

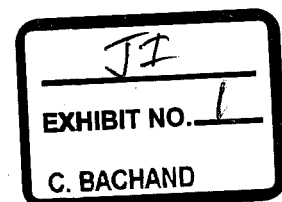
BEFORE THE SOUTH DAKOTA PUBLIC UTILITIES COMMISSION

In the Matter of the Application by Otter Tail Power)
Company on behalf of the Big Stone II Co-owners for)
an Energy Conversion Facility Siting Permit for the) Case No EL05-022
Construction of the Big Stone II Project)

Direct Testimony of
David A. Schlissel and Anna Sommer
Synapse Energy Economics, Inc.

On Behalf of
Minnesotans for an Energy-Efficient Economy
Izaak Walton League of America – Midwest Office
Union of Concerned Scientists
Minnesota Center for Environmental Advocacy

May 19, 2006



List of Joint Intervenors Exhibits

- JI-1-A Resume of David Schlissel
- JI-1-B Resume of Anna Sommer
- JI-1-C EIA Natural Gas Price Forecasts 1990-2006
- JI-1-D Interrogatory 18 of Joint Intervenors' First Set and First Amended Set of Interrogatories
- JI-1-E Descriptive Slide Submitted to Commission by Co-owners on 10.5.2005
- JI-1-F Climate Change and Power: Carbon Dioxide Emissions Costs and Electricity Resource Planning
- JI-1-G Minnesota PUC Order Establishing Environmental Cost Values
- JI-1-H Joint Intervenors' First Set of Requests for Admission

1 **Q. Mr. Schlissel, please state your name, position and business address.**

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

4 **Q. Ms. Sommer, please state your name position and business address.**

5 A. My name is Anna Sommer. I am a Research Associate at Synapse Energy
6 Economics, Inc., 22 Pearl Street, Cambridge, MA 02139.

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

8 A. We are testifying on behalf of Minnesotans for an Energy-Efficient Economy,
9 Izaak Walton League of America – Midwest Office, Union of Concerned
10 Scientists, and Minnesota Center for Environmental Advocacy (“Joint
11 Intervenors”).

12 **Q. Please describe Synapse Energy Economics.**

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

18 Synapse’s clients include state consumer advocates, public utilities commission
19 staff (and have included the Staff of the South Dakota Public Utilities
20 Commission), attorneys general, environmental organizations, federal government
21 and utilities.

22 **Q. Mr. Schlissel, please summarize your educational background and recent
23 work experience.**

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

1 Since 1983 I have been retained by governmental bodies, publicly-owned utilities,
2 and private organizations in 28 states to prepare expert testimony and analyses on
3 engineering and economic issues related to electric utilities. My clients have
4 included the Staff of the Arizona Corporation Commission, the General Staff of
5 the Arkansas Public Service Commission, the Staff of the Kansas State
6 Corporation Commission, municipal utility systems in Massachusetts, New York,
7 Texas, and North Carolina, and the Attorney General of the Commonwealth of
8 Massachusetts.

9 I have testified before state regulatory commissions in Arizona, New Jersey,
10 Connecticut, Kansas, Texas, New Mexico, New York, Vermont, North Carolina,
11 South Carolina, Maine, Illinois, Indiana, Ohio, Massachusetts, Missouri, and
12 Wisconsin and before an Atomic Safety & Licensing Board of the U.S. Nuclear
13 Regulatory Commission.

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

15 **Q. Have you previously submitted testimony before this Commission?**

16 A. No.

17 **Q. Ms. Sommer, please summarize your educational background and work
18 experience.**

19 A. I am a Research Associate with Synapse Energy Economics. I provide research
20 and assist in writing testimony and reports on a wide range of issues from
21 renewable energy policy to integrated resource planning. My recent work includes
22 aiding a Florida utility in its integrated resource planning, evaluating the
23 feasibility of carbon sequestration and reviewing the analyses of the air emissions
24 compliance plans of two Indiana utilities and one Nova Scotia utility.

25 I also have participated in studies of proposed renewable portfolio standards in the
26 United States and Canada. In addition, I have evaluated the equity of utility
27 renewable energy solicitations in Nova Scotia and the feasibility and prudence of
28 the sale and purchase of existing gas and nuclear capacity in Arkansas and Iowa.

1 Prior to joining Synapse, I worked at EFI and XENERGY (now KEMA
2 Consulting) and Zilkha Renewable Energy (now Horizon Wind Energy). At
3 XENERGY and Zilkha I focused on policy and economic aspects of renewable
4 energy. While at Zilkha, I authored a strategy and information plan for the
5 development of wind farms in the western United States.

6 I hold a BS in Economics and Environmental Studies from Tufts University. A
7 copy of my current resume is attached as Exhibit JI-1-B.

8 **Q. Ms. Sommer, have you previously submitted testimony before this**
9 **Commission?**

10 A. No.

11 **Q. What is the purpose of your testimony?**

12 A. Synapse was asked by Joint Intervenors to investigate the following four issues
13 regarding the proposed Big Stone II coal-fired generating facility:

- 14 A. The need and timing for new supply options in the utilities' service
15 territories.
- 16 B. Whether there are alternatives to the proposed facility that are technically
17 feasible and economically cost-effective.
- 18 C. Whether the applicants have included appropriate emissions control
19 technologies in the design of the proposed facility.
- 20 D. Whether the applicants have appropriately reflected the potential for the
21 regulation of greenhouse gases in the design of the proposed facility and in
22 their analyses of the alternatives.

23 This testimony and the testimony of our colleague Dr. Ezra Hausman presents the
24 results of our investigations of Issue D. Our testimony regarding Issues A, B and
25 C will be submitted on May 26, 2006.

26 **Q. Please summarize your conclusions on the issue of whether the Big Stone II**
27 **Co-owners have appropriately reflected the potential for the regulation of**
28 **greenhouse gases in the design of the proposed facility and in their analyses**
29 **of the alternatives.**

30 A. Our conclusions on this issue are as follows:

- 1 1. Climate change is causing and can be expected in the future to cause
2 “significant” environmental harm, as explained in detail in the Testimony
3 of Dr. Ezra Hausman.
- 4 2. There is scientific consensus that emissions of carbon dioxide cause
5 climate change.
- 6 3. Big Stone Unit II would emit significant amounts of additional carbon
7 dioxide.
- 8 4. As a result, the Big Stone Unit II will pose a serious threat to the
9 environment.
- 10 5. The potential for the regulation of carbon dioxide must be considered as
11 part of any prudent cost estimates of Big Stone Unit II and alternatives.
- 12 6. However, the Big Stone II Co-owners have not adequately analyzed the
13 potential for future carbon regulation.
- 14 7. The externality values for carbon dioxide established by the Minnesota
15 Public Utilities Commission and used in resource planning by some of the
16 Co-owners are meant to recognize “external” costs, or, in other words,
17 costs that are not directly paid by utilities or their customers. The
18 Minnesota Commission’s externality values are not reflective of any
19 concerns about the real costs of complying with future carbon dioxide
20 regulation.
- 21 8. Synapse Energy Economics has developed a greenhouse gas allowance
22 price forecast that reflects a range of prices that could reasonably be
23 expected through 2030.
- 24 9. Adopting Synapse’s range of prices would increase Big Stone Unit II’s
25 annual projected costs by \$35,152,128 to \$137,463,322 on a levelized
26 basis.

1 **Q. In the process of your investigation did you keep in mind the interests of the**
2 **Big Stone Co-owners' customers?**

3 A. Absolutely. Synapse regularly works for consumer advocates and has worked for
4 over half of the members of the National Association of State Utility Consumer
5 Advocates. Fundamentally, we believe that greenhouse gas regulation not only is
6 an environmental issue. It also is a consumer issue in that it will have direct and
7 tangible impacts on future rates.

8 **Q. You have mentioned the terms “carbon dioxide regulation” and “greenhouse**
9 **gas regulation.” What is the difference between these two?**

10 A. As we use these terms throughout our testimony, there is no difference. While we
11 believe that the future regulation we discuss here will govern emissions of all
12 types of greenhouse gases, not just carbon dioxide (“CO₂”), for the purposes of
13 our discussion we are chiefly concerned with emissions of carbon dioxide.
14 Therefore, we use the terms “carbon dioxide regulation” and “greenhouse gas
15 regulation” interchangeably. Similarly, the terms “carbon dioxide price,”
16 “greenhouse gas price” and “carbon price” are interchangeable.

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

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

28 Despite being the single largest contributor to global emissions of greenhouse
29 gases, the United States remains one of a very few industrialized nations that have

1 not signed the Kyoto Protocol. Nevertheless, individual states, regional groups of
2 states, shareholders and corporations are making serious efforts and taking
3 significant steps towards reducing greenhouse gas emissions in the United States.
4 Efforts to pass federal legislation addressing carbon, though not yet successful,
5 have gained ground in recent years. These developments, combined with the
6 growing scientific understanding of, and evidence of, climate change as outlined
7 in Dr. Hausman's testimony, mean that establishing federal policy requiring
8 greenhouse gas emission reductions is just a matter of time. The question is not
9 whether the United States will develop a national policy addressing climate
10 change, but when and how. The electric sector will be a key component of any
11 regulatory or legislative approach to reducing greenhouse gas emissions both
12 because of this sector's contribution to national emissions and the comparative
13 ease of regulating large point sources.

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

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

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

28 For example, there are myriad uncertainties that utility planners have learned to
29 address in planning. These include randomly occurring generating unit outages,
30 load forecast error and demand fluctuations, and fuel price volatility and

1 uncertainty. These various uncertainties can be addressed through techniques
2 such as sensitivity and scenario analyses.

3 To illustrate that there is significant uncertainty in other types of forecasts, we
4 think it is informative to examine historical gas price forecasts by the Energy
5 Information Administration (EIA). Exhibit JI-1-C compares EIA forecasts from
6 the period 1990 - 2006 with actual price data through 2005. The data, over more
7 than a decade, shows considerable volatility, even on an annual time scale.¹ But
8 the truly striking thing that jumps out of the figure is how wrong the forecasts
9 have sometimes been. For example, the 1996 forecast predicted gas prices would
10 start at \$2.61/MMBtu and remain under \$3/MMBTU through 2010, but by the
11 year 2000 actual prices had already jumped to \$4.82/MMBTU and by 2005 they
12 were up to \$8.09/MMBtu.

13 In view of the forecasting track record for gas prices one might be tempted to give
14 up, and either throw darts or abandon planning altogether. But thankfully
15 modelers, forecasters, and planners have taken on the challenge – and have
16 improved the models over time, thereby producing more reliable (although still
17 quite uncertain) price forecasts, and system planners have refined and applied
18 techniques for addressing fuel price uncertainty in a rational and proactive way.

19 It is, therefore, troubling and wrong to claim that forecasting carbon allowance
20 prices should not be undertaken as a part of utility resource decision-making
21 because it is “speculative.”

22 **Q. Do the Co-owners have any opinions or thoughts as to when carbon**
23 **regulation will happen?**

24 A. No. Interrogatory 18 of Joint Intervenors’ First Set and First Amended Set of
25 Interrogatories² asked each of the Co-owners to state whether it:

¹ Gas prices also show terrific volatility on shorter time scales (e.g., monthly or weekly prices).

² The Co-owners’ response to Interrogatory 18 is attached as Exhibit JI-1-D.

1 believes it is likely that greenhouse gas regulation (ghg) will be
2 implemented in the U.S. (a) in the next five years, (b) in the next ten
3 years, and (c) in the next twenty years.

4 None of the co-owners had any thoughts as to when or even if greenhouse gas
5 regulation would occur. Two of the Co-owners (GRE and HCPD) claim to
6 closely follow discussion of GHG regulation at the federal and State levels, but
7 apparently had no opinions about what might result from such discussions.

8 **Q. If the siting permit for Big Stone Unit II were to be approved and the unit**
9 **were built, is carbon regulation an issue that could be reasonably dealt with**
10 **in the future, once the timing and stringency of the regulation is known?**

11 A. Unfortunately, no. Unlike for other power plant air emissions like sulfur dioxide
12 and oxides of nitrogen, there currently is no commercial or economical method
13 for post-combustion removal of carbon dioxide from supercritical pulverized coal
14 plants. The Big Stone II Co-owners agree on that point. During the public hearing
15 in Milbank held on September 13, 2005, the Co-owners presented several slides
16 on the expected combined emissions from Big Stone Units I & II. The descriptive
17 slide for the CO₂ emissions chart submitted to the South Dakota PUC states there
18 is “no commercially available capture and sequestration technology.” This slide
19 is attached as Exhibit JI-1-E. Regardless of the uncertainty, this is an issue that
20 needs to be dealt with before new resource decisions are made.

