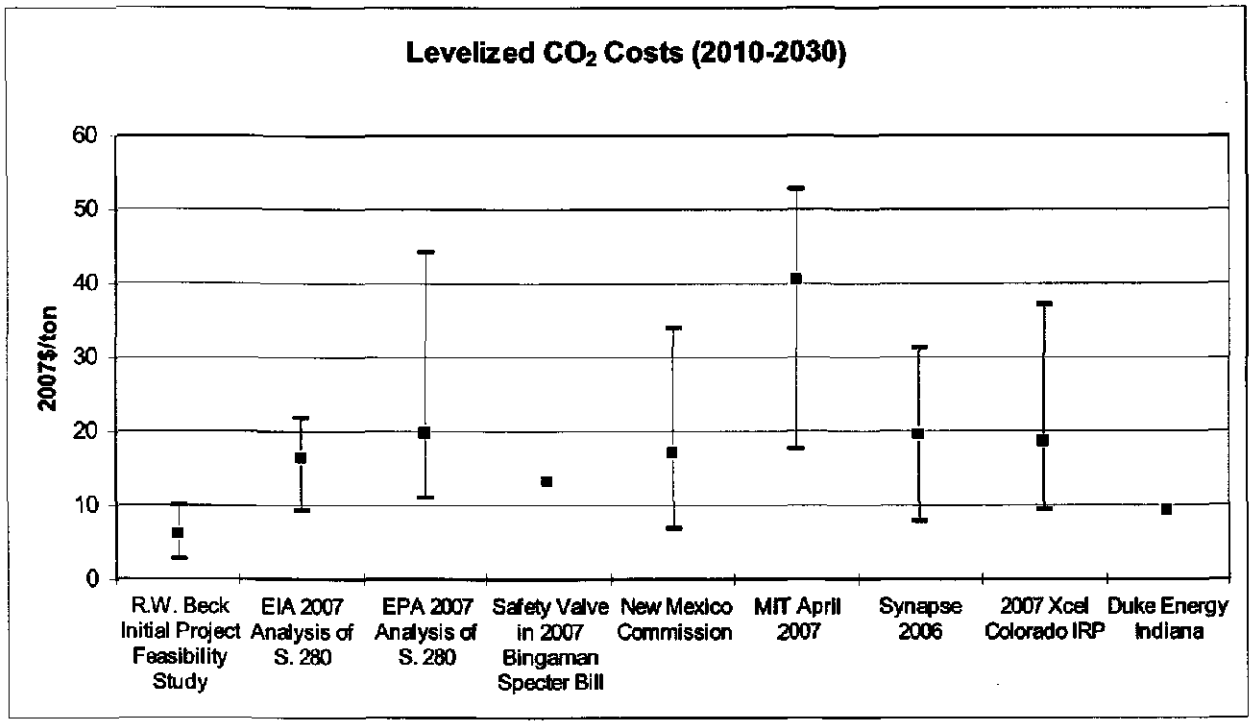
In contrast, the Synapse CO_2 price forecasts are consistent with than the ranges of CO_2 prices forecast by the EPA, EIA and MIT based on the legislative proposals in the current U.S. Congress, the safety valve prices in Senate Bill S. 1766, and

the forecast ranges of the New Mexico Public Regulation Commission and Xcel Energy.

Q. How do the Synapse and the CO_2 price forecast presented in R.W. Beck's *Initial Project Feasibility Study* compare to the expected prices of CO_2 emissions allowances under the legislation currently being considered in the U.S. Congress?

A. Figure 6, below, compares, on a levelized basis, the Synapse CO_2 price forecasts and the CO_2 price forecast from the June 2007 *Initial Project Feasibility Study* with the same forecasts that are included in Figure 5 above.

Figure 6: Synapse and CO_2 Price Forecasts from June 2007 *Initial Project Feasibility Study*



The comparison in Figure 6 shows that the range of CO_2 prices that R.W. Beck considered in the June 2007 *Initial Project Feasibility Study* is narrow and is substantially below the ranges of CO_2 prices forecast by the EPA, EIA and MIT

based on the legislative proposals in the current U.S. Congress and recent forecasts of the New Mexico Public Regulation Commission and Xcel Energy. The top end of the range of CO_2 prices considered by R.W. Beck in its risk assessment also is just about the same as the Duke Energy Indiana forecast recently accepted by the Indiana Utility Regulatory Commission but is below the safety valve prices in Senate Bill S. 1766, the Bingaman-Specter global warming legislation.

Q. Why is there a range of levelized CO_2 prices for the June 2007 *Initial Project Feasibility Study?*

A. The high and low ends of the range of levelized CO_2 prices for the June 2007 *Initial Project Feasibility Study* shown in Figure 6 above reflect the high and low CO_2 forecasts that R.W. Beck considered when it developed the expected values for future CO_2 prices shown in my Table 3 and in Table 4-7 on page 4-18 of the *Initial Project Feasibility Study*. As can be seen from my Figure 6 and from Figure 7-8 in the *Initial Project Feasibility Study*, R.W. Beck considered only a very narrow range of possible CO_2 prices when developing the expected values it used in the *Initial Project Feasibility Study* and in the Analysis of Potential Project Risks contained therein. That is why R.W. Beck is able to conclude that varying CO_2 prices would not have a significant impact on the overall cost of power from the AMPGS Project. In R.W. Beck's Analysis of Potential Project Risks, the price of power from the AMPGS Project does not vary much when CO_2 prices are changed because R.W. Beck only allows that only very minor changes in CO_2 prices will occur. As I have shown this is an extremely unreasonable assumption.

Q. Would it be reasonable to assume that a new pulverized coal-fired plant like the AMPGS will be grandfathered under federal climate change legislation or will be favored with the provision of extra CO_2 emission allowance allocations that could mitigate or offset the impact of CO_2 regulations?

A. No. It is unclear what provisions for grandfathering existing coal plants, if any, will be adopted as part of future greenhouse gas legislation. At the same time, it is unrealistic to expect that many or all of the new coal-fired plants currently being proposed will be grandfathered because of the substantial reductions in CO_2 emissions from current levels that have to be made by 2050 just to stabilize atmospheric concentrations of CO_2 at 450 ppm to 550 ppm.

Meeting these goals will require either a reduction in dependence on coal for electricity generation or a very large investment in conversion of the current coal generating fleet in the U.S. The only realistic way either of these is going to happen is with a large marginal cost on greenhouse gas emissions such as a CO_2 tax or higher emissions allowance prices. It is not reasonable to expect that a new pulverized coal plant, like the AMPGS, which will substantially increase the emissions of CO_2 into the atmosphere, will receive significant emission allowances under any U.S. carbon regulation plan.

For example, the National Commission on Energy Policy has recently recommended that "new coal plants built without [carbon capture and sequestration] not be "grandfathered" (i.e., awarded free allowances) in any future regulatory program to limit greenhouse gas emissions."[60] A report of an interdisciplinary study at the Massachusetts Institute of Technology on *The Future of Coal* similarly noted that:

> There is the possibility of a perverse incentive for increased early investment in coal-fired power plants without capture, whether

[60] *Energy Policy Recommendations to the President and the 110th Congress*, National Commission on Energy Policy, April 2007, at page 21.

> SCPC or IGCC, in the expectation that the emissions from these plants would potentially be "grandfathered" by the grant of free CO_2 allowances as part of future carbon emissions regulations and that (in unregulated markets) they would also benefit from the increase in electricity prices that will accompany a carbon control regime. Congress should act to close this "grandfathering" loophole before it becomes a problem.[61]

Additionally, it has been proposed in Congress that new coal-fired plants would be required to actually have carbon capture and sequestration technology. For example, a bill by Massachusetts Senator Kerry's bill limit CO_2 emissions from new coal-fired facilities to 285 lbs/MWh. New coal-fired facilities would be defined as those that begin construction on or after April 26, 2007 and would certainly include the proposed AMPGS Project.

Q. What is AMP-Ohio's position regarding the likelihood that the emissions from the AMPGS Project will be grandfathered under federal greenhouse gas legislation?

A. AMP-Ohio has said that it cannot predict future legislation/regulations regulating greenhouse gas emissions.[62]

Q. Is it possible that natural gas demand could be higher due to CO_2 emission regulations and, as a result, natural gas prices can be expected to be higher than otherwise would be the case?

A. Yes. However, the effect is very complicated and will depend on a number of factors such as how much new natural gas capacity is built as a result of the higher coal-plant operating costs due to the CO_2 emission allowance prices, how much additional DSM and renewable alternatives become economic and are added to the U.S. system, the levels and prices of any incremental natural gas

---

61 *The Future of Coal, Options for a Carbon-Constrained World, an Interdisciplinary MIT Study*, March 2007, at page (xiv).

62 AMP-Ohio Response to Request No. 45 in Exhibit DAS-2.

imports, and changes in the dispatching of the electric system. There it is very difficult to determine, at this time, the amount by which natural gas prices might be raised due to CO_2 emission regulations.

Q. What are you recommendations concerning the CO_2 prices that the Power Siting Board and the AMP-Ohio member communities should use in evaluating AMP-Ohio proposed AMPGS Project?

A. Given the uncertainty associated with the legislation that eventually will be passed by Congress, we believe that the Power Siting Board should use the Synapse range of forecasts of CO_2 prices shown in Figure 3 above to evaluate the relative economics of the proposed AMPGS plant.

Q. How much additional CO_2 would the AMPGS Project emit into the atmosphere?

A. AMP-Ohio has projected that the AMPGS will emit 7,367,000 tons of CO_2 annually.[63]

Q. What would be the annual costs of greenhouse gas regulations to AMP-Ohio and the customers of the participants in the AMPGS Project under the Synapse CO_2 price forecasts if AMP-Ohio proceeds with the proposed AMPGS Project?

A. The annual expenditures on CO_2 emissions allowances that the participants in the AMPGS would have to pay in 2015, 2020 and 2030 under the Synapse low, mid and high price forecasts are shown in Table 5 below:

---

[63] Initial Project Feasibility Study, Attachment ES-1.

Table 5: Annual AMPGS Project Participant CO_2 Emissions Allowances Payments under Synapse Price Forecasts

Year	Synapse Low CO_2 Price Forecast ($Millions)	Synapse Mid CO_2 Price Forecast ($Millions)	Synapse High CO_2 Price Forecast ($Millions)
2015	$42	$125	$208
2020	$83	$208	$333
2030	$167	$292	$417

4. AMP-Ohio Has Not Adequately Considered The Risk Of Further Increases In The Estimated Cost Of The AMPGS Project

Q. What is the currently estimated cost for The AMPGS?

A. The currently estimated cost of the AMPGS Project, without interest and other financing-related costs, is $2.533 billion.[64] The currently estimated cost, with interest and other financing-related costs is $2.91 billion.[65]

Q. Have you been able to evaluate the reasonableness of this cost estimate?

A. No. AMP-Ohio refused to provide the workpapers and source documents which formed the basis for the current cost estimate for the AMPGS Project.[66] AMP-Ohio also refused to provide any evidence that supports the claim that this cost estimate "reflects equipment, material and labor market conditions in the region of the AMPGS as of the date of the *Initial Project Feasibility Study*.[67]

Q. What is the current status of the AMPGS Project?

A. It appears from the Burns and Roe evaluation for the Division of Cleveland Public Power that the project design is still in a conceptual state:[68]

---

64 Table 1 on page ES-7 of the June 2007 R.W. Beck *Initial Project Feasibility Study*.
65 Table 2 on page ES-8 of the June 2007 R.W. Beck *Initial Project Feasibility Study*.
66 AMP-Ohio Response to Request No. 32.a. in Exhibit DAS-2.
67 AMP-Ohio Response to Request No. 32.b. in Exhibit DAS-2.
68 *Consulting Engineer's Report for the American Municipal Power Generating Station located in Meigs County, Ohio*, for the Division of Cleveland Public Power, Burns and Roe Enterprises, Inc., October 16, 2007, at page 10-1.

> In performing our due diligence review of a conceptual cost estimate, BREI relied on current in-house cost data for plants of a similar size. A more detailed review could not take place at this time since engineering has not begun and bulk quantities for items such as concrete, structural steel, building sizing, piping, electrical cable, conduit and tray, etc., have not been developed. Budget quotations for most major equipment have not been obtained, which further restricted our review to the use of current in-house data.[69]

Q. Is it even certain that the AMPGS Project would be a subcritical pulverized coal power plant?

A. No, it appears that the overall plant technology is not yet set. Burns and Roe noted in its Report for the Division of Cleveland Public Power that it "believes there are significant risks that this technology [subcritical] will be challenged in the air permitting process leading to potential delays in receipt of permits and thereby impacting the commercial operation date. There is a reasonable probability that the project will be forced to make a change to supercritical technology."[70] Burns and Roe further noted that in a conference call held on September 28, 2007, AMP-Ohio "stated that the EPC Contractors will be given the opportunity to propose a supercritical pulverized coal plant as an alternate to the subcritical plant."[71]

Q. What conclusion did Burns and Roe reach concerning the currently estimated cost for the AMPGS Project?

A. Burns and Roe found the current cost estimate to be in the range of the expected cost for a two unit subcritical coal-fired power plant of its size and design.[72] However, Burns and Roe warned that the escalation estimate "may not be

---

69 Id.
70 Id, at page 2-3.
71 Id, at page 2-4.
72 Id, at page 1-3.

conservative as seen by significant increases in construction materials costs in recent years."[73]

Q. Is it reasonable to expect that the actual cost of the project will be higher than AMP-Ohio now estimates?

A. Yes. The costs of building power plants have soared in recent years as a result of the worldwide demand for power plant design and construction resources and commodities. There is no reason to expect that plant costs will not continue to rise during the years when the detailed engineering, procurement and construction of the AMPGS will be underway. This is especially true given the extremely early stage of the engineering and procurement for the project.

For example, Duke Energy Carolinas' originally estimated cost for the two unit coal-fired Cliffside Project was approximately $2 billion. In the fall of 2006, Duke announced that the cost of the project had increased by approximately 47 percent ($1 billion). After the project had been downsized because the North Carolina Utilities Commission refused to granted a permit for two units, Duke announced that the cost of that single unit would be about $1.53 billion, not including financing costs. In late May 2007, Duke announced that the cost of building that single unit had increased by about another 20 percent. As a result, the estimated cost of the one unit that Duke is building at Cliffside is now $1.8 billion exclusive of financing costs. Thus, the single Cliffside unit is now expected to cost almost as much as Duke originally estimated for a two unit plant.

Q. Did Duke explain to the North Carolina Utilities Commission the reasons for the skyrocketing cost of the Cliffside Project?

A. Yes. In testimony filed at the North Carolina Utilities Commission on November 29, 2006, Duke Energy Carolinas emphasized that the competition for resources

---

[73] Id.

had had a significant impact on the costs of building new power plants. This testimony was presented to explain the approximate 47 percent ($1 billion) increase in the estimated cost of Duke Energy Carolinas' proposed coal-fired Cliffside Project that the Company announced in October 2006.

For example, Duke Energy Carolinas explained that:

> The costs of new power plants have escalated very rapidly. This effect appears to be broad based affecting many types of power plants to some degree. One key steel price index has doubled over the last twelve months alone. This reflects global trends as steel is traded internationally and there is international competition among power plant suppliers. Higher steel and other input prices broadly affects power plant capital costs. A key driving force is a very large boom in U.S. demand for coal power plants which in turn has resulted from unexpectedly strong U.S. electricity demand growth and high natural gas prices. Most integrated U.S. utilities have decided to pursue coal power plants as a key component of their capacity expansion plan. In addition, many foreign companies are also expected to add large amounts of new coal power plant capacity. This global boom is straining supply. Since coal power plant equipment suppliers and bidders also supply other types of plants, there is a spill over effect to other types of electric generating plants such as combined cycle plants.[74]

Duke further noted that the actual coal power plant capital costs as reported by plants already under construction exceed government estimates of capital costs by "a wide margin (i.e., 35 to 40 percent). Additionally, current announced power plants appear to face another increase in costs (i.e., approximately 40 percent addition."[75] Thus, according to Duke, new coal-fired power plant capital costs had increased approximately 90 to 100 percent since 2002.

---

[74] Direct Testimony of Judah Rose for Duke Energy Carolinas, North Carolina Utilities Commission Docket No. E-7, SUB 790, at page 4, lines 2-14. Mr. Rose's testimony is available on the North Carolina Utilities Commission website.

[75] Ibid, at page 6, lines 5-9, and page 12, lines 11-16.

Q. Have other coal-fired plant projects experienced similar cost increases?

A. Yes. A large number of projects have announced significant construction cost increases over the past few years. For example, the cost of Westar's proposed coal-fired plant in Kansas, originally estimated at $1 billion, increased by 20 percent to 40 percent, over just 18 months.

The estimated cost of the now-cancelled Taylor Energy Center in Florida increased by 25 percent, $400 million, in just 17 months between November 2005 and March 2007. The estimated cost of the Big Stone II coal-fired power plant project in South Dakota has increased by about 60 percent since the project was first announced. Finally, the estimated cost of the Little Gypsy Repowering Project (gas to coal) increased by 55 percent between announcement of the project in April 2007 and the filing of a request for a license to build in July 2007.

Q. What are the sources of the worldwide competition for power plant design and construction resources, commodities and equipment?

A. The worldwide competition is driven mainly by huge demands for power plants in China and India, by a rapidly increasing demand for power plants and power plant pollution control modifications in the United States required to meet SO_2 and NO_x emissions standards, and by the competition for resources from the petroleum refining industry. The demand for labor and resource to rebuild the Gulf Coast area after Hurricanes Katrina and Rita hit in 2005 also has contributed to rising costs for construction labor and materials. The expected construction of new nuclear power plants also is expected to compete for limited power plant design and construction resources, manufacturing capacity and commodities.

Q. Is it commonly accepted that domestic United States and worldwide competition for power plant design and construction resources, commodities and manufacturing have led to these significant increases in power plant construction costs in recent years?

A. Yes. A wide range of energy, construction and financial industry studies have identified the worldwide competition for power plant resources as the driving force for the skyrocketing construction costs.

For example, a June 2007 report by Standard & Poor's, *Increasing Construction Costs Could Hamper U.S. Utilities' Plan to Build New Power Generation*, has noted that:

> As a result of declining reserve margins in some U.S. regions ... brought about by a sustained growth of the economy, the domestic power industry is in the midst of an expansion. Standing in the way are capital costs of new generation that have risen substantially over the past three years. Cost pressures have been caused by demands of global infrastructure expansion. In the domestic power industry, cost pressures have arisen from higher demand for pollution control equipment, expansion of the transmission grid, and new generation. While the industry has experienced buildout cycles in the past, what makes the current environment different is the supply-side resource challenges faced by the construction industry. A confluence of resource limitations have contributed, which Standard & Poors' Rating Services broadly classifies under the following categories
>
> - Global demand for commodities
> - Material and equipment supply
> - Relative inexperience of new labor force, and
> - Contractor availability
>
> The power industry has seen capital costs for new generation climb by more than 50% in the past three years, with more than 70% of this increase resulting from engineering, procurement and construction (EPC) costs. Continuing demand, both domestic and international, for EPC services will likely keep costs at elevated levels. As a result, it is possible that with declining reserve

> margins, utilities could end up building generation at a time when labor and materials shortages cause capital costs to rise, well north of $2,500 per kW for supercritical coal plants and approaching $1,000 per kW for combined-cycle gas turbines (CCGT). In a separate yet key point, as capital costs rise, energy efficiency and demand side management already important from a climate change perspective, become even more crucial as any reduction in demand will mean lower requirements for new capacity.[76]

More recently, the president of the Siemens Power Generation Group told the New York Times that "There's real sticker shock out there."[77] He also estimated that in the last 18 months, the price of a coal-fired power plant has risen 25 to 30 percent.

A September 2007 report on *Rising Utility Construction Costs* prepared by the Brattle Group for the EDISON Foundation similarly concluded that:

> Construction costs for electric utility investments have risen sharply over the past several years, due to factors beyond the industry's control. Increased prices for material and manufactured components, rising wages, and a tighter market for construction project management services have contributed to an across-the-board increase in the costs of investing in utility infrastructure. These higher costs show no immediate signs of abating.[78]

The report further found that:

- Dramatically increased raw materials prices (e.g., steel, cement) have increased construction cost directly and indirectly through the higher cost of manufactured components common in utility infrastructure projects. These cost increases have primarily been due to high global demand for commodities and manufactured goods, higher production and transportation costs (in part owing to high fuel prices), and a weakening U.S. dollar.

---

76 *Increasing Construction Costs Could Hamper U.S. Utilities' Plans to Build New Power Generation*, Standard & Poor's Rating Services, June 12, 2007, at page 1. A copy of this report is included in Exhibit DAS-7.

77 "Costs Surge for Building Power Plants, *New York Times*, July 10, 2007.

78 *Rising Utility Construction Costs: Sources and Impacts*, prepared by The Brattle Group for the EDISON Foundation, September 2007, at page 31. A copy of this report is attached as Exhibit DAS-8.

- Increased labor costs are a smaller contributor to increased utility construction costs, although that contribution may rise in the future as large construction projects across the country raise the demand for specialized and skilled labor over current or project supply. There also is a growing backlog of project contracts at large engineering, procurement and construction (EPC) firms, and construction management bids have begun to rise as a result. Although it is not possible to quantify the impact on future project bids by EPC, it is reasonable to assume that bids will become less cost-competitive as new construction projects are added to the queue.

- The price increases experienced over the past several years have affected all electric sector investment costs. In the generation sector, all technologies have experienced substantial cost increases in the past three years, from coal plants to windpower projects.... As a result of these cost increases, the levelized capital cost component of baseload coal and nuclear plants has risen by $20/MWh or more – substantially narrowing coal's overall cost advantages over natural gas-fired combined-cycle plants – and thus limiting some of the cost-reduction benefits expected from expanding the solid-fuel fleet.

- The rapid increases experienced in utility construction costs have raised the price of recently completed infrastructure projects, but the impact has been mitigated somewhat to the extent that construction or materials acquisition preceded the most recent price increases. The impact of rising costs has a more dramatic impact on the estimated cost of proposed utility infrastructure projects, which fully incorporates recent price trends. This has raised significant concerns that the next wave of utility investments may be imperiled by the high cost environment. These rising construction costs have also motivated utilities and regulators to more actively pursue energy efficiency and demand response initiatives to reduce the future rate impacts on consumers.[79]

Q. Is it reasonable to expect that these same factors will continue to lead to further construction cost increases in future years?

A. Yes. I have seen no evidence that these factors will abate at any point in the foreseeable future. For example, Burns and Roe noted that it is difficult to predict the escalation of future power plant costs and expressed concern that "India is on the threshold of beginning a rapid expansion in the upcoming years will place

additional pressure on the availability of raw materials, shop fabrication space and available work force for engineering, site management staff and field labor and supervision."[80]

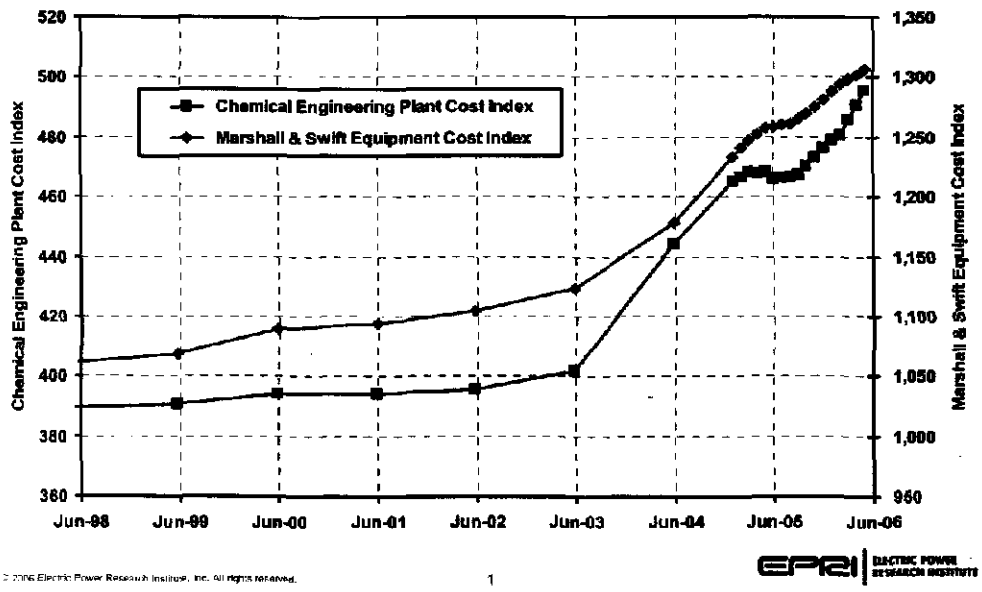
Q. Have you seen any figures or tables that illustrate the cost escalation that has been experienced in the construction industry in recent years?

A. Yes. Figure 7, taken from the August 2006 issue of Chemical Engineering Magazine, gives a sense of the escalation experienced by the construction industry since June 2003:

79 Id, at pages 1-3.

80 *Consulting Engineer's Report for the American Municipal Power Generating Station located in Meigs County, Ohio*, for the Division of Cleveland Public Power, Burns and Roe Enterprises, Inc., October 16, 2007, at page 10-9.

Figure 7: Construction Cost Indices



Q. **Has AMP-Ohio commented on the increases that have recently been experienced in the estimated costs of building new coal-fired power plants?**

A. Yes. In its Application to the Power Siting Board, AMP-Ohio noted that the price increases currently being experienced in the expected construction costs of coal based electric generation "are staggering."[81] AMP-Ohio also noted that "Price increases of 10% in a single six month period are being reported. Using this data and similar data on other projects as an estimate, a one month delay in a $2 billion project is over $33 million."[82]

81 AMP-Ohio Application, Section OAC 4906-13-05, at page 4.
82 Id.

Q. What is AMP-Ohio's assessment of the current state of the power plant construction industry or of construction costs?

A. AMP-Ohio refused to provide any assessments of the current state of the power plant industry or power plant construction costs that it prepared or that were prepared for it in the last two years.[83]

Q. Has AMP-Ohio provided any assessments which examined the potential for future increases in the capital or installed cost of the proposed AMPGS Project?

A. No. AMP-Ohio refused to provide any such assessments other than the June 2007 R.W. Beck *Initial Project Feasibility Study*.[84]

Q. By much does R.W. Beck believe that the cost of the AMPGS Project could increase before it is completed?

A. R.W. Beck has said that "based on our experience related to the construction and construction costs for coal plants similar to AMPGS, we have assumed that the total estimated construction costs reflected in the Base Case could vary by +15 percent or -5 percent."[85]

Q. Did R.W. Beck specify the "experience related to the construction and construction costs for coal plants similar to AMPGS" which formed the basis for this assumption.

A. No. AMP-Ohio refused to even specify the experience referenced by R.W. Beck.[86]

---

83 AMP-Ohio's Response to Request No. 16 in Exhibit DAS-2.
84 AMP-Ohio's Response to Request No. 37 in Exhibit DAS-2.
85 *Initial Project Feasibility Study*, at page 714.
86 AMP-Ohio's Response to Request No. 49.a. in Exhibit DAS-2.

Q. Did R.W. Beck reflect this potential for construction cost increases in the resource planning in which it developed the Power Supply Plans for AMP-Ohio's member communities in which it found that participation in the AMPGS Project was part of a least cost, least risk capacity addition plan?

A. No. [redacted] estimate for the AMPGS Project in mid-calendar 2006 and did not prepare any sensitivities examining how capacity additions would change in response to higher AMPGS Project costs.

Q. It is reasonable to assume that the increased competition for power plant design and construction resources, commodities and manufacturing capacity factors that has led to the significant increases in power plant capital costs also will lead to construction delays?

A. Yes.

Q. By how many months does R.W. Beck believe that its projected construction cost for the AMPGS Project could vary?

A. R.W. Beck has said that based on its experience with construction for coal plants similar to AMPGS, it has assumed that the AMPGS Project schedule could be early by 3 months or delayed by as much as 12 months.[87]

Q. Did R.W. Beck specify the experience related to the construction for coal plants which formed the basis for the assumption that the AMPGS Project schedule could be early by 3 months or delayed by as much as 12 months?

A. No. AMP-Ohio refused to provide that information.[88]

---

87 *Initial Project Feasibility Study*, at page 714
88 AMP-Ohio's Response to Request No. 49.b. in Exhibit DAS-2.

Q. **Did R.W. Beck reflect this potential for construction schedule delays in the resource planning in which it developed the Power Supply Plans for AMP-Ohio's member communities in which it found that participation in the AMPGS Project was part of a least cost, least risk capacity addition plan?**

A. [redacted] delays when it developed the Power Supply Plans.

Q. **Is it your testimony that AMP-Ohio should change its current cost estimate for the AMPGS?**

A. Not necessarily. However, in order to evaluate the risks of continuing with the proposed project, AMP-Ohio should have prepared sensitivity studies that examined the relative economics of the AMPGS Project against alternatives assuming that the capital cost of the project is substantially higher than AMP-Ohio now estimates. For example, in its economic analyses, AMP-Ohio could have prepared sensitivity analyses that reflected capital costs 20 percent and 40 percent higher than its current estimated cost for the AMPGS. It is not unreasonable to expect such additional cost increases at the AMPGS in light of the industry-wide experience and the expectation that worldwide demand will continue to be a driving force for rising prices.

Q. **Is it reasonable to expect that these same current market conditions also will lead to increases in the estimated costs of other supply-side alternatives such as natural gas-fired, wind or biomass facilities?**

A. Yes.

Q. **What impact would higher coal-plant capital costs have on the relative economics of energy efficiency as compared to the AMPGS Project?**

A. I have seen no evidence that the same worldwide demand for power plant resources has led to significant increase in the costs of energy efficiency

measures. Therefore, it is reasonable to expect that higher coal-plant capital costs increase the relative economics and attractiveness of energy efficiency.

Q. AMP-Ohio has said that it can mitigate the risk of further future cost increases by entering into a fixed price EPC contract for the AMPGS project.[89] Have you seen any evidence that suggests that it will be extremely unlikely, or indeed impossible, for AMP-Ohio to find a firm willing to enter into such a fixed price contract for the proposed plant?

A. Yes. As discussed by AEP witness Jasper, because the market has been extremely volatile in recent years, it is "impossible to get reasonable pricing fixed at this time. GE/Bechtel is unable to fix its equipment pricing, material costs and labor rates in advance."[90] Consequently, "GE/Bechtel [the EPC contractor for AEP's Mountaineer IGCC Project] and APCo have developed an adjustment mechanism to deal with significant market escalations in large plant construction costs as well as other commodities, that have impacted and are expected to continue to impact large plant."[91] The following categories of equipment, materials and labor costs will be subject to updating all following the issuance of AEP's Notice to Proceed to reflected updated pricing values and vendor quotes:

- Major Equipment and Subcontracts, with a value more than $1 million, will be competitively re-bid at the appropriate time based on the project schedule, and substituted for the pricing obtained from bids for the FEED [Front End Engineering Design] cost estimate.
- Plant Equipment and Subcontracts, with a value less than $1 million, will also be competitively re-bid at the appropriate time based on the project schedule, and substituted for the pricing obtained from bids, or from historical data from the FEED cost estimate.

---

89 For example, see page 4-2 of the *Initial Project Feasibility Study*.

90 2007 Testimony of Appalachian Power Company witness William M. Jasper, West Virginia Public Service Commission Case No. 06-0033-E-CN, at page 15, lines 18-20.

91 Ibid, at page 16, lines 11-14.

- Bulk Materials. At the time of actual purchase of bulk materials, actual pricing will be obtained through competitive quotes and used to adjust the unit prices for bulk materials.

- Construction Equipment and Construction and Start-up Materials. At the time of actual purchase of equipment and construction and start-up materials, actual pricing will be obtained through competitive bidding. Gasoline and diesel prices will be adjusted based on prices published by the Department of Energy.

- Craft Labor. Actual corresponding labor rates will be used to recalculate the labor expenses actually incurred on a monthly basis.

- Non-Manual Service Rates. Actual corresponding rates paid for these support staff personnel during the execution of the project will be used to recalculate the costs on an annual basis.

- GE Manufactured and Proprietary Equipment. The mechanism for adjusting the price of GE manufactured and proprietary equipment will be agreed upon prior to executing the EPC Contract.[92]

Appalachian Power Company witness Jasper further testified in the same proceeding that:

> Company witness Renchek discusses in his testimony the rapid escalation of key commodity prices in the EPC industry. **In such a situation, no contractor is willing to assume this risk for a multi-year project.** Even if a contractor was willing to do so, its estimated price for the project would reflect this risk and the resulting price estimate would be much higher.[93] [Emphasis added.]

Burns and Roe reaches the same conclusions as these Appalachian Power Company witnesses concerning the possibility of finding a firm willing to agree to a fixed price EPC contract:

> BREI agrees that the fixed price turnkey EPC contract is a reasonable approach to executing the project. However, the viability of obtaining a contract of this type is not certain. The high cost of the EPC contract, in excess of $2 billion, significantly

---

92 Ibid, at page 17, line 1, to page 18, line 3.
93 Ibid, at page 16, lines 16-20.

> reduces the number of potential contractors even when teaming of engineers, constructors and equipment suppliers is taken into account. Recent experience on large U.S. coal projects indicates that the major EPC Contractors are not willing to fix price the entire project cost. This is the result of volatile costs for materials (alloy pipe, steel, copper, concrete) as well as a very tight construction labor market. When asked to fix the price, several EPC Contractors have commented that they are willing to do so, but the amount of money to be added to cover potential risks of a cost overrun would make the project uneconomical.[94]

Q. Has AMP-Ohio been able to provide any evidence or documents which form the basis for the belief that it will be able to finalize a fixed price EPC contract for the AMPGS Project?

A. No. AMP-Ohio refused to provide any evidence or documents supporting the belief that it will be able to finalize a fixed price EPC contract for the AMPGS Project.[95]

5. AMP-Ohio's Resource Planning Analyses Are Flawed and Biased in Favor of the Proposed AMPGS Project

Q. In your experience, what evidence do electric utility companies typically submit in cases where they are seeking to justify the addition of new baseload generating facilities?

A. Electric utility companies typically provide economic and system modeling analyses that compare resource plans that include a range of supply side options and, with increasing frequently, companies are now including demand side options, as well, in their resource planning. These studies project the costs and benefits of the various supply and demand side alternatives for decades into the future. They are used to examine whether the proposed generation facility is a

---

94 *Consulting Engineer's Report for the American Municipal Power Generating Station located in Meigs County, Ohio,* for the Division of Cleveland Public Power, Burns and Roe Enterprises, Inc., October 16, 2007, at page 11-1.

95 AMP-Ohio's Response to Request No. 6 in Exhibit DAS-2.

component of a least cost expansion plan. A standard approach is to calculate and compare the net and cumulative present values of the various alternatives.

In addition to base case studies, prudent utility economic and system modeling analyses also present a wide range of sensitivity analyses that examine the impact of changes in key input assumptions, such as capital costs and fuel costs, on the relative costs and benefits of alternative resource plans and options. As I discussed earlier, prudent and reasonable planning also requires that future CO_2 prices be reflected in resource planning.

Q. In your experience, is the *Initial Project Feasibility Study* that was prepared by R.W. Beck and submitted by AMP-Ohio typical of the types of analyses that companies file in support of applications to add new baseload generating capacity?

A. No. The *Initial Project Feasibility Study* does not provide evidence that the proposed AMPGS would be a component of a least cost, least risk generation expansion plan. In particular, the *Initial Project Feasibility Study* does not compare the economic, or environmental, costs and benefits of expansion plans with the proposed AMPGS Project against the costs and benefits of alternative plans without the Project. Such alternative plans should include other supply-side options, including some renewable resources, and demand-side resources. The *Initial Project Feasibility Study* only presents what it calls the "Beneficial Use of the AMPGS Project" which is not a resource plan in that it does not compare the estimated cost of generating power at the proposed AMPGS Project with the estimated costs of generating power at reasonable alternatives.

Q. Has AMP-Ohio prepared any economic and system modeling analyses regarding the proposed AMPGS Project?

A. Yes. R.W. Beck prepared Power Supply Plans for each of the member communities.

Q. Have you been able to review these Power Supply Plans?

A. We have reviewed the Power Supply Plans that were prepared by R.W. Beck for six or seven of the largest AMPGS Project participants.

Q. Have you been able to review the workpapers for the resource planning process in which R.W. Beck developed these Power Supply Plans?

A. No. AMP-Ohio refused to provide any workpapers or source documents for the resource planning process through which the Power Supply Plans were developed.[96]

Q. Have you nevertheless been able to formulate some opinions about the resource planning process conducted by R.W. Beck and AMP-Ohio?

A. Yes. The [redacted] AMP-Ohio did provide us with [redacted] suggest that there were numerous serious flaws and biases in the resource planning process which in favor of the proposed AMPGS Project. The most significant of these flaws and biases include:

- Energy efficiency was not considered as a resource option.
- Only a single forecast low forecast of CO_2 prices was used.
- A construction cost estimate for the AMPGS Project and other coal plants that was prepared in February 2006 was used.
- Did not conduct any sensitivities reflecting higher CO_2 prices or increased plant construction costs.
- Appears to have used a very high capital cost for wind resources.
- Used what may have been an unreasonably low capacity factor for new wind resources. New wind turbines are achieving higher than 25 percent annual capacity factors.
- It is unclear whether they assumed a continuation of the wind production tax credit.

[96] See AMP-Ohio's Responses to Requests Nos. 13, 24, 26, 27, and 28 in Exhibit DAS-2.

- [redacted]
- [redacted] allow the consideration of [redacted] Portfolio Standard energy requirement.
- R.W. Beck does not appear to have considered the possibility of purchasing an existing natural gas-fired power plant.

Q. Are there any aspects of the methodology used by R.W. Beck that cause concern about the results of the Power Supply Plans?

A. Yes. R.W. Beck [redacted] initial screening analysis.[97] [redacted] determine whether the elimination of these "certain alternatives" was reasonable. More importantly, R.W. Beck predetermined the "specified combinations of the alternatives to be analyzed (i.e., portfolios)."[98] The outcome of the resource planning process can be influenced by the nature of the portfolios predetermined by R.W. Beck. A better approach is to allow the resource planning or capacity expansion model to select adding supply-side and demand-side resources and, thereby, build the portfolios based upon the criterion of minimizing the net or cumulative present value of the optimal or preferred plans.

Q. Have you seen resource planning analyses in which energy efficiency and renewable alternatives were made available to the capacity expansion model for selection based on economic costs?

A. Yes. We have seen and have participated in a number of integrated resource planning processes which have included energy efficiency as an option for meeting projected demands and energy requirements and which also have included wind and other renewable resources.

---

97 February 16, 2007 *Power Supply Plan for the City of Cleveland*, at page 3.
98 February 16, 2007 *Power Supply Plan for the City of Cleveland*, at page 2.

Q. Did AMP-Ohio provide any analyses of the potential for demand-side management and energy efficiency within Ohio or the communities it serves?

A. No. AMP-Ohio refused to provide any studies of the potential for demand-side management and energy efficiency that had been prepared by or for it or by or for the Cities of Cleveland, Cuyahoga Falls, Hudson, Oberlin, Wadsworth and Bowling Green.[99]

Q. Did AMP-Ohio provide any analyses of the potential for wind and/or other renewable resources within Ohio or the communities it serves?

A. No. AMP-Ohio refused to provide any such studies.[100]

Q. Has AMP-Ohio compared the economic costs of the proposed AMPGS Project to demand-side resources?

A. No.[101]

Q. Has AMP-Ohio compared the cost of generating power at the proposed AMPGS Project with the cost of implementing energy efficiency measures?

A, AMP-Ohio refused to even state whether it had compared the cost of generating power at the proposed AMPGS Project with the cost of implementing energy efficiency measures.[102]

Q. Have you seen any evidence that suggests that energy efficiency, wind, or biomass cannot be part of a portfolio of alternatives to the proposed AMPGS Project?

A. No. We have not had the opportunity to conduct any assessments of the potential for energy efficiency or renewable resources in Ohio or in the communities that

---

99 AMP-Ohio's Response to Request No. 8 in Exhibit DAS-2.
100 AMP-Ohio's Response to Request No. 9 in Exhibit DAS-2.
101 AMP-Ohio's Response to Request No. 30 in Exhibit DAS-2.
102 AMP-Ohio's Response to Request No. 46 in Exhibit DAS-2.

would be participants in the AMPGS Project. Nor have we had an opportunity to do any capacity expansion modeling of our own concerning the AMPGS Project. However, Synapse prepared a study in 2001 that suggests that a portfolio of alternatives that includes energy efficiency, renewable resources, and, if necessary, natural gas-fired capacity should be investigated and analyzed before a commitment is made to the proposed AMPGS Project. This study found that by 2020 energy efficiency could save 72,000 GWh by 2020 and reduce energy demands by more than 29 percent, at an average cost 2.4 cents per KWh.[103]

The 2001 Synapse study also found that by 2020 there was the potential for the addition of 900 MW of new wind resources in Ohio, 1,179 MW of biomass co-firing resources and 970 MW of new combined heat and power – biomass resources.

Q. Have you seen any recent examples of states and utilities seeking to achieve significant savings in energy requirements and peak demands through energy efficiency and demand-side measures?

A. Yes. A large number of states, cities and utilities are moving aggressively to save energy and reduce their power consumption through energy efficiency and demand side measures. For example, the City of Austin has set a goal of saving 15 percent of its projected energy requirements by 2020. The Sacramento Municipal Utility District has a goal of achieving 15 percent energy savings by 2017.

At the same time, the State of New York has adopted and is now starting to implement a "15 by 15" program through which it intends to reduce energy

---

[103] Repowering the Midwest, the Clean Energy Development Plan for the Heartland, February 2001, at page 90, available at http://www.synapse-energy.com/Downloads/SynapseReport.2001-01.ELPC.Repowering-the-Midwest..99-42-Full%20Text.pdf

consumption by 15 percent by 2015.[104] The State of New Jersey has set a goal of reducing energy consumption by 20 percent by 2020.[105]

Q. Is it your testimony that the AMPGS Project should be cancelled and that, instead, AMP-Ohio and its member communities should pursue energy efficiency and renewable resources?

A. No. It is my testimony that the Project should not be certified at this time. Instead, before committing to a project that will ultimately cost in excess of $3 billion, AMP-Ohio and its member communities should re-examine the economics of the proposed AMPGS Project against portfolios that include reasonable amounts of energy efficiency and renewable resources and, if necessary new natural gas-fired capacity. As part of these new studies, AMP-Ohio and its member communities should investigate the potential for energy efficiency and renewable resources in Ohio and in their own communities.

Moreover, when it conducts new resource planning analyses comparing the AMPGS Project to supply-side and demand-side alternatives, AMP-Ohio should consider a reasonable range of CO_2 prices, such as that developed by Synapse, and should conduct sensitivities that allow for further increases in the cost of building the AMPGS Project and alternative options.

Q. Have you had an opportunity review the impact that participation in the proposed AMPGS Project will have on the fuel diversity of AMP-Ohio and the participating communities?

A. No. AMP-Ohio refused to provide the information we requested concerning the current and projected fuel diversities (in both MW and MWh) of AMP-Ohio and the larger participants in the proposed AMPGS Project.[106]

---

104 Remarks by Governor Eliot Spitzer. "15 by 15": A Clean Energy Strategy for New York. 19 Apr 2007. Found at: http://www.state.ny.us/governor/keydocs/0419071_speech.html.

105 Governor's *Economic Growth Strategy* 2007.

Q. Is fuel diversity a broader issue than merely deciding whether to build a coal- or gas-fired generating unit?

A. Yes, it should be. Implementing demand side management programs and building or buying power from low carbon-emitting renewable resource facilities also would increase a company's supply diversity. Investments in demand side management and renewable resources would provide real benefits in terms of supply diversity by reducing AMP-Ohio's dependency on coal, gas and oil.

Q. Does this conclude your testimony?

A. Yes.

[106] AMP-Ohio's Response to Request No. 12 in Exhibit DAS-2.

David A. Schlissel

Senior Consultant
Synapse Energy Economics
22 Pearl Street, Cambridge, MA 02139
(617) 661-3248 ext. 224 • Fax: (617) 661-0599
www.synapse-energy.com
dschlissel@synapse-energy.com

SUMMARY

I have worked for thirty years as a consultant and attorney on complex management, engineering, and economic issues, primarily in the field of energy. This work has involved conducting technical investigations, preparing economic analyses, presenting expert testimony, providing support during all phases of regulatory proceedings and litigation, and advising clients during settlement negotiations. I received undergraduate and advanced engineering degrees from the Massachusetts Institute of Technology and Stanford University, respectively, and a law degree from Stanford Law School

PROFESSIONAL EXPERIENCE

Electric System Reliability - Evaluated whether new transmission lines and generation facilities were needed to ensure adequate levels of system reliability. Investigated the causes of distribution system outages and inadequate service reliability. Examined the reasonableness of utility system reliability expenditures.

Transmission Line Siting – Examined the need for proposed transmission lines. Analyzed whether proposed transmission lines could be installed underground. Worked with clients to develop alternate routings for proposed lines that would have reduced impacts on the environment and communities.

Power Plant Operations and Economics - Investigated the causes of more than one hundred power plant and system outages, equipment failures, and component degradation, determined whether these problems could have been anticipated and avoided, and assessed liability for repair and replacement costs. Examined power plant operating, maintenance, and capital costs. Analyzed power plant operating data from the NERC Generating Availability Data System (GADS). Evaluated utility plans for and management of the replacement of major power plant components. Assessed the adequacy of power plant quality assurance and maintenance programs. Examined the selection and supervision of contractors and subcontractors.

Power Plant Repowering - Evaluated the environmental, economic and reliability impacts of rebuilding older, inefficient generating facilities with new combined cycle technology.

Power Plant Air Emissions – Investigated whether proposed generating facilities would provide environmental benefits in terms of reduced emissions of NO_x, SO_2 and CO_2. Examined whether new state emission standards would lead to the retirement of existing power plants or otherwise have an adverse impact on electric system reliability.

Power Plant Water Use – Examined power plant repowering as a strategy for reducing water consumption at existing electric generating facilities. Analyzed the impact of converting power plants from once-through to closed-loop systems with cooling towers on plant revenues and electric system reliability. Evaluated the potential impact of the EPA's Proosed Clean Water Act Section 316(b) Rule for Cooling Water Intake Structures at existing power plants.

Nuclear Power - Examined the impact of the nuclear power plant life extensions and power uprates on decommissioning costs and collections policies. Evaluated utility decommissioning cost estimates and cost collection plans. Examined the reasonableness of utility decisions to sell nuclear power assets and evaluated the value received as a result of the auctioning of those plants. Investigated the significance of the increasing ownership of nuclear power plants by multiple tiered holding companies with limited liability company subsidiaries. Investigated the potential safety consequences of nuclear power plant structure, system, and component failures.

Electric Industry Regulation and Markets - Investigated whether new generating facilities that were built for a deregulated subsidiary should be included in the rate base of a regulated utility. Evaluated the reasonableness of proposed utility power purchase agreements with deregulated affiliates. Investigated the prudence of utility power purchases in deregulated markets. Examined whether generating facilities experienced more outages following the transition to a deregulated wholesale market in New England. Evaluated the reasonableness of nuclear and fossil plant sales, auctions, and power purchase agreements. Analyzed the impact of proposed utility mergers on market power. Assessed the reasonableness of contract provisions and terms in proposed power supply agreements.

Economic Analysis - Analyzed the costs and benefits of energy supply options. Examined the economic and system reliability consequences of the early retirement of major electric generating facilities. Evaluated whether new electric generating facilities are used and useful. Quantified replacement power costs and the increased capital and operating costs due to identified instances of mismanagement.

Expert Testimony - Presented the results of management, technical and economic analyses as testimony in more than ninety proceedings before regulatory boards and commissions in twenty three states, before two federal regulatory agencies, and in state and federal court proceedings.

Litigation and Regulatory Support - Participated in all aspects of the development and preparation of case presentations on complex management, technical, and economic issues. Assisted in the preparation and conduct of pre-trial discovery and depositions. Helped identify and prepare expert witnesses. Aided the preparation of pre-hearing petitions and motions and post-hearing briefs and appeals. Assisted counsel in preparing for hearings and oral arguments. Advised counsel during settlement negotiations.

TESTIMONY, AFFIDAVITS, DEPOSITIONS AND COMMENTS

West Virginia Public Service Commission (Case No. 06-0033-E-CN) – November 2007
Appalachian Power Company's application for a Certificate of Public Convenience and Necessity for a 600 MW integrated gasification combined cycle generating facility.

Iowa Utility Board (Docket No. GCU-07-01) – October 2007
Whether Interstate Power & Light Company's adequately considered the risks associated with building a new coal-fired power plant and whether that Company's participation in the proposed Marshalltown plant is prudent.

Virginia State Corporation Commission (Case No. PUE-2007-00066) – November 2007
Whether Dominion Virginia Power's adequately considered the risks associated with building the proposed Wise County coal-fired power plant and whether that Commission should grant a certificate of public convenience and necessity for the plant.

Louisiana Public Service Commission (Docket No. U-30192) – September 2007
The reasonableness of Entergy Louisiana's proposal to repower the Little Gypsy Unit 3 generating facility as a coal-fired power plant.

Arkansas Public Service Commission (Docket No. 06-154-U) – July 2007
The probable economic impact of the Southwestern Electric Power Company's proposed Hempstead coal-fired power plant project.

North Dakota Public Service Commission (Case Nos. PU-06-481 and 482) – May 2007
Whether the participation of Otter Tail Power Company and Montana-Dakota Utilities in the Big Stone II Generating Project is prudent.

Indiana Utility Regulatory Commission (Cause No. 43114) – May 2007
The appropriate carbon dioxide ("CO_2") emissions prices that should be used to analyze the relative economic costs and benefits of Duke Energy Indiana and Vectren Energy Delivery of Indiana's proposed Integrated Gasification Combined Cycle Facility and whether Duke and Vectren have appropriately reflected the capital cost of the proposed facility in their modeling analyses.

Public Service Commission of Wisconsin (Docket No. 6630-EI-113) – March 2007
Whether the proposed sale of the Point Beach Nuclear Plant to FPL Energy Point Beach, LLC, is in the interest of the ratepayers of Wisconsin Electric Power Company.

Florida Public Service Commission (Docket No. 070098-EI) – March 2007
Florida Light & Power Company's need for and the economics of the proposed Glades Power Park.

Michigan Public Service Commission (Case No. 14992-U) – December 2006
The reasonableness of the proposed sale of the Palisades Nuclear Power Plant.

Minnesota Public Utilities Commission (Docket No. CN-05-619) – November 2006
Whether the co-owners of the proposed Big Stone II coal-fired generating plant have appropriately reflected the potential for the regulation of greenhouse gases in their analyses of the facility; and whether the proposed project is a lower cost alternative than renewable options, conservation and load management.

North Carolina Utilities Commission (Docket No. E-7, Sub 790) – September 2006 and January 2007
Duke's need for two new 800 MW coal-fired generating units and the relative economics of adding these facilities as compared to other available options including energy efficiency and renewable technologies.

New Mexico Public Regulatory Commission (Case No. 05-00275-UT) – September 2006
Report to the New Mexico Commission on whether the settlement value of the adjustment for moving the 141 MW Afton combustion turbine merchant plant into rate base is reasonable.

Arizona Corporation Commission (Docket No. E-01345A-0816) – August and September 2006
Whether APS's acquisition of the Sundance Generating Station was prudent and the reasonableness of the amounts that APS requested for fossil plant O&M.

U.S. District Court for the District of Montana (Billings Generation, Inc. vs. Electrical Controls, Inc, et al., CV-04-123-BLG-RFC) – August 2006
Quantification of plaintiff's business losses during an extended power plant outage and plaintiff's business earnings due to the shortening and delay of future plant outages. [Confidential Expert Report]

Deposition in South Dakota Public Utility Commission Case No. EL05-022 – June 14, 2006

South Dakota Public Utility Commission (Case No. EL05-022) – May and June 2006
Whether the co-owners of the proposed Big Stone II coal-fired generating plant have appropriately reflected the potential for the regulation of greenhouse gases in their analyses of the alternatives to the proposed facility; the need and timing for new supply options in the co-owners' service territories; and whether there are alternatives to the proposed facility that are technically feasible and economically cost-effective.

Georgia Public Service Commission (Docket No. 22449-U) – May 2006
Georgia Power Company's request for an accounting order to record early site permitting and construction operating license costs for new nuclear power plants.

California Public Utilities Commission (Dockets Nos. A.05-11-008 and A.05-11-009) – April 2006
The estimated costs for decommissioning the Diablo Canyon, SONGS 2&3 and Palo Verde nuclear power plants and the annual contributions that are needed from ratepayers to assure that adequate funds will be available to decommission these plants at the projected ends of their service lives.

New Jersey Board of Public Utilities (Docket No. EM05020106) – November and December 2005 and March 2006
Joint Testimony with Bob Fagan and Bruce Biewald on the market power implications of the proposed merger between Exelon Corp. and Public Service Enterprise Group.

Virginia State Corporation Commission (Case No. PUE-2005-00018)– November 2005
The siting of a proposed 230 kV transmission line.

Iowa Utility Board (Docket No. SPU-05-15) – September and October 2005
The reasonableness of IPL's proposed sale of the Duane Arnold Energy Center nuclear plant.

New York State Department of Environmental Conservation (DEC #3-3346-00011/00002) – October 2005
The likely profits that Dynegy will earn from the sale of the energy and capacity of the Danskammer Generating Facility if the plant is converted from once-through to closed-cycle cooling with wet towers or to dry cooling.

Arkansas Public Service Commission (Docket 05-042-U) – July and August 2005
Arkansas Electric Cooperative Corporation's proposed purchase of the Wrightsville Power Facility.

Maine Public Utilities Commission (Docket No. 2005-17) – July 2005
Joint testimony with Peter Lanzalotta and Bob Fagan evaluating Eastern Maine Electric Cooperative's request for a CPCN to purchase 15 MW of transmission capacity from New Brunswick Power.

Federal Energy Regulatory Commission (Docket No. EC05-43-0000) – April and May 2005
Joint Affidavit and Supplemental Affidavit with Bruce Biewald on the market power aspects of the proposed merger of Exelon Corporation and Public Service Enterprise Group, Inc.

Maine Public Utilities Commission (Docket No. 2004-538 Phase II) – April 2005
Joint testimony with Peter Lanzalotta and Bob Fagan evaluating Maine Public Service Company's request for a CPCN to purchase 35 MW of transmission capacity from New Brunswick Power.

Maine Public Utilities Commission (Docket No. 2004-771) – March 2005
Analysis of Bangor Hydro-Electric's Petition for a Certificate of Public Convenience and Necessity to construct a 345 kV transmission line

United States District Court for the Southern District of Ohio, Eastern Division (Consolidated Civil Actions Nos. C2-99-1182 and C2-99-1250)
Whether the public release of company documents more than three years old would cause competitive harm to the American Electric Power Company. [Confidential Expert Report]

New Jersey Board of Public Utilities (Docket No. EO03121014) – February 2005
Whether the Board of Public Utilities can halt further collections from Jersey Central Power & Light Company's ratepayers because there already are adequate funds in the company's decommissioning trusts for the Three Mile Island Unit No. 2 Nuclear Plant to allow for the decommissioning of that unit without endangered the public health and safety.

Maine Public Utilities Commission (Docket No. 2004-538) – January and March 2005
Analysis of Maine Public Service Company's request to construct a 138 kV transmission line from Limestone, Maine to the Canadian Border.

California Public Utilities Commission (Application No. AO4-02-026) – December 2004 and January 2005
Southern California Edison's proposed replacement of the steam generators at the San Onofre Unit 2 and Unit 3 nuclear power plants and whether the utility was imprudent for failing to initiate litigation against Combustion Engineering due to defects in the design of and materials used in those steam generators.

United States District Court for the Southern District of Indiana, Indianapolis Division (Civil Action No. IP99-1693) – December 2004
Whether the public release of company documents more than three years old would cause competitive harm to the Cinergy Corporation. [Confidential Expert Report]

California Public Utilities Commission (Application No. AO4-01-009) – August 2004
Pacific Gas & Electric's proposed replacement of the steam generators at the Diablo Canyon nuclear power plant and whether the utility was imprudent for failing to initiate litigation against Westinghouse due to defects in the design of and materials used in those steam generators.

Public Service Commission of Wisconsin (Docket No. 6690-CE-187) – June, July and August 2004
Whether Wisconsin Public Service Corporation's request for approval to build a proposed 515 MW coal-burning generating facility should be granted.

Public Service Commission of Wisconsin (Docket No. 05-EI-136) – May and June 2004
Whether the proposed sale of the Kewaunee Nuclear Power Plant to a subsidiary of an out-of-state holding company is in the public interest.

Connecticut Siting Council (Docket No. 272) – May 2004
Whether there are technically viable alternatives to the proposed 345-kV transmission line between Middletown and Norwalk Connecticut and the length of the line that can be installed underground.

Arizona Corporation Commission (Docket No. E-01345A-03-0437 – February 2004
Whether Arizona Public Service Company should be allowed to acquire and include in rate base five generating units that were built by a deregulated affiliate.

State of Rhode Island Energy Facilities Siting Board (Docket No. SB-2003-1) – February 2004
Whether the cost of undergrounding a relocated 115kV transmission line would be eligible for regional cost socialization.

State of Maine Department of Environmental Protection (Docket No. A-82-75-0-X) – December 2003
The storage of irradiated nuclear fuel in an Independent Spent Fuel Storage Installation (ISFSI) and whether such an installation represents an air pollution control facility.

Rhode Island Public Utility Commission (Docket No. 3564) – December 2003 and January 2004
Whether Narragansett Electric Company should be required to install a relocated 115kV transmission line underground.

New York State Board on Electric Generation Siting and the Environment (Case No. 01-F-1276) – September, October and November 2003
The environmental, economic and system reliability benefits that can reasonably be expected from the proposed 1,100 MW TransGas Energy generating facility in Brooklyn, New York.

Wisconsin Public Service Commission (Case 6690-UR-115209) - September and October 2003
The reasonableness of Wisconsin Public Service Corporation's decommissioning cost collections for the Kewaunee Nuclear Plant.

Oklahoma Corporation Commission (Cause No. 2003-121) – July 2003
Whether Empire District Electric Company properly reduced its capital costs to reflect the write-off of a portion of the cost of building a new electric generating facility.

Arkansas Public Service Commission (Docket 02-248-U) – May 2003
Entergy's proposed replacement of the steam generators and the reactor vessel head at the ANO Unit 1 Steam Generating Station.

Appellate Tax Board, State of Massachusetts (Docket No C258405-406) – May 2003
The physical nature of electricity and whether electricity is a tangible product or a service.

Maine Public Utilities Commission (Docket 2002-665-U) – April 2003
Analysis of Central Maine Power Company's proposed transmission line for Southern York County and recommendation of alternatives.

Massachusetts Legislature, Joint Committees on Government Regulations and Energy – March 2003
Whether PG&E can decide to permanently retire one or more of the generating units at its Salem Harbor Station if it is not granted an extension beyond October 2004 to reduce the emissions from the Station's three coal-fired units and one oil-fired unit.

New Jersey Board of Public Utilities (Docket No. ER02080614) – January 2003
The prudence of Rockland Electric Company's power purchases during the period August 1, 1999 through July 31, 2002.

New York State Board on Electric Generation Siting and the Environment (Case No. 00-F-1356) – September and October 2002 and January 2003
The need for and the environmental benefits from the proposed 300 MW Kings Park Energy generating facility.

Arizona Corporation Commission (Docket No. E-01345A-01-0822) – March 2002
The reasonableness of Arizona Public Service Company's proposed long-term power purchase agreement with an affiliated company.

New York State Board on Electric Generation Siting and the Environment (Case No. 99-F-1627) – March 2002
Repowering NYPA's existing Poletti Station in Queens, New York.

Connecticut Siting Council (Docket No. 217) – March 2002, November 2002, and January 2003
Whether the proposed 345-kV transmission line between Plumtree and Norwalk substations in Southwestern Connecticut is needed and will produce public benefits.

Vermont Public Service Board (Case No. 6545) – January 2002
Whether the proposed sale of the Vermont Yankee Nuclear Plant to Entergy is in the public interest of the State of Vermont and Vermont ratepayers.

Connecticut Department of Public Utility Control (Docket 99-09-12RE02) – December 2001

The reasonableness of adjustments that Connecticut Light and Power Company seeks to make to the proceeds that it received from the sale of Millstone Nuclear Power Station.

Connecticut Siting Council (Docket No. 208) – October 2001
Whether the proposed cross-sound cable between Connecticut and Long Island is needed and will produce public benefits for Connecticut consumers.

New Jersey Board of Public Utilities (Docket No. EM01050308) - September 2001
The market power implications of the proposed merger between Conectiv and Pepco.

Illinois Commerce Commission Docket No. 01-0423 – August, September, and October 2001
Commonwealth Edison Company's management of its distribution and transmission systems.

New York State Board on Electric Generation Siting and the Environment (Case No. 99-F-1627) - August and September 2001
The environmental benefits from the proposed 500 MW NYPA Astoria generating facility.

New York State Board on Electric Generation Siting and the Environment (Case No. 99-F-1191) - June 2001
The environmental benefits from the proposed 1,000 MW Astoria Energy generating facility.

New Jersey Board of Public Utilities (Docket No. EM00110870) - May 2001
The market power implications of the proposed merger between FirstEnergy and GPU Energy.

Connecticut Department of Public Utility Control (Docket 99-09-12RE01) - November 2000
The proposed sale of Millstone Nuclear Station to Dominion Nuclear, Inc.

Illinois Commerce Commission (Docket 00-0361) - August 2000
The impact of nuclear power plant life extensions on Commonwealth Edison Company's decommissioning costs and collections from ratepayers.

Vermont Public Service Board (Docket 6300) - April 2000
Whether the proposed sale of the Vermont Yankee nuclear plant to AmerGen Vermont is in the public interest.

Massachusetts Department of Telecommunications and Energy (Docket 99-107, Phase II) - April and June 2000
The causes of the May 18, 1999, main transformer fire at the Pilgrim generating station.

Connecticut Department of Public Utility Control (Docket 00-01-11) - March and April 2000
The impact of the proposed merger between Northeast Utilities and Con Edison, Inc. on the reliability of the electric service being provided to Connecticut ratepayers.

Connecticut Department of Public Utility Control (Docket 99-09-12) - January 2000
The reasonableness of Northeast Utilities plan for auctioning the Millstone Nuclear Station.

Connecticut Department of Public Utility Control (Docket 99-08-01) - November 1999
Generation, Transmission, and Distribution system reliability.

Illinois Commerce Commission (Docket 99-0115) - September 1999
Commonwealth Edison Company's decommissioning cost estimate for the Zion Nuclear Station.

Connecticut Department of Public Utility Control (Docket 99-03-36) - July 1999
Standard offer rates for Connecticut Light & Power Company.

Connecticut Department of Public Utility Control (Docket 99-03-35) - July 1999
Standard offer rates for United Illuminating Company.

Connecticut Department of Public Utility Control (Docket 99-02-05) - April 1999
Connecticut Light & Power Company stranded costs.

Connecticut Department of Public Utility Control (Docket 99-03-04) - April 1999
United Illuminating Company stranded costs.

Maryland Public Service Commission (Docket 8795) - December 1998
Future operating performance of Delmarva Power Company's nuclear units.

Maryland Public Service Commission (Dockets 8794/8804) - December 1998
Baltimore Gas and Electric Company's proposed replacement of the steam generators at the Calvert Cliffs Nuclear Power Plant. Future performance of nuclear units.

Indiana Utility Regulatory Commission (Docket 38702-FAC-40-S1) - November 1998
Whether the ongoing outages of the two units at the D.C. Cook Nuclear Plant were caused or extended by mismanagement.

Arkansas Public Service Commission (Docket 98-065-U) - October 1998
Entergy's proposed replacement of the steam generators at the ANO Unit 2 Steam Generating Station.

Massachusetts Department of Telecommunications and Energy (Docket 97-120) - October 1998
Western Massachusetts Electric Company's Transition Charge. Whether the extended 1996-1998 outages of the three units at the Millstone Nuclear Station were caused or extended by mismanagement.

Connecticut Department of Public Utility Control (Docket 98-01-02) - September 1998
Nuclear plant operations, operating and capital costs, and system reliability improvement costs.

Illinois Commerce Commission (Docket 97-0015) - May 1998
Whether any of the outages of Commonwealth Edison Company's twelve nuclear units during 1996 were caused or extended by mismanagement. Whether equipment problems, personnel performance weaknesses, and program deficiencies could have been avoided or addressed prior to plant outages. Outage-related fuel and replacement power costs.

Public Service Commission of West Virginia (Case 97-1329-E-CN) - March 1998
The need for a proposed 765 kV transmission line from Wyoming, West Virginia, to Cloverdate, Virginia.

Illinois Commerce Commission (Docket 97-0018) - March 1998
Whether any of the outages of the Clinton Power Station during 1996 were caused or extended by mismanagement.

Connecticut Department of Public Utility Control (Docket 97-05-12) - October 1997
The increased costs resulting from the ongoing outages of the three units at the Millstone Nuclear Station.

New Jersey Board of Public Utilities (Docket ER96030257) - August 1996
Replacement power costs during plant outages.

Illinois Commerce Commission (Docket 95-0119) - February 1996
Whether any of the outages of Commonwealth Edison Company's twelve nuclear units during 1994 were caused or extended by mismanagement. Whether equipment problems, personnel performance weaknesses, and program deficiencies could have been avoided or addressed prior to plant outages. Outage-related fuel and replacement power costs.

Public Utility Commission of Texas (Docket 13170) - December 1994
Whether any of the outages of the River Bend Nuclear Station during the period October 1, 1991, through December 31, 1993, were caused or extended by mismanagement.

Public Utility Commission of Texas (Docket 12820) - October 1994
Operations and maintenance expenses during outages of the South Texas Nuclear Generating Station.

Wisconsin Public Service Commission (Cases 6630-CE-197 and 6630-CE-209) - September and October 1994
The reasonableness of the projected cost and schedule for the replacement of the steam generators at the Point Beach Nuclear Power Plant. The potential impact of plant aging on future operating costs and performance.

Public Utility Commission of Texas (Docket 12700) - June 1994
Whether El Paso Electric Company's share of Palo Verde Unit 3 was needed to ensure adequate levels of system reliability. Whether the Company's investment in Unit 3 could be expected to generate cost savings for ratepayers within a reasonable number of years.

Arizona Corporation Commission (Docket U-1551-93-272) - May and June 1994
Southwest Gas Corporation's plastic and steel pipe repair and replacement programs.

Connecticut Department of Public Utility Control (Docket 92-04-15) - March 1994
Northeast Utilities management of the 1992/1993 replacement of the steam generators at Millstone Unit 2.

Connecticut Department of Public Utility Control (Docket 92-10-03) - August 1993
Whether the 1991 outage of Millstone Unit 3 as a result of the corrosion of safety-related plant piping systems was due to mismanagement.

Public Utility Commission of Texas (Docket 11735) - April and July 1993
Whether any of the outages of the Comanche Peak Unit 1 Nuclear Station during the period August 13, 1990, through June 30, 1992, were caused or extended by mismanagement.

Connecticut Department of Public Utility Control (Docket 91-12-07) - January 1993 and August 1995
Whether the November 6, 1991, pipe rupture at Millstone Unit 2 and the related outages of the Connecticut Yankee and Millstone units were caused or extended by mismanagement. The impact of environmental requirements on power plant design and operation.

Connecticut Department of Public Utility Control (Docket 92-06-05) - September 1992
United Illuminating Company off-system capacity sales. [Confidential Testimony]

Public Utility Commission of Texas (Docket 10894) - August 1992
Whether any of the outages of the River Bend Nuclear Station during the period October 1, 1988, through September 30, 1991, were caused or extended by mismanagement.

Connecticut Department of Public Utility Control (Docket 92-01-05) - August 1992
Whether the July 1991 outage of Millstone Unit 3 due to the fouling of important plant systems by blue mussels was the result of mismanagement.

California Public Utilities Commission (Docket 90-12-018) - November 1991, April 1992, June and July 1993
Whether any of the outages of the three units at the Palo Verde Nuclear Generating Station during 1989 and 1990 were caused or extended by mismanagement. Whether equipment problems, personnel performance weaknesses and program deficiencies could have been avoided or addressed prior to outages. Whether specific plant operating cost and capital expenditures were necessary and prudent.

Public Utility Commission of Texas (Docket 9945) - June 1991
Whether El Paso Electric Company's share of Palo Verde Unit 3 was needed to ensure adequate levels of system reliability. Whether the Company's investment in the unit could be expected to generate cost savings for ratepayers within a reasonable number of years. El Paso Electric Company's management of the planning and licensing of the Arizona Interconnection Project transmission line.

Arizona Corporation Commission (Docket U-1345-90-007) - December 1990 and April 1991
Arizona Public Service Company's management of the planning, construction and operation of the Palo Verde Nuclear Generating Station. The costs resulting from identified instances of mismanagement.

New Jersey Board of Public Utilities (Docket ER89110912J) - July and October 1990
The economic costs and benefits of the early retirement of the Oyster Creek Nuclear Plant. The potential impact of the unit's early retirement on system reliability. The cost and schedule for siting and constructing a replacement natural gas-fired generating plant.

Public Utility Commission of Texas (Docket 9300) - June and July 1990
Texas Utilities management of the design and construction of the Comanche Peak Nuclear Plant. Whether the Company was prudent in repurchasing minority owners' shares of Comanche Peak without examining the costs and benefits of the repurchase for its ratepayers.

Federal Energy Regulatory Commission (Docket EL-88-5-000) - November 1989
Boston Edison's corporate management of the Pilgrim Nuclear Station.

Connecticut Department of Public Utility Control (Docket 89-08-11) - November 1989
United Illuminating Company's off-system capacity sales.

Kansas State Corporation Commission (Case 164,211-U) - April 1989
Whether any of the 127 days of outages of the Wolf Creek generating plant during 1987 and 1988 were the result of mismanagement.

Public Utility Commission of Texas (Docket 8425) - March 1989
Whether Houston Lighting & Power Company's new Limestone Unit 2 generating facility was needed to provide adequate levels of system reliability. Whether the Company's investment in Limestone Unit 2 would provide a net economic benefit for ratepayers.

Illinois Commerce Commission (Dockets 83-0537 and 84-0555) - July 1985 and January 1989
Commonwealth Edison Company's management of quality assurance and quality control activities and the actions of project contractors during construction of the Byron Nuclear Station.

New Mexico Public Service Commission (Case 2146, Part II) - October 1988
The rate consequences of Public Service Company of New Mexico's ownership of Palo Verde Units 1 and 2.

United States District Court for the Eastern District of New York (Case 87-646-JBW) - October 1988
Whether the Long Island Lighting Company withheld important information from the New York State Public Service Commission, the New York State Board on Electric Generating Siting and the Environment, and the U.S. Nuclear Regulatory Commission.

Public Utility Commission of Texas (Docket 6668) - August 1988 and June 1989
Houston Light & Power Company's management of the design and construction of the South Texas Nuclear Project. The impact of safety-related and environmental requirements on plant construction costs and schedule.