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

23 A. Yes. For example, James Rogers, CEO of Duke Energy, has publicly said “[I]n
24 private, 80-85% of my peers think carbon regulation is coming within ten years,
25 but most sure don’t want it now.”³ Not wanting carbon regulation from a utility
26 perspective is understandable because carbon price forecasting is not simple and
27 easy, it makes resource planning more difficult and is likely to change “business

³ “The Greening of General Electric: A Lean, Clean Electric Machine,” *The Economist*, December 10, 2005, at page 79.

1 as usual.” For many utilities, including the Big Stone II Co-owners, that means
2 that it is much more difficult to justify building a pulverized coal plant.
3 Regardless, it is imprudent to ignore the risk.

4 Duke is not alone in believing that carbon regulation is inevitable and, indeed,
5 some utilities are advocating for mandatory greenhouse gas reductions. In a May
6 6, 2005, statement to the Climate Leaders Partners (a voluntary EPA-industry
7 partnership), John Rowe, Chair and CEO of Exelon stated, “At Exelon, we accept
8 that the science of global warming is overwhelming. We accept that limitations
9 on greenhouse gases emissions [sic] will prove necessary. Until those limitations
10 are adopted, we believe that business should take voluntary action to begin the
11 transition to a lower carbon future.”

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

20 Some of the companies believe that there is a high likelihood of federal regulation
21 of greenhouse gas emissions within their planning period. For example,
22 PacifiCorp states a 50% probability of a CO₂ limit starting in 2010 and a 75%
23 probability starting in 2011. The Northwest Power and Conservation Council
24 models a 67% probability of federal regulation in the twenty-year planning period
25 ending 2025 in its resource plan. Northwest Energy states that CO₂ taxes “are no
26 longer a remote possibility.”⁴

⁴ Northwest Energy 2005 Electric Default Supply Resource Procurement Plan, December 20, 2005; Volume 1, p. 4.

1 Even those in the electric industry who oppose mandatory limits on greenhouse
2 gas regulation believe that regulation is inevitable. David Ratcliffe, CEO of
3 Southern Company, a predominantly coal-fired utility that opposes mandatory
4 limits, said at a March 29, 2006, press briefing that “There certainly is enough
5 public pressure and enough Congressional discussion that it is likely we will see
6 some form of regulation, some sort of legislation around carbon.”⁵

7 **Q. Do companies outside of electric utilities support greenhouse gas regulation?**

8 Support for the passage of greenhouse gas regulation has been expressed by
9 senior executives in companies such as Wal-Mart, General Electric, BP, Shell,
10 and Goldman Sachs. For example, on April 4, 2006, during a Senate hearing on
11 the design of a CO₂ cap-and-trade system, a representative of GE Energy said the
12 following:

13 “GE supports development of market-based programs to slow, eventually stop,
14 and ultimately reverse the growth of greenhouse gases (GHG).”

15 --David Slump, GE Energy, General Manager, Global Marketing, executive
16 summary of comments to Senate Energy and Natural Resources Committee

17 **Q. Why would so many electric utilities, in particular, be concerned about**
18 **future carbon regulation?**

19 A. Electricity generation is very carbon-intensive. Electric utilities are likely to be
20 one of the first, if not the first, industries subject to carbon regulation because of
21 the relative ease in regulating stationary sources as opposed to mobile sources
22 (automobiles) and because electricity generation represents a significant portion
23 of total U.S. greenhouse gas emissions. A new generating facility may have a
24 book life of twenty to forty years, but in practice, the utility may expect that that
25 asset will have an operating life of 50 years or more. By adding new plants,
26 especially new coal plants, a utility is essentially locking-in a large quantity of

⁵ Quoted in “U.S. Utilities Urge Congress to Establish CO₂ Limits,” Bloomberg.com,
<http://www.bloomberg.com/apps/news?pid=10000103&sid=a75A1ADJv8cs&refer=us>

1 carbon dioxide emissions for decades to come. In general, electric utilities are
2 increasingly aware that the fact that we do not currently have federal greenhouse
3 gas regulation is irrelevant to the issue of whether we will in the future, and that
4 new plant investment decisions are extremely sensitive to the expected cost of
5 greenhouse gas regulation throughout the life of the facility.

6 **Q. Have mandatory greenhouse gas emissions reductions programs begun to be**
7 **examined and debated in the U.S. federal government?**

8 A. To date, the U.S. government has not required greenhouse gas emission
9 reductions. However, legislative initiatives for a mandatory market-based
10 greenhouse gas cap and trade program are under consideration.⁶

11 Several mandatory emissions reduction proposals have been introduced in
12 Congress. These proposals establish carbon dioxide emission trajectories below
13 the projected business-as-usual emission trajectories, and they generally rely on
14 market-based mechanisms (such as cap and trade programs) for achieving the
15 targets. The proposals also include various provisions to spur technology
16 innovation, as well as details pertaining to offsets, allowance allocation,
17 restrictions on allowance prices and other issues. Through their consideration of
18 these proposals, legislators are increasingly educated on the complex details of
19 different policy approaches, and they are laying the groundwork for a national
20 mandatory program. Federal proposals that would require greenhouse gas
21 emission reductions are summarized in Table 5.1 in Exhibit JI-1-F.

22 It is significant that the U.S. Congress is examining and debating these emissions
23 reduction proposals. However, as shown in Figure 5.2 in Exhibit JI-1-F, the
24 emissions trajectories contained in the proposed federal legislation are in fact
25 quite modest compared with the emissions reductions that are anticipated to be
26 necessary to achieve stabilization of atmospheric concentrations of greenhouse
27 gases. Figure 5.2 in Exhibit JI-1-F compares various emission reduction
28 trajectories and goals in relation to a 1990 baseline. U.S. federal proposals, and

⁶ Exhibit JI-1-F, at pages 11- 16.

1 even Kyoto Protocol reduction targets, are small compared with the current E.U.
2 emissions reduction target for 2020, and the emissions reductions that most
3 scientists claim will ultimately be necessary to avoid the most dangerous impacts
4 of global warming.

5 **Q. Are any states developing and implementing climate change policies that will**
6 **have a bearing on resource choices in the electric sector?**

7 A. Yes. A growing number of states are developing and implementing the following
8 types of policies that will affect greenhouse gas emissions in the electric sector:
9 (1) direct policies that require specific emissions reductions from electric
10 generation sources; (2) indirect policies that affect electric sector resource mix
11 such as through promoting low-emission electric sources; (3) legal proceedings;
12 or (4) voluntary programs including educational efforts and energy planning.⁷

13 Direct policies include the New Hampshire and Massachusetts laws imposing
14 caps on carbon dioxide emissions from power plants in those states.

15 Indirect policies include the requirements by various states to either consider
16 future carbon dioxide regulation or use specific “adders” for carbon dioxide in
17 resource planning. It also includes policies and incentives to increase energy
18 efficiency and renewable energy use, such as renewable portfolio standards.
19 Some of these requirements are at the direction of state public utilities
20 commissions, others are statutory requirements.

21 Lawsuits make up the majority of the third category. For example, several states
22 are suing the U.S. Environmental Protection Agency (EPA) to have carbon
23 dioxide regulated as a pollutant under the Clean Air Act.

24 Among the voluntary programs undertaken at the state level are the climate
25 change action plans developed by 28 states.

⁷ Exhibit JL-1-F, at pages 16 through 20.

1 But states are not just acting individually; there are a number of examples of
2 innovative regional policy initiatives that range from agreeing to coordinate
3 information (e.g., Southwest governors and Midwestern legislators) to
4 development of a regional cap and trade program through the Regional
5 Greenhouse Gas Initiative in the Northeast (“RGGI”). The objective of the RGGI
6 is the stabilization of CO₂ emissions from power plants at current levels for the
7 period 2009-2015, followed by a 10 percent reduction below current levels by
8 2019. These regional activities are summarized in Table 5.5 in Exhibit JI-1-F.

9 **Q. Have any states adopted direct policies that require specific emissions**
10 **reductions from electric sources?**

11 A. Yes. The states of Massachusetts, New Hampshire, Oregon and California have
12 adopted policies requiring greenhouse gas emission reductions from power
13 plants.⁸

14 **Q. Do any states require that utilities or default service suppliers evaluate costs**
15 **or risks associated with greenhouse gas emissions in long-range planning or**
16 **resource procurement?**

17 A. Yes. As shown in Table 1 below, several states require companies under their
18 jurisdiction to account for the emission of greenhouse gases in resource planning.

⁸ Exhibit JI-1-F, Table 5.3 on page 18.

1 **Table 1. Requirements for Consideration of Greenhouse Gas Emissions in Electric**
 2 **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 CO ₂ 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) (2005)

3

1 **Q. What carbon dioxide values are being used by utilities in electric resource**
2 **planning?**

3 A. Table 2 below presents the carbon dioxide costs, in \$/ton CO₂, that are presently
4 being used in the industry for both resource planning and modeling of carbon
5 regulation policies.

6 **Table 2. Carbon Dioxide Costs Used by Utilities**

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

7 **Values for these utilities from Wiser, Ryan, and Bolinger, Mark. "Balancing Cost and Risk: The*
8 *Treatment of Renewable Energy in Western Utility Resource Plans." Lawrence Berkeley National*
9 *Laboratories. August 2005. LBNL-58450. Table 7.*
10 *Other values: PacifiCorp, Integrated Resource Plan 2003, pages 45-46; and Idaho Power*
11 *Company, 2004 Integrated Resource Plan Draft, July 2004, page 59; Avista Integrated Resource*
12 *Plan 2005, Section 6.3; Northwestern Energy Integrated Resource Plan 2005, Volume 1 p. 62;*
13 *Northwest Power and Conservation Council, Fifth Power Plan pp. 6-7. Xcel-PSCCo,*
14 *Comprehensive Settlement submitted to the CO PUC in dockets 04A-214E, 215E and 216E,*
15 *December 3, 2004. Converted to \$2005 using GDP implicit price deflator.*

16 **Q. How should utilities plan for and mitigate the risk of greenhouse gas**
17 **regulation?**

18 A. The key part of that question is "plan for the risk of greenhouse gas regulation."
19 Mitigating risk begins with the resource planning process and the decision as to
20 the demand-side and supply-side options that should be pursued. A utility that
21 chooses to go forward with a new, carbon intensive energy resource without
22 proper consideration of carbon regulation is imprudent. To give an analogy it
23 would be like choosing to build a gas-fired power plant without consideration of

1 the cost of gas because one believes that building the plant is “worth it” regardless
2 of what gas might cost.

3 A utility that desires to be prudent about the risk of carbon regulation would, at a
4 minimum, consider carbon regulation by developing an expected carbon price
5 forecast as well as reasonable sensitivities around that case.

6 **Q. Please explain how Synapse developed its carbon price forecast.**

7 A. Our forecast is described in more detail in Exhibit JI-1-F starting on page 39.

8 During the decade from 2010 to 2020, we anticipate that a reasonable range of
9 carbon emissions prices will reflect the effects of increasing public concern over
10 climate change (this public concern is likely to support increasingly stringent
11 emission reduction requirements) and the reluctance of policymakers to take steps
12 that would increase the cost of compliance (this reluctance could lead to increased
13 emphasis on energy efficiency, modest emission reduction targets, or increased
14 use of offsets). We expect that the widest uncertainty in our forecasts will begin at
15 the end of this decade, that is, from \$10 to \$40 per ton of CO₂ in 2020, depending
16 on the relative strength of these factors.

17 After 2020, we expect the price of carbon emissions allowances to trend upward
18 toward a marginal mitigation cost. This number will depend on currently
19 uncertain factors such as technological innovation and the stringency of carbon
20 caps, but it is likely that, by this time, the least expensive mitigation options (such
21 as simple energy efficiency and fuel switching) will have been exhausted. Our
22 projection for greenhouse gas emissions costs at the end of this decade ranges
23 from \$20 to \$50 per ton of CO₂ emissions.