Federal Energy Regulatory Commission (Docket ER88-202-000) - June 1988
Whether the turbine generator vibration problems that extended the 1987 outage of the Maine Yankee nuclear plant were caused by mismanagement.

Illinois Commerce Commission (Docket 87-0695) - April 1988
Illinois Power Company's planning for the Clinton Nuclear Station.

North Carolina Utilities Commission (Docket E-2, Sub 537) - February 1988
Carolina Power & Light Company's management of the design and construction of the Harris Nuclear Project. The Company's management of quality assurance and quality control activities. The impact of safety-related and environmental requirements on construction costs and schedule. The cost and schedule consequences of identified instances of mismanagement.

Ohio Public Utilities Commission (Case 87-689-EL-AIR) - October 1987
Whether any of Ohio Edison's share of the Perry Unit 2 generating facility was needed to ensure adequate levels of system reliability. Whether the Company's investment in Perry Unit 1 would produce a net economic benefit for ratepayers.

North Carolina Utilities Commission (Docket E-2, Sub 526) - May 1987
Fuel factor calculations.

New York State Public Service Commission (Case 29484) - May 1987
The planned startup and power ascension testing program for the Nine Mile Point Unit 2 generating facility.

Illinois Commerce Commission (Dockets 86-0043 and 86-0096) - April 1987
The reasonableness of certain terms in a proposed Power Supply Agreement.

Illinois Commerce Commission (Docket 86-0405) - March 1987
The in-service criteria to be used to determine when a new generating facility was capable of providing safe, adequate, reliable and efficient service.

Indiana Public Service Commission (Case 38045) - November 1986
Northern Indiana Public Service Company's planning for the Schaefer Unit 18 generating facility. Whether the capacity from Unit 18 was needed to ensure adequate system reliability. The rate consequences of excess capacity on the Company's system.

Superior Court in Rockingham County, New Hampshire (Case 86E328) - July 1986
The radiation effects of low power testing on the structures, equipment and components in a new nuclear power plant.

New York State Public Service Commission (Case 28124) - April 1986 and May 1987
The terms and provisions in a utility's contract with an equipment supplier. The prudence of the utility's planning for a new generating facility. Expenditures on a canceled generating facility.

Arizona Corporation Commission (Docket U-1345-85) - February 1986
The construction schedule for Palo Verde Unit No. 1. Regulatory and technical factors that would likely affect future plant operating costs.

New York State Public Service Commission (Case 29124) – December 1985 and January 1986
Niagara Mohawk Power Corporation's management of construction of the Nine Mile Point Unit No. 2 nuclear power plant.

New York State Public Service Commission (Case 28252) - October 1985
A performance standard for the Shoreham nuclear power plant.

New York State Public Service Commission (Case 29069) - August 1985
A performance standard for the Nine Mile Point Unit No. 2 nuclear power plant.

Missouri Public Service Commission (Cases ER-85-128 and EO-85-185) - July 1985
The impact of safety-related regulatory requirements and plant aging on power plant operating costs and performance. Regulatory factors and plant-specific design features that will likely affect the future operating costs and performance of the Wolf Creek Nuclear Plant.

Massachusetts Department of Public Utilities (Case 84-152) - January 1985
The impact of safety-related regulatory requirements and plant aging on power plant operating costs and performance. Regulatory factors and plant-specific design features that will likely affect the future operating costs and performance of the Seabrook Nuclear Plant.

Maine Public Utilities Commission (Docket 84-113) - September 1984
The impact of safety-related regulatory requirements and plant aging on power plant operating costs and performance. Regulatory factors and plant-specific design features that will likely affect the future operating costs and performance of the Seabrook Nuclear Plant.

South Carolina Public Service Commission (Case 84-122-E) - August 1984
The repair and replacement strategy adopted by Carolina Power & Light Company in response to pipe cracking at the Brunswick Nuclear Station. Quantification of replacement power costs attributable to identified instances of mismanagement.

Vermont Public Service Board (Case 4865) - May 1984
The repair and replacement strategy adopted by management in response to pipe cracking at the Vermont Yankee nuclear plant.

New York State Public Service Commission (Case 28347) -January 1984
The information that was available to Niagara Mohawk Power Corporation prior to 1982 concerning the potential for cracking in safety-related piping systems at the Nine Mile Point Unit No. 1 nuclear plant.

New York State Public Service Commission (Case 28166) - February 1983 and February 1984
Whether the January 25, 1982, steam generator tube rupture at the Ginna Nuclear Plant was caused by mismanagement.

U.S. Nuclear Regulatory Commission (Case 50-247SP) - May 1983
The economic costs and benefits of the early retirement of the Indian Point nuclear plants.

REPORTS, ARTICLES, AND PRESENTATIONS

The Risks of Building New Nuclear Power Plants, Presentation to the Utah State Legislature Public Utilities and Technology Committee, September 19, 2007.

The Risks of Building New Nuclear Power Plants, Presentation to Moody's and Standard & Poor's rating agencies, May 17, 2007.

The Risks of Building New Nuclear Power Plants, U.S. Senate and House of Representative Briefings, April 20, 2007.

Carbon Dioxide Emissions Costs and Electricity Resource Planning, New Mexico Public Regulation Commission, Case 06-00448-UT, March 28, 2007, with Anna Sommer.

The Risks of Building New Nuclear Power Plants, Presentation to the New York Society of Securities Analysts, June 8, 2006.

Conservation and Renewable Energy Should be the Cornerstone for Meeting Future Natural Gas Needs. Presentation to the Global LNG Summit, June 1, 2004. Presentation given by Cliff Chen.

Comments on natural gas utilities' Phase I Proposals for pre-approved full cost recovery of contracts with liquid natural gas (LNG) suppliers and the costs of interconnecting their systems with LNG facilities. Comments in California Public Utilities Commission Rulemaking 04-01-025. March 23, 2004.

The 2003 Blackout: Solutions that Won't Cost a Fortune, The Electricity Journal, November 2003, with David White, Amy Roschelle, Paul Peterson, Bruce Biewald, and William Steinhurst.

The Impact of Converting the Cooling Systems at Indian Point Units 2 and 3 on Electric System Reliability. An Analysis for Riverkeeper, Inc. November 3, 2003.

The Impact of Converting Indian Point Units 2 and 3 to Closed-Cycle Cooling Systems with Cooling Towers on Energy's Likely Future Earnings. An Analysis for Riverkeeper, Inc. November 3, 2003.

Entergy's Lost Revenues During Outages of Indian Point Units 2 and 3 to Convert to Closed-Cycle Cooling Systems. An Analysis for Riverkeeper, Inc. November 3, 2003.

Power Plant Repowering as a Strategy for Reducing Water Consumption at Existing Electric Generating Facilities. A presentation at the May 2003 Symposium on Cooling Water Intake Technologies to Protect Aquatic Organisms. May 6, 2003.

Financial Insecurity: The Increasing Use of Limited Liability Companies and Multi-tiered Holding Companies to Own Electric Generating Plants. A presentation at the 2002 NASUCA Annual Meeting. November 12, 2002.

Determining the Need for Proposed Overhead Transmission Facilities. A Presentation by David Schlissel and Paul Peterson to the Task Force and Working Group for Connecticut Public Act 02-95. October 17, 2002.

Future PG&E Net Revenues From The Sale of Electricity Generated at its Brayton Point Station. An Analysis for the Attorney General of the State of Rhode Island. October 2, 2002.

PG&E's Net Revenues From The Sale of Electricity Generated at its Brayton Point Station During the Years 1999-2002. An Analysis for the Attorney General of the State of Rhode Island. October 2, 2002.

Financial Insecurity: The Increasing Use of Limited Liability Companies and Multi-Tiered Holding Companies to Own Nuclear Power Plants. A Synapse report for the STAR Foundation and Riverkeeper, Inc., by David Schlissel, Paul Peterson, and Bruce Biewald, August 7, 2002.

Comments on EPA's Proposed Clean Water Act Section 316(b) for Cooling Water Intake Structures at Phase II Existing Facilities, on behalf of Riverkeeper, Inc., by David Schlissel and Geoffrey Keith, August 2002.

The Impact of Retiring the Indian Point Nuclear Power Station on Electric System Reliability. A Synapse Report for Riverkeeper, Inc. and Pace Law School Energy Project. May 7, 2002.

Preliminary Assessment of the Need for the Proposed Plumtree-Norwalk 345-kV Transmission Line. A Synapse Report for the Towns of Bethel, Redding, Weston, and Wilton Connecticut. October 15, 2001.

ISO New England's Generating Unit Availability Study: Where's the Beef? A Presentation at the June 29, 2001 Restructuring Roundtable.

Clean Air and Reliable Power: Connecticut Legislative House Bill HB6365 will not Jeopardize Electric System Reliability. A Synapse Report for the Clean Air Task Force. May 2001.

Room to Breathe: Why the Massachusetts Department of Environmental Protection's Proposed Air Regulations are Compatible with Reliability. A Synapse Report for MASSPIRG and the Clean Water Fund. March 2001.

Generator Outage Increases: A Preliminary Analysis of Outage Trends in the New England Electricity Market, a Synapse Report for the Union of Concerned Scientists, January 7, 2001.

Cost, Grid Reliability Concerns on the Rise Amid Restructuring, with Charlie Harak, Boston Business Journal, August 18-24, 2000.

Report on Indian Point 2 Steam Generator Issues, Schlissel Technical Consulting, Inc., March 10, 2000.

Preliminary Expert Report in Case 96-016613, Cities of Wharton, Pasadena, et al v. Houston Lighting & Power Company, October 28, 1999.

Comments of Schlissel Technical Consulting, Inc. on the Nuclear Regulatory Commission's Draft Policy Statement on Electric Industry Economic Deregulation, February 1997.

Report to the Municipal Electric Utility Association of New York State on the Cost of Decommissioning the Fitzpatrick Nuclear Plant, August 1996.

Report to the Staff of the Arizona Corporation Commission on U.S. West Corporation's telephone cable repair and replacement programs, May, 1996.

Nuclear Power in the Competitive Environment, NRRI Quarterly Bulletin, Vol. 16, No. 3, Fall 1995.

Nuclear Power in the Competitive Environment, presentation at the 18th National Conference of Regulatory Attorneys, Scottsdale, Arizona, May 17, 1995.

The Potential Safety Consequences of Steam Generator Tube Cracking at the Byron and Braidwood Nuclear Stations, a report for the Environmental Law and Policy Center of the Midwest, 1995.

Report to the Public Policy Group Concerning Future Trojan Nuclear Plant Operating Performance and Costs, July 15, 1992.

Report to the New York State Consumer Protection Board on the Costs of the 1991 Refueling Outage of Indian Point 2, December 1991.

Preliminary Report on Excess Capacity Issues to the Public Utility Regulation Board of the City of El Paso, Texas, April 1991.

Nuclear Power Plant Construction Costs, presentation at the November, 1987, Conference of the National Association of State Utility Consumer Advocates.

Comments on the Final Report of the National Electric Reliability Study, a report for the New York State Consumer Protection Board, February 27, 1981.

OTHER SIGNIFICANT INVESTIGATIONS AND LITIGATION SUPPORT WORK

Reviewed the salt deposition mitigation strategy proposed for Reliant Energy's repowering of its Astoria Generating Station. October 2002 through February 2003.

Assisted the Connecticut Office of Consumer Counsel in reviewing the auction of Connecticut Light & Power Company's power purchase agreements. August and September, 2000.

Assisted the New Jersey Division of the Ratepayer Advocate in evaluating the reasonableness of Atlantic City Electric Company's proposed sale of its fossil generating facilities. June and July, 2000.

Investigated whether the 1996-1998 outages of the three Millstone Nuclear Units were caused or extended by mismanagement. 1997 and 1998. Clients were the Connecticut Office of Consumer Counsel and the Office of the Attorney General of the Commonwealth of Massachusetts.

Investigated whether the 1995-1997 outages of the two units at the Salem Nuclear Station were caused or extended by mismanagement. 1996-1997. Client was the New Jersey Division of the Ratepayer Advocate.

Assisted the Associated Industries of Massachusetts in quantifying the stranded costs associated with utility generating plants in the New England states. May through July, 1996

Investigated whether the December 25, 1993, turbine generator failure and fire at the Fermi 2 generating plant was caused by Detroit Edison Company's mismanagement of fabrication, operation or maintenance. 1995. Client was the Attorney General of the State of Michigan.

Investigated whether the outages of the two units at the South Texas Nuclear Generating Station during the years 1990 through 1994 were caused or extended by mismanagement. Client was the Texas Office of Public Utility Counsel.

Assisted the City Public Service Board of San Antonio, Texas in litigation over Houston Lighting & Power Company's management of operations of the South Texas Nuclear Generating Station.

Investigated whether outages of the Millstone nuclear units during the years 1991 through 1994 were caused or extended by mismanagement. Client was the Office of the Attorney General of the Commonwealth of Massachusetts.

Evaluated the 1994 Decommissioning Cost Estimate for the Maine Yankee Nuclear Plant. Client was the Public Advocate of the State of Maine.

Evaluated the 1994 Decommissioning Cost Estimate for the Seabrook Nuclear Plant. Clients were investment firms that were evaluating whether to purchase the Great Bay Power Company, one of Seabrook's minority owners.

Investigated whether a proposed natural-gas fired generating facility was need to ensure adequate levels of system reliability. Examined the potential impacts of environmental regulations on the unit's expected construction cost and schedule. 1992. Client was the New Jersey Rate Counsel.

Investigated whether Public Service Company of New Mexico management had adequately disclosed to potential investors the risk that it would be unable to market its excess generating capacity. Clients were individual shareholders of Public Service Company of New Mexico.

Investigated whether the Seabrook Nuclear Plant was prudently designed and constructed. 1989. Clients were the Connecticut Office of Consumer Counsel and the Attorney General of the State of Connecticut.

Investigated whether Carolina Power & Light Company had prudently managed the design and construction of the Harris nuclear plant. 1988-1989. Clients were the North Carolina Electric Municipal Power Agency and the City of Fayetteville, North Carolina.

Investigated whether the Grand Gulf nuclear plant had been prudently designed and constructed. 1988. Client was the Arkansas Public Service Commission.

Reviewed the financial incentive program proposed by the New York State Public Service Commission to improve nuclear power plant safety. 1987. Client was the New York State Consumer Protection Board.

Reviewed the construction cost and schedule of the Hope Creek Nuclear Generating Station. 1986-1987. Client was the New Jersey Rate Counsel.

Reviewed the operating performance of the Fort St. Vrain Nuclear Plant. 1985. Client was the Colorado Office of Consumer Counsel.

WORK HISTORY

2000 - Present: Senior Consultant, Synapse Energy Economics, Inc.

1994 - 2000: President, Schlissel Technical Consulting, Inc.

1983 - 1994: Director, Schlissel Engineering Associates

1979 - 1983: Private Legal and Consulting Practice

1975 - 1979: Attorney, New York State Consumer Protection Board

1973 - 1975: Staff Attorney, Georgia Power Project

EDUCATION

1983-1985: Massachusetts Institute of Technology
Special Graduate Student in Nuclear Engineering and Project Management,

1973: Stanford Law School,
Juris Doctor

1969: Stanford University
Master of Science in Astronautical Engineering,

1968: Massachusetts Institute of Technology
Bachelor of Science in Astronautical Engineering,

PROFESSIONAL MEMBERSHIPS

- New York State Bar since 1981
- American Nuclear Society
- National Association of Corrosion Engineers

BEFORE THE
OHIO POWER SITING BOARD

In the Matter of the Application of	)	
American Municipal Power-Ohio, Inc., for	)	
a Certificate of Environmental	)	
Compatibility and Public Need for an	)	**Case No. 06-1358-EL-BGN**
Electric Generation Station and Related	)	
Facilities in Meigs County, Ohio.	)	

AMP-OHIO'S RESPONSES TO NATURAL RESOURCES DEFENSE COUNCIL, INC., OHIO ENVIRONMENTAL COUNCIL, AND SIERRA CLUB'S FIRST SET OF INTERROGATORIES AND REQUEST FOR PRODUCTION OF DOCUMENTS

GENERAL OBJECTIONS

1. American Municipal Power-Ohio, Inc. ("AMP-Ohio"), by responding to these Interrogatories and Requests for Production of Documents, does not waive its right to object to the use of the discovery responses at any time or on any ground in this or any other proceeding. In addition, discovery in this action is still proceeding and, therefore, AMP-Ohio reserves the right to amend any response in light of later discovered facts or introduce additional documents in support of its position at the hearing. With respect to all answers and documents produced in these responses, AMP-Ohio does not waive, but expressly preserves:

   A. All questions as to the competency, relevancy, privilege and admissibility as to evidence of all documents, for any purpose in any subsequent proceeding or the hearing or trial of this or any other action;

   B. The right to object to the use of any document produced pursuant to these requests in any subsequent proceeding or in the hearing or trial of this or any other action on any grounds;

C. The right to object on any grounds at any time to a demand for further responses to discovery requests;

D. The right at any time to revise, correct, add or to clarify any of the responses herein;

E. The right to seek protection from disclosure of confidential or proprietary information which may subsequently be provided in response to these requests through the entry of a motion or agreed order;

2. AMP-Ohio objects to these Interrogatories and Requests for Production of Documents to the extent they seek information that is neither relevant to the subject matter of the pending action nor appear reasonably calculated to lead to the discovery of admissible evidence.

3. AMP-Ohio objects to the form of these Interrogatories and Requests for Production of Documents to the extent Intervenor Groups have failed to identify each request as either an Interrogatory or a Request for Production of Documents.

4. By submitting these responses, AMP-Ohio does not in any way adopt the Natural Resources Defense Council, Inc., Ohio Environmental Council, and Sierra Club's (collectively referrred to hereafter as "Intervenor Groups'") purported definitions of words and phrases contained in Intervenor Groups' requests. AMP-Ohio objects to those definitions to the extent they are inconsistent with either (a) the definitions set forth by AMP-Ohio in its responses, or (b) the ordinary and customary meaning of such words and phrases. Similarly, AMP-Ohio objects to Intervenor Groups' purported definitions to the extent they purport to impose upon AMP-Ohio any obligation broader than, or inconsistent with, applicable discovery rules or common law.

5. AMP-Ohio objects to these Interrogatories and Requests for Production of Documents to the extent they seek information protected by the attorney-client privilege, the work product doctrine or any other applicable privilege. Any

inadvertant disclosure of material protected by any such applicable privilege or discovery immunity is not intended to, and should not be construed to, constitute a waiver of such privilege or immunity.

6. AMP-Ohio objects to Intervenor Groups' Interrogatories and Requests for Production of Documents insofar as they seek discovery of any material that constitutes the mental impressions, conclusions, opinions or legal theories of AMP-Ohio's counsel.

7. AMP-Ohio objects to Intervenor Groups' Interrogatories and Requests for Production of Documents insofar as they seek discovery of opinions of law which are beyond the scope of permissible discovery.

8. Except as otherwise stated below, an objection to a specific document request does not imply that documents responsive to the request exist. AMP-Ohio does not hereby admit, adopt or acquiesce in any factual or legal contention, assertion or characterization contained in these requests.

9. AMP-Ohio objects to these Interrogatories and Requests for Production of Documents to the extent they purport to impose obligations beyond those imposed by the Ohio Rules of Civil Procedure and the Rules of the Ohio Power Siting Board.

10. AMP-Ohio objects to these Interrogatories and Requests for Production of Documents to the extent they are unreasonably cumulative or duplicative, vague, ambiguous, overly broad, unduly burdensome, or do not specify the information sought with sufficient particularity.

11. AMP-Ohio objects to these Interrogatories and Requests for Production of Documents to the extent they seek information that is publicly available, or that may be obtained from another source that is more convenient, less burdensome, or less expensive, or that are solely in the possession, custody, or control of third-parties.

12. AMP-Ohio submits these responses without conceding the relevancy or materiality of the subject matter of any Interrogatory or Request for Production of Documents and without prejudice to AMP-Ohio's right to object to further discovery or object to the admissibility of any answer at the time of the hearing.

13. AMP-Ohio reserves the right to amend or supplement these answers and objections.

14. These general objections are incorporated by reference into each specific answer made by AMP-Ohio to Intervenor Groups' Interrogatories and Requests for Production of Documents.

ANSWERS TO INTERROGATORIES AND REQUESTS FOR PRODUCTIONS OF DOCUMENTS

1. Provide copies of any technical, economic, business or other assessment of the currently proposed global warming legislation in the 110th Congress that have been prepared by or for AMP.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and is vague, overbroad, and unduly burdensome.

2. Provide copies of any assessments, evaluations, or projections of future CO2 allowance prices, taxes, fees, or other costs of emissions associated with possible future CO_2 regulation that have been prepared by or for AMP since January 1, 2005 or that AMP has referenced or relied upon for internal planning purposes whether or not prepared by or for AMP.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, vague, overbroad, unduly burdensome, and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, AMP-Ohio refers to the portions of the R.W. Beck

June 2007 Initial Project Feasibility Study already in Intervenor Groups' possession.

3. Reference page ES-6 of the R.W. Beck June 2007 Initial Project Feasibility Study:

a. Specify what the construction schedule and construction and operating cost impacts would be if the project had to use a limestone wet scrubber.

ANSWER: **AMP-Ohio specifically objects to this Interrogatory because it is not reasonably calculated to lead to the discovery of admissible evidence and calls for a narrative response. See, *Penn Central Transportation Co. v. Armco Steel Corp.* (C.P. 1971), 27 Ohio Misc. 76. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:**

The construction schedule of the Powerspan scrubber and a wet limestone scrubber are expected to be comparable. The specific construction schedule and the integration of the scrubber construction schedule with the overall plant construction schedule would be identified by the EPC Contractor during the detailed design phase of the project.

As to the construction costs of the Powerspan scrubber and a wet limestone scrubber:

- **The construction costs of the Powerspan SO_2 scrubber were estimated by Powerspan and reviewed by R. W. Beck.**
- **The construction costs of a wet limestone scrubber were estimated by R. W. Beck based on its proprietary data base of capital and O&M costs.**
- **R. W. Beck concluded that the construction costs of the two types of SO_2 scrubber systems are comparable.**

As to the operating costs, R. W. Beck utilized its proprietary model to estimate such costs for both systems. The cost model estimates reagent use, maintenance costs, waste disposal costs, labor costs, revenues from product sales, and other auxiliaries such as water use, steam use, compressed air use, etc. The operating costs for the wet limestone scrubber vary from $3.08/MWh to $3.25/MWh for coals with SO_2 contents of 3.5 to 4.31 lb/MMBtu, respectively. The Powerspan SO_2 process operating costs could vary from approximately $2.50/MWh (based on 2006 price spreads between urea and ammonium sulfate) and $4.60/MWh (based on no price spread between urea and ammonium sulfate). The operating costs of the Powerspan process will vary with the variation in the price spread between urea and ammonium sulfate fertilizer. While certain variations may exist in operating costs between the two systems, the variations are not judged to be significant in comparison to the total cost of power generation from the AMPGS.

b. Provide copies of any assessments or analyses of the construction schedule and

the construction and operating cost impacts of having to use a limestone wet scrubber instead of the Powerspan technology.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and is vague, overbroad, and unduly burdensome. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:

See response to 3.a.

4. Reference page ES-6 of the R.W. Beck June 2007 Initial Project Feasibility Study. Provide the evidence and the documents which formed the basis for including a contingency of six percent in the EPC contract estimate.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, calls for a narrative response, is vague, overbroad, and unduly burdensome, and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:

The six percent contingency value was based on the estimated costs for the "Balance of Plant", excluding major equipment items that were based on direct quotes. The overall project has additional contingencies provided as detailed in Table 1 – Estimated Costs of Construction on page ES-7 of the R. W. Beck June 2007 Initial Project Feasibility Study.

5. Reference page ES-8 of the R.W. Beck June 2007 Initial Project Feasibility Study. Provide the evidence and the documents which form the basis for the conclusions that (a) the EPC schedule for engineering, procurement and construction of Unit 1 would be 48 months and (b) that Unit 2 commissioning and substantial completion can be assumed approximately six months later than Unit 1.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, calls for a narrative response, and is vague, overbroad, and unduly burdensome. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:

The 48 month schedule for engineering, procurement, and construction is based on timeframes for similar coal projects in the U.S. as well as verbal estimated timeframes from construction contractors in the coal power industry for a project the size of AMPGS. The assumption that Unit 2 would be completed 6 months later is a general industry overlap that is used for initial scheduling of power projects. The EPC Contractor will provide input to the timeframe for completion of Unit 2.

6. Reference pages ES-8 to ES-9 of the R.W. Beck June 2007 Initial Project Feasibility Study. Provide all evidence and documents which form the basis for the belief that AMP will be able to finalize a fixed price EPC contract for the AMPGS project.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, calls for a narrative response, is vague, overbroad, and unduly burdensome, and requests information that is business confidential and proprietary.

7. Reference page ES-9 of the R.W. Beck June 2007 Initial Project Feasibility Study.

a. Specify the current status of negotiations with The Andersons.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, AMP-Ohio has entered into a memorandum of understanding with The Andersons.

b. Provide copies of any correspondence between AMP and The Andersons concerning the proposed fertilizer plant.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and requests information that is business confidential and proprietary.

c. Provide any evidence and documents that support the belief that AMP-Ohio will be able to contract with The Andersons for an initial five-year period to operate and maintain the fertilizer plant.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, calls for a narrative response, is vague, overbroad, and unduly burdensome, and requests information that is business confidential and proprietary.

Without waiving this or the foregoing general objections, the five year term is included in the memorandum of understanding.

8. Provide the workpapers and source documents for the figures in Table 3 on page ES-9 of the R.W. Beck June 2007 Initial Project Feasibility Study.

ANSWER: AMP-Ohio specifically objects to this Request because it requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:

The O&M data developed and included in Table 3 was formulated from R. W. Beck's proprietary in-house O&M database of production related non-fuel O&M expenses of coal fired generating resources, taking into account the projected design and operation of the AMPGS project. The fuel expense is a direct calculation based on the estimated price for the blended fuel and the estimated heat rate for the plant.

9. Reference page ES-11 of the R.W. Beck June 2007 Initial Project Feasibility Study

Provide the evidence and source documents which form the basis for the conclusion that "a carbon tax ranging between $5/ton to $15/ton (in 2006 dollars) is assumed to be in place beginning between 2012 and 2018."

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, is vague, overbroad, and unduly burdensome, and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:

R. W. Beck developed the $5 - $15 / ton range (in 2006$) in preparation for the AMP-Ohio Power Supply Study that began in the fall of 2006. The range was based on R. W. Beck's review of historical prices in Europe and certain studies and analysis available at that time including a study by the National Commission on Energy Policy (December 2004). The ultimate costs for CO_2 control will be influenced by several factors including the stringency of potential legislation, whether offsets from other sectors of the economy would be allowed to offset emissions from the power industry, the method of regulation (a cap and trade system or a tax), etc. Additionally, costs for Powerspan ECO_2 carbon dioxide capture technology has been estimated at approximately $20 per ton.

10. Reference page ES-14 of the R.W. Beck June 2007 Initial Project Feasibility Study.

Provide the workpapers and source documents in which R.W. Beck estimated the

Participant sales of energy from their share of the AMPGS Project.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and is vague, overbroad, and unduly burdensome. Without waiving this or the foregoing general objections, the participant sales of energy from their share of the AMPGS project was based upon developmental subscriptions, which will be produced.

11. Provide the workpapers and source documents for Table 6 on page ES-15 of the R.W. Beck June 2007 Initial Project Feasibility Study.

ANSWER: AMP-Ohio specifically objects to this Request because it requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:

Detailed calculations that form the basis of summary Table 6 on page ES-15 are contained in Attachments 6-1, 6-2 and 6-3 of the Report. Additional detailed analysis and source information related to operating costs are shown on Attachment ES-1. Additional detailed analysis related to construction costs are set forth in Attachment 3-2 of the R.W. Beck June 2007 Initial Feasibility Study. See the footnotes on all the Attachments for source information and assumptions.

12. a. Specify the current supply diversity of AMP-Ohio and each of the following project participants -- Cleveland, Cuyahoga Falls, Hudson, Oberlin, Wadsworth and Bowling Green -- in terms of the MWs of each resource type (i.e., base, intermediate and peaking).

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding and not reasonably calculated to lead to the discovery of admissible evidence.

b. Specify the current supply diversity of AMP-Ohio and each of the following project participants -- Cleveland, Cuyahoga Falls, Hudson, Oberlin, Wadsworth and Bowling Green -- in terms of the MWs of each fuel-type (coal, natural gasfired, etc.).

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding and not reasonably calculated to lead to the discovery of admissible evidence.

c. Specify the current supply diversity of AMP-Ohio and each of the following project participants -- Cleveland, Cuyahoga Falls, Hudson, Oberlin, Wadsworth and Bowling Green -- in terms of the MWHs generated during each of the years 2004, 2005, and 2006 by plants of each fuel type (e.g., coal-fired, natural gasfired, etc.).

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding and not reasonably calculated to lead to the discovery of admissible evidence.

13. Provide the workpapers and source documents for Figure 5 on page ES-18 of the R.W. Beck June 2007 Initial Project Feasibility Study.

ANSWER: AMP-Ohio specifically objects to this Request because it requests information that is business confidential and proprietary, overbroad, unduly burdensome, irrelevant, and not reasonably calculated to lead to the discovery of admissible evidence. Without waiving this or the general objections, AMP-Ohio will produce certain documents responsive to this request.

14. Provide copies of the most recent analyses of the potential for demand-side management and energy efficiency prepared by or for AMP-Ohio or for any of the following project participants: Cleveland, Cuyahoga Falls, Hudson, Oberlin, Wadsworth and Bowling Green.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding and not reasonably calculated to lead to the discovery of admissible evidence.

15. Provide copies of the most recent analyses of the potential for wind and/or other renewable resources prepared by or for AMP-Ohio or for any of the following project participants: Cleveland, Cuyahoga Falls, Hudson, Oberlin, Wadsworth and Bowling Green.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding. not reasonably calculated to lead to the discovery of

admissible evidence, and requests information that is business confidential and proprietary.

16. Provide copies of any assessments of the current state of the power plant construction industry or of power plant construction costs prepared since January 1, 2006 by or for AMP-Ohio or for any of the following project participants: Cleveland, Cuyahoga Falls, Hudson, Oberlin, Wadsworth and Bowling Green.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and is vague, overbroad, and unduly burdensome.

17. Provide copies of the minutes or other notes of any meetings of the AMP Board of Trustees and all committees thereof, held since January 1, 2006, at which any of the following subjects were discussed.

a. The AMPGS Project.

b. The potential for federal regulation of greenhouse gas emissions.

c. Future CO2 allowance or Carbon tax prices.

d. The risks associated with building and/or operating new coal fired power plants.

e. The economics of pursuing a new coal-fired power plant given the potential for federal regulation of greenhouse gas emissions.

f. The AMP system fuel mix.

g. The resource needs of AMP participants.

h. The cost and schedule of the proposed AMPGS Project.

i. The selection of the technology for the AMPGS Project.

j. The possible schedule for, cost of, or equipment required for carbon capture and sequestration.

k. The potential for energy efficiency or demand side management.

l. The potential for renewable resources.

m. The February 2007 Member Power Supply Analysis or the May 2007 update to that Analysis.

n. The technical and/or commercial viability of carbon capture and sequestration technology for the AMPGS Project.

ANSWER: **AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, vague, overbroad, unduly burdensome, requests information that is business confidential and proprietary, and requests attorney-client privileged material. Without waiving this or the foregoing general objections, non-privileged portions of minutes of meetings, if in existence, will be produced.**

18. Provide copies of the documents provided to the members of the AMP Board of Trustees, and all committees thereof, since January 1, 2006, which addressed or discussed any of the following subjects.

a. The AMPGS Project.

b. The potential for federal regulation of greenhouse gas emissions.

c. Future CO2 allowance or Carbon tax prices.

d. The risks associated with building and/or operating new coal fired power plants.

e. The economics of pursuing a new coal-fired power plant given the potential for federal regulation of greenhouse gas emissions.

f. The AMP system fuel mix.

g. The resource needs of AMP participants.

h. The cost and schedule of the proposed AMPGS Project.

i. The selection of the technology for the AMPGS Project.

j. The possible schedule for, cost of, or equipment required for carbon capture and

sequestration.

k. The potential for energy efficiency or demand side management.

l. The potential for renewable resources.

m. The February 2007 Member Power Supply Analysis or the May 2007 update to that Analysis.

n. The technical and/or commercial viability of carbon capture and sequestration technology for the AMPGS Project.

ANSWER: **AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, vague, overbroad, unduly burdensome, requests information that is business confidential and proprietary, and requests attorney-client privileged material. Without waiving this or the foregoing general objections, non-privileged portions of minutes of meetings, if in existence, will be produced.**

19. Provide copies of the materials used in presentations given at meetings of the AMP Board of Trustees, and all committee(s) thereof, since January 1, 2006 which addressed or discussed any of the following subjects.

a. The AMPGS Project.

b. The potential for federal regulation of greenhouse gas emissions.

c. Future CO2 allowance or Carbon tax prices.

d. The risks associated with building and/or operating new coal fired power plants.

e. The economics of pursuing a new coal-fired power plant given the potential for federal regulation of greenhouse gas emissions.

f. The AMP system fuel mix.

g. The resource needs of AMP participants.

h. The cost and schedule of the proposed AMPGS Project.

i. The selection of the technology for the AMPGS Project.

j. The possible schedule for, cost of, or equipment required for carbon capture and

sequestration.

k. The potential for energy efficiency or demand side management.

l. The potential for renewable resources.

m. The February 2007 Member Power Supply Analysis or the May 2007 update to that Analysis.

n. The technical and/or commercial viability of carbon capture and sequestration technology for the AMPGS Project.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, vague, overbroad, unduly burdensome, requests information that is business confidential and proprietary, and requests attorney-client privileged material. Without waiving this or the foregoing general objections, non-privileged portions of minutes of meetings, if in existence, will be produced.

20. Provide copies of the minutes or other notes of any meetings of the Participants Committee held since January 1, 2006, at which any of the following subjects were discussed.

a. The AMPGS Project.

b. The potential for federal regulation of greenhouse gas emissions.

c. Future CO2 allowance or Carbon tax prices.

d. The risks associated with building and/or operating new coal fired power plants.

e. The economics of pursuing a new coal-fired power plant given the potential for federal regulation of greenhouse gas emissions.

f. The AMP system fuel mix.

g. The resource needs of AMP participants.

h. The cost and schedule of the proposed AMPGS Project.

i. The selection of the technology for the AMPGS Project.

j. The possible schedule for, cost of, or equipment required for carbon capture and sequestration.

k. The potential for energy efficiency or demand side management.

l. The potential for renewable resources.

m. The February 2007 Member Power Supply Analysis or the May 2007 update to that Analysis.

n. The technical and/or commercial viability of carbon capture and sequestration technology for the AMPGS Project.

ANSWER: **AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, vague, overbroad, unduly burdensome, requests information that is business confidential and proprietary, and requests attorney-client privileged material. Without waiving this or the foregoing general objections, the Participants Committee under the Power Sales Contracts has not yet been formed.**

21. Provide copies of the documents provided to the members of the Participants Committee since January 1, 2006, which addressed or discussed any of the following subjects.

a. The AMPGS Project.

b. The potential for federal regulation of greenhouse gas emissions.

c. Future CO2 allowance or Carbon tax prices.

d. The risks associated with building and/or operating new coal fired power plants.

e. The economics of pursuing a new coal-fired power plant given the potential for federal regulation of greenhouse gas emissions.

f. The AMP system fuel mix.

g. The resource needs of AMP participants.

h. The cost and schedule of the proposed AMPGS Project.

i. The selection of the technology for the AMPGS Project.

j. The possible schedule for, cost of, or equipment required for carbon capture and sequestration.

k. The potential for energy efficiency or demand side management.

l. The potential for renewable resources.

m. The February 2007 Member Power Supply Analysis or the May 2007 update to that Analysis.

n. The technical and/or commercial viability of carbon capture and sequestration technology for the AMPGS Project.

ANSWER: See Response to Request 20.

22. Provide copies of the materials used in presentations given at meetings of the Participants Committee since January 1, 2006 which addressed or discussed any of the following subjects.

a. The AMPGS Project.

b. The potential for federal regulation of greenhouse gas emissions.

c. Future CO2 allowance or Carbon tax prices.

d. The risks associated with building and/or operating new coal fired power plants.

e. The economics of pursuing a new coal-fired power plant given the potential for federal regulation of greenhouse gas emissions.

f. The AMP system fuel mix.

g. The resource needs of AMP participants.

h. The cost and schedule of the proposed AMPGS Project.

i. The selection of the technology for the AMPGS Project.

j. The possible schedule for, cost of, or equipment required for carbon capture and

sequestration.

k. The potential for energy efficiency or demand side management.

l. The potential for renewable resources.

m. The February 2007 Member Power Supply Analysis or the May 2007 update to that Analysis.

n. The technical and/or commercial viability of carbon capture and sequestration technology for the AMPGS Project.

ANSWER: See Response to Request 20.

23. Reference page ES-20 of the R.W. Beck June 2007 Initial Project Feasibility Study. Provide a copy of the February 2007 Member Power Supply Analysis and the long-term power supply plans prepared for each of the following AMPGS Project Participants: Cleveland, Cuyahoga Falls, Hudson, Oberlin, Wadsworth and Bowling Green.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, documents responsive to this Request will be produced.

24. Reference page ES-21 of the R.W. Beck June 2007 Initial Project Feasibility Study. Provide the following input assumptions used in the development of the February 2007 Member Power Supply Analysis and the long-term power supply plans prepared for the 119 AMP-Ohio members:

a. Construction costs for the future generic base load coal, natural gas-fired combined cycle and peak resources, the AMPGS Project, the Prairie State Energy Campus, the proposed AMP-Ohio hydroelectric plants and future wind plants.

b. Coal and natural gas prices.

c. Plant capacity factors and availability.

d. CO2 prices or a carbon tax.

e. Specify the assumptions that were used for the potential for and cost of demandside management or energy efficiency programs or measures.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, calls for a narrative response, is vague, overbroad, and unduly burdensome, and requests information that is business confidential and proprietary.

25. Reference page ES-21 of the R.W. Beck June 2007 Initial Project Feasibility Study.

Please explain why a study period of only 20 years, i.e., 2008-2027, was used in the development of the power supply plans, when the proposed AMPGS Project is expected to have a 40 year operating life and not commence operations until 2013.

ANSWER: AMP-Ohio specifically objects to this Request because it calls for a narrative response and is not relevant to this proceeding and not reasonably calculated to lead to the discovery of admissible evidence. Without waiving this or the foregoing general objections, for each of the resources considered, a 20-year forecast was presented, but end effects were considered for the life of each option in developing the power supply plans.

26. Reference page ES-21 of the R.W. Beck June 2007 Initial Project Feasibility Study.

Provide the manual for the SERF model.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence and requests information that relates to a computer program that is business confidential and proprietary.

27. Provide the workpapers and source documents for Figure 6 on page ES-22 of the R.W. Beck June 2007 Initial Project Feasibility Study.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence, calls for response that is unduly burdensome in that it would require information for all of more than 90 AMPGS Participants.

28. Provide the workpapers and source documents for Figures 7 and 8 on page ES-26 of the

R.W. Beck June 2007 Initial Project Feasibility Study.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence, calls for information that is confidential and proprietary, and is unduly burdensome in that it would require information for all of more than 90 AMPGS Participants.

29. Provide copies of any assessments or analyses, prepared by or for AMP-Ohio, in which the economic costs of the proposed AMPGS Project have been compared to alternative supply side resources.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, Section 6.3 of the R. W. Beck June 2007 Initial Feasibility Study sets forth a high level economic cost comparison of AMPGS to the market and other base load alternatives. Further documents responsive to this Request will be produced.

30. Provide copies of any assessments or analyses, prepared by or for AMP-Ohio, in which the economic costs of the proposed AMPGS Project have been compared to demand-side resources. Include any underlying analyses and input assumptions used to generate the cost-effectiveness profiles for each demand side option.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding and not reasonably calculated to lead to the discovery of admissible evidence. Without waiving this or the foregoing general objections, there are none.

31. Reference the Quantitative Risk Assessment discussed at pages ES-31 to ES-34 of the R.W. Beck June 2007 Initial Project Feasibility Study.

a. Provide the workpapers and source documents, including but not limited to the input and output data files, in electronic excel or ASCII format, for each of the analyses of construction cost risks and potential CO2 risks.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, the basis and the assumptions used in the Quantitative Risk Assessment are discussed in detail in Section 7.3 of the R.W. Beck June 2007 Initial Feasibility Study. For more information on CO2 prices refer to Section 4.5 of the R.W. Beck June 2007 Initial Feasibility Study and response to Interrogatory No. 9.

b. Specify in $/MWh the range of CO2 prices used in the Risk Assessment.

ANSWER: See Response to Request 31.a.

c. Provide the workpapers and source documents for Figure 11 and Table 9.

ANSWER: See Response to Request 31.a.

32. Reference page ES-35 of the R.W. Beck June 2007 Initial Project Feasibility Study.

a. Provide the workpapers and source documents for the estimated construction cost of the AMPGS Project.

ANSWER: AMP-Ohio specifically objects to this Request because it requests information that is business confidential and proprietary.

b. Provide the evidence that supports the statement on page ES-35 that this cost estimate "reflects equipment, material and labor market conditions in the region of the AMPGS Project as of the date of this Report."

ANSWER: AMP-Ohio specifically objects to this Request because it requests information that is business confidential and proprietary.

c. Provide the evidence that supports the statement that the estimated cost of the AMPGS Project is "comparable to similar projects with which [R.W. Beck is] familiar."

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, calls for a narrative response and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, see the R.W. Beck June 2007 Initial Feasibility Study.

33. Reference page ES-35 of the R.W. Beck June 2007 Initial Project Feasibility Study.

Provide the workpapers and source documents which form the basis for the statement that the project power costs of the AMPGS Project "are comparable with similar projects with which [R.W. Beck is] familiar."

ANSWER: AMP-Ohio specifically objects to this Request because it is vague, overbroad and unduly burdensome, is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, see the R.W. Beck June 2007 Initial Feasibility Study.

34. Reference pages ES-35 to ES-36 of the R.W. Beck June 2007 Initial Project Feasibility Study. Provide the workpapers and source documents which form the basis for each of the statements in the paragraphs listed under Initial Finding and Conclusion No. 12.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding and not reasonably calculated to lead to the discovery of admissible evidence. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:

The initial findings and conclusions shown on pages ES-35 and ES-36 were based on the principal assumptions and considerations and the studies and analysis conducted by R. W. Beck, Inc. as described and set forth in the R. W. Beck June 2007 Initial Feasibility Study.

35. Provide the estimate of market prices that was used to develop the estimated Participant Surplus Energy Sales revenues shown on line 64 of Attachment ES-2 of the R.W. Beck June 2007 Initial Project Feasibility Study.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence and requests information that is business confidential and proprietary.

36. Provide copies of the two most recent long-term natural gas price forecasts prepared for AMP-Ohio and its current official natural gas price forecast.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of

admissible evidence and requests information that is business confidential and proprietary.

37. Provide copies of any assessments prepared by or for AMP or any AMPGS Project participant which examined the potential for future increases in the capital or installed cost of the proposed AMPGS Project, including without limitation material costs, labor costs, financing costs, and equipment costs.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, is vague, overbroad, and unduly burdensome, and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, the description of cost increase risk analysis is described in Section 1 of the R. W. Beck June 2007 Initial Feasibility Study.

38. Please provide copies of any assessments prepared by or for AMP regarding the potential or capacity for, or feasibility of CO2 sequestration from the proposed AMPGS project.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, is vague, overbroad and unduly burdensome and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, AMP-Ohio is a part of the Midwest Carbon Sequestration Project, and as such receives information and data from that Project.

39. Please describe and provide the documentation associated with any plan by AMP to capture and sequester the CO2 that will be produced at the proposed AMPGS Project.

ANSWER: See Response to Request 40.

40. Please state whether any equipment for carbon capture and sequestration has been included in the design for the proposed AMPGS Project. If the answer is yes, please identify the equipment and its cost.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:

Powerspan has identified their intent to develop an ammonia-based cost effective CO_2 capture process. Use of ammonia for CO_2 capture will likely provide opportunities for cross-utilization of ammonia streams between the SO_2 and CO_2 processes resulting in cost savings. AMPGS is proposing the use of the SO_2 Powerspan process. According to Powerspan, it is planning to perform testing at the Burger demonstration facility for CO_2 capture during 2008 and another demonstration with NRG at a 125MW level has just been announced.

41. Please state whether it is the position of AMP-Ohio that the carbon capture and sequestration that would be used on the proposed AMPGS Project is currently technologically and commercially viable.

ANSWER: It is the position of AMP-Ohio that there is currently no carbon capture and sequestration technology that is technologically and commercially viable for coal or other fossil fuel fired baseload electric power generation facilities.

42. Please state whether the design for the proposed AMPGS Project otherwise allows for the installation and operation of equipment for carbon capture and sequestration. If the answer is yes, please identify each way in which the design allows for the installation and operation of equipment for carbon capture and sequestration.

ANSWER: See Response to Request 40.

43. Please provide copies of any assessments or estimates, prepared by or for AMP-Ohio, of the potential costs of retrofitting the proposed plant for carbon capture and sequestration equipment (including all aspects of such retrofit, such as the need to increase federate and generating capacity to account for parasitic load loss) when that technology becomes commercially viable.

ANSWER: See Responses to Requests 38 and 40. Legislation/regulations for CCS are not in effect. However, AMPGS has given consideration of the potential *savings that could materialize with* Powerspan. Based on estimates presented by Powerspan, the cost of an ammonia absorption system on a power plant equipped with the Powerspan SO_2 process comparable to AMPGS is estimated at approximately $20 per ton of CO_2.

44. Please provide copies of any assessments or estimates, prepared by or for AMP-Ohio,

which have addressed or examined the operating costs, performance penalties, and/or additional fuel needs that can be expected to be experienced as a result of the addition and use of carbon capture and sequestration equipment.

ANSWER: See Responses to Requests 38, 40 and 43.

45. Discuss AMP's view on the likelihood that the proposed AMPGS Project will be grandfathered under federal legislation regulating greenhouse gas emissions, and provide the specific basis for any assumption that CO2 emissions from the proposed AMPGS project will be grandfathered under such legislation.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding and not reasonably calculated to lead to the discovery of admissible evidence. Without waiving this or the foregoing general objections, AMP-Ohio responds as follows:

AMP-Ohio cannot predict future legislation/regulations regulating greenhouse gas emissions.

46. Explain if AMP-Ohio has compared the cost of generating power at the proposed AMPGS Project with the cost of implementing energy efficiency or demand side management measures. If the answer is no, please explain why not. If the answer is yes, please provide the studies and assessments in which such comparisons were made.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and is vague, overbroad, and unduly burdensome.

47. Reference pages 2-12 and 2-13 of the R.W. Beck June 2007 Initial Project Feasibility Study. Provide the following input assumptions used in the development of the updated Member Power Supply Analysis that was prepared in May 2007:

a. Construction costs for the future generic base load coal, natural gas-fired combined cycle and peak resources, the AMPGS Project, the Prairie State Energy

Campus, the proposed AMP-Ohio hydroelectric plants and future wind plants.

b. Coal and natural gas prices.

c. Plant capacity factors and availability.

d. CO2 prices or a carbon tax.

e. The assumptions that were used for the potential for and cost of demand-side management or energy efficiency programs or measures.

Please also provide the workpapers and source documents for Figures 2-4 and 2-5.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and requests information that is business confidential and proprietary.

48. Reference Table 4-7 on page 4-18 of the R.W. Beck June 2007 Initial Project Feasibility Study.

a. Explain how the expected values of the CO2 tax were developed and provide the associated workpapers and source documents.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections refer to Response to Request 9 for more information.

b. Please state whether the figures in Table 4-7 are in 2006 dollars. If not, please state in what year's dollars the figures are presented.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, the amounts shown on Table 4-7 are in future dollars based on an assumed inflation rate of 2.4%.

49. Reference pages 7-14 and 7-15 of the R.W. Beck June 2007 Initial Project Feasibility

Study.

a. Specify the experience related to the construction and construction costs for coal plants similar to AMPGS which forms the basis for the assumption that the total estimated construction costs reflected in the Base Case could vary by +15 percent or -5 percent.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and calls for a narrative response.

b. Specify any experience which forms the basis for the assumption that the construction schedule could be early by 3 months or delayed by as much as 12 months.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, and calls for a narrative response.

50. Provide the workpapers and source documents for Figure 7-18 on page 7-19 of the R.W. Beck June 2007 Initial Project Feasibility Study.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, the basis and the assumptions used in the Quantitative Risk Assessment are discussed in detail in Section 7.3 the Report.

51. Reference page 7-19 of the R.W. Beck June 2007 Initial Project Feasibility Study. Provide the workpapers in which the annual levelized cost of $77.55/Mwh as developed.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, the basis and the assumptions used in the Quantitative Risk Assessment are discussed in detail in Section 7.3 the Report.

52. Provide the workpapers and source documents for Figure 7-19 and Table 7-3 on page 7-20 and 7-21 of the R.W. Beck June 2007 Initial Project Feasibility Study.

ANSWER: AMP-Ohio specifically objects to this Interrogatory because it is not relevant to this proceeding, not reasonably calculated to lead to discovery of admissible evidence and requests information that is business confidential and proprietary. Without waiving this or the foregoing general objections, the basis and the assumptions used in the Quantitative Risk Assessment are discussed in detail in Section 7.3 the Report.

53. Provide copies of any assessments that have been prepared by or for AMP of the use of Integrated Gasification Combined Cycle ("IGCC") technology for the proposed AMPGS project – including all assumptions, estimates, and calculations regarding the cost, pollution control performance, technical feasibility, and availability of IGCC.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding, not reasonably calculated to lead to the discovery of admissible evidence, is vague, overbroad, and unduly burdensome, and requests information that is business confidential and proprietary.

54. Provide copies of any assessments that have been prepared by or for AMP of the use of Powerspan's pollution control technologies for the proposed AMPGS project – including all assumptions, estimates, and calculations regarding the cost, pollution control performance, technical feasibility, and availability of such technologies.

ANSWER: See Response to Request 53. Without waiving this or any of the foregoing general objections, the Powerspan SO_2 process or ECO-SO_2 will utilize urea as a reagent and produce ammonium sulfate from the process that can be marketed as fertilizer. Urea (46% nitrogen by weight and ammonium sulfate (21% nitrogen by weight)) are two types of fertilizer used in the United States. As part of the R. W. Beck assessment, R. W. Beck visited the commercial demonstration unit at the Burger, Ohio facility and had Business Confidential discussions with Powerspan on technical and economic aspects of their process. Based on the R. W. Beck assessment, the following key findings and conclusions were identified:

- **Powerspan has identified the important variables critical in commercializing the ammonia scrubbing process, ECO-SO_2.**
- **Powerspan has selected partners to engineer, design, and construct the ECO-SO_2 process that have demonstrated experience in their respective areas of expertise.**
- **The scale-up of the process from the Burger commercial demonstration unit is technically feasible given the types of equipment involved and the vendors' demonstrated experience with the equipment.**

- **AMPGS intends to pursue appropriate guarantees from the EPC Contractors to minimize the risk to AMP-Ohio.**
- **Operation and maintenance costs are dependent on prices of urea and ammonium sulfate and more specifically dependent on the spread in the prices (see response 3. a).**
- **Capital or construction costs are comparable to wet limestone scrubbers.**
- **The Powerspan process affords the AMPGS the opportunity in the future to capture CO_2 using the Powerspan ammonia-based scrubbing system in combination with the Powerspan SO_2 process when the CO_2 system is technologically and commercially available.**

55. Provide copies of any assessments that have been prepared by or for AMP of the cost, feasibility, and alternatives for satisfying current and likely future regulatory limits on mercury emissions from the proposed AMPGS project.

ANSWER: The design for AMPGS includes a multi-control system approach that offers redundancy for air emissions control. This system is designed and expected to meet the federal Clean Air Mercury Rule as well as terms, conditions and requirements established by Ohio EPA for mercury. AMP-Ohio cannot predict future regulations.

56. Provide copies of any assessments that have been prepared by or for AMP regarding disposal methods for scrubber sludge, fly ash, bottom ash, and waste water from the proposed AMPGS, including all assumptions, estimates, and calculations regarding the cost, effectiveness, and environmental impacts of such disposal methods.

ANSWER: AMP-Ohio specifically objects to this Request because it is vague, overbroad, and unduly burdensome. Without waiving this or any foregoing general objections, documents responsive to this request will be produced.

57. Provide and explain any plans that AMP has for monitoring for the possible leaching of toxic metals (such as mercury) into groundwater from scrubber sludge, fly ash, and bottom ash from the proposed AMPGS, including all assumptions, estimates, and calculations regarding the cost and effectiveness of such monitoring.

ANSWER: See Response to Request 56.

58. Provide copies of any notices of violations issued against any power source owned or operated by AMP, and explain the status of each such notice.

ANSWER: AMP-Ohio specifically objects to this Request because it is not relevant to this proceeding and not reasonably calculated to lead to the discovery of admissible evidence and is unduly burdensome.

59. Provide copies of any assessments, including cost estimates, for the delivery of coal to the proposed AMPGS project.

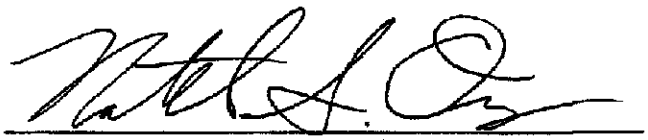
ANSWER: AMP-Ohio specifically objects to this Request because it seeks information that is business confidential and proprietary. The estimated cost for delivery of coal to the proposed AMPGS site is based on confidential and proprietary transportation cost information.

AS TO OBJECTIONS:

John W. Bentine /by N.S.O.
John W. Bentine (0016388)
Trial Counsel

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing American Municipal Power-Ohio, Inc.'s Responses to the Natural Resources Defense Council, Ohio Environmental Council, and Sierra Club's First Set of Interrogatories and Request for Production of Documents for Case No. 06-1358-EL-BGN was served upon the following persons via electronic mail and/or via postage prepaid U.S. Mail on November 26, 2007:



Attorney for American Municipal Power-Ohio, Inc.

Service List:

William L. Wright, Esq.
John H. Jones, Esq.
Public Utilities Section
180 East Broad Street, 9th Floor
Columbus, OH 43215
john.jones@puc.state.oh.us
william.wright@puc.state.oh.us

Counsel for Staff

Margaret A. Malone, Esq.
Assistant Attorney General
Environmental Enforcement Section
30 East Broad Street, 25th Floor
Columbus, OH 43215
MMalone@ag.state.oh.us

Counsel for Staff

Shannon Fisk, Esq.
Natural Resources Defense Council
101 North Wacker Drive, Suite 609
Chicago, IL 60606
sfisk@nrdc.org

Staff Attorney

Trent Dougherty, Esq.
Ohio Environmental Council
1207 Grandview Avenue, Suite 201
Columbus, OH 43212
trent@theoec.org

Staff Attorney

Sanjay Narayan, Esq.
Sierra Club Environmental Law Program
85 Second Street, 2nd Floor
San Francisco, CA 94105
Sanjay.Narayan@sierraclub.org

Staff Attorney

Elisa Young
48360 Carnel Road
Racine, OH 45771
Elisa@EnergyJustice.net

Lee Fisher, Director
Ohio Department of Development
77 South High Street
Columbus, OH 43215

Robert Boggs, Director
Ohio Department of Agriculture
8995 East Main Street
Reynoldsburg, OH 43068

Sean Logan, Director
Ohio Department of Natural Resources
2045 Morse Road, Bldg. D-3
Columbus, OH 43229

Senator Bob Schuler
Ohio Senate
Statehouse
Room 221, Second Floor
Columbus, OH 43215

Representative Steven L. Driehaus
Ohio House of Representatives
77 South High Street, 14th Floor
Columbus, OH 43215

Alvin Jackson, M.D., Director
Ohio Department of Health
246 North High Street
Columbus, OH 43215

Christopher Korleski, Director
Ohio Environmental Protection Agency
50 West Town Street, Suite 700
Columbus, OH 43215

Andrew M. Boatright, Public Member
Electric Utility Manager
City of Westerville Electric Division
139 East Broadway
Westerville, OH 43081

Senator Jason Wilson
Ohio Senate
Statehouse
Room 052, Ground Floor
Columbus, OH 43215

Representative John P. Hagan
Ohio House of Representatives
77 South High Street, 11th Floor
Columbus, OH 43215

PEW CENTER ON Global CLIMATE CHANGE

Senate Greenhouse Gas Cap-And-Trade Proposals

Includes Legislation Introduced in the 110th Congress as of August 2, 2007

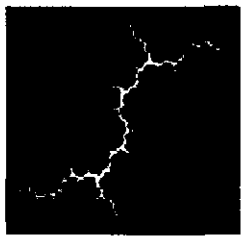
Bill	Scope of Coverage	2010-2019 Cap	2020-2029 Cap	2030-2050 Cap	Offsets	Allocation	Other Cost Controls	Early Action	Technology and Misc.
ECONOMY-WIDE (MULTI-SECTOR) LEGISLATION									
Lieberman-Warner * Discussion principles – 8/2/2007 * Not yet introduced	All 6 GHGs Economy-wide, "hybrid" – upstream for oil refineries; downstream for electric utilities and large sources	2005 level in 2012	10% below 2005 levels in 2020	30% below 2005 levels by 2030 50% below 2005 levels by 2040 70% below 2005 levels by 2050	15% limit on use of domestic offsets 15% limit on use of international credits	Increasing auction: 24% from 2012-2034, rising to 52% in 2035 Some sector allocations are specified including: 4% to states, 20% to power plants (transitions to zero in 2035), 20% to industry, 10% to electricity load-serving entities	Borrowing up to 15% per company Creates Carbon Market Efficiency Board to allow for borrowing with payback	8% of allowances for early action in 2012, phasing to zero in 2020	Funds and incentives for technology, adaptation and mitigating effects on poor Target subject to periodic NAS review
Bingaman-Specter S. 1766 – 7/11/2007 Low Carbon Economy Act	All 6 GHGs Economy-wide, "hybrid" – upstream for natural gas & petroleum; downstream for coal	2012 level in 2012	2006 levels by 2020	1990 levels by 2030 President may set long-term target ≥60% below 2006 levels by 2050 contingent upon international effort	Provides certain initial categories including bio sequestration and industrial offsets President may implement use of international offsets subject to 10% limit	Increasing auction: 24% from 2012-2017, rising to 63% in 2030 Some sector allocations are specified including: 9% to states, 53% to industry declining 2%/year starting in 2017 5% set-aside of allowances for agricultural	$12/ton CO_2e "technology accelerator payment" (i.e., safety valve) starting in 2012 and increasing 5%/year above inflation Allows banking	From 2012-2020, 1% of allowances allocated to those registering GHG reductions prior to enactment	Bonus allocation for carbon capture and storage Funds and incentives for technology R&D Target subject to 5-year review of new science and actions by other nations
McCain-Lieberman S.280 – 1/12/2007 Climate Stewardship and Innovation Act	All 6 GHGs Economy-wide, "hybrid" – upstream for transportation sector; downstream for electric utilities & large sources	2004 level in 2012	1990 level in 2020	20% below 1990 level in 2030 60% below 1990 level in 2050	30% limit on use of international credits and domestic reduction or sequestration offsets	Administrator determines allocation/auction split; considering consumer impact, competitiveness, etc.	Borrowing for 5-year periods with interest	Credit for reductions before 2012	Funds and incentives for tech R&D, efficiency adaptation, mitigating effects on poor
Sanders-Boxer S.309 – 1/16/2007 Global Warming Pollution Reduction Act	All 6 GHGs Economy-wide, point of regulation not specified	2010 level in 2010 2%/year reduction from 2010-2020	1990 level in 2020	27% below 1990 level in 2030. 53% below 1990 level in 2040 80% below 1990 level in 2050	Includes provision for offsets generated from biological sequestration	Cap and trade permitted but not required. Allocation criteria include transition assistance and consumer impacts	"Technology-indexed stop price" freezes cap if prices high relative to tech options	Not specified	Standards for vehicles, power plants, efficiency, renewables, certain categories of bio sequestration
Kerry-Snowe S.485 – 2/1/2007 Global Warming Reduction Act	All 6 GHGs Economy-wide, point of regulation not specified	2010 level in 2010	1990 level in 2020 2.5%/year reduction from 2020-2029	3.5%/year reduction from 2030-2050. 62% below 1990 level in 2050	Includes provision for offsets generated from biological sequestration	Determined by the President; requires unspecified amount of allowances to be auctioned	Not specified	Goal to "recognize and reward early reductions"	Funds for tech. R&D, consumer impacts, adaptation Standards for vehicles, efficiency, renewables, certain categories of bio sequestration

PEW CENTER Global CLIMATE CHANGE

Senate Greenhouse Gas Cap-And-Trade Proposals

Includes Legislation Introduced in the 110th Congress as of August 2, 2007

Bill	Scope of Coverage	2010-2019 Cap	2020-2029 Cap	2030-2050 Cap	Offsets	Allocation	Other Cost Controls	Early Action	Technology and Misc.
ELECTRICITY SECTOR LEGISLATION									
Feinstein-Carper S.317 – 1/17/2007 Electric Utility Cap and Trade Act	All 6 GHGs Electricity sector, downstream	2006 level in 2011 2001 level in 2015, 1%/year reduction from 2016-2019	1.5%/year reduction starting in 2020 (may be adjusted by Administrator)	1.5%/year reduction starting in 2020 (may be adjusted by Administrator)	Certain categories of bio sequestration and industrial offsets; 5% limit on forest mgmt; 25% limit on intl.	Increasing auction: 15% in 2011; 60% in 2026; 100% in 2036 Output-based allocation to generators	If economic harm, potential for borrowing and/or increased international offsets. Borrowing of *offsets*	Credit for reductions from 2000-2010, limit 10% of cap	Funds for tech R&D, habitat protection, and adaptation Bills expected on industry, efficiency, fuels, and vehicles
Alexander-Lieberman S.1168 – 4/19/2007 Clean Air Climate Change Act of 2007	4 pollutants – SO_2, NO_x, mercury, and CO_2 Electricity sector	2300 MMT CO_2 (approx. 2006 level) from 2011-2014 2100 MMT CO_2 (approx. 1997 level) from 2015-2019	1800 MMT CO_2 (approx.1990 level) from 2020-2024 1500 MMT CO_2 (approx.17% below 1990 level) from 2025 forward	1500 MMT CO_2 (approx. 17% below 1990 level) indefinitely	System of offsets considering RGGI model rules	75% historical allocation; 25% auction Input-based "benchmarked" allocation to generators.	Auction revenue can offset costs of electricity increases to consumers and affected industries	Bonus allowances to first 30 new or modified coal-fired utilities meeting new performance standards	Standards for new power plants
Carper S. 1177 – 4/20/2007 Clean Air Planning Act of 2007	4 pollutants – SO_2, NO_x, mercury, and CO_2 Electricity Sector	2006 CO_2 level in 2012-2014 2001 CO_2 level in 2015 1%/year reduction CO_2 level from 2016-2019	1.5%/year reduction CO_2 levels starting in 2020	1.5%/year reduction CO_2 levels starting in 2020 (may be adjusted by Administrator to 3% in 2030 & beyond) 25% below 1990 CO_2 level in 2050	Agricultural sequestration allowances	Increasing auction: 18% in 2012; 60% in 2026; 100% in 2036 and beyond Output-based allocation to generators transitioning to 100% auction	Purchase offsets from other sectors of economy; transition assistance to affected workers and communities	From 2012-2025, 3% set-aside of allowances for clean coal Credit for reductions from 2000-2012	Funds and incentives for CCS technology R&D; efficiency adaptation; mitigating effects on communities and wildlife
Sanders S. 1201 – 4/24/2007 Clean Power Act of 2007 ** If Congress has not passed, and the President has not signed, legislation to address 85% of GHG emissions economy-wide by 2012, further 3%/year reduction in CO_2 limits until global GHG emissions reach 450ppm.*	4 pollutants – SO_2, NO_x, mercury, and CO_2 Electricity sector	2300 MMT CO_2 (approx. 2006 level) by 2011 2100 MMT CO_2 (approx. 1997 level) by 2015*	1803 MMT CO_2 (approx. 1990 level) by 2020* 1500 MMT CO_2 (approx. 17% below 1990 level) by 2025*	*Goal is to facilitate the worldwide stabilization of atmospheric concentrations of global warming pollutants at 450ppm CO_2e by 2050**	Includes provision for offsets generated from biological sequestration	Administrator determines; considers consumer and corporate impact, Increasing auction: 50% in 2020; rising annually to 100% by 2035	Consideration of costs and competitiveness concerns in allocation	Credit for low-carbon generation	Standards for power plants, efficiency, renewables, certain categories of bio sequestration Funds for tech R&D, specifically geologic carbon sequestration



Synapse
Energy Economics, Inc.

Climate Change and Power:

Carbon Dioxide Emissions Costs and Electricity Resource Planning

Prepared by:
Lucy Johnston, Ezra Hausman, Anna Sommer, Bruce Biewald, Tim Woolf, David Schlissel, Amy Roschelle, and David White

Synapse Energy Economics
22 Pearl Street, Cambridge, MA 02139
www.synapse-energy.com
617-661-3248

March 2, 2007

Table of Contents

Executive Summary

The fact of human-induced global climate change as a consequence of our greenhouse gas emissions is now well established, and the only remaining questions among mainstream scientists concern the nature and timing of future disruptions and dislocations and the magnitude of the socio-economic impacts. It is also generally agreed that different CO_2 emissions trajectories will lead to varying levels of environmental, economic, and social costs – which means that the more sharply and the sooner we can reduce emissions, the greater the avoided costs will be.

This report is designed to assist utilities, regulators, consumer advocates and others in projecting the future cost of complying with carbon dioxide regulations in the United States.[1] These cost forecasts are necessary for use in long-term electricity resource planning, in electricity resource economics, and in utility risk management.

We recognize that there is considerable uncertainty inherent in projecting long-term carbon emissions costs, not least of which concerns the timing and form of future emissions regulations in the United States. However, this uncertainty is no reason to ignore this very real component of future production cost. In fact, this type of uncertainty is similar to that of other critical electricity cost drivers such as fossil-fuel prices.

Accounting for Climate Change Regulations in Electricity Planning

The United States contributes more than any other nation, by far, to global greenhouse gas emissions on both a total and a per capita basis. The United States contributes 24 percent of the world CO_2 emissions, but has only 4.6 percent of the population.

Within the United States, the electricity sector is responsible for roughly 39% of CO_2 emissions. Within the electricity industry, roughly 82% of CO_2 emissions come from coal-fired plants, roughly 13% come from gas-fired plants, and roughly 5% come from oil-fired plants.

Because of its contribution to US and worldwide CO_2 emissions, the US electricity industry will clearly need to play a critical role in reducing greenhouse gas (GHG) emissions. In addition, the electricity industry is composed of large point sources of emissions, and it is often easier and more cost-effective to control emissions from large sources than multiple small sources. Analyses by the US Energy Information Administration indicate that 65% to 90% of energy-related carbon dioxide emissions reductions are likely to come from the electric sector under a wide range of economy-wide federal policy scenarios.[2]

[1] This paper does not address the determination of an "externality value" associated with greenhouse gas emissions. The externality value would include societal costs beyond those internalized into market costs through regulation. While this report refers to the ecological and socio-economic impacts of climate change, estimation of the external costs of greenhouse gas emissions is beyond the scope of this analysis.

[2] EIA 2003, page 13; EIA 2004, page 5; EIA 2006, page 19.

In this context, the failure of entities in the electric sector to anticipate the future costs associated with carbon dioxide regulations is short-sighted, economically unjustifiable, and ultimately self-defeating. Long-term resource planning and investment decisions that do not quantify the likely future cost of CO_2 regulations will understate the true cost of future resources, and thus will result in uneconomic, imprudent decisions. Generating companies will naturally attempt to pass these unnecessarily high costs on to electricity ratepayers. Thus, properly accounting for future CO_2 regulations is as much a consumer issue as it is an issue of prudent resource selection.

Some utility planners argue that the cost of complying with future CO_2 regulations involves too much uncertainty, and thus they leave the cost out of the planning process altogether. This approach results in making an implicit assumption that the cost of complying with future CO_2 regulations will be zero. This assumption of zero cost will apply to new generation facilities that may operate for 50 or more years into the future. In this report, we demonstrate that under all reasonable forecasts of the near- to mid-term future, the cost of complying with CO_2 regulations will certainly be greater than zero.

Federal Initiatives to Regulate Greenhouse Gases

The scientific consensus on climate change has spurred efforts around the world to reduce greenhouse gas emissions, many of which are grounded in the United Nations Framework Convention on Climate Change (UNFCCC). The United States is a signatory to this convention, which means that it has agreed to a goal of "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." However, the United States has not yet agreed to the legally binding limits on greenhouse gas emissions contained in the Kyoto Protocol, a supplement to the UNFCCC.

Table ES-1. Summary of Federal Mandatory Emission Reduction Legislation

Proposed National Policy	Title or Description	Year Proposed	Emission Targets	Sectors Covered
McCain Lieberman S.139	Climate Stewardship Act	2003	Cap at 2000 levels 2010-2015. Cap at 1990 levels beyond 2015.	Economy-wide, large emitting sources
McCain Lieberman SA 2028	Climate Stewardship Act	2003	Cap at 2000 levels	Economy-wide, large emitting sources
National Commission on Energy Policy (basis for Bingaman-Domenici legislative work)	Greenhouse Gas Intensity Reduction Goals	2005	Reduce GHG intensity by 2.4%/yr 2010-2019 and by 2.8%/yr 2020-2025. Safety-valve on allowance price	Economy-wide, large emitting sources
Sen. Feinstein	Strong Economy and Climate Protection Act	2006	Stabilize emissions through 2010; 0.5% cut per year from 2011-15; 1% cut per year from 2016-2020. Total reduction is 7.25% below current levels.	Economy-wide, large emitting sources
Jeffords S. 150	Multi-pollutant legislation	2005	2.050 billion tons beginning 2010	Existing and new fossil-fuel fired electric generating plants > 15 MW
Carper S. 843	Clean Air Planning Act	2005	2006 levels (2.655 billion tons CO2) starting in 2009, 2001 levels (2.454 billion tons CO2) starting in 2013.	Existing and new fossil-fuel fired, nuclear, and renewable electric generating plants > 25 MW
Rep. Udall - Rep. Petri	Keep America Competitive Global Warming Policy Act	2006	Establishes prospective baseline for greenhouse gas emissions, with safety valve.	Not available

Nonetheless, there have been several important attempts at the federal level to limit the emissions of greenhouse gases in the United States. Table ES-1 presents a summary of federal legislation that has been introduced in recent years. Most of this legislation includes some form of mandatory national limits on the emissions of greenhouse gases, as well as market-based cap and trade mechanisms to assist in meeting those limits.