24 We currently believe that the most likely scenario is that as policymakers commit
25 to taking serious action to reduce carbon emissions, they will choose to enact both
26 cap and trade regimes and a range of complementary energy policies that lead to
27 lower cost scenarios, and that technology innovation will reduce the price of low-
28 carbon technologies, making the most likely scenario closer to (though not equal
29 to) low case scenarios than the high case scenario. We expect that the probability

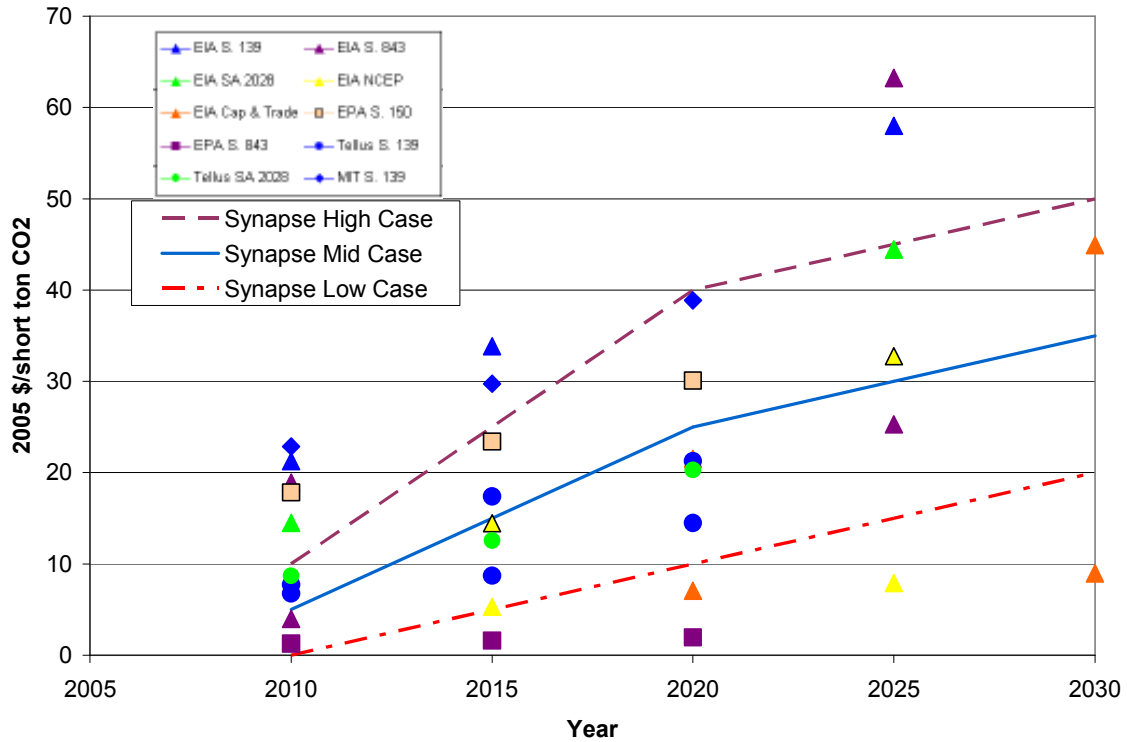
1 of taking this path will increase over time, as society learns more about optimal
2 carbon reduction policies.

3 After 2030, and possibly even earlier, the uncertainty surrounding a forecast of
4 carbon emission prices will increase due to the interplay of factors such as the
5 level of carbon constraints required and technological innovation. As discussed in
6 Exhibit II-1-F, scientists anticipate that very significant emission reductions will
7 be necessary, in the range of 80 percent below 1990 emission levels, to achieve
8 stabilization targets that will keep global temperature increases to a somewhat
9 manageable level. As such, we believe there is a substantial likelihood that
10 response to climate change impacts will require much more aggressive emission
11 reductions than those contained in U.S. policy proposals, and in the Kyoto
12 Protocol, to date. If the severity and certainty of climate change are such that
13 emissions levels 70-80% below current rates are mandated, this could result in
14 very high marginal emissions reduction costs, though we have not quantified the
15 cost of such deeper cuts on a per ton basis.

16 **Q. What is Synapse's forecast of carbon dioxide emissions prices?**

17 A. Synapse's forecast of future carbon dioxide emissions prices are presented in
18 Figure 1 below. This figure superimposes Synapse's forecast on the results of
19 other cost analyses of proposed federal policies:

1 **Figure 1. Synapse Carbon Dioxide Prices**



2
 3 **Q. What is Synapse’s levelized carbon price forecast?**

4 A. Synapse’s forecast, levelized⁹ over 20 years, 2011 – 2030, is provided in Table 3
 5 below.

6 **Table 3. Synapse’s Levelized Carbon Price Forecast (2005\$/ton)**

Low Case	Mid Case	High Case
\$7.8	\$19.1	\$30.5

⁹ 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).

1 **Q. The Minnesota Public Utilities Commission has established environmental**
2 **externality values for a number of pollutants including CO₂. Wouldn't it be**
3 **sufficient and more efficient to simply use the CO₂ externality values? The**
4 **effect is the same, to bias resource selection towards non-CO₂ emitting**
5 **resources.**

6 A. That would appear to be an easy solution, but the MN PUC values are meant to
7 reflect external costs arising from damage to the environment caused by climate
8 change (as a percentage of GDP). The Commission's order of January 3, 1997
9 explained:¹⁰

10 The environmental values for CO₂ quantified in this Order follow
11 MPCA witness Ciborowski's general methodology. First, Ciborowski
12 estimated **long-term global costs** based on the existing economic
13 literature and **discounted** them to current values. Then, he divided
14 that amount by the amount of long-term CO₂ emissions to arrive at an
15 average cost per ton. Ciborowski essentially converted published
16 damage estimates made by economists from percentages of gross
17 domestic product (GDP) into costs per ton of CO₂.

18 The full order is attached as Exhibit JI-1-G. Clearly this order shows that the
19 Minnesota environmental externality values contain no consideration of future
20 carbon regulation and the *actual* costs that regulation would impose on utilities.
21 Indeed, the range of CO₂ values adopted by the Minnesota PUC is much smaller
22 than the range of Synapse's price forecasts, \$0.35 – 3.64 per ton of CO₂ (2004\$).

23 **Q. Have the Big Stone II co-owners adequately considered the risk of**
24 **greenhouse gas regulation?**

25 A. No. The Co-owners' approach is what might be called keeping their heads in the
26 sand and hoping that the problem of global warming goes away. For example, the
27 Co-owners could not answer basic questions about the United Nations Framework
28 Convention on Climate Change. Request for Admission No. 22 in the Joint
29 Intervenors' First Set of Requests for Admission asked the Co-owners to:

¹⁰ Page 27 of the Order Establishing Environmental Cost Values in Docket No. E-99/CI-93-583 issued January 3, 1997.

1 Admit that in 1992 the United Nations Framework Convention on
2 Climate Change was adopted [IPCC 2005, p 5].

3 The Co-owners responded by saying that:

4 Applicant has made reasonable inquiry and the information known to
5 it is insufficient to enable Applicant to admit or deny this statement.

6 Similarly, Request for Admission No. 25 asked the Co-owners to:

7 Admit that the most recent Assessment Report released by the IPCC is
8 the Third Assessment Report (TAR), released in 2001, and that part of
9 the TAR is the report of the Working Group I of the IPCC, entitled
10 “Climate Change 2001: The Scientific Basis.”

11 Again, the Co-owners responded, in part:

12 Applicant has made reasonable inquiry and the information known to
13 it is insufficient to enable Applicant to admit or deny this statement.

14 In *twenty* separate instances, the Co-owners could not answer requests for
15 admission requiring them to do nothing more than admit facts that could easily be
16 verified by an internet search (starting with the internet addresses that Joint
17 Intervenors in many cases provided in the questions) or by referring to the
18 document(s) attached to the request. Attached as Exhibit JI-1-H, is the Joint
19 Intervenors’ First Set of Requests for Admission with these twenty responses
20 highlighted.

21 **Q. How are such responses relevant to the issue of considering carbon
22 regulation in resource planning?**

23 A. If a utility does not rely upon outside expertise to, at a basic level, advise the
24 utility on future carbon regulation and second to forecast carbon allowance prices,
25 it must rely upon its own knowledge and information gathering to do so. A major
26 step in that process is to understand the various parties involved and what their
27 recommendations mean to policymakers. Organizations such as the
28 Intergovernmental Panel on Climate Change are well recognized and regarded
29 and their thoughts on topics such as climate change do not go by the wayside.
30 The inability to answer these basic questions, let alone put in the small effort that

1 would be necessary to answer such questions, bodes poorly for the Co-owners'
2 decision-making.

3 **Q. Did the Co-owners reflect any potential greenhouse gas regulations in their**
4 **resource planning for Big Stone II?**

5 A. No. In certain instances they used the Minnesota PUC environmental externality
6 value for carbon dioxide, which as we discussed above is not adequate
7 consideration of regulatory risk and uncertainty.

8 **Q. Are the Big Stone II Co-owners already heavily dependent upon coal-fired**
9 **generation?**

10 A. Yes. The testimony in this proceeding reveals that each of the Co-owners already
11 is heavily dependent upon coal-fired generation. Although some Co-owners are
12 making some efforts to add wind, participation in Big Stone II will further
13 increase the Co-owners' dependence upon coal-fired generation and,
14 consequently, their exposure to future greenhouse gas regulations.

15 For example, Otter Tail Power's testimony in this proceeding reveals that as of
16 2004, 60.3 percent (winter) to 65.3 percent (summer) of the Company's
17 generating capacity was coal-fired.¹¹ When oil and natural gas fired capacity is
18 included, more than 75 percent of Otter Tail's current generating capacity is
19 fossil-fired.

20 GRE's 2006 generation mix is 76 percent from coal, not including additional
21 coal-fired generation that might be the sources for the other purchased power
22 listed in the Company's testimony.¹²

23 CMMPA's listing of its existing and planned capacity resources includes 43 MW
24 of coal-fired capacity (75 percent of the total) and 13.5 MW of wind.¹³

¹¹ Applicants' Exhibits 10-D and 10-E.

¹² Applicants' Exhibit 2, page 14, lines 19-23.

¹³ Applicants' Exhibit 6, page 10, lines 1-2.

1 Seventy-six percent of Montana-Dakota Utilities existing owned-generation is
2 coal-fired.¹⁴ However, despite this reliance on coal, Montana-Dakota Utilities
3 2005 Integrated Resource Plan reveals that, other than possible purchases from
4 other utilities or the energy market, the only new baseload options that the
5 company was considering were coal-fired units.¹⁵

6 Approximately 50 percent of MRES' existing capacity, and all of its baseload
7 capacity, is coal-fired.¹⁶

8 Approximately 59 percent of SMMPA's existing generating capacity is coal-
9 fired.¹⁷

10 Finally, Heartland's existing resources appear to be a mix of coal-fired generation
11 and purchased power contracts.¹⁸ Heartland has indicated that from 2013 to 2020,
12 i.e., after the end of its purchased power agreement with Nebraska Public Power
13 District, it plans to have the following resources available for its customers:
14 Laramie River Station (50 MW); Customer-owned peaking generation (24 MW);
15 Big Stone Unit II (25 MW); and Whelan Energy Center Unit 2 (80 MW).¹⁹ This
16 means that all of the resources that Heartland plans to have available for its
17 customers during these years will be fossil-fired, and approximately 86 percent
18 will be coal-fired.

19 **Q. How much additional CO₂ will Big Stone II emit into the atmosphere?**

20 A. At its projected 88 percent capacity factor (i.e., 4625 GWH), Big Stone II will
21 emit approximately 4,506,000 tons of CO₂ annually.

¹⁴ Applicants' Exhibit 11, page 8, lines 9-17.

¹⁵ *Montana-Dakota Utilities Co. 2005 Integrated Resource Plan submitted to the Montana Public Service Commission*, dated September 15, 2005, at pages (iii) and (iv).

¹⁶ Applicants' Exhibit 14, at page 9, line 6, to page 10, line 3.

¹⁷ Applicants' Exhibit 13, page 4, line 14, to page 5, line 8.

¹⁸ Applicants' Exhibit 15, page 16, lines 16-23.

¹⁹ Co-owners' Response to Interrogatory 62 of the Intervenors' Sixth Set of Interrogatories in this Docket.

1 **Q. Would incorporating Synapse’s carbon price forecast have a material effect**
 2 **on the economics of building and operating the proposed Big Stone II**
 3 **Project?**

4 A. Yes. For illustrative purposes, we have calculated the CO₂ cost of a new fossil-
 5 fuel fired generating unit built in 2011 using each case of our carbon price
 6 forecast levelized over the 20-year period from 2011 to 2030.

7 **Table 4. CO₂ Cost of New Fossil-Fuel Resources**

	For a new plant online in 2011			
	Supercritical PC	Combined Cycle	IGCC	Source Notes
Size (MW)	600	600	535	1
CO ₂ (lb/MMBtu)	208	110	200	1
Heat Rate (Btu/KWh)	9,369	7,400	9,612	1
CO ₂ Low Price (2005\$/ton)	7.80	7.80	7.80	2
CO ₂ Mid Price (2005\$/ton)	19.10	19.10	19.10	2
CO ₂ High Price (2005\$/ton)	30.50	30.50	30.50	2
CO ₂ Low Cost per MWh	\$7.60	\$3.17	\$7.50	
CO ₂ Mid Cost per MWh	\$18.61	\$7.77	\$18.36	
CO ₂ High Cost per MWh	\$29.72	\$12.41	\$29.32	

1 - From Applicants’ Exhibit 23-A

2 - Synapse’s carbon allowance price forecast levelized over 20 years at 7.32% real discount rate

8

9 As demonstrated in Table 4, the cost per MWh attributable to a supercritical coal
 10 plant like Big Stone II from greenhouse gas regulation is quite significant. From
 11 a purely qualitative standpoint, it is very difficult to imagine that other resources
 12 would not be more cost-effective than Big Stone II with the addition of
 13 \$18.61/MWh in operating costs from our mid-case CO₂ price forecast.

14 According to Applicants’ Exhibit 23-A, Burns & McDonnell’s *Analysis of*
 15 *Baseload Generation Alternatives*, the busbar cost of Big Stone II is \$50.71/MWh
 16 (2005\$) for investor-owned utilities (IOUs) and \$40.85/MWh (2005\$) for public
 17 power. An \$18.61/MWh increase in operating costs would represent a 37%
 18 increase in cost per MWh of Big Stone II generation to the Big Stone II investor
 19 owned utilities and a 46% increase to the public power Co-owners.

1 **Q. What would be the annual CO₂ cost to the Big Stone II Co-owners?**

2 A. Assuming the *Analysis of Baseload Generation Alternatives* will accurately
3 reflect the operating parameters of Big Stone Unit II including an 88% capacity
4 factor, the range of annual, levelized cost to the Big Stone II Co-owners of CO₂
5 regulation would be:

6 Low Case - $4,625,280 \text{ MWh} \cdot \$7.74/\text{MWh} = \$35,152,128$

7 Mid Case - $4,625,280 \text{ MWh} \cdot \$19.60/\text{MWh} = \$86,076,461$

8 High Case - $4,625,280 \text{ MWh} \cdot \$30.39/\text{MWh} = \$137,463,322$

9 **Q. Does this conclude your testimony?**

10 A. No. The remainder of our testimony will be filed on May 26, 2006.

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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, SO₂ and CO₂. 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 Proposed 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. 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 and the auctions of 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 AND COMMENTS

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.

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.

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.

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, March 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) - July 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) - June 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) - December 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) - 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

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.

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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.

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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.

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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
- National Academy of Forensic Engineers (Correspondent Affiliate)

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics, Inc., Cambridge, MA. Research Associate. June 2003 - Present. Consulting on economic analysis of technologies and policies, electric policy modeling, evaluation of water use and air emissions of electricity generation, and other topics including energy efficiency, consumer advocacy, and technology strategy within the energy industry.

EFI/Xenergy, Burlington, MA Intern, September 2000 – May 2003. Co-authored three regional sections in a nationwide annual review of regional transmission organizations (RTOs). Researched and wrote client reports and intra-company memos about various energy technologies such as wind, solar, geothermal, fuel cells and ethanol. Interviewed energy stakeholders and experts in order to answer client policy and legislative questions. Wrote sections of a guidebook on utility, local, state and federal incentives for renewable energy.

Zilkha Renewable Energy, Houston, TX. Intern, May - August 2002. Authored comprehensive strategy for developing wind power projects on federal lands in eight states, including legislation, financial incentive, wind resource, transmission and public support overviews. “Wind prospected” possible sites for wind farms throughout the western United States. Identified and monetized value of renewable energy attributes as part of power supply bids to utilities.

EDUCATION

Tufts University, BS in Economics and Environmental Studies, Medford, MA, 2003

REPORTS

Mohave Alternatives and Complements Study: Assessment of Carbon Sequestration Feasibility and Markets, a Synapse Energy Economics, Inc. and Sargeant and Lundy report prepared for Southern California Edison and Stakeholders by Anna Sommer and William Steinhurst. Pending.

Considering Climate Change in Electric Resource Planning: Zero is the Wrong Carbon Value, a Synapse Energy Economics, Inc. report prepared by Lucy Johnston, Amy Roschelle, Ezra Hausman, Anna Sommer and Bruce Biewald. September 20, 2005.

NSPI's 2004 100 kW - 2 MW Renewable Solicitation: Summary and Observations, a Synapse Energy Economics, Inc. report prepared for the Nova Scotia Utility and Review Board by William Steinhurst, David E. White, and Anna Sommer. October 19, 2004.

Potential Cost Impacts of a Vermont Renewable Portfolio Standard, a Synapse Energy Economics, Inc. report prepared for the Vermont Public Service Board, by Tim Woolf, David E. White, Cliff Chen, and Anna Sommer. October 16, 2003.

Estimating the Environmental Benefits of Renewable Energy and Energy Efficiency in North America: Experience and Methods, a report for the Commission for Environmental Cooperation, by Geoffrey Keith, Bruce Biewald, Anna Sommer, Patrick Henn, and Miguel Breceda, September 22, 2003.

Comments on the RPS Cost Analyses of the Joint Utilities and the DPS Staff, a Synapse Energy Economics, Inc. report prepared for the Renewable Energy Technology and Environment Coalition, by Bruce Biewald, Cliff Chen, Anna Sommer, William Steinhurst, and David E. White. September 19, 2003.

Cleaner Air, Fuel Diversity and High-Quality Jobs: Reviewing Selected Potential Benefits of an RPS in New York State, a Synapse Energy Economics, Inc. report prepared for The Renewable Energy Technology and Environment Coalition, by Geoff Keith, Bruce Biewald, David E. White, Anna Sommer, and Cliff Chen. July 28, 2003.

INVESTIGATIONS

Public Utilities Commission of Nevada (Docket No. 05-10021) - Ongoing

Evaluation of Sierra Pacific Power Company's proposal to provide gas demand side-management (DSM) programs to its customers.

South Dakota Public Utilities Commission (Docket No. EL05-022) – Ongoing

Issues regarding a proposal to build a supercritical, pulverized coal unit including resource planning, cost and environmental regulations.

Indiana Utility Regulatory Commission (Cause No. 42873) – Ongoing

Issues regarding the proposed merger of Duke Energy and Cinergy, Inc. including compliance with DSM goals in previous mergers.

Indiana Utility Regulatory Commission (Cause No. 42861) – Ongoing

Issues regarding Vectren Energy's proposal to install emission controls for SO₂, PM and Hg including compliance with present and future emissions regulations and planning analysis.

Utah Public Service Commission (Docket No. 05-035-54) – November 2005

Issues regarding the acquisition of PacifiCorp by MidAmerican Energy Holdings Company including underfunding of maintenance,

Iowa Utilities Board (Docket No. SPU-05-15) – November 2005

Evaluation of proposed sale of a nuclear power plant from a regulated utility to a non-regulated, unaffiliated third party.

Arkansas Public Utilities Commission (Docket No. 05-042-U) – August 2005

Issues regarding the purchase of a gas-fired power plant by an Arkansas coop including appropriateness and reasonableness of the purchase.

New Jersey Division of Ratepayer Advocate – 2005

Issues regarding the effect of New Jersey's declining auction for standard offer service power on the reasonableness of New Jersey residential rates.

Indiana Utility Regulatory Commission (Cause No. 42718) – May 2005

Issues regarding PSI Energy's proposal to install \$1.4 billion in control technologies for SO₂, NO_x and Hg including rate of return on investment, analysis of emissions regulation risk, scenario planning, estimates of control technology cost and equitableness of plan to ratepayers.

Nuclear Regulatory Commission (Docket No. 52-007) – April 2005

Issues regarding Exelon Generation's petition for an early permit to site a baseload nuclear generating facility in Illinois including the Company's analysis of alternatives.

Georgia Public Service Commission (Docket No. 18300-U) – February 2005

Georgia Power Company rate case involving issues of cost allocation and consideration of public benefits in rate-making for the Metropolitan Atlanta Rapid Transit Authority.

Indiana Utility Regulatory Commission (Cause No. 42612) – November 2004

Public Service Company of Indiana demand side management (DSM) case involving issues of program scope, funding, lost revenue recovery, shared savings incentive recovery, and third-party administration issues.

California Public Utilities Commission (Rulemaking 04-04-003) – August 2004

Issues in the San Diego Gas & Electric, Pacific Gas & Electric and Southern California Edison long-term resource plans including modeling the cost of carbon regulation, modeling of renewables, scenario planning and debt equivalency.

Texas Public Utility Commission (Docket No. 29526) – June 2004

Issues in CenterPoint Energy Houston Electric LLC's true up filing, including environmental cleanup costs, excess mitigation credits, and construction work in progress.

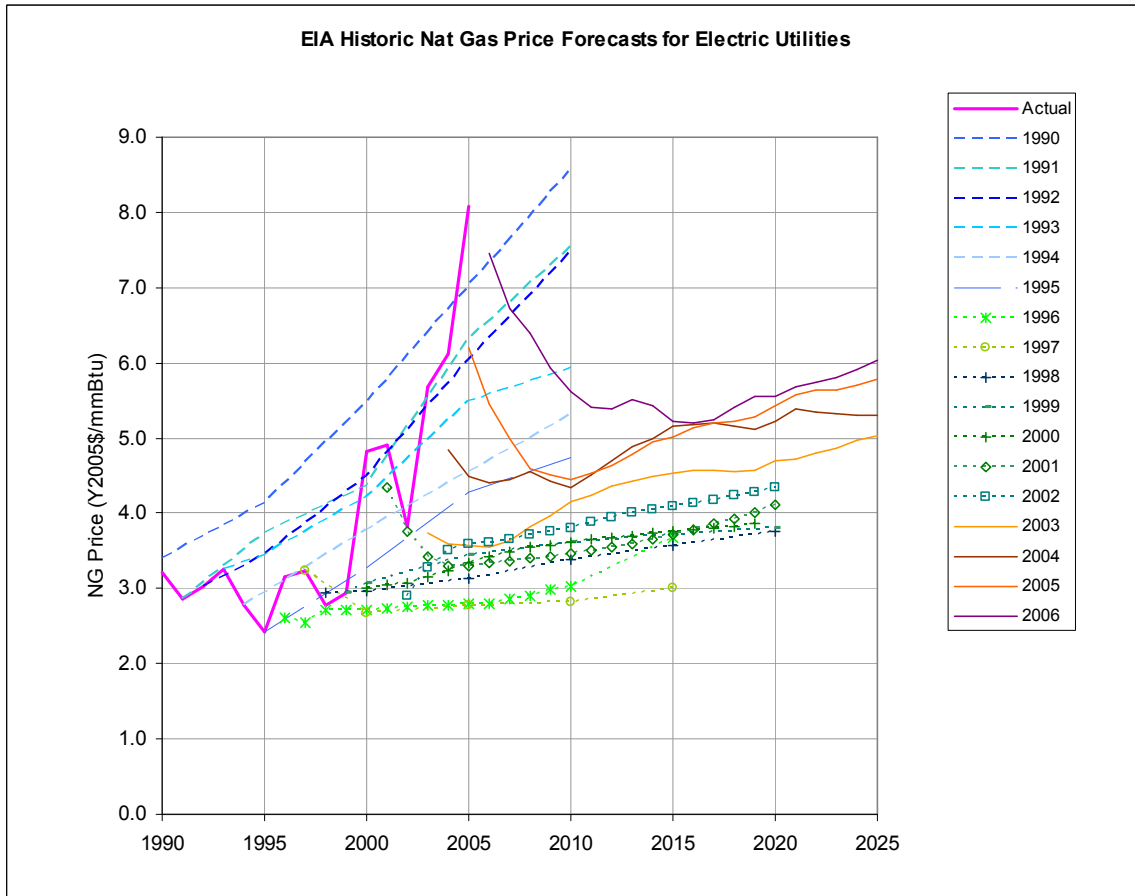
ARTICLES

Woolf, Tim, Anna Sommer, John Nielsen, David Barry and Ronald Lehr. "Managing Electric Industry Risk with Clean and Efficient Resources," The Electricity Journal, Volume 18, Issue 2, March 2005.

Woolf, Tim and Anna Sommer. "Local Policy Measures to Improve Air Quality: A Case Study of Queens County, New York," Local Environment, Volume 9, Number 1, February 2004.

Resume dated November 2005.