State and Regional Initiatives to Regulate Greenhouse Gases

Many states across the country have not waited for federal policies, and are developing and implementing climate change-related policies that have a direct bearing on electric resource planning. States, acting individually and through regional coordination, have been the leaders on climate change policies in the United States.

State policies generally fall into the following categories: (a) direct policies that require specific emission reductions from electric generation sources; (b) indirect policies that affect electric sector resource mix such as through promoting low-emission electric sources; (c) legal proceedings; or (d) voluntary programs including educational efforts and energy planning. Table ES-2 presents a summary of types of policies with recent state policies on climate change listed on the right side of the table.

Table ES-2. Summary of Individual State Climate Change Policies

Type of Policy	State Examples
Direct	
• Power plant emission restrictions (e.g. cap or emission rate)	• MA, NH
• New plant emission restrictions	• OR, WA
• State GHG reduction targets	• CT, NJ, ME, MA, CA, NM, NY, OR, WA
• Fuel/generation efficiency	• CA vehicle emissions standards to be adopted by CT, NY, ME, MA, NJ, OR, PA, RI, VT, WA
Indirect (clean energy)	
• Load-based GHG cap	• CA
• GHG in resource planning	• CA, WA, OR, MT, KY
• Renewable portfolio standards	• 22 states and D.C.
• Energy efficiency/renewable charges and funding; energy efficiency programs	• More than half the states
• Net metering, tax incentives	• 41 states
Lawsuits	
• States, environmental groups sue EPA to determine whether greenhouse gases can be regulated under the Clean Air Act	• States include CA, CT, ME, MA, NM, NY, OR, RI, VT, and WI
• States sue individual companies to reduce GHG emissions	• NY, CT, CA, IA, NJ, RI, VT, WI
Climate change action plans	• 28 states, with NC and AZ in progress

Several states require that regulated utilities evaluate costs or risks associated with greenhouse gas emissions regulations in long-range planning or resource procurement. Some of the states require that companies use a specific value, while other states require that companies consider the risk of future regulation in their planning process. Table ES-3 summarizes state requirements for considering greenhouse gas emissions in electricity resource planning.

Table ES-3. Requirements for Consideration of GHG Emissions in Electric Resource Decisions

Program type	State	Description	Date	Source
GHG value in resource planning	CA	PUC requires that regulated utility IRPs include carbon adder of $8/ton CO_2, escalating at 5% per year.	April 1, 2005	CPUC Decision 05-04-024
GHG value in resource planning	WA	Law requiring that cost of risks associated with carbon emissions be included in Integrated Resource Planning for electric and gas utilities	January, 2006	WAC 480-100-238 and 480-90-238
GHG value in resource planning	OR	PUC requires that regulated utility IRPs include analysis of a range of carbon costs	Year 1993	Order 93-695
GHG value in resource planning	NWPCC	Inclusion of carbon tax scenarios in Fifth Power Plan	May, 2006	NWPCC Fifth Energy Plan
GHG value in resource planning	MN	Law requires utilities to use PUC established environmental externalities values in resource planning	January 3, 1997	Order in Docket No. E-999/CI-93-583
GHG in resource planning	MT	IRP statute includes an "Environmental Externality Adjustment Factor" which includes risk due to greenhouse gases. PSC required Northwestern to account for financial risk of carbon dioxide emissions in 2005 IRP.	August 17, 2004	Written Comments Identifying Concerns with NWE's Compliance with A.R.M. 38.5.8209-8229; Sec. 38.5.8219, A.R.M.
GHG in resource planning	KY	KY staff reports on IRP require IRPs to demonstrate that planning adequately reflects impact of future CO_2 restrictions	2003 and 2006	Staff Report On the 2005 Integrated Resource Plan Report of Louisville Gas and Electric Company and Kentucky Utilities Company - Case 2005-00162, February 2006
GHG in resource planning	UT	Commission directs Pacificorp to consider financial risk associated with potential future regulations, including carbon regulation	June 18, 1992	Docket 90-2035-01, and subsequent IRP reviews
GHG in resource planning	MN	Commission directs Xcel to "provide an expansion of CO2 contingency planning to check the extent to which resource mix changes can lower the cost of meeting customer demand under different forms of regulation."	August 29, 2001	Order in Docket No. RP00-787
GHG in CON	MN	Law requires that proposed non-renewable generating facilities consider the risk of environmental regulation over expected useful life of the facility	2005	Minn. Stat. §216B.243 subd. 3(12)

States are not just acting individually; there are several examples of innovative regional policy initiatives. To date, there are regional initiatives including Northeastern and Mid-Atlantic states (CT, DE, MD, ME, NH, NJ, NY, and VT), West Coast states (CA, OR, WA), Southwestern states (NM, AZ), and Midwestern states (IL, IA, MI, MN, OH, WI).

The Northeastern and Mid-Atlantic states recently reached agreement on the creation of the Regional Greenhouse Gas Initiative (RGGI); a multi-year cooperative effort to design a regional cap and trade program covering CO_2 emissions from power plants in the region. The RGGI states have agreed to the following:

- Stabilization of CO_2 emissions from power plants at current levels for the period 2009-2015, followed by a 10 percent reduction below current levels by 2019.
- Allocation of a minimum of 25 percent of allowances for consumer benefit and strategic energy purposes.
- Certain offset provisions that increase flexibility to moderate price impacts.
- Development of complimentary energy policies to improve energy efficiency, decrease the use of higher polluting electricity generation and to maintain economic growth.

Electric Industry Actions to Address Greenhouse Gases

Some CEOs in the electric industry have determined that inaction on climate change issues is not good corporate strategy, and individual electric companies have begun to evaluate the risks associated with future greenhouse gas regulation and take steps to reduce greenhouse gas emissions. Their actions represent increasing initiative in the electric industry to address the threat of climate change and manage risk associated with future carbon constraints.

Recently, eight US-based utility companies have joined forces to create the "Clean Energy Group." This group's mission is to seek "national four-pollutant legislation that would, among other things... stabilize carbon emissions at 2001 levels by 2013."

In addition, leaders of electric companies such as Duke and Exelon have vocalized support for mandatory national carbon regulation. These companies urge a mandatory federal policy, stating that climate change is a pressing issue that must be resolved, that voluntary action is not sufficient, and that companies need regulatory certainty to make appropriate decisions. Even companies that do not advocate federal requirements, anticipate their adoption and urge regulatory certainty. Several companies have established greenhouse gas reduction goals for their company.

Several electric utilities and electric generation companies have incorporated specific forecasts of carbon regulation and costs into their long term planning practices. Table ES-4 illustrates the range of carbon cost values, in $/ton CO_2, that are currently being used in the industry for both resource planning and modeling of carbon regulation policies.

Table ES-4. CO_2 Cost Estimates Used in Electricity Resource Plans

Company	CO2 emissions trading assumptions for various years ($2005)
PG&E*	$0-9/ton (start year 2006)
Avista 2003*	$3/ton (start year 2004)
Avista 2005	$7 and $25/ton (2010) $15 and $62/ton (2026 and 2023)
Portland General Electric*	$0-55/ton (start year 2003)
Xcel-PSCCo	$9/ton (start year 2010) escalating at 2.5%/year
Idaho Power*	$0-61/ton (start year 2008)
Pacificorp 2004	$0-55/ton
Northwest Energy 2005	$15 and $41/ton
Northwest Power and Conservation Council	$0-15/ton between 2008 and 2016 $0-31/ton after 2016

**Values for these utilities from Wiser, Ryan, and Bolinger, Mark. "Balancing Cost and Risk: The Treatment of Renewable Energy in Western Utility Resource Plans." Lawrence Berkeley National Laboratories. August 2005. LBNL-58450. Table 7.*
Other values: PacifiCorp, Integrated Resource Plan 2004, pages 62-63; and Idaho Power Company, 2004 Integrated Resource Plan Draft, July 2004, page 59; Avista Integrated Resource Plan 2005, Section 6.3; Northwestern Energy Integrated Resource Plan 2005, Volume 1 p. 62; Northwest Power and Conservation Council, Fifth Power Plan pp. 6-7. Xcel-PSCCo, Comprehensive Settlement submitted to the CO PUC in dockets 04A-214E, 215E and 216E, December 3, 2004. Converted to $2005 using GDP implicit price deflator.

Synapse Forecast of Carbon Dioxide Allowance Prices

This report presents our current forecast of the most likely costs of compliance with future climate change regulations. In making this forecast we review a range of current estimates from a variety of different sources. We review the results of several analyses of federal policy proposals, and a few analyses of the Kyoto Protocol. We also look briefly at carbon markets in the European Union to demonstrate the levels at which carbon dioxide emissions are valued in an active market.

Figure ES-1 presents CO_2 allowance price forecasts from the range of recent studies that we reviewed. All of the studies here are based on the costs associated with complying with potential CO_2 regulations in the United States. The range of these price forecasts reflects the range of policy initiatives that have been proposed in the United States, as well as the diversity of economic models and methodologies used to estimate their price impacts.

Figure ES-1 superimposes the Synapse long term forecasts of CO_2 allowance prices upon the other forecasts gleaned from the literature. In order to help address the uncertainty involved in forecasting CO_2 prices, we present a "base case" forecast as well as a "low case" and a "high case." All three forecasts are based on our review of both regulatory trends and economic models, as outlined in this document.

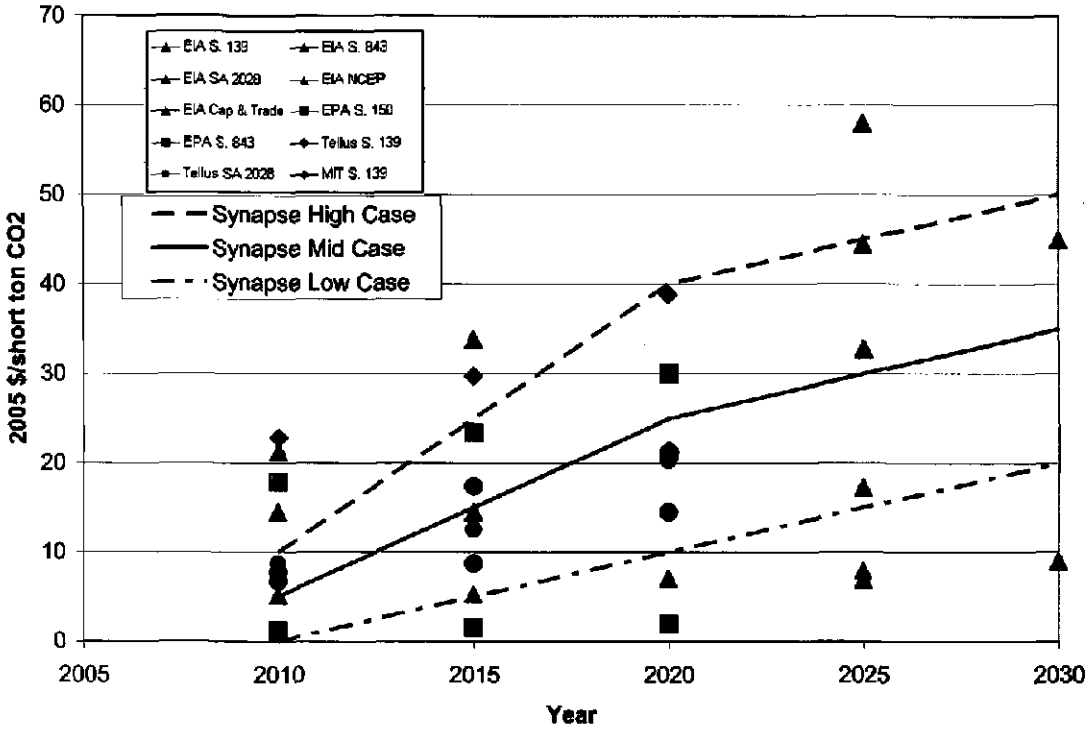


Figure ES-1. Synapse Forecast of Carbon Dioxide Allowance Prices

High, mid and low-case Synapse carbon emissions price forecasts superimposed on policy model forecasts as presented in Figure 6.3.

As with any forecast, our forecast is likely to be revised over time as the form and timing of carbon emission regulations come increasingly into focus. It is our judgment that this range represents a reasonable quantification of what is known today about future carbon emissions costs in the United States. As such, it is appropriate for use in long range resource planning purposes until better information or more clarity become available.

Additional Costs Associated with Greenhouse Gases

This report summarizes current policy initiatives and costs associated with greenhouse gas emissions from the electric sector. It is important to note that the greenhouse gas emission reduction requirements contained in federal legislation proposed to date, and even the targets in the Kyoto Protocol, are relatively modest compared with the range of emissions reductions that are anticipated to be necessary for keeping global warming at a manageable level. Further, we do not attempt to calculate the full cost to society (or to electric utilities) associated with anticipated future climate changes. Even if electric utilities comply with some of the most aggressive regulatory requirements underlying our CO_2 price forecasts presented above, climate change will continue to occur, albeit at a slower pace, and more stringent emissions reductions will be necessary to avoid dangerous changes to the climate system.

The consensus from the international scientific community clearly indicates that in order to stabilize the concentration of greenhouse gases in the atmosphere and to try to keep

further global warming trends manageable, greenhouse gas emissions will have to be reduced significantly below those limits underlying our CO_2 price forecasts. The scientific consensus expressed in the Intergovernmental Panel on Climate Change Report from 2001 is that greenhouse gas emissions would have to decline to a very small fraction of current emissions in order to stabilize greenhouse gas concentrations, and keep global warming in the vicinity of a 2-3 degree centigrade temperature increase. Simply complying with the regulations underlying our CO_2 price forecasts does not eliminate the ecological and socio-economic threat created by CO_2 emissions – it merely mitigates that threat.

In keeping with these findings, the European Union has adopted an objective of keeping global surface temperature increases to 2 degrees centigrade above pre-industrial levels. The EU Environment Council concluded in 2005 that this goal is likely to require emissions reductions of 15-30% below 1990 levels by 2020, and 60-80% below 1990 levels by 2050.

In other words, incorporating a reasonable CO_2 price forecast into electricity resource planning will help address electricity consumer concerns about prudent economic decision-making and direct impacts on future electricity rates, but it does not address all the ecological and socio-economic concerns posed by greenhouse gas emissions. Regulators should consider other policy mechanisms to account for the remaining pervasive impacts associated with greenhouse gas emissions.

1. Introduction

Climate change is not only an "environmental" issue. It is at the confluence of energy and environmental policy, posing challenges to national security, economic prosperity, and national infrastructure. Many states do not require greenhouse gas reductions, nor do we yet have a federal policy requiring greenhouse gas reductions in the United States; thus many policy makers and corporate decision-makers in the electric sector may be tempted to consider climate change policy a hazy future possibility rather than a current factor in resource decisions. However, such a "wait and see" approach is imprudent for resource decisions with horizons of more than a few years. Scientific developments, policy initiatives at the local, state, and federal level, and actions of corporate leaders, all indicate that climate change policy will affect the electric sector – the question is not "whether" but "when," and in what magnitude.

Attention to global warming and its potential environmental, economic, and social impacts has rapidly increased over the past few years, adding to the pressure for comprehensive climate change policy in the United States The April 3, 2006 edition of TIME Magazine reports the results of a new survey conducted by TIME, ABC News and Stanford University which reveals that more than 80 percent of Americans believe global warming is occurring, while nearly 90 percent are worried that warming presents a serious problem for future generations. The poll reveals that 75 percent would like the US government, US businesses, and the American people to take further action on global warming in the next year.[3]

In the past several years, climate change has emerged as a significant financial risk for companies. A 2002 report from the investment community identifies climate change as representing a potential multi-billion dollar risk to a variety of US businesses and industries.[4] Addressing climate change presents particular risk and opportunity to the electric sector. Because the electric sector (and associated emissions) continue to grow, and because controlling emissions from large point sources (such as power plants) is easier, and often cheaper, than small disparate sources (like automobiles), the electric sector is likely to be a prime component of future greenhouse gas regulatory scenarios. The report states that "climate change clearly represents a major strategic issue for the electric utilities industry and is of relevance to the long-term evolution of the industry and possibly the survival of individual companies." Risks to electric companies include the following:

- Cost of reducing greenhouse gas emissions and cost of investment in new, cleaner power production technologies and methods;
- Higher maintenance and repair costs and reliability concerns due to more frequent weather extremes and climatic disturbance; and

[3] TIME/ABC News/Stanford University Poll, appearing in April 3, 2006 issue of Time Magazine.

[4] Innovest Strategic Value Advisors; "Value at Risk: Climate Change and the Future of Governance;" The Coalition for Environmentally Responsible Economies; April 2002.

- Growing pressure from customers and shareholders to address emissions contributing to climate change.[5]

A subsequent report, "Electric Power, Investors, and Climate Change: A Call to Action," presents the findings of a diverse group of experts from the power sector, environmental and consumer groups, and the investment community.[6] Participants in this dialogue found that greenhouse gas emissions, including carbon dioxide emissions, will be regulated in the United States; the only remaining issue is when and how. Participants also agreed that regulation of greenhouse gases poses financial risks and opportunities for the electric sector. Managing the uncertain policy environment on climate change is identified as "one of a number of significant environmental challenges facing electric company executives and investors in the next few years as well as the decades to come."[7] One of the report's four recommendations is that investors and electric companies come together to quantify and assess the financial risks and opportunities of climate change.

In a 2003 report for the World Wildlife Fund, Innovest Strategic Advisors determined that climate policy is likely to have important consequences for power generation costs, fuel choices, wholesale power prices and the profitability of utilities and other power plant owners.[8] The report found that, even under conservative scenarios, additional costs could exceed 10 percent of 2002 earnings, though there are also significant opportunities. While utilities and non-utility generation owners have many options to deal with the impact of increasing prices on CO_2 emissions, doing nothing is the worst option. The report concludes that a company's profits could even increase with astute resource decisions (including fuel switching or power plant replacement).

Increased CO_2 emissions from fossil-fired power plants will not only increase environmental damages and challenges to socio-economic systems; on an individual company level they will also increase the costs of complying with future regulations – costs that are likely to be passed on to all customers. Power plants built today can generate electricity for as long as 50 years or more into the future.[9]

As illustrated in the table below, factoring costs associated with future regulations of carbon dioxide has an impact on the costs of resources. Resources with higher CO_2 emissions have a higher CO_2 cost per megawatt-hour than those with lower emissions.

[5] Ibid., pages 45-48.

[6] CERES; "Electric Power, Investors, and Climate Change: A Call to Action;" September 2003.

[7] Ibid., p. 6

[8] Innovest Strategic Value Advisors; "Power Switch: Impacts of Climate Change on the Global Power Sector;" WWF International; November 2003

[9] Biewald et. al.; "A Responsible Electricity Future: An Efficient, Cleaner and Balanced Scenario for the US Electricity System;" prepared for the National Association of State PIRGs; June 11, 2004.

Table I.1. Comparison of CO_2 costs per MWh for Various Resources

Resource	Scrubbed Coal (Bit)	Scrubbed Coal (Sub)	IGCC	Combined Cycle	Source Notes
Size	600	600	550	400	1
CO_2 (lb/MMBtu)	205.45	212.58	205.45	116.97	2, 3
Heat Rate (Btu/kWh)	8844	8844	8309	7196	1
CO_2 Price (2005$/ton)	19.63	19.63	19.63	19.63	4
CO_2 Cost per MWh	$17.83	$18.45	$16.75	$8.26	

1 - From AEO 2006
2 - From EIA's Electric Power Annual 2004, page 76
3 - IGCC emission rate assumed to be the same as the bituminous scrubbed coal rate
4 - From Synapse's carbon emissions price forecast levelized from 2010-2040 at a 7.32% real discount rate

Many trends in this country show increasing pressure for a federal policy requiring greenhouse gas emissions reductions. Given the strong likelihood of future carbon regulation in the United States, the contributions of the power sector to our nation's greenhouse gas emissions, and the long lives of power plants, utilities and non-utility generation owners should include carbon cost in all resource evaluation and planning.

The purpose of this report is to identify a reasonable basis for anticipating the likely cost of future mandated carbon emissions reductions for use in long-term resource planning decisions.[10] Section 2 presents information on US carbon emissions. Section 3 describes recent scientific findings on climate change. Section 4 describes international efforts to address the threat of climate change. Section 5 summarizes various initiatives at the state, regional, and corporate level to address climate change. Finally, section 6 summarizes information that can form the basis for forecasts of carbon allowance prices; and provides a reasonable carbon allowance price forecast for use in resource planning and investment decisions in the electric sector.

2. Growing scientific evidence of climate change

In 2001 the Intergovernmental Panel on Climate Change issued its Third Assessment Report.[11] The report, prepared by hundreds of scientists worldwide, concluded that the earth is warming, that most of the warming over the past fifty years is attributable to human activities, and that average surface temperature of the earth is likely to increase

[10] This paper focuses on anticipating the cost of future emission reduction requirements. This paper does not address the determination of an "externality value" associated with greenhouse gas emissions. The externality value would include societal costs beyond those internalized into market costs through regulation. While this report refers to the ecological and socio-economic impacts of climate change, estimation of the external costs of greenhouse gas emissions is beyond the scope of this analysis.

[11] Intergovernmental Panel on Climate Change, *Third Assessment Report*, 2001.

between 1.4 and 5.8 degrees Centigrade during this century, with a wide range of impacts on the natural world and human societies.

Scientists continue to explore the possible impacts associated with temperature increase of different magnitudes. In addition, they are examining a variety of possible scenarios to determine how much the temperature is likely to rise if atmospheric greenhouse gas concentrations are stabilized at certain levels. The consensus in the international scientific community is that greenhouse gas emissions will have to be reduced significantly below current levels. This would correspond to levels much lower than those limits underlying our CO_2 price forecasts. In 2001 the Intergovernmental Panel on Climate Change reported that greenhouse gas emissions would have to decline to a very small fraction of current emissions in order to keep global warming in the vicinity of a 2-3 degree centigrade temperature increase.[12]

Since 2001 the evidence of climate change, and human contribution to climate change, is even more compelling. In June 2005 the National Science Academies from eleven major nations, including the United States, issued a Joint Statement on a Global Response to Climate Change.[13] Among the conclusions in the statement were that

- Significant global warming is occurring;
- It is likely that most of the warming in recent decades can be attributed to human activities;
- The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action;
- Action taken now to reduce significantly the build-up of greenhouse gases in the atmosphere will lessen the magnitude and rate of climate change;
- The Joint Academies urge all nations to take prompt action to reduce the causes of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies.

There is increasing concern in the scientific community that the earth may be more sensitive to global warming than previously thought. Increasing attention is focused on understanding and avoiding dangerous levels of climate change. A 2005 Scientific Symposium on Stabilization of Greenhouse Gases reached the following conclusions:[14]

---

[12] IPCC, *Climate Change 2001: Synthesis Report*, Fourth Volume of the IPCC Third Assessment Report. IPCC 2001. Question 6.

[13] *Joint Science Academies' Statement: Global Response to Climate Change*, National Academies of Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, United Kingdom, and United States, June 7, 2005.

[14] UK Department of Environment, Food, and Rural Affairs, *Avoiding Dangerous Climate Change – Scientific Symposium on Stabilization of Greenhouse Gases, February 1-3, 2005 Exeter, U.K. Report of the International Scientific Steering Committee*, May 2005. http://www.stabilisation2005.com/Steering_Commitee_Report.pdf

- There is greater clarity and reduced uncertainty about the impacts of climate change across a wide range of systems, sectors and societies. In many cases the risks are more serious than previously thought.
- Surveys of the literature suggest increasing damage if the globe warms about 1 to 3^0C above current levels. Serious risk of large scale, irreversible system disruption, such as reversal of the land carbon sink and possible de-stabilisation of the Antarctic ice sheets is more likely above 3^0C.
- Many climate impacts, particularly the most damaging ones, will be associated with an increased frequency or intensity of extreme events (such as heat waves, storms, and droughts).
- Different models suggest that delaying action would require greater action later for the same temperature target and that even a delay of 5 years could be significant. If action to reduce emissions is delayed by 20 years, rates of emission reduction may need to be 3 to 7 times greater to meet the same temperature target.

As scientific evidence of climate change continues to emerge, including unusually high temperatures, increased storm intensity, melting of the polar icecaps and glaciers worldwide, coral bleaching, and sea level rise, pressure will continue to mount for concerted governmental action on climate change.[15]

3. US carbon emissions

The United States contributes more than any other nation, by far, to global greenhouse gas emissions on both a total and a per capita basis. The United States contributes 24 percent of the world CO_2 emissions from fossil fuel consumption, but has only 4.6 percent of the population. According to the International Energy Agency, 80 percent of 2002 global energy-related CO_2 emissions were emitted by 22 countries – from all world regions, 12 of which are OECD countries. These 22 countries also produced 80 percent of the world's 2002 economic output (GDP) and represented 78 percent of the world's Total Primary Energy Supply.[16] Figure 3.1 shows the top twenty carbon dioxide emitters in the world.

[15] Several websites provide summary information on climate change science including www.ipcc.org www.nrdc.org, www.ucsusa.org, and www.climateark.org.

[16] International Energy Agency, "CO_2 from Fuel Combustion – Fact Sheet," 2005

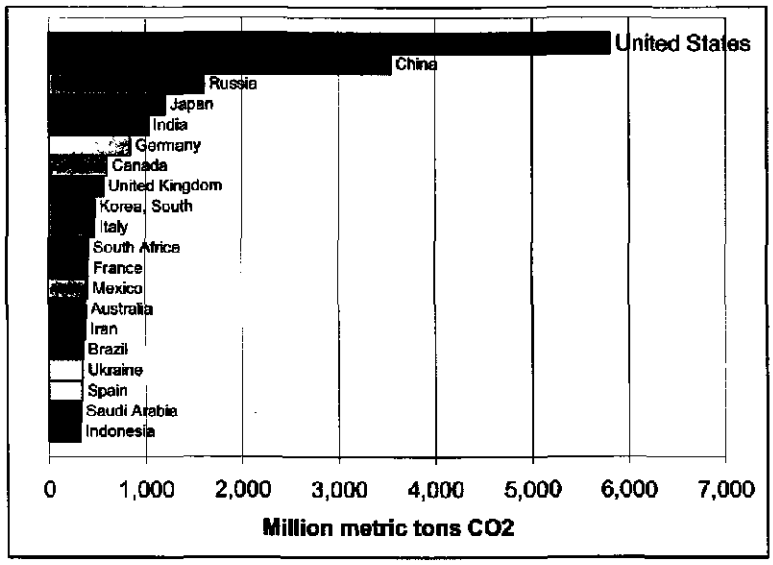


Figure 3.1. Top Worldwide Emitters of Carbon Dioxide in 2003

Source: Data from EIA Table H.1co2 World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1980-2003, July 11, 2005

Emissions in this country in 2004 were roughly divided among three sectors: transportation (1,934 million metric tons CO_2), electric generation (2,299 million metric tons CO_2), and other (which includes commercial and industrial heat and process applications – 1,673 million metric tons CO_2). These emissions, largely attributable to the burning of fossil fuels, came from combustion of oil (44%), coal (35.4%), and natural gas (20.4%). Figure 3.2 shows emissions from the different sectors, with the electric sector broken out by fuel source.

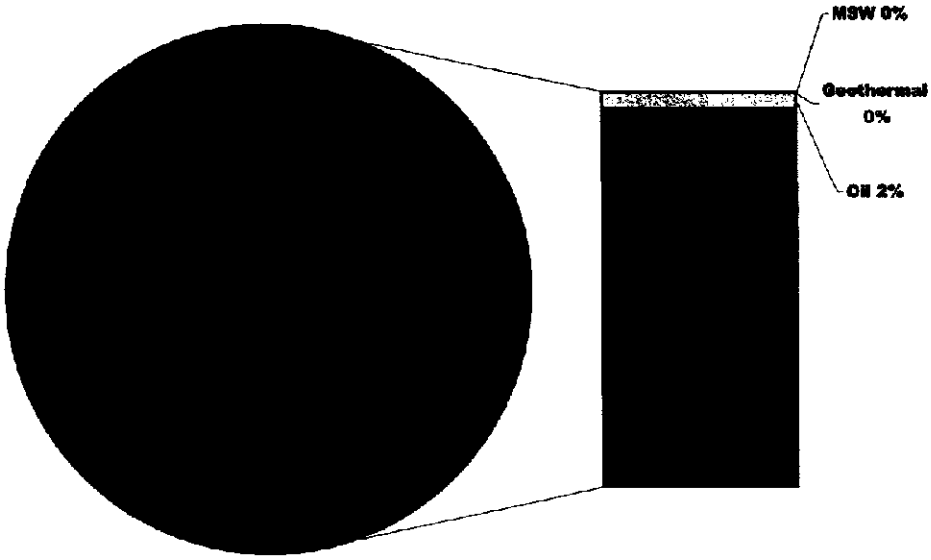


Figure 3.2. US CO_2 Emissions by Sector in 2004

Source: Data from EIA Emissions of Greenhouse Gases in the United States 2004, December 2005

Recent analysis has shown that in 2004, power plant CO_2 emissions were 27 percent higher than they were in 1990.[17] US greenhouse gas emissions per unit of Gross Domestic Product (GDP) fell from 677 metric tons per million 2000 constant dollars of GDP (MTCO2e/$Million GDP) in 2003 to 662 MTCO2e /$Million GDP in 2004, a decline of 2.1 percent.[18] However, while the carbon intensity of the US economy (carbon emissions per unit of GDP) fell by 12 percent between 1991 and 2002, the carbon intensity of the electric power sector held steady.[19] This is because the carbon efficiency gains from the construction of efficient and relatively clean new natural gas plants have been offset by increasing reliance on existing coal plants. Since federal acid rain legislation was enacted in 1990, the average rate at which existing coal plants are operated increased from 61 percent to 72 percent. Power plant CO_2 emissions are concentrated in states along the Ohio River Valley and in the South. Five states – Indiana, Ohio, Pennsylvania, Texas, and West Virginia – are the source of 30 percent of the electric power industry's NO_x and CO_2 emissions, and nearly 40 percent of its SO_2 and mercury emissions.

---

[17] EIA, "Emissions of Greenhouse Gases in the United Sates, 2004;" Energy Information Administration; December 2005, xiii

[18] EIA *Emissions of Greenhouse Gases in the United States 2004,* December 2005.

[19] Goodman, Sandra; "Benchmarking Air Emissions of the 100 Largest Electric Generation Owners in the US - 2002;" CERES, Natural Resources Defense Council (NRDC), and Public Service Enterprise Group Incorporated (PSEG); April 2004. An updated "Benchmarking Study" has been released: Goodman, Sandra and Walker, Michael. "Benchmarking Air Emissions of the 100 Largest Electric Generation Owners in the US - 2004." CERES, Natural Resources Defense Council (NRDC), and Public Service Enterprise Group Incorporated (PSEG). April 2006.

4. Governments worldwide have agreed to respond to climate change by reducing greenhouse gas emissions

The prospect of global warming and associated climate change has spurred one of the most comprehensive international treaties on environmental issues.[20] The 1992 United Nations Framework Convention on Climate Change has almost worldwide membership; and, as such, is one of the most widely supported of all international environmental agreements.[21] President George H.W. Bush signed the Convention in 1992, and it was ratified by Congress in the same year. In so doing, the United States joined other nations in agreeing that "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities."[22] Industrialized nations, such as the United States, and Economies in Transition, known as Annex I countries in the UNFCCC, agree to adopt climate change policies to reduce their greenhouse gas emissions.[23] Industrialized countries that were members of the Organization for Economic Cooperation and Development (OECD) in 1992, called Annex II countries, have the further obligation to assist developing countries with emissions mitigation and climate change adaptation.

Following this historic agreement, most Parties to the UNFCCC adopted the Kyoto Protocol on December 11, 1997. The Kyoto Protocol supplements and strengthens the Convention; the Convention continues as the main focus for intergovernmental action to combat climate change. The Protocol establishes legally-binding targets to limit or reduce greenhouse gas emissions.[24] The Protocol also includes various mechanisms to cut emissions reduction costs. Specific rules have been developed on emissions sinks, joint implementation projects, and clean development mechanisms. The Protocol envisions a long-term process of five-year commitment periods. Negotiations on targets for the second commitment period (2013-2017) are beginning.

The Kyoto targets are shown below, in Table 4.1. Only Parties to the Convention that have also become Parties to the Protocol (i.e. by ratifying, accepting, approving, or acceding to it), are bound by the Protocol's commitments, following its entry into force in

---

[20] For comprehensive information on the UNFCC and the Kyoto Protocol, see UNFCC, "Caring for Climate: a guide to the climate change convention and the Kyoto Protocol," issued by the Climate Change Secretariat (UNFCC) Bonn, Germany. 2003. This and other publications are available at the UNFCCC's website: http://unfccc.int/.

[21] The First World Climate Conference was held in 1979. In 1988, the World Meteorological Society and the United Nations Environment Programme created the Intergovernmental Panel on Climate Change to evaluate scientific information on climate change. Subsequently, in 1992 countries around the world, including the United States, adopted the United Nations Framework Convention on Climate Change.

[22] From Article 3 of the United Nations Framework Convention on Climate Change, 1992.

[23] One of obligations of the United States and other industrialized nations is to a National Report describing actions it is taking to implement the Convention

[24] Greenhouse gases covered by the Protocol are CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.

February 2005.[25] The individual targets for Annex I Parties add up to a total cut in greenhouse-gas emissions of at least 5 percent from 1990 levels in the commitment period 2008-2012.

Only a few industrialized countries have not signed the Kyoto Protocol; these countries include the United States, Australia, and Monaco. Of these, the United States is by far the largest emitter with 36.1 percent of Annex I emissions in 1990; Australia and Monaco were responsible for 2.1 percent and less than 0.1 percent of Annex I emissions, respectively. The United States did not sign the Kyoto protocol, stating concerns over impacts on the US economy and absence of binding emissions targets for countries such as India and China. Many developing countries, including India, China and Brazil have signed the Protocol, but do not yet have emission reduction targets.

In December 2005, the Parties agreed to final adoption of a Kyoto "rulebook" and a two-track approach to consider next steps. These next steps will include negotiation of new binding commitments for Kyoto's developed country parties, and, a nonbinding "dialogue on long-term cooperative action" under the Framework Convention.

Table 4.1. Emission Reduction Targets Under the Kyoto Protocol[26]

Country	**Target**: change in emissions from 1990** levels by 2008/2012
EU-15*, Bulgaria, Czech Republic, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia, Switzerland	-8%
United States***	-7%
Canada, Hungary, Japan, Poland	-6%
Croatia	-5%
New Zealand, Russian Federation, Ukraine	0
Norway	+1%
Australia***	+8%
Iceland	+10%

** The EU's 15 member States will redistribute their targets among themselves, as allowed under the Protocol. The EU has already reached agreement on how its targets will be redistributed.*
*** Some Economies In Transition have a baseline other than 1990.*
**** The United States and Australia have indicated their intention not to ratify the Kyoto Protocol.*

As the largest single emitter of greenhouse gas emissions, and as one of the only industrialized nations not to sign the Kyoto Protocol, the United States is under significant international scrutiny; and pressure is building for the United States to take more initiative in addressing the emerging problem of climate change. In 2005 climate change was a priority at the G8 Summit in Gleneagles, with the G8 leaders agreeing to "act with resolve and urgency now" on the issue of climate change.[27] The leaders

[25] Entry into force required 55 Parties to the Convention to ratify the Protocol, including Annex I Parties accounting for 55 percent of that group's carbon dioxide emissions in 1990. This threshold was reached when Russia ratified the Protocol in November 2004. The Protocol entered into force February 16, 2005.