Exhibit
Exhibit JI-1-C – EIA Natural Gas Price Forecasts 1990-2006



**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA**

Docket No. EL05-022

In the Matter of Otter Tail Power Company on
Behalf of Big Stone II Co-owners for an Energy
Conversion Facility Permit for the Construction of
the Big Stone II Project

**BIG STONE II CO-OWNERS'
ANSWERS TO PROPOUNDING
INTERVENORS' FIRST AND FIRST
AMENDED SET OF
INTERROGATORIES**

The Big Stone II Co-owners ("Co-owners") for their answers to the First Set and First Amended Set of Interrogatories of Minnesotans For An Energy-Efficient Economy, Izaak Walton League Of America - Midwest Office, Union Of Concerned Scientists, And Minnesota Center For Environmental Advocacy ("Propounding Intervenors"), state as follows:

OBJECTIONS

On November 1, 2005, the Co-owners served their objections to Propounding Intervenors' First Set and First Amended Set of Interrogatories. Said objections, which were both general and specific to the interrogatories, are incorporated herein by reference. Without waiving any of the general or specific objections, and subject to said objections, Co-Owners jointly and individually answer as follows.

ANSWERS TO INTERROGATORIES

INTERROGATORY 1. Identify all persons answering these interrogatories or contributing to the answers to these interrogatories.

OTP Response:	Identification will be provided with each response.
GRE Response:	Michele Beck - Market & Pricing Analyst Gary Connett - Manager of Member and Resource Services Joe Jubert - Project Manager, Generation Development Sam Kokkinen - Power Marketing Engineer Stan Selander - Resource Development Administrator Mark Strohfus - Environmental Project Leader Carl Sulzer - Manager, Generation Services
HCPD Response:	John Knofczynski - Manager of Engineering Francis McGowan - Manager of Finance
SMMPA Response:	Larry Anderson - Senior Planner/Economist

INTERROGATORY 18. State whether each of the Co-owners believes it is likely that greenhouse gas (ghg) regulation will be implemented in the U.S (a) in the next five years, (b) in the next ten years, and (c) in the next twenty years.

OTP Response: (Response by: Terry Graumann, Manager, Environmental Services)

Otter Tail Power Company has not speculated on the likelihood of greenhouse gas (GHG) regulation. As a part of its resource planning, it specifically includes the externality value adapted by the MPUC for CO₂.

Otter Tail Power Company is doing what it can to reduce the intensity of carbon dioxide emissions (pounds of CO₂ per megawatt hour) through efficiency improvements to its existing units, by selection of more efficient super-critical technology for Big Stone II, and by a commitment to meet its Minnesota Renewable Energy Objective.

GRE Response: (Response by: Mark Strohfus, Environmental Project Leader)

GRE has followed the legislative initiatives proposing to regulate green house gases. None of the proposals to date at the federal or state level have had sufficient support to pass. Nonetheless, GRE closely follows the GHG discussion at the federal and state levels, but it has not attempted to speculate a likely date when GHG legislation may be enacted or when regulations may be promulgated.

HCPD Response: (Response by: John Knofczynski, Manager of Engineering)

Heartland has followed closely the public discussions of CHG. It is not possible to speculate on what policy decisions, if any, will be taken by federal or state governments in response to these discussions. Heartland is committed to the most efficient use of energy. The investment in Big Stone II, with its super-critical technology, is a part of that commitment.

SMMPA Response: (Response by: Larry Johnston, Director of Corporate Development, Agency Relations and Officer of Legislative and Regulatory Affairs)

SMMPA has not made any estimates regarding the type or timing of regulations relative to green house gases. The Minnesota Resource Planning process requires a discussion of contingencies. While green house gases have not been a portion of that contingency section, with the MPUC's acceptance of our 2000 Resource Plan, the MPUC requested that SMMPA conduct a supplemental filing looking at CO₂ and mercury mitigation strategies. In addition to reporting SMMPA's 1990 and 2000 CO₂ emissions, SMMPA referenced the modeling that was being conducted by Xcel (State Impact Assessment Model - SIAM) and efforts being conducted by EPRI. SMMPA indicated that there was little it could do to add to that modeling.

MDU Response: (Response by: Jay Skabo, Environmental Manager)

Montana-Dakota Utilities Co. has not adopted a statement of belief on the likelihood of such regulation but monitors legislative and administrative action on the matter.

CMMPA Response: (Response by: Don Kom, Executive Director)

CMMPA is uncertain as to the type, timing, or level of future CHG regulation.

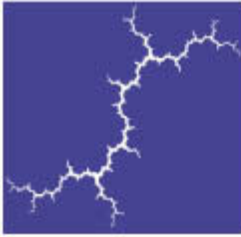
MRES Response: (Response by: Bill Radio, Director, Member Services and Public Relations).

MRES cannot say whether it is likely or what form, if any, GHG regulation will take in the next five to twenty years.



Carbon Dioxide Emissions

- Carbon dioxide produced by combustion of all fossil fuels
- Emission rate determined by fuel carbon content and process efficiency
- No commercially available capture and sequestration technology
- In the meantime, CO₂ intensity is an appropriate benchmark



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

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May 18, 2006

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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 CO₂ 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 CO₂ emissions, but has only 4.6 percent of the population.

Within the United States, the electricity sector is responsible for roughly 39% of CO₂ emissions. Within the electricity industry, roughly 82% of CO₂ 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 CO₂ 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 60% to 90% of all domestic greenhouse gas reductions are likely to come from the electric sector under a wide range of economy-wide federal policy scenarios.

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,

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.

and ultimately self-defeating. Long-term resource planning and investment decisions that do not quantify the likely future cost of CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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	2005	Cap at 2000 levels	Economy-wide, large emitting sources
Bingaman- Domenici (NCEP)	Greenhouse Gas Intensity Reduction Goals	2004	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 CO ₂) starting in 2009, 2001 levels (2.454 billion tons CO ₂) 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
<p>Direct</p> <ul style="list-style-type: none"> Power plant emission restrictions (e.g. cap or emission rate) New plant emission restrictions State GHG reduction targets Fuel/generation efficiency 	<ul style="list-style-type: none"> MA, NH OR, WA CT, NJ, ME, MA, CA, NM, NY, OR, WA CA vehicle emissions standards to be adopted by CT, NY, ME, MA, NJ, OR, PA, RI, VT, WA
<p>Indirect (clean energy)</p> <ul style="list-style-type: none"> Load-based GHG cap GHG in resource planning Renewable portfolio standards Energy efficiency/renewable charges and funding; energy efficiency programs Net metering, tax incentives 	<ul style="list-style-type: none"> CA CA, WA, OR, MT, KY 22 states and D.C. More than half the states 41 states
<p>Lawsuits</p> <ul style="list-style-type: none"> States, environmental groups sue EPA to determine whether greenhouse gases can be regulated under the Clean Air Act States sue individual companies to reduce GHG emissions 	<ul style="list-style-type: none"> States include CA, CT, ME, MA, NM, NY, OR, RI, VT, and WI NY, CT, CA, IA, NJ, RI, VT, WI
<p>Climate change action plans</p>	<ul style="list-style-type: none"> 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 CO ₂ 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 CO₂ emissions from power plants in the region. The RGGI states have agreed to the following:

- Stabilization of CO₂ 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 CO₂, that are currently being used in the industry for both resource planning and modeling of carbon regulation policies.

Table ES-4. CO₂ Cost Estimates Used in Electricity Resource Plans

Company	CO ₂ 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 CO₂ 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 CO₂ 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 CO₂ allowance prices upon the other forecasts gleaned from the literature. In order to help address the uncertainty involved in forecasting CO₂ 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.

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.

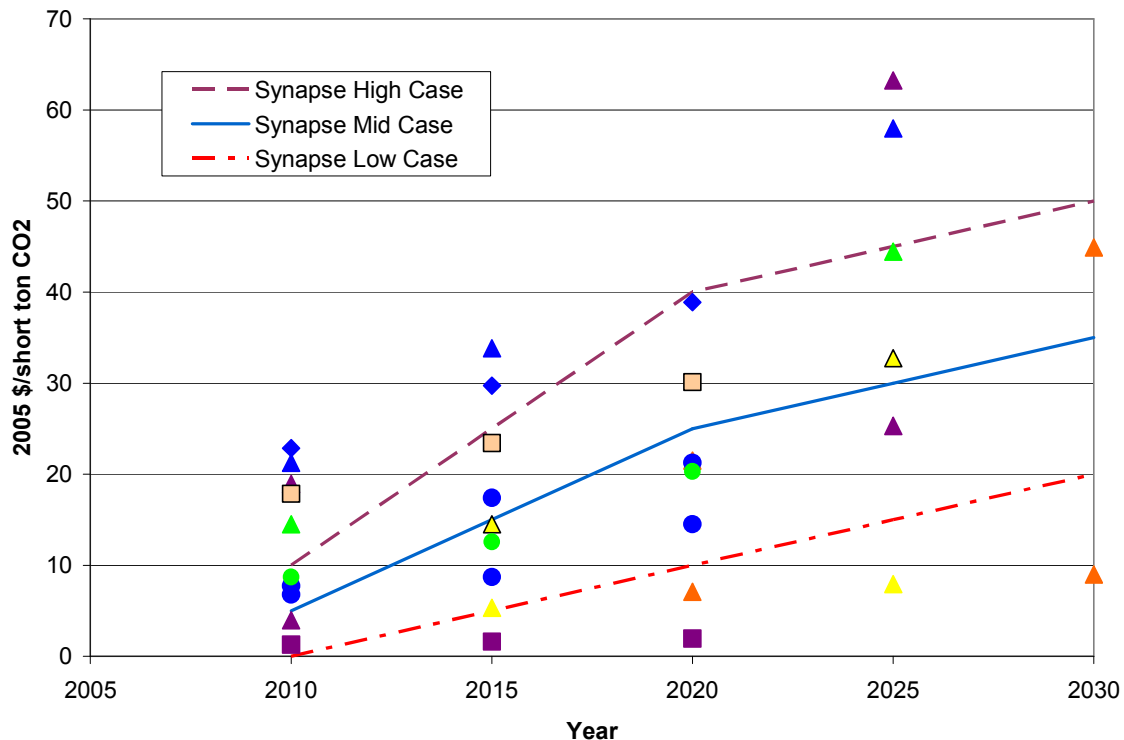


Figure ES-1. Synapse Forecast of Carbon Dioxide Allowance Prices

High, mid and low-case Synapse carbon emissions price forecasts superimposed on policy model forecasts as presented in Figure 6.3.

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 CO₂ 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 CO₂ 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 CO₂ price forecasts does not eliminate the ecological and socio-economic threat created by CO₂ 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 CO₂ 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.²

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.³ 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

² TIME/ABC News/Stanford University Poll, appearing in April 3, 2006 issue of Time Magazine.

³ Innovest Strategic Value Advisors; “Value at Risk: Climate Change and the Future of Governance;” The Coalition for Environmentally Responsible Economies; April 2002.

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- Growing pressure from customers and shareholders to address emissions contributing to climate change.⁴

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.⁵ 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.”⁶ 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.⁷ 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 CO₂ 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 CO₂ 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.⁸

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 CO₂ emissions have a higher CO₂ cost per megawatt-hour than those with lower emissions.

⁴ Ibid., pages 45-48.

⁵ CERES; “Electric Power, Investors, and Climate Change: A Call to Action;” September 2003.

⁶ Ibid., p. 6

⁷ Innovest Strategic Value Advisors; “Power Switch: Impacts of Climate Change on the Global Power Sector;” WWF International; November 2003

⁸ 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 CO₂ 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 leveled 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.⁹ 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.¹⁰ 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

⁹ 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.

¹⁰ 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 CO₂ 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.¹¹

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.¹² 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:¹³

¹¹ IPCC, *Climate Change 2001: Synthesis Report*, Fourth Volume of the IPCC Third Assessment Report. IPCC 2001. Question 6.

¹² *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.

¹³ 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_Committee_Report.pdf

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- 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 3⁰C 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 3⁰C.
 - 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.¹⁴

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 CO₂ 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 CO₂ 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.¹⁵ Figure 3.1 shows the top twenty carbon dioxide emitters in the world.

¹⁴ Several websites provide summary information on climate change science including www.ipcc.org, www.nrdc.org, www.ucsusa.org, and www.climateark.org.

¹⁵ International Energy Agency, “CO₂ from Fuel Combustion – Fact Sheet,” 2005

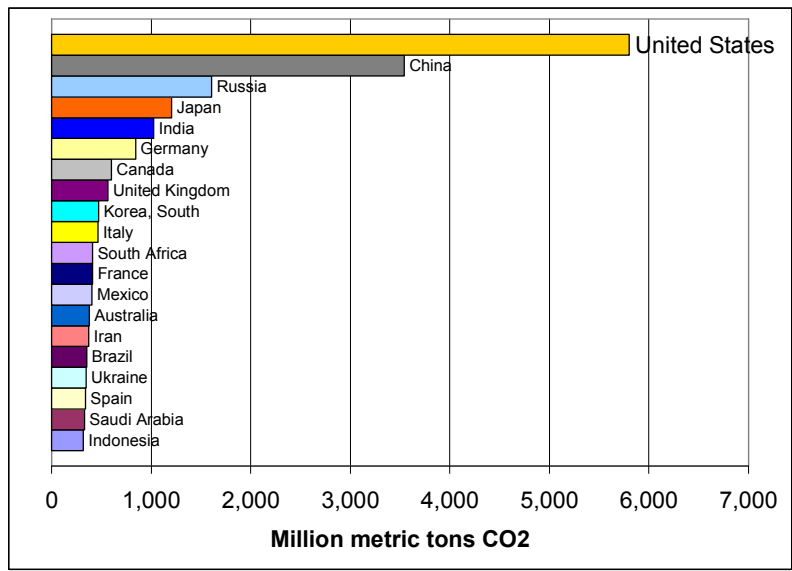


Figure 3.1. Top Worldwide Emitters of Carbon Dioxide in 2003

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 CO₂), electric generation (2,299 million metric tons CO₂), and other (which includes commercial and industrial heat and process applications – 1,673 million metric tons CO₂). 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.

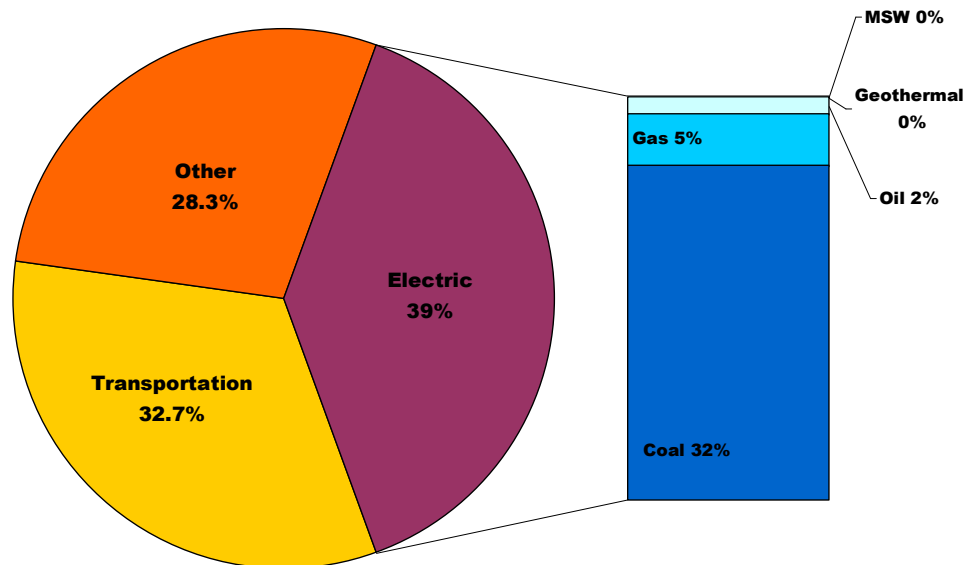


Figure 3.2. US CO₂ Emissions by Sector in 2004

Source: Data from EIA Emissions of Greenhouse Gases in the United States 2004, December 2005

Recent analysis has shown that in 2004, power plant CO₂ emissions were 27 percent higher than they were in 1990.¹⁶ 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.¹⁷ 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.¹⁸ 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 CO₂ 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 CO₂ emissions, and nearly 40 percent of its SO₂ and mercury emissions.

¹⁶ EIA, "Emissions of Greenhouse Gases in the United States, 2004;" Energy Information Administration; December 2005, xiii

¹⁷ EIA *Emissions of Greenhouse Gases in the United States 2004*, December 2005.

¹⁸ 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.¹⁹ 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.²⁰ 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.”²¹ 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.²² 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.²³ 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

¹⁹ For comprehensive information on the UNFCCC and the Kyoto Protocol, see UNFCCC, “Caring for Climate: a guide to the climate change convention and the Kyoto Protocol,” issued by the Climate Change Secretariat (UNFCCC) Bonn, Germany. 2003. This and other publications are available at the UNFCCC’s website: <http://unfccc.int/>.

²⁰ 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.

²¹ From Article 3 of the United Nations Framework Convention on Climate Change, 1992.

²² 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

²³ Greenhouse gases covered by the Protocol are CO₂, CH₄, N₂O, HFCs, PFCs and SF₆.

February 2005.²⁴ 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 Protocol²⁵

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.²⁶ The leaders

²⁴ 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.

²⁵ Background information at: http://unfccc.int/essential_background/kyoto_protocol/items/3145.php

²⁶ 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.²⁷ 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.²⁸ The EU has committed to emission reductions of 20-30% below 1990 levels by 2020, and reduction targets for 2050 are still under discussion.²⁹

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>

²⁷ Council of the European Union, *Information Note – Brussels March 10, 2005*.
<http://ue.eu.int/uedocs/cmsUpload/st07242.en05.pdf>

²⁸ 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

²⁹ *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.”³⁰ 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.³¹ 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.³²

³⁰ The UNFCCC was signed by President George H. Bush in 1992 and ratified by the Senate in the same year.

³¹ “Bush acknowledges human contribution to global warming; calls for post-Kyoto strategy.” Greenwire, July 6, 2005.

³² 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.³³

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.

³³ “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	2005	Cap at 2000 levels	Economy-wide, large emitting sources
Bingaman- Domenici (NCEP)	Greenhouse Gas Intensity Reduction Goals	2004	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 CO ₂) starting in 2009, 2001 levels (2.454 billion tons CO ₂) 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 CO₂ 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 bipartisan 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 CO₂ equivalent in 2010 with the cap rising 5 percent annually.³⁴ 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.³⁵ 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.³⁶

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.³⁷ 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,

³⁴ National Commission on Energy Policy, *Ending the Energy Stalemate*, December 2004, pages 19-29.

³⁵ 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.

³⁶ 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

³⁷ 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 \$25.³⁸

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.

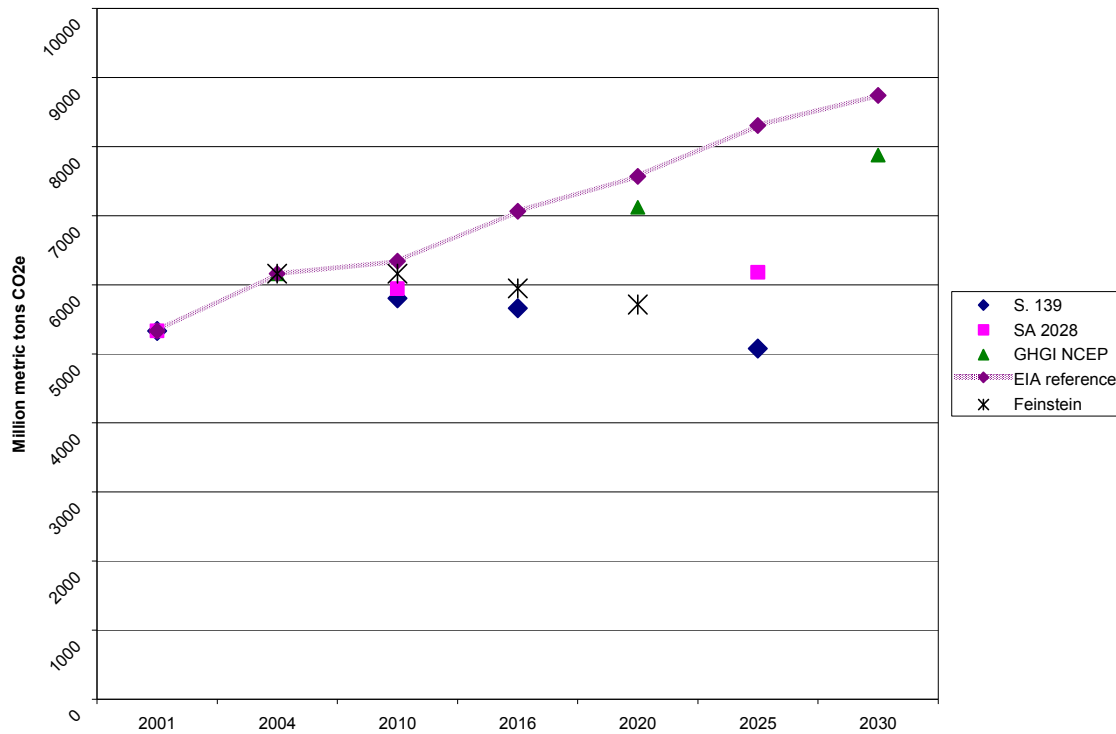


Figure 5.1. Emission Trajectories of Proposed Federal Legislation

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.

³⁸ Press release, “Udall and Petri introduce legislation to curb global warming,” March 29, 2006.

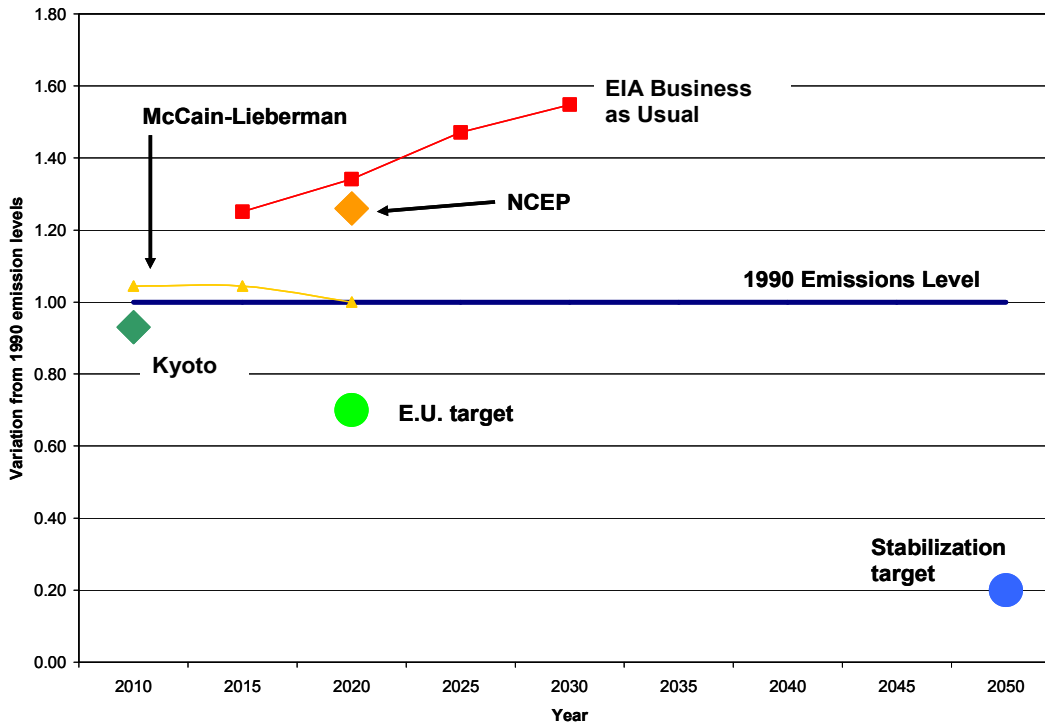


Figure 5.2 Comparison of Emission Reduction Goals

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
<p>Direct</p> <ul style="list-style-type: none"> • Power plant emission restrictions (e.g. cap or emission rate) • New plant emission restrictions • State GHG reduction targets • Fuel/generation efficiency 	<ul style="list-style-type: none"> • MA, NH • OR, WA • CT, NJ, ME, MA, CA, NM, NY, OR, WA • CA vehicle emissions standards to be adopted by CT, NY, ME, MA, NJ, OR, PA, RI, VT, WA
<p>Indirect (clean energy)</p> <ul style="list-style-type: none"> • Load-based GHG cap • GHG in resource planning • Renewable portfolio standards • Energy efficiency/renewable charges and funding; energy efficiency programs • Net metering, tax incentives 	<ul style="list-style-type: none"> • CA • CA, WA, OR, MT, KY • 22 states and D.C. • More than half the states • 41 states
<p>Lawsuits</p> <ul style="list-style-type: none"> • States, environmental groups sue EPA to determine whether greenhouse gases can be regulated under the Clean Air Act • States sue individual companies to reduce GHG emissions 	<ul style="list-style-type: none"> • States include CA, CT, ME, MA, NM, NY, OR, RI, VT, and WI • NY, CT, CA, IA, NJ, RI, VT, WI
<p>Climate change action plans</p>	<ul style="list-style-type: none"> • 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	NWPC C	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 CO ₂ 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 2013.³⁹ 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).⁴⁰

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.⁴¹ 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

³⁹ 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.

⁴⁰ Press release, "Codey Takes Crucial Step to Combat Global Warming," October 18, 2005.