[26] Background information at: http://unfccc.int/essential_background/kyoto_protocol/items/3145.php

[27] G8 Leaders, *Climate Change, Clean Energy, and Sustainable Development*, Political Statement and Action Plan from the G8 Leaders' Communiqué at the G8 Summit in Gleneagles U.K., 2005. Available

reached agreement that greenhouse gas emissions should slow, peak and reverse, and that the G8 nations must make "substantial cuts" in greenhouse gas emissions. They also reaffirmed their commitment to the UNFCCC and its objective of stabilizing greenhouse gas concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system.

The EU has already adopted goals for emissions reductions beyond the Kyoto Protocol. The EU has stated its commitment to limiting global surface temperature increases to 2 degrees centigrade above pre-industrial levels.[28] The EU Environment Council concluded in 2005 that to meet this objective in an equitable manner, developed countries should reduce emissions 15-30% below 1990 levels by 2020, and 60-80% below 1990 levels by 2050. A 2005 report from the European Environment Agency concluded that a 2 degree centigrade temperature increase was likely to require that global emissions increases be limited at 35% above 1990 levels by 2020, with a reduction by 2050 of between 15 and 50% below 1990 levels.[29] The EU has committed to emission reductions of 20-30% below 1990 levels by 2020, and reduction targets for 2050 are still under discussion.[30]

5. Legislators, state governmental agencies, shareholders, and corporations are working to reduce greenhouse gas emissions from the United States

There is currently no mandatory federal program requiring greenhouse gas emission reductions. Nevertheless, various federal legislative proposals are under consideration, and President Bush has acknowledged that humans are contributing to global warming. Meanwhile, state and municipal governments (individually and in cooperation), are leading the development and design of climate policy in the United States. Simultaneously, companies in the electric sector, acting on their own initiative or in compliance with state requirements, are beginning to incorporate future climate change policy as a factor in resource planning and investment decisions.

---

at: http://www.g8.gov.uk/servlet/Front?pagename=OpenMarket/Xcelerate/ShowPage&c=Page&cid=1094235520309

[28] Council of the European Union, *Information Note – Brussels March 10, 2005.* http://ue.eu.int/uedocs/cmsUpload/st07242.en05.pdf

[29] European Environment Agency, *Climate Change and a European Low Carbon Energy System,* 2005. EEA Report No 1/2005. ISSN 1725-9177. http://reports.eea.europa.eu/eea_report_2005_1/en/Climate_change-FINAL-web.pdf

[30] Ibid; and European Parliament Press Release "Winning the Battle Against Climate Change" November 17, 2005. http://www.europarl.europa.eu/news/expert/infopress_page/064-2439-320-11-46-911-20051117IPR02438-16-11-2005-2005-false/default_en.htm

5.1 Federal initiatives

With ratification of the United Nations Framework Convention on Climate Change in 1992, the United States agreed to a goal of "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[31] To date, the Federal Government in the United States has not required greenhouse gas emission reductions, and the question of what constitutes a dangerous level of human interference with the climate system remains unresolved. However, legislative initiatives for a mandatory market-based greenhouse gas cap and trade program are under consideration.

To date, the Bush Administration has relied on voluntary action. In July 2005, President Bush changed his public position on causation, acknowledging that the earth is warming and that human actions are contributing to global warming.[32] That summer, the Administration launched a new climate change pact between the United States and five Asian and Pacific nations aimed at stimulating technology development and inducing private investments in low-carbon and carbon-free technologies. The Asia-Pacific Partnership on Clean Development and Climate – signed by Australia, China, India, Japan, South Korea and the United States – brings some of the largest greenhouse gas emitters together; however its reliance on voluntary measures reduces its effectiveness.

The legislative branch has been more active in exploring mandatory greenhouse gas reduction policies. In June 2005, the Senate passed a sense of the Senate resolution recognizing the need to enact a US cap and trade program to slow, stop and reverse the growth of greenhouse gases. [33]

---

[31] The UNFCC was signed by President George H. Bush in 1992 and ratified by the Senate in the same year.

[32] "Bush acknowledges human contribution to global warming; calls for post-Kyoto strategy." Greenwire, July 6, 2005.

[33] US Senate, *Sense of the Senate Resolution on Climate Change,* US Senate Resolution 866; June 22, 2005. Available at: http://energy.senate.gov/public/index.cfm?FuseAction=PressReleases.Detail&PressRelease_id=234715&Month=6&Year=2005&Party=0

Sense of the Senate Resolution – June 2005

> It is the sense of the Senate that, before the end of the 109th Congress, Congress should enact a comprehensive and effective national program of mandatory, market-based limits on emissions of greenhouse gases that slow, stop, and reverse the growth of such emissions at a rate and in a manner that
>
> (1) will not significantly harm the United States economy; and
>
> (2) will encourage complementary action by other nations that are major trading partners and key contributors to global emissions.

This Resolution built upon previous areas of agreement in the Senate, and provides a foundation for future agreement on a cap and trade program. On May 10, 2006 the House Appropriations Committee adopted very similar language supporting a mandatory cap on greenhouse gas emissions in a non-binding amendment to a 2007 spending bill.[34]

Several mandatory emissions reduction proposals have been introduced in Congress. These proposals establish 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 details pertaining to offsets, allowance allocation, restrictions on allowance prices and other issues. Through their consideration of these proposals, legislators are increasingly educated on the complex details of different policy approaches, and they are laying the groundwork for a national mandatory program. Federal proposals that would require greenhouse gas emission reductions are summarized in Table 5.1, below.

[34] "House appropriators OK resolution on need to cap emissions," Greenwire, May 10, 2005.

Table 5.1. Summary of Federal Mandatory Emission Reduction Proposals

Proposed National Policy	Title or Description	Year Proposed	Emission Targets	Sectors Covered
McCain Lieberman S.139	Climate Stewardship Act	2003	Cap at 2000 levels 2010-2015. Cap at 1990 levels beyond 2015.	Economy-wide, large emitting sources
McCain Lieberman SA 2028	Climate Stewardship Act	2003	Cap at 2000 levels	Economy-wide, large emitting sources
National Commission on Energy Policy (basis for Bingaman-Domenici legislative work)	Greenhouse Gas Intensity Reduction Goals	2005	Reduce GHG intensity by 2.4%/yr 2010-2019 and by 2.8%/yr 2020-2025. Safety-valve on allowance price	Economy-wide, large emitting sources
Sen. Feinstein	Strong Economy and Climate Protection Act	2006	Stabilize emissions through 2010; 0.5% cut per year from 2011-15; 1% cut per year from 2016-2020. Total reduction is 7.25% below current levels.	Economy-wide, large emitting sources
Jeffords S. 150	Multi-pollutant legislation	2005	2.050 billion tons beginning 2010	Existing and new fossil-fuel fired electric generating plants >15 MW
Carper S. 843	Clean Air Planning Act	2005	2006 levels (2.655 billion tons CO2) starting in 2009, 2001 levels (2.454 billion tons CO2) starting in 2013.	Existing and new fossil-fuel fired, nuclear, and renewable electric generating plants >25 MW
Rep. Udall - Rep. Petri	Keep America Competitive Global Warming Policy Act	2006	Establishes prospective baseline for greenhouse gas emissions, with safety valve.	Not available

Landmark legislation that would regulate carbon, the Climate Stewardship Act (S.139), was introduced by Senators McCain and Lieberman in 2003, and received 43 votes in the Senate. A companion bill was introduced in the House by Congressmen Olver and Gilchrest. As initially proposed, the bill created an economy-wide two-step cap on greenhouse gas emissions. The bill was reintroduced in the 109th Congress on February 10, 2005; the revised Climate Stewardship Act, SA 2028, would create a national cap and

trade program to reduce CO_2 to year 2000 emission levels over the period 2010 to 2015. Other legislative initiatives on climate change were also under consideration in the spring of 2005, including a proposal by Senator Jeffords (D-VT) to cap greenhouse gas emissions from the electric sector (S. 150), and an electric sector four-pollutant bill from Senator Carper (D-DE) (S. 843).

In 2006, the Senate appears to be moving beyond the question of whether to regulate greenhouse gas emissions, to working out the details of how to regulate greenhouse gas emissions. Senators Domenici (R-NM) and Bingaman (D-NM) are working on bi-partisan legislation based on the recommendations of the National Commission on Energy Policy (NCEP). The NCEP – a bipartisan group of energy experts from industry, government, labor, academia, and environmental and consumer groups – released a consensus strategy in December 2004 to address major long-term US energy challenges. Their report recommends a mandatory economy-wide tradable permits program to limit GHG. Costs would be capped at $7/metric ton of CO_2 equivalent in 2010 with the cap rising 5 percent annually.[35] The Senators are investigating the details of creating a mandatory economy-wide cap and trade system based on mandatory reductions in greenhouse gas intensity (measured in tons of emissions per dollar of GDP). In the spring of 2006, the Senate Energy and Natural Resources Committee held hearings to develop the details of a proposal.[36] During these hearings many companies in the electric power sector, such as Exelon, Duke Energy, and PNM Resources, expressed support for a mandatory national greenhouse gas cap and trade program.[37]

Two other proposals in early 2006 have added to the detail of the increasingly lively discussion of federal climate change strategies. Senator Feinstein (D-CA) issued a proposal for an economy-wide cap and trade system in order to further spur debate on the issue.[38] Senator Feinstein's proposal would cap emissions and seek reductions at levels largely consistent with the original McCain-Lieberman proposal. The most recent proposal to be added to the discussion is one by Reps. Tom Udall (D-NM) and Tom Petri (R-WI). The proposal includes a market-based trading system with an emissions cap to be established by the EPA about three years after the bill becomes law. The bill includes provisions to spur new research and development by setting aside 25 percent of the trading system's allocations for a new Energy Department technology program, and 10 percent of the plan's emission allowances to the State Department for spending on zero-carbon and low-carbon projects in developing nations. The bill would regulate greenhouse gas emissions at "upstream" sources such as coal mines and oil imports. Also,

---

[35] National Commission on Energy Policy, *Ending the Energy Stalemate*, December 2004, pages 19-29.

[36] The Senators have issued a white paper, inviting comments on various aspects of a greenhouse gas regulatory system. See, Senator Pete V. Domenici and Senator Jeff Bingaman, "Design Elements of a Mandatory Market-based Greenhouse Gas Regulatory System," issued February 2, 2006.

[37] All of the comments submitted to the Senate Energy and Natural Resources Committee are available at: http://energy.senate.gov/public/index.cfm?FuseAction=IssueItems.View&IssueItem_ID=38

[38] Letter of Senator Feinstein announcing "Strong Economy and Climate Protection Act of 2006," March 20, 2006.

it would establish a "safety valve" initially limiting the price of a ton of carbon dioxide emission to $25.[39]

Figure 5.1 illustrates the anticipated emissions trajectories from the economy-wide proposals - though the most recent proposal in the House is not included due to its lack of a specified emissions cap.

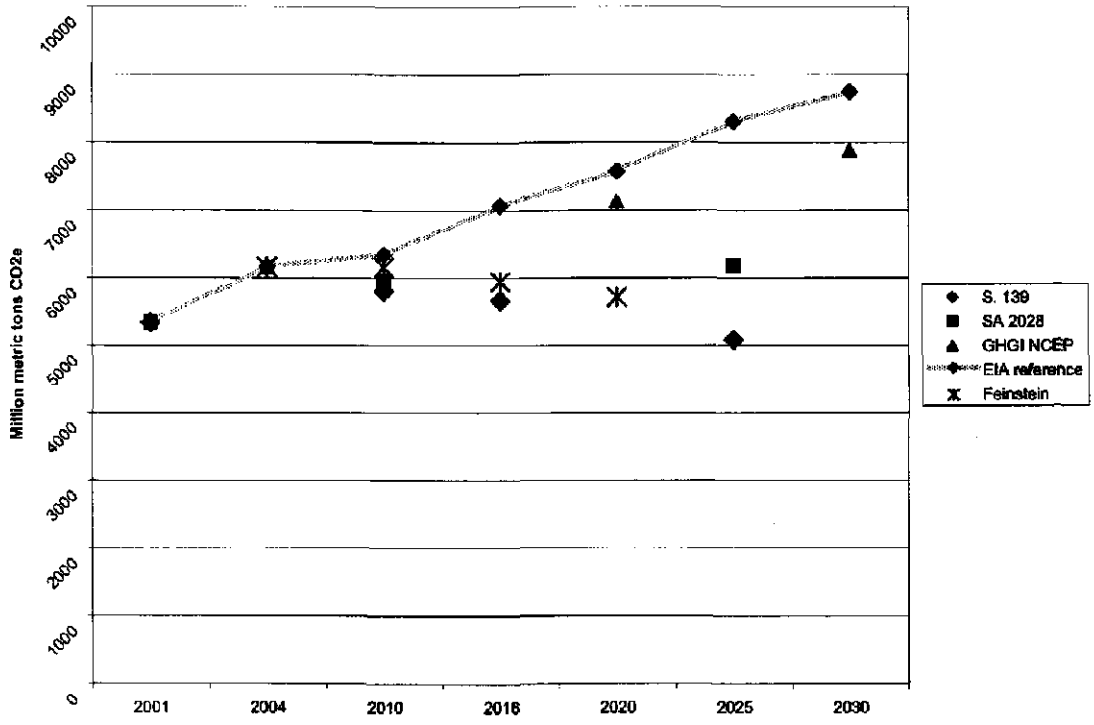


Figure 5.1. Emission Trajectories of Proposed Federal Legislation

Anticipated emissions trajectories from federal proposals for economy-wide greenhouse gas cap and trade proposals (McCain Lieberman S.139 Climate Stewardship Act 2003, McCain-Lieberman SA 2028 Climate Stewardship Act 2005, National Commission on Energy Policy greenhouse gas emissions intensity cap, and Senator Feinstein's Strong Economy and Climate Protection Act). EIA Reference trajectory is a composite of Reference cases in EIA analyses of the above policy proposals.

The emissions trajectories contained in the proposed federal legislation are in fact quite modest compared with emissions reductions that are anticipated to be necessary to achieve stabilization of atmospheric concentrations of greenhouse gases at levels that correspond to temperature increase of about 2 degrees centigrade. Figure 5.2 compares various emission reduction trajectories and goals in relation to a 1990 baseline. US federal proposals, and even Kyoto Protocol reduction targets, are small compared with the current EU emissions reduction target for 2020, and emissions reductions that will ultimately be necessary to cope with global warming.

[39] Press release, "Udall and Petri introduce legislation to curb global warming," March 29, 2006.

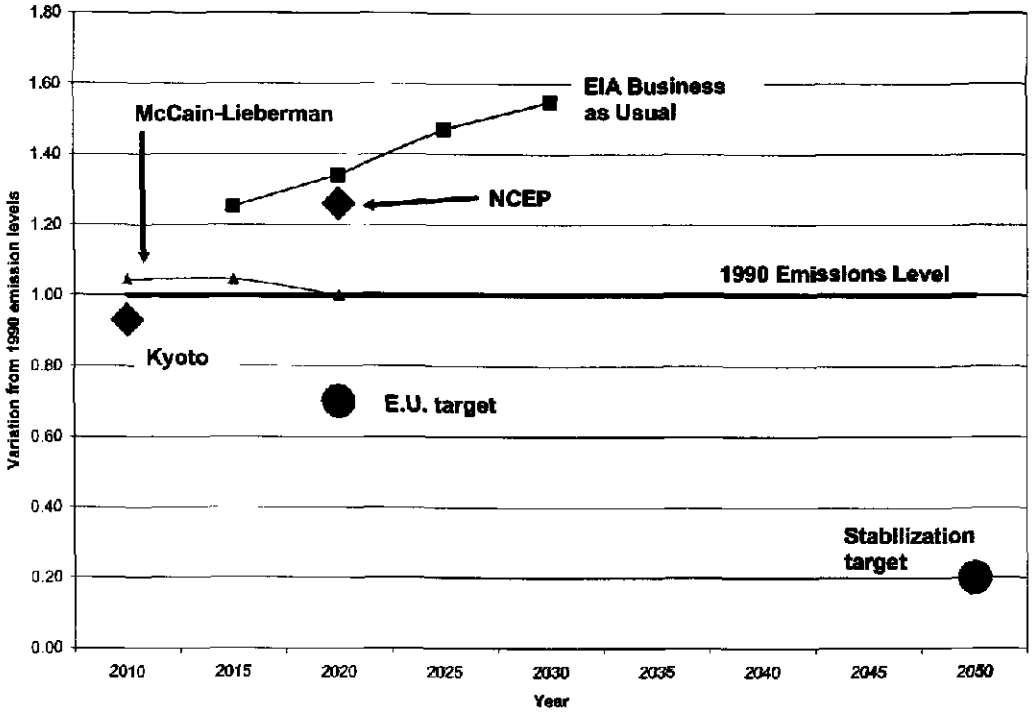


Figure 5.2 Comparison of Emission Reduction Goals

Figure compares emission reduction goals with 1990 as the baseline. Kyoto Protocol target for the United States would have been 7% below 1990 emissions levels. EU target is 20-30% below 1990 emissions levels. Stabilization target represents a reduction of 80% below 1990 levels. While there is no international agreement on the level at which emissions concentrations should be stabilized, and the emissions trajectory to achieve a stabilization target is not determined, reductions of 80% below 1990 levels indicates the magnitude of emissions reductions that are currently anticipated to be necessary.

As illustrated in the above figure, long term emission reduction goals are likely to be much more aggressive than those contained in federal policy proposals to date. Thus it is likely that cost projections will increase as targets become more stringent.

While efforts continue at the federal level, some individual states and regions are adopting their own greenhouse gas mitigation policies. Many corporations are also taking steps, on their own initiative, pursuant to state requirements, or under pressure from shareholder resolutions, in anticipation of mandates to reduce emissions of greenhouse gases. These efforts are described below.

5.2 State and regional policies

Many states across the country have not waited for federal policies and are developing and implementing climate change-related policies that have a direct bearing on resource choices in the electric sector. States, acting individually, and through regional coordination, have been the leaders on climate change policies in the United States. Generally, policies that individual states adopt fall into the following categories: (1) Direct policies that require specific emission reductions from electric generation sources; and (2) Indirect policies that affect electric sector resource mix such as through

promoting low-emission electric sources; (3) Legal proceedings; or (4) Voluntary programs including educational efforts and energy planning.

Table 5.2. Summary of Individual State Climate Change Policies

Type of Policy	Examples
Direct	
• Power plant emission restrictions (e.g. cap or emission rate)	• MA, NH
• New plant emission restrictions	• OR, WA
• State GHG reduction targets	• CT, NJ, ME, MA, CA, NM, NY, OR, WA
• Fuel/generation efficiency	• CA vehicle emissions standards to be adopted by CT, NY, ME, MA, NJ, OR, PA, RI, VT, WA
Indirect (clean energy)	
• Load-based GHG cap	• CA
• GHG in resource planning	• CA, WA, OR, MT, KY
• Renewable portfolio standards	• 22 states and D.C.
• Energy efficiency/renewable charges and funding; energy efficiency programs	• More than half the states
• Net metering, tax incentives	• 41 states
Lawsuits	
• States, environmental groups sue EPA to determine whether greenhouse gases can be regulated under the Clean Air Act	• States include CA, CT, ME, MA, NM, NY, OR, RI, VT, and WI
• States sue individual companies to reduce GHG emissions	• NY, CT, CA, IA, NJ, RI, VT, WI
Climate change action plans	• 28 states, with NC and AZ in progress

Several states have adopted direct policies that require specific emission reductions from specific electric sources. Some states have capped carbon dioxide emissions from sources in the state (through rulemaking or legislation), and some restrict emissions from new sources through offset requirements. The California Public Utilities Commission recently stated that it will develop a load-based cap on greenhouse gas emissions in the electric sector. Table 5.3 summarizes these direct policies.

Table 5.3. State Policies Requiring GHG Emission Reductions From Power Plants

Program type	State	Description	Date	Source
Emissions limit	MA	Department of Environmental Protection decision capping GHG emissions, requiring 10 percent reduction from historic baseline	April 1, 2001	310 C.M.R. 7.29
Emissions limit	NH	NH Clean Power Act	May 1, 2002	HB 284
Emissions limit on new plants	OR	Standard for CO_2 emissions from new electricity generating facilities (base-load gas, and non-base load generation)	Updated September 2003	OR Admin. Rules, Ch. 345, Div 24
Emissions limit on new plants	WA	Law requiring new power plants to mitigate emissions or pay for a portion of emissions	March 1, 2004	RCW 80.70.020
Load-based emissions limit	CA	Public Utilities Commission decision stating intent to establish load-based cap on GHG emissions	February 17, 2006	D. 06-02-032 in docket R. 04-04-003

Several states require that integrated utilities or default service suppliers evaluate costs or risks associated with greenhouse gas emissions in long-range planning or resource procurement. Some of the states such as California require that companies use a specific value, while other states require generally that companies consider the risk of future regulation in their planning process. Table 5.4 summarizes state requirements for consideration of greenhouse gas emissions in the planning process.

Table 5.4. Requirements for Consideration of GHG Emissions in Electric Resource Decisions

Program type	State	Description	Date	Source
GHG value in resource planning	CA	PUC requires that regulated utility IRPs include carbon adder of $8/ton CO_2, escalating at 5% per year.	April 1, 2005	CPUC Decision 05-04-024
GHG value in resource planning	WA	Law requiring that cost of risks associated with carbon emissions be included in Integrated Resource Planning for electric and gas utilities	January, 2006	WAC 480-100-238 and 480-90-238
GHG value in resource planning	OR	PUC requires that regulated utility IRPs include analysis of a range of carbon costs	Year 1993	Order 93-695
GHG value in resource planning	NWPCC	Inclusion of carbon tax scenarios in Fifth Power Plan	May, 2006	NWPCC Fifth Energy Plan
GHG value in resource planning	MN	Law requires utilities to use PUC established environmental externalities values in resource planning	January 3, 1997	Order in Docket No. E-999/CI-93-583
GHG in resource planning	MT	IRP statute includes an "Environmental Externality Adjustment Factor" which includes risk due to greenhouse gases. PSC required Northwestern to account for financial risk of carbon dioxide emissions in 2005 IRP.	August 17, 2004	Written Comments Identifying Concerns with NWE's Compliance with A.R.M. 38.5.8209-8229; Sec. 38.5.8219, A.R.M.
GHG in resource planning	KY	KY staff reports on IRP require IRPs to demonstrate that planning adequately reflects impact of future CO_2 restrictions	2003 and 2006	Staff Report On the 2005 Integrated Resource Plan Report of Louisville Gas and Electric Company and Kentucky Utilities Company - Case 2005-00162, February 2006
GHG in resource planning	UT	Commission directs Pacificorp to consider financial risk associated with potential future regulations, including carbon regulation	June 18, 1992	Docket 90-2035-01, and subsequent IRP reviews
GHG in resource planning	MN	Commission directs Xcel to "provide an expansion of CO2 contingency planning to check the extent to which resource mix changes can lower the cost of meeting customer demand under different forms of regulation."	August 29, 2001	Order in Docket No. RP00-787
GHG in CON	MN	Law requires that proposed non-renewable generating facilities consider the risk of environmental regulation over expected useful life of the facility	2005	Minn. Stat. §216B.243 subd. 3(12)

In June 2005 both California and New Mexico adopted ambitious greenhouse gas emission reduction targets that are consistent with current scientific understanding of the emissions reductions that are likely to be necessary to avoid dangerous human interference with the climate system. In California, an Executive Order directs the state to reduce GHG emissions to 2000 levels by 2010, 1990 levels by 2020, and 80 percent below 1990 levels by 2050. In New Mexico, an Executive Order established statewide goals to reduce New Mexico's total greenhouse gas emissions to 2000 levels by 2012, 10 percent below those levels by 2020, and 75 percent below 2000 levels by 2050. In September 2005 New Mexico also adopted a legally binding agreement to lower emissions through the Chicago Climate Exchange. More broadly, to date at least twenty-eight states have developed Climate Action Plans that include statewide plans for addressing climate change issues. Arizona and North Carolina are in the process of developing such plans.

States are also pursuing other approaches. For example, in November 2005, the governor of Pennsylvania announced a new program to modernize energy infrastructure through replacement of traditional coal technology with advanced coal gasification technology. Energy Deployment for a Growing Economy allows coal plant owners a limited time to continue to operate without updated emissions technology as long as they make a commitment by 2007 to replace older plants with IGCC by 2013.[40] In September of 2005 the North Carolina legislature formed a commission to study and make recommendations on voluntary GHG emissions controls. In October 2005, New Jersey designated carbon dioxide as a pollutant, a necessary step for the state's participation in the Regional Greenhouse Gas Initiative (described below).[41]

Finally, states are pursuing legal proceedings addressing greenhouse gas emissions. Many states have participated in one or several legal proceedings to seek greenhouse gas emission reductions from some of the largest polluting power plants. Some states have also sought a legal determination regarding regulation of greenhouse gases under the Clean Air Act. The most recent case involves 10 states and two cities suing the Environmental Protection Agency to determine whether greenhouse gases can be regulated under the Clean Air Act.[42] The states argue that EPA's recent emissions standards for new sources should include carbon dioxide since carbon dioxide, as a major contributor to global warming, harms public health and welfare, and thus falls within the scope of the Clean Air Act.

While much of the focus to date has been on the electric sector, states are also beginning to address greenhouse gas emissions in other sectors. For example, California has

[40] Press release, "Governor Rendell's New Initiative, 'The Pennsylvania EDGE,' Will Put Commonwealth's Energy Resources to Work to Grow Economy, Clean Environment," November 28, 2005.

[41] Press release, "Codey Takes Crucial Step to Combat Global Warming," October 18, 2005.

[42] The states are CA, CT, ME, MA, NM, NY, OR, RI, VT, and WI. New York City and Washington D.C., as well as the Natural Resources Defense Council, the Sierra Club, and Environmental Defense. New York State Attorney General Eliot Spitzer, "States Sue EPA for Violating Clean Air Act and Failing to Act on Global Warming," press release, April 27, 2006.

adopted emissions standards for vehicles that would restrict carbon dioxide emissions. Ten other states have decided to adopt California's vehicle emissions standards.

States are not just acting individually; there are several examples of innovative regional policy initiatives that range from agreeing to coordinate information (e.g. Southwest governors, and Midwestern legislators) to development of a regional cap and trade program through the Regional Greenhouse Gas Initiative in the Northeast. These regional activities are summarized in Table 5.5, below.

Table 5.5. Regional Climate Change Policy Initiatives

Program type	State	Description	Date	Source
Regional GHG reduction Plan	CT, DE, MD, ME, NH, NJ, NY, VT	Regional Greenhouse Gas Initiative capping GHG emissions in the region and establishing trading program	MOU December 20, 2005, Model Rule February 2006	Memorandum of Understanding and Model Rule
Regional GHG reduction Plan	CA, OR, WA	West Coast Governors' Climate Change Initiative	September 2003, Staff report November 2004	Staff Report to the Governors
Regional GHG coordination	NM, AZ	Southwest Climate Change Initiative	February 28, 2006	Press release
Regional legislative coordination	IL, IA, MI, MN, OH, WI	Legislators from multiple states agree to coordinate regional initiatives limiting global warming pollution	February 7, 2006	Press release
Regional Climate Change Action Plan	New England, Eastern Canada	New England Governors and Eastern Canadian Premiers agreement for comprehensive regional Climate Change Action Plan. Targets are to reduce regional GHG emissions to 1990 levels by 2010, at least 10 percent below 1990 levels by 2020, and long-term reduction consistent with elimination of dangerous threat to climate (75-85 percent below current levels).	August, 2001	Memorandum of Understanding

Seven Northeastern and Mid-Atlantic states (CT, DE, ME, NH, NJ, NY, and VT) reached agreement in December 2005 on the creation of a regional greenhouse gas cap and trade program. The Regional Greenhouse Gas Initiative (RGGI) is a multi-year cooperative effort to design a regional cap and trade program initially covering CO_2 emissions from power plants in the region. Massachusetts and Rhode Island have actively participated in RGGI, but have not yet signed the agreement. Collectively, these states and Massachusetts and Rhode Island (which participated in RGGI negotiations) contribute 9.3 percent of total US CO_2 emissions and together rank as the fifth highest CO_2 emitter

in the world. Maryland passed a law in April 2006 requiring participation in RGGI.[43] Pennsylvania, the District of Columbia, the Eastern Canadian Provinces, and New Brunswick are official "observers" in the RGGI process.[44]

The RGGI states have agreed to the following:

- Stabilization of CO_2 emissions from power plants at current levels for the period 2009-2015, followed by a 10 percent reduction below current levels by 2019.
- Allocation of a minimum of 25 percent of allowances for consumer benefit and strategic energy purposes
- Certain offset provisions that increase flexibility to moderate price impacts
- Development of complimentary energy policies to improve energy efficiency, decrease the use of higher polluting electricity generation and to maintain economic growth.[45]

The states released a Model Rule in February 2006. The states must next consider adoption of rules consistent with the Model Rule through their regular legislative and regulatory policies and procedures.

Many cities and towns are also adopting climate change policies. Over 150 cities in the United States have adopted plans and initiatives to reduce emissions of greenhouse gases, setting emissions reduction targets and taking measures within municipal government operations. Climate change was a major issue at the annual US Conference of Mayors convention in June 2005, when the Conference voted unanimously to support a climate protection agreement, which commits cities to the goal of reducing emissions seven percent below 1990 levels by 2012.[46] World-wide, the Cities for Climate Protection Campaign (CCP), begun in 1993, is a global campaign to reduce emissions that cause climate change and air pollution. By 1999, the campaign had engaged more than 350 local governments in this effort, who jointly accounted for approximately seven percent of global greenhouse gas emissions.[47]All of these recent activities contribute to growing pressure within the United States to adopt regulations at a national level to reduce the emissions of greenhouse gases, particularly CO_2. This pressure is likely to increase over time as climate change issues and measures for addressing them become better

---

[43] Maryland Senate Bill 154 *Healthy Air Act*, signed April 6, 2006.

[44] Information on this effort is available at www.rggi.org

[45] The MOU states "Each state will maintain and, where feasible, expand energy policies to decrease the use of less efficient or relatively higher polluting generation while maintaining economic growth. These may include such measures as: end-use efficiency programs, demand response programs, distributed generation policies, electricity rate designs, appliance efficiency standards and building codes. Also, each state will maintain and, where feasible, expand programs that encourage development of non-carbon emitting electric generation and related technologies." RGGI MOU, Section 7, December 20, 2005.

[46] the US Mayors Climate Protection Agreement, 2005. Information available at http://www.ci.seattle.wa.us/mayor/climate

[47] Information on the Cities for Climate Protection Campaign, including links to over 150 cities that have adopted greenhouse gas reduction measures, is available at http://www.iclei.org/projserv.htm#ccp

understood by the scientific community, by the public, the private sector, and particularly by elected officials.

5.3 Investor and corporate action

Several electric companies and other corporate leaders have supported the concept of a mandatory greenhouse gas emissions program in the United States. For example, in April 2006, the Chairman of Duke Energy, Paul Anderson, stated:

> From a business perspective, the need for mandatory federal policy in the United States to manage greenhouse gases is both urgent and real. In my view, voluntary actions will not get us where we need to be. Until business leaders know what the rules will be – which actions will be penalized and which will be rewarded – we will be unable to take the significant actions the issue requires.[48]

Similarly, in comments to the Senate Energy and Natural Resources Committee, the vice president of Exelon reiterated the company's support for a federal mandatory carbon policy, stating that "It is critical that we start now. We need the economic and regulatory certainty to invest in a low-carbon energy future."[49] Corporate leaders from other sectors are also increasingly recognizing climate change as a significant policy issue that will affect the economy and individual corporations. For example, leaders from Wal-Mart, GE, Shell, and BP, have all taken public positions supporting the development of mandatory climate change policies.[50]

In a 2004 national survey of electric generating companies in the United States, conducted by PA Consulting Group, about half the respondents believe that Congress will enact mandatory limits on CO_2 emissions within five years, while nearly 60 percent anticipate mandatory limits within the next 10 years. Respondents represented companies that generate roughly 30 percent of US electricity.[51] Similarly, in a 2005 survey of the North American electricity industry, 93% of respondents anticipate increased pressure to take action on global climate change.[52]

---

[48] Paul Anderson, Chairman, Duke Energy, "Being (and Staying in Business): Sustainability from a Corporate Leadership Perspective," April 6, 2006 speech to CERES Annual Conference, at: http://www.duke-energy.com/news/mediainfo/viewpoint/PAnderson_CERES.pdf

[49] Elizabeth Moler, Exelon V.P., to the Senate Energy and Natural Resources Committee, April 4, 2006, quoted in Grist, http://www.grist.org/news/muck/2006/04/14/griscom-little/

[50] See, e.g., Raymond Bracy, V.P. for Corporate Affairs, Wal-Mart, Comments to Senate Energy and Natural Resources Committee hearings on the design of CO2 cap-and-trade system, April 4, 2006; David Slump, GE Energy, General Manager, Global Marketing, Comments to Senate Energy and Natural Resources Committee hearings on the design of CO2 cap-and-trade system, April 4, 2006; John Browne, CEO of BP, "Beyond Kyoto," Foreign Affairs, July/August 2004; Shell company website at www.shell.com.

[51] PA Consulting Group, "Environmental Survey 2004" Press release, October 22, 2004.

[52] GF Energy, "GF Energy 2005 Electricity Outlook" January 2005. However, it is interesting to note that climate ranked 11th among issues deemed important to individual companies.

Some investors and corporate leaders have taken steps to manage risk associated with climate change and carbon policy. Investors are gradually becoming aware of the financial risks associated with climate change, and there is a growing body of literature regarding the financial risks to electric companies and others associated with climate change. Many investors are now demanding that companies take seriously the risks associated with carbon emissions. Shareholders have filed a record number of global warming resolutions for 2005 for oil and gas companies, electric power producers, real estate firms, manufacturers, financial institutions, and auto makers.[53] The resolutions request financial risk disclosure and plans to reduce greenhouse gas emissions. Four electric utilities – AEP, Cinergy, TXU and Southern – have all released reports on climate risk following shareholder requests in 2004. In February 2006, four more US electric power companies in Missouri and Wisconsin also agreed to prepare climate risk reports.[54]

State and city treasurers, labor pension fund officials, and foundation leaders have formed the Investor Network on Climate Risk (INCR) which now includes investors controlling $3 trillion in assets. In 2005, the INCR issued "A New Call for Action: Managing Climate Risk and Capturing the Opportunities," which discusses efforts to address climate risk since 2003 and identifies areas for further action. It urges institutional investors, fund managers, companies, and government policymakers to increase their oversight and scrutiny of the investment implications of climate change.[55] A 2004 report cites analysis indicating that carbon constraints affect market value – with modest greenhouse gas controls reducing the market capitalization of many coal-dependent US electric utilities by 5 to 10 percent, while a more stringent reduction target could reduce their market value 10 to 35 percent. [56] The report recommends, as one of the steps that company CEOs should pursue, integrating climate policy in strategic business planning to maximize opportunities and minimize risks.

Institutional investors have formed The Carbon Disclosure Project (CDP), which is a forum for institutional investors to collaborate on climate change issues. Its mission is to inform investors regarding the significant risks and opportunities presented by climate change; and to inform company management regarding the serious concerns of shareholders regarding the impact of these issues on company value. Involvement with the CDP tripled in about two and a half years, from $10 trillion under managements in

---

[53] "US Companies Face Record Number of Global Warming Shareholder Resolutions on Wider Range of Business Sectors," CERES press release, February 17, 2005.

[54] "Four Electric Power Companies in Midwest Agree to Disclose Climate Risk," CERES press release February 21, 2006. Companies are Great Plains Energy Inc. in Kansas City, MO, Alliant Energy in Madison, WI, WPS Resources in Green Bay, WI and MGE Energy in Madison, WI.