⁴¹ 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 CO₂ 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 CO₂ emissions and together rank as the fifth highest CO₂ emitter

in the world. Maryland passed a law in April 2006 requiring participation in RGGI.⁴² Pennsylvania, the District of Columbia, the Eastern Canadian Provinces, and New Brunswick are official “observers” in the RGGI process.⁴³

The RGGI states have agreed to the following:

- Stabilization of CO₂ 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.⁴⁴

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 2012.⁴⁵ 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.⁴⁶ 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 CO₂. This pressure is likely to increase over time as climate change issues and measures for addressing them become better

⁴² Maryland Senate Bill 154 *Healthy Air Act*, signed April 6, 2006.

⁴³ Information on this effort is available at www.rggi.org

⁴⁴ 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.

⁴⁵ the [US Mayors Climate Protection Agreement](http://www.ci.seattle.wa.us/mayor/climate), 2005. Information available at <http://www.ci.seattle.wa.us/mayor/climate>

⁴⁶ 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.⁴⁷

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."⁴⁸ 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.⁴⁹

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 CO₂ 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.⁵⁰ Similarly, in a 2005 survey of the North American electricity industry, 93% of respondents anticipate increased pressure to take action on global climate change.⁵¹

⁴⁷ 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

⁴⁸ 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/>

⁴⁹ 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.

⁵⁰ PA Consulting Group, "Environmental Survey 2004" Press release, October 22, 2004.

⁵¹ 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.⁵² 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.⁵³

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.⁵⁴ 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.⁵⁵ 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

⁵² “US Companies Face Record Number of Global Warming Shareholder Resolutions on Wider Range of Business Sectors,” CERES press release, February 17, 2005.

⁵³ “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.

⁵⁴ 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.

⁵⁵ 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.⁵⁶ 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.⁵⁷

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 CDP1.⁵⁸
- 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.⁵⁹

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.⁶⁰

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

⁵⁶ See: <http://www.cdproject.net/aboutus.asp>

⁵⁷ 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.

⁵⁸ FT 500 is the Financial Times' ranking of the top 500 companies ranked globally and by sector based on market capital.

⁵⁹ CDP press release, September 14, 2005. Information on the Carbon Disclosure Project, including reports, are available at: <http://www.cdproject.net/index.asp>.

⁶⁰ *Greenwire*, February 16, 2005

reduction targets and supporting a national policy to limit greenhouse gas emissions.⁶¹ 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.”⁶² The President of Duke Energy urges a federal carbon tax, and states that Duke should be a leader on climate change policy.⁶³ 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 2008.⁶⁴ 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

⁶¹ Goldman Sachs Environmental Policy Framework, http://www.gs.com/our_firm/our_culture/corporate_citizenship/environmental_policy_framework/docs/EnvironmentalPolicyFramework.pdf

⁶² Jacobson, Sanne, Neil Numark and Paloma Sarria, “Greenhouse Gas Emissions: A Changing US Climate,” *Public Utilities Fortnightly*, February 2005.

⁶³ Paul M. Anderson Letter to Shareholders, March 15, 2005.

⁶⁴ 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.”⁶⁵ 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.⁶⁶ 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 SO₂ and carbon emissions reduction options lead to further emissions reductions.⁶⁷ Similarly, in one of several studies on multi-pollutant strategies, the Energy Information Administration (EIA) found that using an integrated approach to NO_x, SO₂, and CO₂, is likely to lead to lower total costs than addressing pollutants one at a time.⁶⁸ 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.

⁶⁵ Lempert, Popper, Resitar and Hart, “Capital Cycles and the Timing of Climate Change Policy.” Pew Center on Global Climate Change, October 2002. page

⁶⁶ US EPA, *Analysis of Emissions Reduction Options for the Electric Power Industry*, March 1999.

⁶⁷ US EPA, *Briefing Report*, March 1999.

⁶⁸ 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 CO₂ in that year.⁶⁹

Prices for current- and near-term EU allowances (2006-2007) escalated sharply in 2005, rising from roughly \$11/ton CO₂ (9 euros/ton-CO₂) in the second half of 2004 and leveling off at about \$36/ton CO₂ (28 euros/ton- CO₂) early in 2006. In March 2006, the market price for 2008 allowances hovered at around \$32/ton CO₂ (25 euros/ton- CO₂).⁷⁰ 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.⁷¹

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

⁶⁹ “What determines the Price of Carbon,” Carbon Market Analyst, *Point Carbon*, October 14, 2004.

⁷⁰ These prices are from Evolution Express trade data, <http://www.evomarkets.com/>, accessed on 3/31/06.

⁷¹ 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.⁷²

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 CO₂ in their submissions, and to justify their selection of a number.⁷³ In April 2005, the Commission adopted, for use in resource planning and bid evaluation, a CO₂ adder of \$8 per ton of CO₂ in 2004, escalating at 5% per year.⁷⁴ 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).⁷⁵ 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 CO₂ 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 CO₂ taxes “are no longer a remote possibility.”⁷⁶ Table 6.1 illustrates the range of carbon cost values, in \$/ton CO₂, that are currently being used in the industry for both resource planning and modeling of carbon regulation policies.

⁷² For a discussion of the use of carbon values in integrated resource planning see, Wisner, 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

⁷³ California Public Utilities Commission, Decision 04-12-048, December 16, 2004

⁷⁴ California Public Utilities Commission, Decision 05-04-024, April 2005.

⁷⁵ Montana Public Service Commission, “Written Comments Identifying Concerns with NWE's Compliance with A.R.M. 38.5.8209-8229,” August 17, 2004.

⁷⁶ Northwest Energy 2005 Electric Default Supply Resource Procurement Plan, December 20, 2005; Volume 1, p. 4.

Table 6.1 CO₂ Costs in Long Term Resource Plans

Company	CO ₂ 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 Wisser, 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 economy-wide 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).⁷⁷

In 2003 researchers at the Massachusetts Institute of Technology also analyzed potential costs of the McCain Lieberman legislation.⁷⁸ 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).⁷⁹ 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

⁷⁷ 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

⁷⁸ 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.

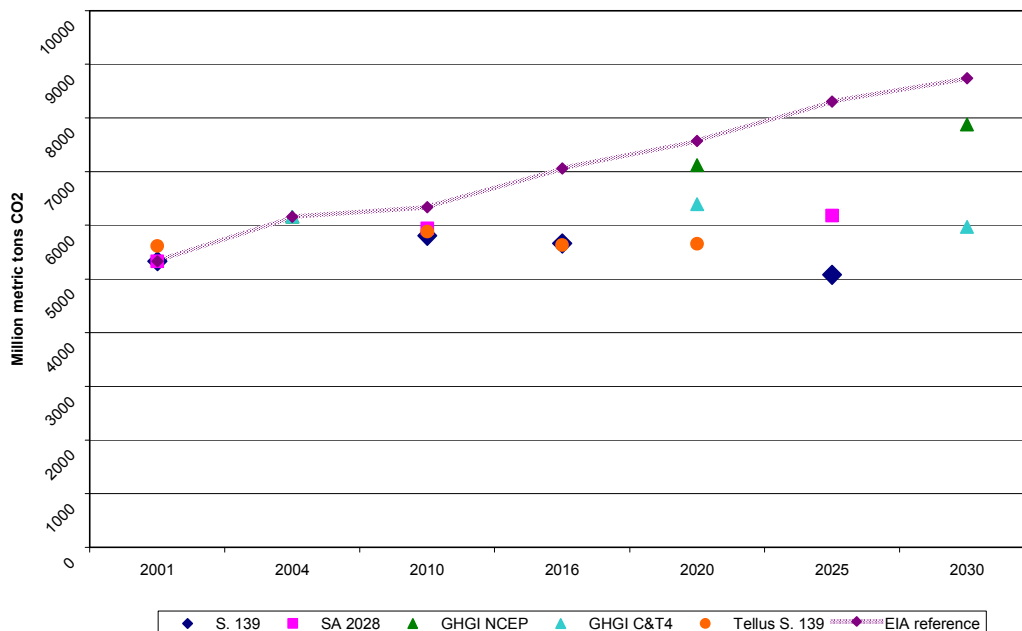
⁷⁹ Bailie et al., *Analysis of the Climate Stewardship Act*, July 2003; Bailie and Dougherty, *Analysis of the Climate Stewardship Act Amendment*, Tellus Institute, June, 2004. Available at <http://www.tellus.org/energy/publications/McCainLieberman2004.pdf>

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.⁸⁰ 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).⁸¹ EPA also analyzed the power sector proposal from Senator Jeffords (S. 150).⁸²

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.



⁸⁰ EIA, *Energy Market Impacts of Alternative Greenhouse Gas Intensity Reduction Goals*, March 2006. SR/OIAF/2006-01.

⁸¹ 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.

⁸² 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 2004 dollars per metric ton of carbon dioxide.

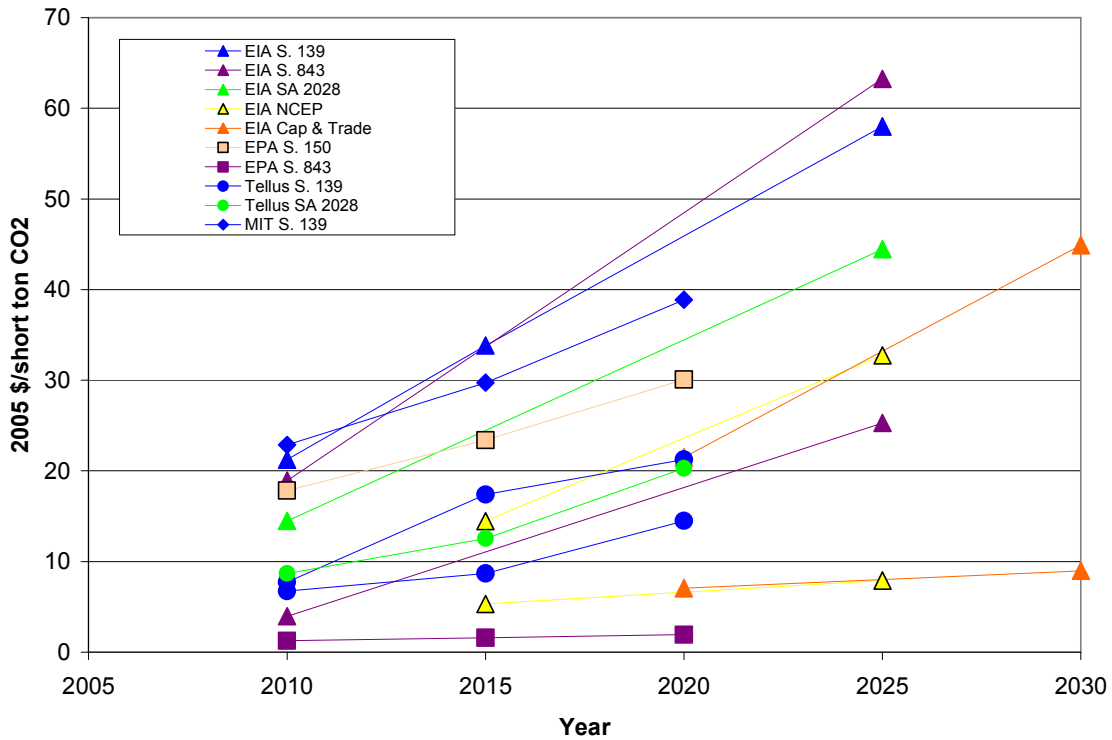


Figure 6.2. Allowance Cost Estimates From Studies of Economy-wide and Electric Sector US Policy Proposals

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.⁸³ In 1999 EIA performed a very similar study, but looked at phasing in carbon prices beginning in 2000 instead of 2005 as in the

⁸³ EIA, “Impacts of the Kyoto Protocol on US Energy Markets and Economic Activity,” October 1998. SR/OIAD/98-03

original study.⁸⁴ 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 CO₂ (\$2005) and \$100 per short ton CO₂ (\$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 CO₂ in 2009 to about \$2.50-\$12/ton CO₂ in 2024.⁸⁵ 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 of their emissions in 2015 and 10 percent in 2020. The CO₂ 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 2020.⁸⁶

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.

⁸⁴ EIA, "Analysis of the Impacts of an Early Start for Compliance with the Kyoto Protocol," July 1999. SR/OIAF/99-02.

⁸⁵ ICF Consulting presentation of "RGGI Electricity Sector Modeling Results," September 21, 2005. Results of the ICF analysis are available at www.rggi.org

⁸⁶ 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.⁸⁷ 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.⁸⁸

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

⁸⁷ 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>

⁸⁸ 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 CO₂ but can include other GHGs on an equivalent basis, and indeed can potentially include trading for offsets which reduce atmospheric CO₂ 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.⁸⁹ Emissions reductions must be credited only once, and offsets and trades must be associated with verifiable actions to reduce atmospheric CO₂. 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.”⁹⁰ 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 SO₂ and NO_x in the years since regulations of those two pollutants were enacted. For CO₂, looming questions include the future feasibility and cost of carbon capture and sequestration, and cost improvements in carbon-free generation

⁸⁹ 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.