[55] 2005 Institutional Investor Summit, "A New Call for Action: Managing Climate Risk and Capturing the Opportunities," May 10, 2005. The Final Report from the 2003 Institutional Investors Summit on Climate Risk, November 21, 2003 contains good summary information on risk associated with climate change.

[56] Cogan, Douglas G.; "Investor Guide to Climate Risk: Action Plan and Resource for Plan Sponsors, Fund Managers, and Corporations;" Investor Responsibility Research Center; July 2004 citing Frank Dixon and Martin Whittaker, "Valuing Corporate Environmental Performance: Innovest's Evaluation of the Electric Utilities Industry," New York, 1999.

Nov. 2003 to $31 trillion under management today.[57] The CDP released its third report in September 2005. This report continued the trend in the previous reports of increased participation in the survey, and demonstrated increasing awareness of climate change and of the business risks posed by climate change. CDP traces the escalation in scope and awareness – on behalf of both signatories and respondents – to an increased sense of urgency with respect to climate risk and carbon finance in the global business and investment community. [58]

Findings in the third CDP report included:

- More than 70% of FT500 companies responded to the CDP information request, a jump from 59% in CDP2 and 47% in CDP1.[59]
- More than 90% of the 354 responding FT500 companies flagged climate change as posing commercial risks and/or opportunities to their business.
- 86% reported allocating management responsibility for climate change.
- 80% disclosed emissions data.
- 63% of FT500 companies are taking steps to assess their climate risk and institute strategies to reduce greenhouse gas emissions.[60]

The fourth CDP information request (CDP4) was sent on behalf of 211 institutional investors with significant assets under management to the Chairmen of more than 1900 companies on February 1, 2006, including 300 of the largest electric utilities globally.

The California Public Employees' Retirement System (CalPERS) announced that it will use the influence made possible by its $183 billion portfolio to try to convince companies it invests in to release information on how they address climate change. The CalPERS board of trustees voted unanimously for the environmental initiative, which focuses on the auto and utility sectors in addition to promoting investment in firms with good environmental practices.[61]

Major financial institutions have also begun to incorporate climate change into their corporate policy. For example, Goldman Sachs and JP Morgan support mandatory market-based greenhouse gas reduction policies, and take greenhouse gas emissions into account in their financial analyses. Goldman Sachs was the first global investment bank to adopt a comprehensive environmental policy establishing company greenhouse gas

---

[57] See: http://www.cdproject.net/aboutus.asp

[58] Innovest Strategic Value Advisors; "Climate Change and Shareholder Value In 2004," second report of the Carbon Disclosure Project; Innovest Strategic Value Advisors and the Carbon Disclosure Project; May 2004.

[59] FT 500 is the Financial Times' ranking of the top 500 companies ranked globally and by sector based on market capital.

[60] CDP press release, September 14, 2005. Information on the Carbon Disclosure Project, including reports, are available at: http://www.cdproject.net/index.asp.

[61] *Greenwire*, February 16, 2005

reduction targets and supporting a national policy to limit greenhouse gas emissions. [62] JP Morgan, Citigroup, and Bank of America have all adopted lending policies that cover a variety of project impacts including climate change.

Some CEOs in the electric industry have determined that inaction on climate change issues is not good corporate strategy, and individual electric companies have taken steps to reduce greenhouse gas emissions. Their actions represent increasing initiative in the electric industry to address the threat of climate change and manage risk associated with future carbon constraints. Recently, eight US-based utility companies have joined forces to create the "Clean Energy Group." This group's mission is to seek "national four-pollutant legislation that would, among other things... stabilize carbon emissions at 2001 levels by 2013."[63] The President of Duke Energy urges a federal carbon tax, and states that Duke should be a leader on climate change policy.[64] Prior to its merger with Duke, Cinergy Corporation was vocal on its support of mandatory national carbon regulation. Cinergy established a target is to produce 5 percent below 2000 levels by 2010 – 2012. AEP adopted a similar target. FPL Group and PSEG are both aiming to reduce total emissions by 18 percent between 2000 and 2008.[65] A fundamental impediment to action on the part of electric generating companies is the lack of clear, consistent, national guidelines so that companies could pursue emissions reductions without sacrificing competitiveness.

While statements such as these are an important first step, they are only a starting point, and do not, in and of themselves, cause reductions in carbon emissions. It is important to keep in mind the distinction between policy statements and actions consistent with those statements.

6. Anticipating the cost of reducing carbon emissions in the electric sector

Uncertainty about the form of future greenhouse gas reduction policies poses a planning challenge for generation-owning entities in the electric sector, including utilities and non-utility generators. Nevertheless, it is not reasonable or prudent to assume in resource planning that there is no cost or financial risk associated with carbon dioxide emissions, or with other greenhouse gas emissions. There is clear evidence of climate change, federal legislation has been under discussion for the past few years, state and regional regulatory efforts are currently underway, investors are increasingly pushing for companies to address climate change, and the electric sector is likely to constitute one of

---

[62] Goldman Sachs Environmental Policy Framework, http://www.gs.com/our_firm/our_culture/corporate_citizenship/environmental_policy_framework/docs/EnvironmentalPolicyFramework.pdf

[63] Jacobson, Sanne, Neil Numark and Paloma Sarria, "Greenhouse Gas Emissions: A Changing US Climate," *Public Utilities Fortnightly*, February 2005.

[64] Paul M. Anderson Letter to Shareholders, March 15, 2005.

[65] Ibid.

the primary elements of any future regulatory plan. Analyses of various economy-wide policies indicate that a majority of emissions reductions will come from the electric sector. In this context and policy climate, utilities and non-utility generators must develop a reasoned assessment of the costs associated with expected emissions reductions requirements. Including this assessment in the evaluation of resource options enables companies to judge the robustness of a plan under a variety of potential circumstances.

This is particularly important in an industry where new capital stock usually has a lifetime of 50 or more years. An analysis of capital cycles in the electric sector finds that "external market conditions are the most significant influence on a firm's decision to invest in or decommission large pieces of physical capital stock.[66] Failure to adequately assess market conditions, including the potential cost increases associated with likely regulation, poses a significant investment risk for utilities. It would be imprudent for any company investing in plants in the electric sector, where capital costs are high and assets are long-lived, to ignore policies that are inevitable in the next five to twenty years. Likewise, it would be short-sighted for a regulatory entity to accept the valuation of carbon emissions at no cost.

Evidence suggests that a utility's overall compliance decisions will be more efficient if based on consideration of several pollutants at once, rather than addressing pollutants separately. For example, in a 1999 study EPA found that pollution control strategies to reduce emissions of nitrogen oxides, sulfur dioxide, carbon dioxide, and mercury are highly inter-related, and that the costs of control strategies are highly interdependent.[67] The study found that the total costs of a coordinated set of actions is less than that of a piecemeal approach, that plant owners will adopt different control strategies if they are aware of multiple pollutant requirements, and that combined SO_2 and carbon emissions reduction options lead to further emissions reductions.[68] Similarly, in one of several studies on multi-pollutant strategies, the Energy Information Administration (EIA) found that using an integrated approach to NO_x, SO_2, and CO_2, is likely to lead to lower total costs than addressing pollutants one at a time.[69] While these studies clearly indicate that federal emissions policies should be comprehensive and address multiple pollutants, they also demonstrate the value of including future carbon costs in current resource planning activities.

There are a variety of sources of information that form a basis for developing a reasonable estimate of the cost of carbon emissions for utility planning purposes. Useful sources include recent market transactions in carbon markets, values that are currently being used in utility planning, and costs estimates based on scenario modeling of proposed federal legislation and the Regional Greenhouse Gas Initiative.

---

[66] Lempert, Popper, Resitar and Hart, "Capital Cycles and the Timing of Climate Change Policy." Pew Center on Global Climate Change, October 2002. page

[67] US EPA, *Analysis of Emissions Reduction Options for the Electric Power Industry,* March 1999.

[68] US EPA, *Briefing Report*, March 1999.

[69] EIA, *Analysis of Strategies for Reducing Multiple Emissions from Power Plants: Sulfur Dioxide, Nitrogen Oxides, and Carbon Dioxide.* December 2000.

6.1 International market transactions

Implementation of the Kyoto Protocol has moved forward with great progress in recent years. Countries in the European Union (EU) are now trading carbon in the first international emissions market, the EU Emissions Trading Scheme (ETS), which officially launched on January 1, 2005. This market, however, was operating before that time – Shell and Nuon entered the first trade on the ETS in February 2003. Trading volumes increased steadily throughout 2004 and totaled approximately 8 million tons CO_2 in that year. [70]

Prices for current- and near-term EU allowances (2006-2007) escalated sharply in 2005, rising from roughly \$11/ton CO_2 (9 euros/ton-CO_2) in the second half of 2004 and leveling off at about \$36/ton CO_2 (28 euros/ton- CO_2) early in 2006. In March 2006, the market price for 2008 allowances hovered at around \$32/ton CO_2 (25 euros/ton- CO_2).[71] Lower prices in late April resulted from several countries' announcements that their emissions were lower than anticipated. The EU member states will submit their carbon emission allocation plans for the period 2008-2012 in June. Market activity to date in the EU Emissions trading system illustrates the difficulty of predicting carbon emissions costs, and the financial risk potentially associated with carbon emissions.

With the US decision not to ratify the Kyoto Protocol, US businesses are unable to participate in the international markets, and emissions reductions in the United States have no value in international markets. When the United States does adopt a mandatory greenhouse gas policy, the ability of US businesses and companies to participate in international carbon markets will be affected by the design of the mandatory program. For example, if the mandatory program in the United States includes a safety valve price, it may restrict participation in international markets.[72]

6.2 Values used in electric resource planning

Several companies in the electric sector evaluate the costs and risks associated with carbon emissions in resource planning. Some of them do so at their own initiative, as part of prudent business management, others do so in compliance with state law or regulation.

Some states require companies under their jurisdiction to account for costs and/or risks associated with regulation of greenhouse gas emissions in resource planning. These states include California, Oregon, Washington, Montana, Kentucky (through staff reports), and Utah. Other states, such as Vermont, require that companies take into account environmental costs generally. The Northwest Power and Conservation Council

---

[70] "What determines the Price of Carbon," Carbon Market Analyst, *Point Carbon*, October 14, 2004.

[71] These prices are from Evolution Express trade data, http://www.evomarkets.com/, accessed on 3/31/06.

[72] See, e.g. Pershing, Jonathan, Comments in Response to Bingaman-Domenici Climate Change White Paper, March 13, 2006. Sandalow, David, Comments in Response to Bingaman-Domenici Climate Change White Paper, The Brookings Institution, March 13, 2006.

includes various carbon scenarios in its Fifth Power Plan. For more information on these requirements, see the section above on state policies.[73]

California has one of the most specific requirements for valuation of carbon in integrated resource planning. The California Public Utilities Commission (PUC) requires companies to include a carbon adder in long-term resource procurement plans. The Commission's decision requires the state's largest electric utilities (Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric) to factor the financial risk associated with greenhouse gas emissions into new long-term power plant investments, and long-term resource plans. The Commission initially directed utilities to include a value between \$8–25/ton CO_2 in their submissions, and to justify their selection of a number.[74] In April 2005, the Commission adopted, for use in resource planning and bid evaluation, a CO_2 adder of \$8 per ton of CO_2 in 2004, escalating at 5% per year.[75] The Montana Public Service Commission specifically directed Northwest Energy to evaluate the risks associated with greenhouse gas emissions in its 2005 Integrated Resource Plan (IRP).[76] In 2006 the Oregon Public Utilities Commission (PUC) will be investigating its long-range planning requirements, and will consider whether a specific carbon adder should be required in the base case (Docket UM 1056).

Several electric utilities and electric generation companies have incorporated assumptions about carbon regulation and costs in their long term planning, and have set specific agendas to mitigate shareholder risks associated with future US carbon regulation policy. These utilities cite a variety of reasons for incorporating risk of future carbon regulation as a risk factor in their resource planning and evaluation, including scientific evidence of human-induced climate change, the US electric sector emissions contribution to emissions, and the magnitude of the financial risk of future greenhouse gas regulation.

Some of the companies believe that there is a high likelihood of federal regulation of greenhouse gas emissions within their planning period. For example, Pacificorp states a 50% probability of a CO_2 limit starting in 2010 and a 75% probability starting in 2011. The Northwest Power and Conservation Council models a 67% probability of federal regulation in the twenty-year planning period ending 2025 in its resource plan. Northwest Energy states that CO_2 taxes "are no longer a remote possibility."[77] Table 6.1 illustrates the range of carbon cost values, in \$/ton CO_2, that are currently being used in the industry for both resource planning and modeling of carbon regulation policies.

---

[73] For a discussion of the use of carbon values in integrated resource planning see, Wiser, Ryan, and Bolinger, Mark; *Balancing Cost and Risk: The Treatment of Renewable Energy in Western Utility Resource Plans;* Lawrence Berkeley National Laboratories; August 2005. LBNL-58450

[74] California Public Utilities Commission, Decision 04-12-048, December 16, 2004

[75] California Public Utilities Commission, Decision 05-04-024, April 2005.

[76] Montana Public Service Commission, "Written Comments Identifying Concerns with NWE's Compliance with A.R.M. 38.5.8209-8229," August 17, 2004.

[77] Northwest Energy 2005 Electric Default Supply Resource Procurement Plan, December 20, 2005; Volume 1, p. 4.

Table 6.1 CO_2 Costs in Long Term Resource Plans

Company	CO2 emissions trading assumptions for various years ($2005)
PG&E*	$0-9/ton (start year 2006)
Avista 2003*	$3/ton (start year 2004)
Avista 2005	$7 and $25/ton (2010) $15 and $62/ton (2026 and 2023)
Portland General Electric*	$0-55/ton (start year 2003)
Xcel-PSCCo	$9/ton (start year 2010) escalating at 2.5%/year
Idaho Power*	$0-61/ton (start year 2008)
Pacificorp 2004	$0-55/ton
Northwest Energy 2005	$15 and $41/ton
Northwest Power and Conservation Council	$0-15/ton between 2008 and 2016 $0-31/ton after 2016

**Values for these utilities from Wiser, Ryan, and Bolinger, Mark. "Balancing Cost and Risk: The Treatment of Renewable Energy in Western Utility Resource Plans." Lawrence Berkeley National Laboratories. August 2005. LBNL-58450. Table 7.*
Other values: PacifiCorp, Integrated Resource Plan 2003, pages 45-46; and Idaho Power Company, 2004 Integrated Resource Plan Draft, July 2004, page 59; Avista Integrated Resource Plan 2005, Section 6.3; Northwestern Energy Integrated Resource Plan 2005, Volume 1 p. 62; Northwest Power and Conservation Council, Fifth Power Plan pp. 6-7. Xcel-PSCCo, Comprehensive Settlement submitted to the CO PUC in dockets 04A-214E, 215E and 216E, December 3, 2004. Converted to $2005 using GDP implicit price deflator.

These early efforts by utilities have brought consideration of the risks associated with future carbon regulations into the mainstream in resource planning the electric sector.

6.3 Analyses of carbon emissions reduction costs

With the emergence of federal policy proposals in the United States in the past several years, there have been several policy analyses that project the cost of carbon-dioxide equivalent emission allowances under different policy designs. These studies reveal a range of cost estimates. While it is not possible to pinpoint emissions reduction costs given current uncertainties about the goal and design of carbon regulation as well as the inherent uncertainties in any forecast, the studies provide a useful source of information for inclusion in resource decisions. In addition to establishing ranges of cost estimates, the studies give a sense of which factors affect future costs of reducing carbon emissions.

There have been several studies of proposed federal cap and trade programs in the United States. Table 6.2 identifies some of the major recent studies of carbon policy proposals.

Table 6.2. Analyses of US Carbon Policy Proposals

Policy proposal	Analysis
McCain Lieberman – S. 139	EIA 2003, MIT 2003, Tellus 2003
McCain Lieberman – SA 2028	EIA 2004, MIT 2003, Tellus 2004
Greenhouse Gas Intensity Targets	EIA 2005, EIA 2006
Jeffords – S. 150	EPA 2005
Carper 4-P – S. 843	EIA 2003, EPA 2005

Both versions of the McCain and Lieberman proposal (also known as the Climate Stewardship Act) were the subject of analyses by EIA, MIT, and the Tellus Institute. As originally proposed, the McCain Lieberman legislation capped 2010 emissions at 2000 levels, with a reduction in 2016 to 1990 levels. As revised, McCain Lieberman just included the initial cap at 2000 levels without a further restriction. In its analyses, EIA ran several sensitivity cases exploring the impact of technological innovation, gas prices, allowance auction, and flexibility mechanisms (banking and international offsets).[78]

In 2003 researchers at the Massachusetts Institute of Technology also analyzed potential costs of the McCain Lieberman legislation.[79] MIT held emissions for 2010 and beyond at 2000 levels (not modeling the second step of the proposed legislation). Due to constraints of the model, the MIT group studied an economy-wide emissions limit rather than a limit on the energy sector. A first set of scenarios considers the cap tightening in Phase II and banking. A second set of scenarios examines the possible effects of outside credits. And a final set examines the effects of different assumptions about baseline gross domestic product (GDP) and emissions growth.

The Tellus Institute conducted two studies for the Natural Resources Defense Council of the McCain Lieberman proposals (July 2003 and June 2004).[80] In its analysis of the first proposal (S. 139), Tellus relied on a modified version of the National Energy Modeling System that used more optimistic assumptions for energy efficiency and renewable energy technologies based on expert input from colleagues at the ACEEE, the Union of Concerned Scientists, the National Laboratories and elsewhere. Tellus then modeled two policy cases. The "Policy Case" scenario included the provisions of the Climate Stewardship Act (S.139) as well as oil savings measures, a national renewable transportation fuel standard, a national RPS, and emissions standards contained in the Clean Air Planning Act. The "Advanced Policy Case" included the same complimentary energy policies as the "Policy Case" and assumed additional oil savings in the

[78] Energy Information Administration, *Analysis of S. 139, the Climate Stewardship Act of 2003*, EIA June 2003, SR/OIAF/2003-02; Energy Information Administration, *Analysis of Senate Amendment 2028, the Climate Stewardship Act of 2003*, EIA May 2004, SR/OIAF/2004-06

[79] Paltsev, Sergei; Reilly, John M.; Jacoby, Henry D.; Ellerman, A. Denny; Tay, Kok Hou; *Emissions Trading to Reduce Greenhouse Gas Emissions in the United States: the McCain-Lieberman Proposal.* MIT Joint Program on the Science and Policy of Global Change; Report No. 97; June 2003.

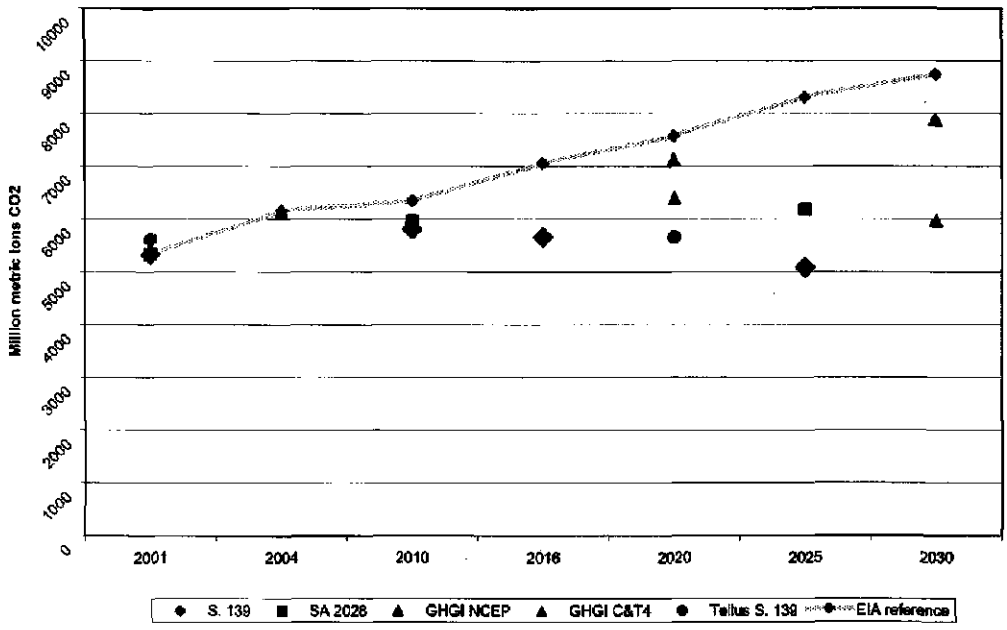
[80] Bailie et al., *Analysis of the Climate Stewardship Act,* July 2003; Bailie and Dougherty, *Analysis of the Climate Stewardship Act Amendment*, Tellus Institute, June, 2004. Available at http://www.tellus.org/energy/publications/McCainLieberman2004.pdf

transportation sector from increase the fuel efficiency of light-duty vehicles (CAFÉ) (25 mpg in 2005, increasing to 45 mpg in 2025).

EIA has also analyzed the effect and cost of greenhouse gas intensity targets as proposed by Senator Bingaman based on the National Commission on Energy Policy, as well as more stringent intensity targets.[81] Some of the scenarios included safety valve prices, and some did not.

In addition to the analysis of economy-wide policy proposals, proposals for GHG emissions restrictions have also been analyzed. Both EIA and the U.S. Environmental Protection Agency (EPA) analyzed the four-pollutant policy proposed by Senator Carper (S. 843).[82] EPA also analyzed the power sector proposal from Senator Jeffords (S. 150).[83]

Figure 6.1 shows the emissions trajectories that the analyses of economy-wide policies projected for specific policy proposals. The graph does not include projections for policies that would just apply to the electric sector since those are not directly comparable to economy-wide emissions trajectories.



[81] EIA, *Energy Market Impacts of Alternative Greenhouse Gas Intensity Reduction Goals,* March 2006. SR/OIAF/2006-01.

[82] EIA. Analysis of S. 485, the Clear Skies Act of 2003, and S. 843, the Clean Air Planning Act of 2003. EIA Office of Integrated Analysis and Forecasting. SR/OIAF/2003-03. September 2003. US EPA, *Multi-pollutant Legislative Analysis: The Clean Power Act (Jeffords, S. 150 in the 109th).* US EPA Office of Air and Radiation, October 2005.

[83] US Environmental Protection Agency, *Multi-pollutant Legislative Analysis: The Clean Air Planning Act (Carper, S. 843 in the 108th).* US EPA Office of Air and Radiation, October 2005.

Figure 6.1. Projected Emissions Trajectories for US Economy-wide Carbon Policy Proposals.

Projected emissions trajectories from EIA and Tellus Institute Analyses of US economy-wide carbon policies. Emissions projections are for "affected sources" under proposed legislation. S. 139 is the EIA analysis of McCain Lieberman Climate Stewardship Act from 2003, SA 2028 is the EIA analysis of McCain Lieberman Climate Stewardship Act as amended in 2005. GHGI NCEP is the EIA analysis of greenhouse gas intensity targets recommended by the National Commission on Energy Policy and endorsed by Senators Bingaman and Domenici, GHGIC&T4 is the most stringent emission reduction target modeled by EIA in its 2006 analysis of greenhouse gas intensity targets, and Tellus S.139 is from the Tellus Institute analysis of S. 139.

Figure 6.2 presents projected carbon allowance costs from the economy-wide and electric sector studies in constant 2005 dollars per ton of carbon dioxide.

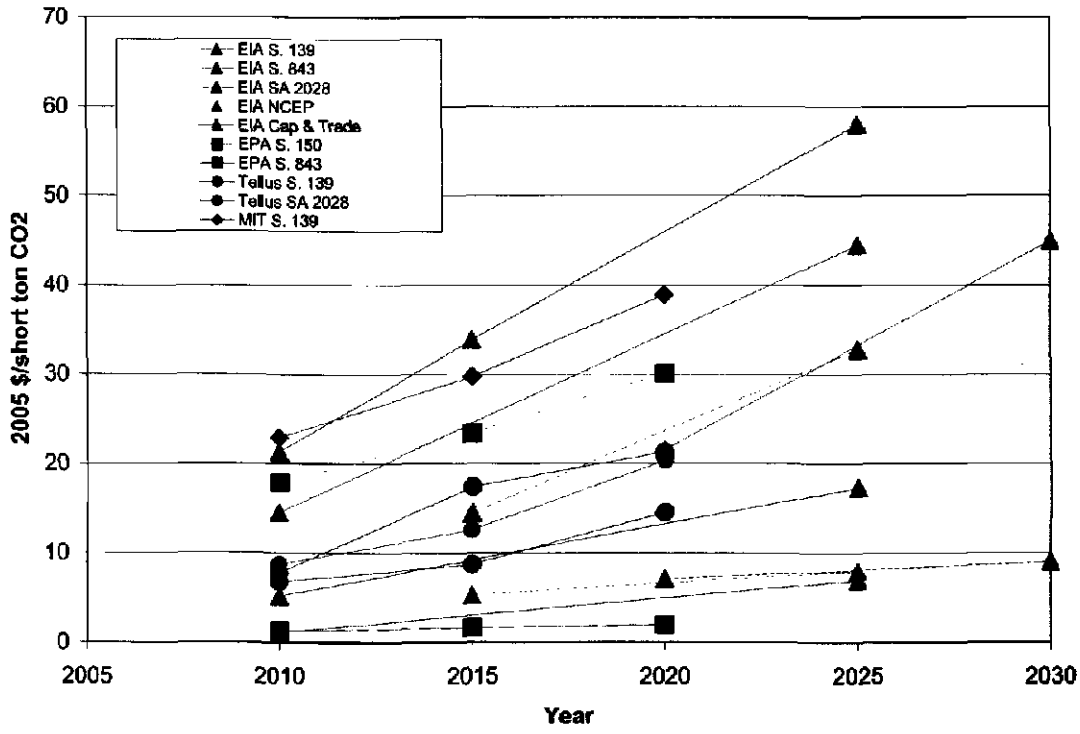


Figure 6.2. Allowance Cost Estimates From Studies of Economy-wide and Electric Sector US Policy Proposals

Carbon emissions price forecasts based on a range of proposed federal carbon regulations. Sources of data include: Triangles – US Energy Information Agency (EIA); Square – US EPA; Circles – Tellus Institute; Diamond – MIT. All values shown have been converted into 2005 dollars per short ton CO2 equivalent. Color-coded policies evaluated include:
***Blue:** S. 139, the McCain-Lieberman Climate Stewardship Act of January 2003. MIT Scenario includes banking and zero-cost credits (effectively relaxing the cap by 15% and 10% in phase I and II, respectively.) The Tellus scenarios are the "Policy" case (higher values) and the "Advanced" case (lower values). Both Tellus cases include complimentary emission reduction policies, with "advance" policy case assuming additional oil savings in the transportation sector from increase the fuel efficiency of light-duty vehicles (CAFÉ).*
***Tan:** S.150, the Clean Power Act of 2005*
***Violet:** S. 843, the Clean Air Planning Act of 2003. Includes international trading of offsets. EIA data include "High Offsets"(lower prices) and "Mid Offsets" (higher prices) cases. EPA data shows effect of tremendous offset flexibility.*
***Bright Green:** SA 2028, the McCain-Lieberman Climate Stewardship Act Amendment of October 2003. This version sets the emissions cap at constant 2000 levels and allows for 15% of the carbon reductions to be met through offsets from non-covered sectors, carbon sequestration and qualified international sources.*
***Yellow:** EIA analysis of the National Commission on Energy Policy (NCEP) policy option recommendations. Lower series has a safety-valve maximum permit price of $6.10 per metric ton CO2 in 2010 rising to $8.50 per metric ton CO2 in 2025, in 2003 dollars. Higher series has no safety value price. Both include a range of complementary policies recommended by NCEP.*
***Orange:** EIA analysis of cap and trade policies based on NCEP, but varying the carbon intensity reduction goals. Lower-priced series (Cap and trade 1) has an intensity reduction of 2.4%/yr from 2010 to 2020 and 2.8%/yr from 2020 to 2030; safety-valve prices are $6.16 in 2010, rising to $9.86 in 2030, in 2004 dollars. Higher-priced series (Cap and trade 4) has intensity reductions of 3% per year and 4% per year for 2010-2020 and 2020-2030, respectively, and safety-valve prices of $30.92 in 2010 rising to $49.47 in 2030, in 2004 dollars.*

The lowest allowance cost results (EPA S. 843, EIA NCEP, and EIA Cap & Trade) correspond to the EPA analysis of a power sector program with very extensive offset use, and to EIA analyses of greenhouse gas intensity targets with allowance safety valve prices. In these analyses, the identified emission reduction target is not achieved because the safety valve is triggered. In EIA GHGI C&T 4, the price is higher because the greenhouse gas intensity target is more stringent, and there is no safety valve. The EIA analysis of S. 843 shows higher cost projections because of the treatment of offsets, which clearly cause a huge range in the projections for this policy. In the EPA analysis, virtually all compliance is from offsets from sources outside of the power sector.

In addition to its recent modeling of US policy proposals, EIA has performed several studies projecting costs associated with compliance with the Kyoto Protocol. In 1998, EIA performed a study analyzing allowance costs associated with six scenarios ranging from emissions in 2010 at 24 percent above 1990 emissions levels, to emissions in 2010 at 7 percent below 1990 emissions levels.[84] In 1999 EIA performed a very similar study, but looked at phasing in carbon prices beginning in 2000 instead of 2005 as in the

[84] EIA, "Impacts of the Kyoto Protocol on US Energy Markets and Economic Activity," October 1998. SR/OIAD/98-03

original study.[85] Carbon dioxide costs projected in these EIA studies of Kyoto targets were generally higher than those projected in the studies of economy-wide legislative proposals due in part to the more stringent emission reduction requirements of the Kyoto Protocol. For example, carbon dioxide allowances for 2010 were projected at $91 per short ton CO_2 ($2005) and $100 per short ton CO_2 ($2005) respectively for targets of seven percent below 1990 emissions levels. While the United States has not ratified the Kyoto Protocol, these studies are informative since they evaluate more stringent emission reduction requirements than those contained in current federal policy proposals. Scientists anticipate that avoiding dangerous climate change will require even steeper reductions than those in the Kyoto Protocol.

The State Working Group of the RGGI in the Northeast engaged ICF Consulting to analyze the impacts of implementing a CO2 cap on the electric sector in the northeastern states. ICF used the IPM model to analyze the program package that the RGGI states ultimately agreed to. ICF's analysis results (in $2004) range from $1-$5/ton CO_2 in 2009 to about $2.50-$12/ton CO_2 in 2024.[86] The lowest CO2 allowance prices are associated with the RGGI program package under the expected emission growth scenario. The costs increase significantly under a high emissions scenario, and increase even more when the high emissions scenario is combined with a national cap and trade program due to the greater demand for allowances in a national program. ICF performed some analysis that included aggressive energy efficiency scenarios and found that those energy efficiency components would reduce the costs of the RGGI program significantly.

In 2003 ICF was retained by the state of Connecticut to model a carbon cap across the 10 northeastern states. The cap is set at 1990 levels in 2010, 5 percent below 1990 levels in 2015, and 10 percent below 1990 levels in 2020. The use of offsets is phased in with entities able to offset 5 percent or their emissions in 2015 and 10 percent in 2020. The CO_2 allowance price, in $US2004, for the 10-state region increases over the forecast period in the policy case, rising from $7/ton in 2010 to $11/ton in 2020.[87]

6.4 Factors that affect projections of carbon cost

Results from a range of studies highlight certain factors that affect projections of future carbon emissions prices. In particular, the studies provide insight into whether the factors increase or decrease expected costs, and to the relationships among different factors. A number of the key assumptions that affect policy cost projections (and indeed policy costs) are discussed in this section, and summarized in Table 6.3.

---

[85] EIA, "Analysis of the Impacts of an Early Start for Compliance with the Kyoto Protocol," July 1999. SR/OIAF/99-02.

[86] ICF Consulting presentation of "RGGI Electricity Sector Modeling Results," September 21, 2005. Results of the ICF analysis are available at www.rggi.org

[87] Center for Clean Air Policy, *Connecticut Climate Change Stakeholder Dialogue: Recommendations to the Governors' Steering Committee*, January 2004, p. 3.3-27.

Here we only consider these factors in a qualitative sense, although quantitative meta-analyses do exist.[88] It is important to keep these factors in mind when attempting to compare and survey the range of cost/benefit studies for carbon emissions policies so the varying forecasts can be kept in the proper perspective.

Base case emissions forecast

Developing a business-as-usual case (in the absence of federal carbon emission regulations) is a complex modeling exercise in itself, requiring a wide range of assumptions and projections which are themselves subject to uncertainty. In addition to the question of future economic growth, assumptions must be made about the emissions intensity of that growth. Will growth be primarily in the service sector or in industry? Will technological improvements throughout the economy decrease the carbon emissions per unit of output?

In addition, a significant open question is the future generation mix in the United States. Throughout the 1990s most new generating investments were in natural gas-fired units, which emit much less carbon per unit of output than other fossil fuel sources. Today many utilities are looking at baseload coal due to the increased cost of natural gas, implying much higher emissions per MWh output. Some analysts predict a comeback for nuclear energy, which despite its high cost and unsolved waste disposal and safety issues has extremely low carbon emissions.

A business-as-usual case which included several decades of conventional base load coal, combined with rapid economic expansion, would present an extremely high emissions baseline. This would lead to an elevated projected cost of emissions reduction regardless of the assumed policy mechanism.

Complimentary policies

Complimentary energy policies, such as direct investments in energy efficiency, are a very effective way to reduce the demand for emissions allowances and thereby to lower their market price. A policy scenario which includes aggressive energy efficiency along with carbon emissions limits will result in lower allowances prices than one in which energy efficiency is not directly addressed.[89]

Policy implementation timeline and reduction target

Most "policy" scenarios are structured according to a goal such as achieving "1990 emissions by 2010" meaning that emissions should be decreased to a level in 2010 which

---

[88] See, *e.g.*, Carolyn Fischer and Richard D. Morgenstern, *Carbon Abatement Costs: Why the Wide Range of Estimates?* Resources for the Future, September, 2003. http://www.rff.org/Documents/RFF-DP-03-42.pdf

[89] A recent analysis by ACEEE demonstrates the effect of energy efficiency investments in reducing the projected costs of the Regional Greenhouse Gas Initiative. Prindle, Shipley, and Elliott; *Energy Efficiency's Role in a Carbon Cap-and-Trade System: Modeling Results from the Regional Greenhouse Gas Initiative*; American Council for an Energy Efficient Economy, May 2006. Report Number E064.

is no higher than they were in 1990. Both of these policy parameters have strong implications for policy costs, although not necessarily in the intuitive sense. A later implementation date means that there is more time for the electric generating industry to develop and install mitigation technology, but it also means that if they wait to act, they will have to make much more drastic cuts in a short period of time. Models which assume phased-in targets, forcing industry to take early action, may stimulate technological innovations so that later, more aggressive targets can be reached at lower cost.

Program flexibility

The philosophy behind cap and trade regulation is that the rules should specify an overall emissions goal, but the market should find the most efficient way of meeting that goal. For emissions with broad impacts (as opposed to local health impacts) this approach will work best at minimizing cost if maximum flexibility is built into the system. For example, trading should be allowed across as broad as possible a geographical region, so that regions with lower mitigation cost will maximize their mitigation and sell their emission allowances. This need not be restricted to CO_2 but can include other GHGs on an equivalent basis, and indeed can potentially include trading for offsets which reduce atmospheric CO_2 such as reforestation projects. Another form of flexibility is to allow utilities to put emissions allowances "in the bank" to be used at a time when they hold higher value, or to allow international trading as is done in Europe through the Kyoto protocol.

One drawback to programs with higher flexibility is that they are much more complex to administer, monitor, and verify.[90] 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, verifiable, permanent and enforceable."[91] Still, there is a clear 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 higher flexibility in all of these areas are likely to predict lower compliance costs for reaching any specified goal.

Technological progress

The rate of improvement in mitigation technology is a crucial assumption in predicting future emissions control costs. This has been an important factor in every major air emissions law, and has resulted, for example, in the pronounced downward trend in allowance prices for SO_2 and NO_x in the years since regulations of those two pollutants were enacted. For CO_2, looming questions include the future feasibility and cost of carbon capture and sequestration, and cost improvements in carbon-free generation

[90] An additional consideration is that greater geographic flexibility reduces potential local co-benefits, discussed below, that can derive from efforts to reduce greenhouse gas emissions.

[91] Massachusetts 310 CMR 7.29.

technologies. Improvements in the efficiency of coal burning technology or in the cost of nuclear power plants may also be a factor.

Reduced emissions co-benefits

Most technologies which reduce carbon emissions also reduce emissions of other criteria pollutants, such as NO_x, SO_2 and mercury. This results in cost savings not only to the generators who no longer need these permits, but also to 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.

Table 6.3. Factors That Affect Future Carbon Emissions Policy Costs

Assumption	Increases Prices if...	Decreases Prices if...
• **"Base case" emissions forecast**	Assumes high rates of growth in the absence of a policy, strong and sustained economic growth	Lower forecast of business-as-usual" emissions
• **Complimentary policies**	No investments in programs to reduce carbon emissions	Aggressive investments in energy efficiency and renewable energy independent of emissions allowance market
• **Policy implementation timeline**	Delayed and/or sudden program implementation	Early action, phased-in emissions limits.
• **Reduction targets**	Aggressive reduction target, requiring high-cost marginal mitigation strategies	Minimal reduction target, within range of least-cost mitigation strategies
• **Program flexibility**	Minimal flexibility, limited use of trading, banking and offsets	High flexibility, broad trading geographically and among emissions types including various GHGs, allowance banking, inclusion of offsets perhaps including international projects.
• **Technological progress**	Assume only today's technology at today's costs	Assume rapid improvements in mitigation technology and cost reductions
• **Emissions co-benefits**	Ignore emissions co-benefits	Includes savings in reduced emissions of criteria pollutants.

Because of the uncertainties and interrelationships surrounding these factors, forecasting long-range carbon emissions price trajectories is quite complicated and involves significant uncertainty. Of course, this uncertainty is no greater than the uncertainty surrounding other key variables underlying future electricity costs, such as fuel prices, although there are certain characteristics that make carbon emissions price forecasting unique.

One of these is that the forecaster must predict the future political climate. As documented throughout this paper, recent years have seen a dramatic increase in both the documented effects of and the public awareness of global climate change. As these trends continue, it is likely that more aggressive and more expensive emissions policies will be politically feasible. Political events in other areas of the world may be another factor, in that it will be easier to justify aggressive policies in the United States if other nations such as China are also limiting emissions.

Another important consideration is the relationship between early investments and later emissions costs. It is likely that policies which produce high prices early will greatly accelerate technological innovation, which could lead to prices in the following decades which are lower than they would otherwise be. This effect has clearly played a role in NO_x and SO_2 allowance trading prices. However, the effect would be offset to some degree by the tendency for emissions limits to become more restrictive over time, especially if mitigation becomes less costly and the effects of global climate change become increasingly obvious.

6.5 Synapse forecast of carbon dioxide allowance prices

Below we offer an emissions price forecast which the authors judge to represent a reasonable range of likely future CO_2 allowance prices. Because of the factors discussed above and others, it is likely that the actual cost of emissions will not follow a smooth path like those shown here but will exhibit swings between and even outside of our "low" and "high" cases in response to political, technological, market and other factors. Nonetheless, we believe that these represent the most reasonable range to use for planning purposes, given all of the information we have been able to collect and analyze bearing on this important cost component of future electricity generation.

Figure 6.3 shows our price forecasts for the period 2010 through 2030, superimposed upon projections collected from other studies mentioned in this paper.

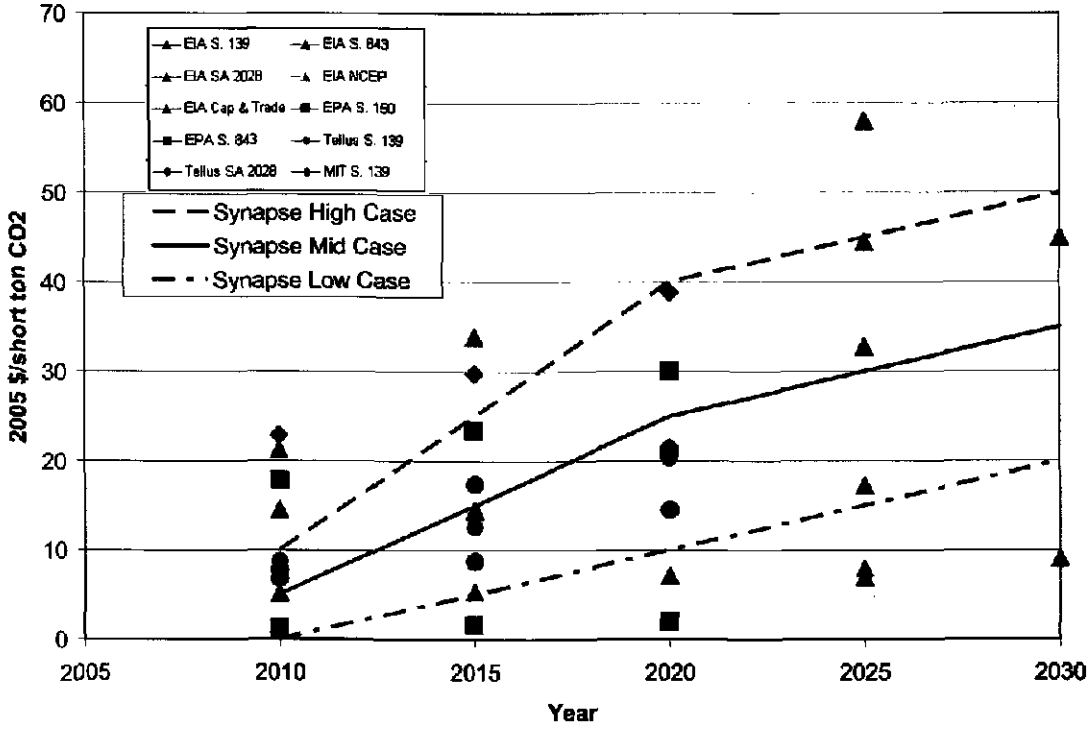


Figure 6.3. Synapse Forecast of Carbon Dioxide Allowance Prices

High, mid and low-case Synapse carbon dioxide emissions price forecasts superimposed on policy model forecasts as presented in Figure 6.2.

In developing our forecast we have reviewed the cost analyses of federal proposals, the Kyoto Protocol, and current electric company use of carbon values in IRP processes, as described earlier in this paper. The highest cost projections from studies of U.S. policy proposals generally reflect a combination of factors including more aggressive emissions reductions, conservative assumptions about complimentary energy policies, and limited or no offsets. For example, some of the highest results come from EIA analysis of the most aggressive emission reductions proposed -- the Climate Stewardship Act, as originally proposed by Senators McCain and Lieberman in 2003. Similarly, the highest cost projection for 2025 is from the EPA analysis of the Carper 4-P bill, S. 843, in a scenario with fairly restricted offset use. The lowest cost projections are from the analysis of the greenhouse gas intensity goal with a safety valve, as proposed by the National Commission on Energy Policy, as well as from an EPA analysis of the Carper 4-P bill, S. 843, with no restrictions on offset use. These highest and lowest cost estimates illustrate the effect of the factors that affect projections of CO_2 emissions costs, as discussed in the previous section.

We believe that the U.S. policies that have been modeled can reasonably be considered to represent the range of U.S. policies that could be adopted in the next several years. However, we do not anticipate the adoption of either the most aggressive or restrictive, or the most lenient and flexible policies illustrated in the range of projections from recent

analyses. Thus we consider both the highest and the lowest cost projections from those studies to be outside of our reasonable forecast.

We note that EIA projections of costs to comply with Kyoto Protocol targets were much higher, in the range of $100/ton CO_2. The higher cost projections associated with the Kyoto Protocol targets, which are somewhat more aggressive than U.S. policy proposals, are consistent with the anticipated effect of a more carbon-constrained future. The EIA analysis also has pessimistic assumptions regarding carbon emission-reducing technologies and complementary policies. The range of values that certain electric companies currently use in their resource planning and evaluation processes largely fall within the high and low cost projections from policy studies. Our forecast of carbon dioxide allowance prices is presented in Table 6.4.

Table 6.4. Synapse forecast of carbon dioxide allowance prices ($2005/ton CO_2).

	2010	2020	2030	Levelized Value 2011-2030
Synapse Low Case	0	10	20	8.23
Synapse Mid Case	5	25	35	19.83
Synapse High Case	10	40	50	31.43

As illustrated in the table, we have identified what we believe to be a reasonable high, low, and mid case for three time periods: 2010, 2020, and 2030. These high, low, and mid case values for the years in question represent a range of values that are reasonably plausible for use in resource planning. Certainly other price trajectories are possible, indeed likely depending on factors such as level of reduction target, and year of implementation of a policy. We have much greater confidence in the levelized values over the period than we do in any particular annual values or in the specific shape of the price projections.

Using these value ranges, we have plotted cost lines in Figure 6.3 for use in resource analysis. In selecting these values, we have taken into account a variety of factors for the three time periods. While some regions and states may impose carbon emissions costs sooner, or federal legislation may be adopted sooner, our assumption conservatively assumes that implementation of any federal legislative requirements is unlikely before 2010. We project a cost in 2010 of between zero and $10 per ton of CO_2.

During the decade from 2010 to 2020, we anticipate that a reasonable range of carbon emissions prices reflects the effects of increasing public concern over climate change (this public concern is likely to support increasingly stringent emission reduction requirements) and the reluctance of policymakers to take steps that would increase the cost of compliance (this reluctance could lead to increased emphasis on energy efficiency, modest emission reduction targets, or increased use of offsets). Thus we find the widest uncertainty in our forecasts begins at the end of this decade from $10 to $40 per ton of CO_2, depending on the relative strength of these factors.

After 2020, we expect the price of carbon emissions allowances to trend upward toward the marginal mitigation cost of carbon emissions. This number still depends on uncertain

factors such as technological innovation and the stringency of carbon caps, but it is likely that the least expensive mitigation options (such as simple energy efficiency and fuel switching) will be exhausted. Our projection for the end of this decade ranges from $20 to $50 per ton of CO_2 emissions.

We think the most likely scenario is that as policymakers commit to taking serious action to reduce carbon emissions, they will choose to enact both cap and trade regimes and a range of complementary energy policies that lead to lower cost scenarios, and that technology innovation will reduce the price of low-carbon technologies, making the most likely scenario closer to (though not equal to) low case scenarios than the high case scenario. The probability of taking this path increases over time, as society learns more about optimal carbon reduction policies.

After 2030, and possibly even earlier, the uncertainty surrounding a forecast of carbon emission prices increases due to interplay of factors such as the level of carbon constraints required, and technological innovation. As discussed in previous sections, scientists anticipate that very significant emission reductions will be necessary, in the range of 80 percent below 1990 emission levels, to achieve stabilization targets that keep global temperature increases to a somewhat manageable level. As such, we believe there is a substantial likelihood that response to climate change impacts will require much more aggressive emission reductions than those contained in U.S. policy proposals, and in the Kyoto Protocol, to date. If the severity and certainty of climate change are such that emissions levels 70-80% below current rates are mandated, this could result in very high marginal emissions reduction costs, though the cost of such deeper cuts has not been quantified on a per ton basis.

On the other hand, we also anticipate a reasonable likelihood that increasing concern over climate change impacts, and the accompanying push for more aggressive emission reductions, will drive technological innovation, which may be anticipated to prevent unlimited cost escalation. For example, with continued technology improvement, coupled with attainment of economies of scale, significant price declines in distributed generation, grid management, and storage technologies, are likely to occur. The combination of such price declines and carbon prices could enable tapping very large supplies of distributed resources, such as solar, low-speed wind and bioenergy resources, as well as the development of new energy efficiency options. The potential development of carbon sequestration strategies, and/or the transition to a renewable energy-based economy may also mitigate continued carbon price escalation.

7. Conclusion

The earth's climate is strongly influenced by concentrations of greenhouse gases in the atmosphere. International scientific consensus, expressed in the Third Assessment Report of the Intergovernmental Panel on Climate Change and in countless peer-reviewed scientific studies and reports, is that the climate system is already being – and will continue to be – disrupted due to anthropogenic emissions of greenhouse gases. Scientists expect increasing atmospheric concentrations of greenhouse gases to cause temperature increases of 1.4 – 5.8 degrees centigrade by 2100, the fastest rate of change

since end of the last ice age. Such global warming is expected to cause a wide range of climate impacts including changes in precipitation patterns, increased climate variability, melting of glaciers, ice shelves and permafrost, and rising sea levels. Some of these changes have already been observed and documented in a growing body of scientific literature. All countries will experience social and economic consequences, with disproportionate negative impacts on those countries least able to adapt.

The prospect of global warming and changing climate has spurred international efforts to work towards a sustainable level of greenhouse gas emissions. These international efforts are embodied in the United Nations Framework Convention on Climate Change. The Kyoto Protocol, a supplement to the UNFCCC, establishes legally binding limits on the greenhouse gas emissions by industrialized nations and by economies in transition.

The United States, which is the single largest contributor to global emissions of greenhouse gases, remains one of a very few industrialized nations that have not signed onto the Kyoto Protocol. Nevertheless, federal legislation seems likely in the next few years, and individual states, regional organizations, corporate shareholders and corporations themselves are making serious efforts and taking significant steps towards reducing greenhouse gas emissions in the United States. Efforts to pass federal legislation addressing carbon emissions, though not yet successful, have gained ground in recent years. And climate change issues have seen an unprecedented level of attention in the United States at all levels of government in the past few years.

These developments, combined with the growing scientific certainty related to climate change, mean that establishing federal policy requiring greenhouse gas emission reductions is just a matter of time. The question is not whether the United States will develop a national policy addressing climate change, but when and how, and how much additional damage will have been incurred by the process of delay. The electric sector will be a key component of any regulatory or legislative approach to reducing greenhouse gas emissions both because of this sector's contribution to national emissions and the comparative ease of controlling emissions from large point sources. While the future costs of compliance are subject to uncertainty, they are real and will be mandatory within the lifetime of electric industry capital stock being planned for and built today.

In this scientific, policy and economic context, it is imprudent for decision-makers in the electric sector to ignore the cost of future carbon emissions reductions or to treat future carbon emissions reductions merely as a sensitivity case. Failure to consider the potential future costs of greenhouse gas emissions under future mandatory emission reductions will result in investments that prove quite uneconomic in the future. Long term resource planning by utility and non-utility owners of electric generation must account for the cost of mitigating greenhouse gas emissions, particularly carbon dioxide. For example, decisions about a company's resource portfolio, including building new power plants, reducing other pollutants or installing pollution controls, avoided costs for efficiency or renewables, and retirement of existing power plants all can be more sophisticated and more efficient with appropriate consideration of future costs of carbon emissions mitigation.

Regulatory uncertainty associated with climate change clearly presents a planning challenge, but this does not justify proceeding as if no costs will be associated with

carbon emissions in the future. The challenge, as with any unknown future cost driver, is to forecast a reasonable range of costs based on analysis of the information available. This report identifies many sources of information that can form the basis of reasonable assumptions about the likely costs of meeting future carbon emissions reduction requirements.

Additional Costs Associated with Greenhouse Gases

It is important to note that the greenhouse gas emission reduction requirements contained in federal legislation proposed to date, and even the targets in the Kyoto Protocol, are relatively modest compared with the range of emissions reductions that are anticipated to be necessary for keeping global warming at a manageable level. Further, we do not attempt to calculate the full cost to society (or to electric utilities) associated with anticipated future climate changes. Even if electric utilities comply with some of the most aggressive regulatory requirements underlying our CO_2 price forecasts presented above, climate change will continue to occur, albeit at a slower pace, and more stringent emissions reductions will be necessary to avoid dangerous changes to the climate system.

The consensus from the international scientific community clearly indicates that in order to stabilize the concentration of greenhouse gases in the atmosphere and to try to keep further global warming trends manageable, greenhouse gas emissions will have to be reduced significantly below those limits underlying our CO_2 price forecasts. The scientific consensus expressed in the Intergovernmental Panel on Climate Change Report from 2001 is that greenhouse gas emissions would have to decline to a very small fraction of current emissions in order to stabilize greenhouse gas concentrations, and keep global warming in the vicinity of a 2-3 degree centigrade temperature increase. Simply complying with the regulations underlying our CO_2 price forecasts does not eliminate the ecological and socio-economic threat created by CO_2 emissions – it merely mitigates that threat.

Incorporating a reasonable CO_2 price forecast into electricity resource planning will help address electricity consumer concerns about prudent economic decision-making and direct impacts on future electricity rates. However, current policy proposals are just a first step in the direction of emissions reductions that are likely to ultimately be necessary. Consequently, electric sector participants should anticipate increasingly stringent regulatory requirements. In addition, anticipating the financial risks associated with greenhouse gas regulation does not address all the ecological and socio-economic concerns posed by greenhouse gas emissions. Regulators should consider other policy mechanisms to account for the remaining pervasive impacts associated with greenhouse gas emissions.

This report is unchanged from the August 31, 2006 version except for the correction of a graphical error.

References

Anderson, Paul M. Chairman, Duke Energy. "Letter to Shareholders." March 15, 2005. http://www.duke-energy.com/investors/publications/annual/ar_2004/downloads/Duke_Energy_2004_Annual_Report.pdf

Anderson, Paul. Chairman, Duke Energy. "Being (and Staying in Business): Sustainability from a Corporate Leadership Perspective." April 6, 2006 speech to CERES Annual Conference, at: http://www.duke-energy.com/news/mediainfo/viewpoint/PAnderson_CERES.pdf

Avista Utilities, *Electric Integrated Resource Plan 2005,* August 31, 2005. Available at http://www.avistautilities.com/resources/plans/documents/Avista_2005_IRP_Final.pdf

Bailie, Bernow, Dougherty, and Lazarus. *Analysis of the Climate Stewardship Act.* Tellus Institute, July 2003. Available at: http://www.tellus.org/energy/publications/McCainLieberman2003.pdf

Bailie and Dougherty. *Analysis of the Climate Stewardship Act Amendment.* Tellus Institute. June 2004. Available at http://www.tellus.org/energy/publications/McCainLieberman2004.pdf

Biewald et. al. "A Responsible Electricity Future: An Efficient, Cleaner and Balanced Scenario for the US Electricity System." Prepared for the National Association of State PIRGs. June 11, 2004. Available at http://www.synapse-energy.com/Downloads/AResponsibleElectricityFuture.pdf

California Public Utilities Commission. Decision 04-12-048. December 16, 2004. Available at http://www.cpuc.ca.gov/PUBLISHED/AGENDA_DECISION/42314-07.htm#P761_196099

California Public Utilities Commission. Decision 05-04-024 "Interim Opinion on E3 Avoided Cost Methodology." April 7, 2005. http://www.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/45284.htm

Carbon Disclosure Project. "$21 Trillion Investor Coalition Spurs Greater Awareness of Climate Change Among US Corporations US Corporates Wake Up to Climate Change Risks and Opportunities." Press release. September 14, 2005. http://www.cdproject.net/viewrelease.asp?id=2

Carbon Market Analyst. "What determines the Price of Carbon." *Point Carbon.* October 14, 2004.

Center for Clean Air Policy. *Connecticut Climate Change Stakeholder Dialogue: Recommendations to the Governors' Steering Committee.* January 2004. Available at http://www.ctclimatechange.com/pdf/01_history_ed.pdf

CERES. "Electric Power, Investors, and Climate Change: A Call to Action." September 2003. Available at http://www.ceres.org/pub/docs/Ceres_electric_power_calltoaction_0603.pdf

CERES. "Four Electric Power Companies in Midwest Agree to Disclose Climate Risk." Press release. February 21, 2006. http://ceres.org

CERES. "US Companies Face Record Number of Global Warming Shareholder Resolutions on Wider Range of Business Sectors." Press release. February 17, 2005. Available at http://ceres.org/newsroom/press/gwsc_pr_021805.htm

Cities for Climate Protection Campaign, including links to over 150 cities that have adopted greenhouse gas reduction measures, is available at http://www.iclei.org/projserv.htm#ccp

Codey, Acting Governor Richard. "Codey Takes Crucial Step to Combat Global Warming." Press release. October 18, 2005. http://www.nj.gov/cgi-bin/governor/njnewsline/view_article.pl?id=2779

Cogan, Douglas G. citing Frank Dixon and Martin Whittaker. "Valuing corporate environmental performance: Innovest's evaluation of the electric utilities industry," *Corporate Environmental Strategy*, Vol. 6, No. 4. New York, 1999. (NOTE: This cite is contained in the following paper).

Cogan, Douglas G.. "Investor Guide to Climate Risk: Action Plan and Resource for Plan Sponsors, Fund Managers, and Corporations." Investor Responsibility Research Center. July 2004. Available at http://www.incr.com/investor_guide/

Congressional Budget Office, *Uncertainty in Analyzing Climate Change: Policy Implications*, January 2005. http://www.cbo.gov/showdoc.cfm?index=6061&sequence=0

Congressional Budget Office, Economic and Budget Issue Brief, *Limiting Carbon Dioxide Emissions: Prices Versus Caps*, March 15, 2005. http://www.cbo.gov/ftpdocs/61xx/doc6148/03-15-PriceVSQuantity.pdf

Congressional Budget Office, *Shifting the Cost Burden of a Carbon Cap-and-TradeProgram,* July 2003. http://www.cbo.gov/showdoc.cfm?index=4401&sequence=0

Council of the European Union, Information Note – Brussels March 10, 2005. http://ue.eu.int/uedocs/cmsUpload/st07242.en05.pdf

Domenici, Senator Pete V. and Senator Jeff Bingaman. "Design Elements of a Mandatory Market-based Greenhouse Gas Regulatory System," Senate Committee on Energy and Natural Resources, issued February 2, 2006. http://members.4cleanair.org/rc_files/3243/Domenici&Bingamanwhitepaper2-2-06.pdf

EIA. "Impacts of the Kyoto Protocol on US Energy Markets and Economic Activity." October 1998. SR/OIAF/98-03. Available at: http://www.eia.doe.gov/oiaf/kyoto/pdf/sroiaf9803.pdf

EIA. "Analysis of the Impacts of an Early Start for Compliance with the Kyoto Protocol." July 1999. SR/OIAF/99-02. http://www.eia.doe.gov/oiaf/kyoto3/pdf/sroiaf9902.pdf

EIA. *Analysis of Strategies for Reducing Multiple Emissions from Power Plants: Sulfur Dioxide, Nitrogen Oxides, and Carbon Dioxide*. December 2000. SR/OIAF/2001-03. Available at http://www.eia.doe.gov/oiaf/servicerpt/epp/

EIA, Analysis of S. 139, the Climate Stewardship Act of 2003, EIA June 2003, SR/OIAF/2003-02. Available at http://tonto.eia.doe.gov/FTPROOT/service/sroiaf(2003)02.pdf

EIA. *Analysis of S. 485, the Clear Skies Act of 2003, and S. 843, the Clean Air Planning Act of 2003*. EIA Office of Integrated Analysis and Forecasting. SR/OIAF/2003-03. September 2003. Available at http://www.eia.doe.gov/oiaf/servicerpt/ccs/pdf/sroiaf(2003)03.pdf

Energy Information Administration, Analysis of Senate Amendment 2028, the Climate Stewardship Act of 2003, EIA May 2004, SR/OIAF/2004-06. Available at http://www.eia.doe.gov/oiaf/analysispaper/sacsa/pdf/s139amend_analysis.pdf

EIA Table H.1co2 World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels. 1980-2002 (posted June 9, 2004). Available at http://www.eia.doe.gov/emeu/international/environm.html#IntlCarbon

EIA. "Emissions of Greenhouse Gases in the United States, 2004." December 2005. DOE/EIA-0573(2004). http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html

EIA, "Impacts of Modeled Recommendations of the National Commission on Energy Policy." April 2005. SR/OIAF/2005-02. http://www.eia.doe.gov/oiaf/servicerpt/bingaman/pdf/sroiaf(2005)02.pdf

EIA. "Energy Market Impacts of Alternative Greenhouse Gas Intensity Reduction Goals." March 2006. SR/OIAF/2006-01. http://www.eia.doe.gov/oiaf/servicerpt/agg/pdf/sroiaf(2006)01.pdf

European Environment Agency, Climate Change and a European Low Carbon Energy System, 2005. EEA Report No 1/2005. ISSN 1725-9177. http://reports.eea.europa.eu/eea_report_2005_1/en/Climate_change-FINAL-web.pdf

Feinstein, Senator Dianne. "Senator Feinstein Outlines New Legislation to Curb Global Warming, Keep Economy Strong." *News from Senator Feinstein*. March 20, 2006. http://feinstein.senate.gov/06releases/r-global-warm320.pdf

Fischer, Carolyn and Richard D. Morgenstern. "Carbon Abatement Costs: Why the Wide Range of Estimates?" Resources for the Future. September, 2003. Available at http://www.rff.org/Documents/RFF-DP-03-42.pdf

Fontaine, Peter. "Greenhouse-Gas Emissions: A New World Order." *Public Utilities Fortnightly*. February 2005.

G8 Leaders, *Climate Change, Clean Energy, and Sustainable Development*, Political Statement and Action Plan from the G8 Leaders' Communiqué at the G8 Summit in Gleneagles U.K., 2005. Available at: http://www.g8.gov.uk/servlet/Front?pagename=OpenMarket/Xcelerate/ShowPage&c=Page&cid=1094235520309

GF Energy. "GF Energy 2005 Electricity Outlook." January 2005. http://www.gfenergy.com/download.html

Goldman Sachs Environmental Policy Framework, November 2005. http://www.gs.com/our_firm/our_culture/corporate_citizenship/environmental_policy_framework/docs/EnvironmentalPolicyFramework.pdf

Goodman, Sandra; "Benchmarking Air Emissions of the 100 Largest Electric Generation Owners in the US - 2002;" CERES, Natural Resources Defense Council (NRDC), and Public Service Enterprise Group Incorporated (PSEG); April 2004. http://www.ceres.org/pub/

Goodman, Sandra and Walker, Michael. "Benchmarking Air Emissions of the 100 Largest Electric Generation Owners in the US - 2004." CERES, Natural Resources Defense Council (NRDC), and Public Service Enterprise Group Incorporated (PSEG). April 2006. Available at http://www.nrdc.org/air/pollution/benchmarking/default.asp

Greenwire. February 16, 2005. Available at http://www.eenews.net/gw/

ICF Consulting presentation of "RGGI Electricity Sector Modeling Results," September 21, 2005. Results of the ICF analysis are available at www.rggi.org

Idaho Power Company. *2004 Integrated Resource Plan Draft*. July 2004. Available at http://www.idahopower.com/energycenter/2004IRPFinal.htm

Innovest Strategic Value Advisors. *Carbon Disclosure Project 2005*, third report of the Carbon Disclosure Project. Innovest Strategic Value Advisors and the Carbon Disclosure Project. September 2005. Available at http://www.cdproject.net/

Innovest Strategic Value Advisors. "Power Switch: Impacts of Climate Change on the Global Power Sector." World Wildlife Fund International. November 2003. Available at http://www.innovestgroup.com/pdfs/2003-11-PowerSwitch.pdf

Innovest Strategic Value Advisors. "Value at Risk: Climate Change and the Future of Governance." The Coalition for Environmentally Responsible Economies. June 2003. Available at http://www.ceres.org/pub/docs/Ceres_value_at_risk_0418.pdf

Intergovernmental Panel on Climate Change. "16 Years of Scientific Assessment in Support of the Climate Convention." December 2004. Available at http://www.ipcc.ch/about/anniversarybrochure.pdf

Intergovernmental Panel on Climate Change. "Introduction to the Intergovernmental Panel on Climate Change." 2003 edition. Available at www.ipcc.ch/about/beng.pdf.

International Association for Energy Economics. "The Costs of the Kyoto Protocol: A Multi-Model Evaluation." *The Energy Journal*. 1999.

International Energy Agency. "CO_2 from Fuel Combustion – Fact Sheet." 2005. Available at http://www.iea.org/journalists/docs/CO2.pdf.

Investor Network on Climate Risk. "A New Call for Action: Managing Climate Risk and Capturing the Opportunities." 2005 Institutional Investor Summit. May 10, 2005. http://www.ceres.org/pub/docs/Ceres_INCR_05_call_for_action.pdf

Investor Network on Climate Risk. "Institutional Investor Summit on Climate Risk Final Report." Available at http://www.incr.com/summit_final_report.pdf.

IPCC. *Third Assessment Report: Climate Change 2001.* Intergovernmental Panel on Climate Change 2001. http://www.ipcc.ch/

Jacobson, Sanne, Neil Numark and Paloma Sarria. "Greenhouse – Gas Emissions: A Changing US Climate." *Public Utilities Fortnightly.* February 2005.

Joint Science Academies' Statement: *Global Response to Climate Change*, National Academies of Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, United Kingdom, and United States, June 7, 2005. http://www.academie-sciences.fr/actualites/textes/G8_gb.pdf

Lempert, Popper, Resitar and Hart. "Capital Cycles and the Timing of Climate Change Policy." Pew Center on Global Climate Change. October 2002. Available at http://www.pewclimate.org/docUploads/capital%5Fcycles%2Epdf

Maryland Senate Bill 154 Healthy Air Act, signed April 6, 2006. http://mlis.state.md.us/2006rs/billfile/sb0154.htm

Moler, Elizabeth, Exelon V.P., to the Senate Energy and Natural Resources Committee, April 4, 2006, quoted in Grist, http://www.grist.org/news/muck/2006/04/14/griscom-little/

Montana Public Service Commission. "Written Comments Identifying Concerns with NWE's Compliance with A.R.M. 38.5.8209-8229." August 17, 2004. http://www.montanaenergyforum.com/pdf/2005_Plan/2005_v2_CH1_Sources.pdf (page 38 of the sources document).

National Commission on Energy Policy. *Ending the Energy Stalemate.* December 2004. Available at http://www.energycommission.org/

Nordhaus, William and Boyer, Joseph. "Requiem for Kyoto: An Economic Analysis." *The Energy Journal.* 1999.

Northwestern Energy, *2005 Electric Default Supply Resource Procurement Plan,* December 20, 2005. http://www.montanaenergyforum.com/plan.html.

Northwest Power and Conservation Council, *The Fifth Northwest Electric Power and Conservation Plan*, May 2005. http://www.nwcouncil.org/energy/powerplan/plan/Default.htm

PA Consulting Group. "Environmental Survey 2004." Press release, October 22, 2004. http://www.paconsulting.com/news/press_release/2004/pr_carbon_dioxide_regulations.htm

PacifiCorp. *Integrated Resource Plan 2003.* Available at http://www.pacificorp.com/File/File25682.pdf

Paltsev, Sergei; Reilly, John M.; Jacoby, Henry D.; Ellerman, A. Denny; Tay, Kok Hou. *Emissions Trading to Reduce Greenhouse Gas Emissions in the United States: the McCain-Lieberman Proposal.* MIT Joint Program on the Science and Policy of Global Change. Report No. 97. June 2003. http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt97.pdf

Pershing, Jonathan, *Comments in Response to Bingaman-Domenici Climate Change White Paper*, World Resources Institute, March 13, 2006.

Prindle, Shipley, and Elliott; *Energy Efficiency's Role in a Carbon Cap-and-Trade System: Modeling Results from the Regional Greenhouse Gas Initiative*; American Council for an Energy Efficient Economy, May 2006. Report Number E064.

Regional Greenhouse Gas Initiative. Information, including Memorandum of Understanding, proposed Model Rule, comments on State Working Group proposals, and all meeting presentations, available at: www.rggi.org

Rendell, Governor Edward. "Governor Rendell Launches Initiative to Support Manufacturers, Continue Job Growth; Bold Homegrown Solution Maintains PA Energy Leadership." Press release. November 28, 2005. http://www.state.pa.us/papower/cwp/view.asp?A=11&Q=447926

Rowe, John W., *Comments in Response to Bingaman-Domenici Climate Change White Paper*, March 13, 2006

Sandalow, David, *Comments in Response to Bingaman-Domenici Climate Change White Paper*, The Brookings Institution, March 13, 2006

TIME/ABC News/Stanford University Poll. "Global Warming - Seeing the problem, not the solution." *TIME.* April 3, 2006 Vol. 167 No. 14. http://www.time.com/time/magazine/article/0,9171,1176975,00.html

UK Department of Environment, Food, and Rural Affairs, *Avoiding Dangerous Climate Change – Scientific Symposium on Stabilization of Greenhouse Gases, February 1-3, 2005 Exeter, U.K. Report of the International Scientific Steering Committee*, May 2005. http://www.stabilisation2005.com/Steering_Commitee_Report.pdf

US Conference of Mayors, The. "US Mayors Climate Protection Agreement." 2005. http://www.usmayors.org/uscm/resolutions/73rd_conference/env_04.asp. Information on the Mayors Climate Protection Agreement also available at: http://www.ci.seattle.wa.us/mayor/climate/

Udall, Rep. Tom. "Udall and Petri introduce legislation to curb global warming." Press release. March 29, 2006 http://www.tomudall.house.gov/issues2.cfm?id=11699

United Nations Framework Convention on Climate Change, 1992. Available at http://unfccc.int/resource/docs/convkp/conveng.pdf. The UNFCC has comprehensive information on the UNFCC, and the Kyoto Protocol on its website at http://unfccc.int/

UNFCCC, *Caring for Climate: A guide to the Climate Change Convention and the Kyoto Protocol (revised 2005 edition)*; 2005. Issued by the Climate Change Secretariat (UNFCCC) Bonn, Germany. http://unfccc.int/resource/cfc_guide.pdf

US Environmental Protection Agency. "Analysis of Emissions Reduction Options for the Electric Power Industry." March 1999.

US Environmental Protection Agency, *Multi-pollutant Legislative Analysis: The Clean Power Act (Jeffords, S. 150 in the 109th)*. US EPA Office of Air and Radiation, October 2005. Available at: http://www.epa.gov/airmarkets/mp/

US Environmental Protection Agency, *Multi-pollutant Legislative Analysis: The Clean Air Planning Act (Carper, S. 843 in the 108th)*. US EPA Office of Air and Radiation, October 2005. Available at: http://www.epa.gov/airmarkets/mp/

US Senate, Sense of the Senate Resolution on Climate Change, US Senate Resolution 866; June 22, 2005. Available at: http://energy.senate.gov/public/index.cfm?FuseAction=PressReleases.Detail&PressRelease_id=234715&Month=6&Year=2005&Party=0

Wiser, Ryan and Mark Bolinger. *An Overview of Alternative Fossil Fuel Price and Carbon Regulation Scenarios*. Lawrence Berkeley National Laboratory. October 2004. LBNL-56403. Available at http://eetd.lbl.gov/ea/ems/reports/56403.pdf

Wiser, Ryan, and Bolinger, Mark. *Balancing Cost and Risk: The Treatment of Renewable Energy in Western Utility Resource Plans*. Lawrence Berkeley National Laboratories. August 2005. LBNL-58450. http://eetd.lbl.gov/ea/ems/reports/58450.pdf

Xcel-PSCCo, *Comprehensive Settlement submitted to the CO PUC in dockets 04A-214E, 215E and 216E*, December 3, 2004. http://www.xcelenergy.com/docs/corpcomm/SettlementAgreementFinalDraftclean20041203.pdf