⁹⁰ 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, SO₂ 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...
<ul style="list-style-type: none"> • “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
<ul style="list-style-type: none"> • Complimentary policies 	No investments in programs to reduce carbon emissions	Aggressive investments in energy efficiency and renewable energy independent of emissions allowance market
<ul style="list-style-type: none"> • Policy implementation timeline 	Delayed and/or sudden program implementation	Early action, phased-in emissions limits.
<ul style="list-style-type: none"> • Reduction targets 	Aggressive reduction target, requiring high-cost marginal mitigation strategies	Minimal reduction target, within range of least-cost mitigation strategies
<ul style="list-style-type: none"> • 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.
<ul style="list-style-type: none"> • Technological progress 	Assume only today’s technology at today’s costs	Assume rapid improvements in mitigation technology and cost reductions

Assumption	Increases Prices if...	Decreases Prices if...
<ul style="list-style-type: none"> • 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 SO₂ 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 CO₂ 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.

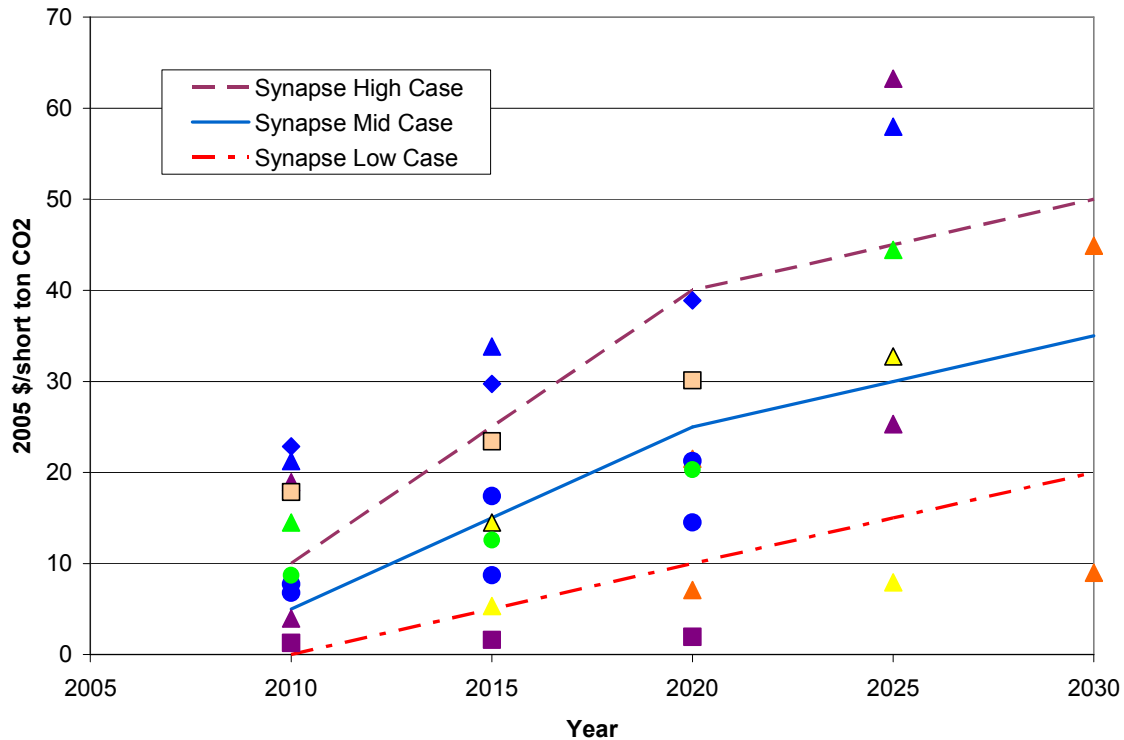


Figure 6.3. Synapse Forecast of Carbon Dioxide Allowance Prices

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 CO₂ 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 CO₂. 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 CO₂).

	2010	2020	2030	Levelized Value 2010-2040
Synapse Low Case	0	10	20	8.5
Synapse Mid Case	5	25	35	19.6
Synapse High Case	10	40	50	30.8

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 CO₂.

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 CO₂, 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ price forecasts does not eliminate the ecological and socio-economic threat created by CO₂ emissions – it merely mitigates that threat.

Incorporating a reasonable CO₂ 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 updates and expands upon previous versions Synapse Energy Economics reports on climate change and carbon prices.

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ISSUE DATE: January 3, 1997

DOCKET NO. E-999/C1-93-583

ORDER ESTABLISHING ENVIRONMENTAL COST VALUES

BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

Joel Jacobs
Marshall Johnson
Dee Knaak
Mac McCollar
Don Storm

Chair
Commissioner
Commissioner
Commissioner
Commissioner

In the Matter of the Quantification of
Environmental Costs Pursuant to Laws of
Minnesota 1993, Chapter 356, Section 3

ISSUE DATE: January 3, 1997

DOCKET NO. E-999/CI-93-583

ORDER ESTABLISHING
ENVIRONMENTAL COST VALUES

PROCEDURAL HISTORY

On August 1, 1993, the Laws of Minnesota 1993, Chapter 356, Section 3 became effective. This law, codified as Minn. Stat. § 216B.2422, requires that the Commission "to the extent practicable, quantify and establish a range of environmental costs associated with each method of electricity generation." The law requires each utility to use the values in conjunction with other external factors when evaluating resource options in all proceedings before the Commission. In addition to requiring the development of environmental cost values, the statute required the Commission to develop interim values by March 1, 1994.

To address its obligation to establish interim environmental cost values by the March 1, 1994 statutory deadline, the Commission issued its ORDER ESTABLISHING PROCEDURE FOR ESTABLISHING INTERIM ENVIRONMENTAL COST VALUES on August 17, 1993. This Order contained a number of questions regarding environmental externalities, requested the parties address these questions, and set deadlines for interested parties to file comments and reply comments. The Commission encouraged interested parties to work together to reach a consensus on interim values.

After reviewing the written and oral comments by interested parties, the Commission issued its ORDER ESTABLISHING INTERIM ENVIRONMENTAL COST VALUES on March 1, 1994.

On March 3, 1994, the Commission issued a NOTICE AND ORDER FOR HEARING initiating formal evidentiary hearings to set the final environmental cost values. This Order also directed parties to address the following issues in the course of the contested case proceedings:

- (1) What range of environmental cost values should the Commission adopt for use in resource planning and other resource-selection proceedings as required by

Minn. Stat. § 216B.2422? Specifically, for which pollutants or externalities should the Commission establish a range of values, and what are the appropriate boundaries of each range? Should these values be geographically sensitive?

- (2) What methodology or methodologies should be used to establish these ranges of values (e.g., damage costs, control costs, other methodologies, or some combination of these)?
- (3) Is it practicable for the Commission to quantify and establish a range of environmental cost values for methods of electric generation that do not generate significant air emissions? If so, how should the Commission establish such values and what are the appropriate boundaries of any such range?
- (4) Is it practicable for the Commission to adopt environmental cost values which reflect the full cycle of electric generation, including both upstream and downstream costs? If so, how should the Commission establish such values and what are the appropriate boundaries of any such range?

On May 13, 1994, Administrative Law Judge (ALJ) Allan W. Klein issued his Third Prehearing Order in which he reinstated the scoping process with a modified schedule and named the following as parties: Northern States Power Company (NSP), Minnesota Power and Light Company (MP), Minnegasco, a Division of NorAm Energy Corporation, Otter Tail Power Company (OTP), Cooperative Power Association (CPA), United Power Association (UPA), other "jurisdictional utilities," the Minnesota Department of Public Service (the Department), Residential and Small Business Utilities Division of the Office of the Attorney General (RUD-OAG), Minnesota Pollution Control Agency (MPCA), American Wind Energy Association (AWEA), Center for Energy and the Environment (CEE), District Energy of St. Paul (District Energy), Institute for Local Self Reliance (ILSR), Izaak Walton League of America (IWLA), Minnesotans for an Energy Efficient Economy (ME3), Western Fuels Association (Western Fuels), Lignite Energy Council (LEC), Center for Energy & Economic Development (CEED), Potlatch Corporation (Potlatch), Northern Municipal Power Agency (NMPA), Southern Minnesota Municipal Power Agency (SMMPA), Large Power Intervenors, and Boise Cascade Corporation (Boise).

On July 13, 1994, the ALJ issued his Fourth Prehearing Order which defined the scope of the proceeding and requested parties to submit memoranda on the question of whether evidence should be limited to environmental costs or whether it should also include socioeconomic and other factors.

On August 24, 1994, the ALJ issued his Fifth Prehearing Order which, among other things, limited the scope of this proceeding by excluding "testimony and arguments relating to non-environmental issues, such as socioeconomic costs and benefits . . ., {except} for the purposes of creating a record to support or defend constitutional challenges."

On October 28, 1994, the Commission issued its ORDER MODIFYING ADMINISTRATIVE

LAW JUDGE'S FIFTH PREHEARING ORDER ON THE CONSIDERATION OF SOCIOECONOMIC FACTORS. In its Order, the Commission generally agreed with the ALJ's analysis but stated that it "does not construe the statute to exclude all socioeconomic evidence from consideration." The Commission modified the ALJ's order to "ensure that socioeconomic evidence is not excluded from consideration in this proceeding if it is relevant to quantifying the impact of electric generation on the natural environment ..." In its Order, the Commission also responded to parties' claims that the Commission should look at the possible social and economic consequences of applying environmental cost values in deciding what those values should be. Addressing this issue, the Commission stated:

The Commission does not, at this juncture, find this concern sufficiently compelling to justify departure from the two-stage process set forth in the statute, which clearly contemplates the Commission establishing environmental cost values independent from its consideration of the consequences of applying those values.

The parties filed direct testimony on November 29, 1994, rebuttal testimony on March 15, 1995, and surrebuttal testimony on April 28, 1995.

On April 26, 1995, the ALJ issued a Memorandum extending the filing date for surrebuttal testimony relating to mercury and all testimony relating to criteria pollutants except for the emissions trading aspects of SO₂ to May 29, 1995.

From April 18 to April 27, 1995, the ALJ held six public hearings throughout the state, including a three-city videoconference. Over 160 people presented testimony at the public hearings.

From May 8 to June 28, 1995, the ALJ conducted evidentiary hearings. Over 50 witnesses presented testimony during the course of the proceeding.

Between September 8, 1995 and October 24, 1995, many of the parties filed briefs and reply briefs regarding constitutional and evidentiary issues.

On November 16, 1995, the ALJ issued his Post-Hearing Ruling on Evidentiary Motions. On December 7, 1995, the ALJ issued an Order Clarifying Post-Hearing Ruling on Evidentiary Motions.

Between January 12, 1996 and February 21, 1996, the following parties filed briefs and reply briefs on substantive issues: Western Fuels; the Department; NSP; RUD-OAG; MPCA; Dairyland Power Cooperative (Dairyland); OTP; CEED; Minnegasco and Peoples Natural Gas Company (Peoples), (together the Natural Gas Utilities); CPA, Minnkota Power Cooperative (Minnkota), and UPA (together the Cooperatives); State of North Dakota; LEC; IWLA, ME3, AWEA, Clean Water Action, the American Lung Association, the Minnesota Center for Environmental Advocacy, and ILSR (together the Environmental Coalition); and MP.

On March 25, 1996, the ALJ issued his Findings of Fact, Conclusions, Recommendation and Memorandum in this matter.

Between April 15 and April 29, 1996, the parties filed their Exceptions to the ALJ's Recommendation and their Replies to Exceptions.

On May 8, 1996, Western Fuels, CEED, LEC, North Dakota, and OTP filed their joint opposition to the MPCA request to take official notice of an Intergovernmental Panel on Climate Change (IPCC) report.

On September 16, 1996, the Commission met to hear oral argument and deliberate upon several preliminary issues of this matter. On September 17, 1996, the Commission met to hear oral argument regarding the substantive issues in this matter. On September 19, 1996, the Commission met to deliberate upon those issues.

FINDINGS AND CONCLUSIONS

I. INTRODUCTION

In this Order, the Commission fulfills its obligation to quantify and establish a range of environmental costs associated with each method of electricity generation "to the extent practicable," as directed by Minnesota's externalities statute, Minn. Stat. § 216B.2422 (1994).

II. SUMMARY OF FINDINGS

Based on the record established in this proceeding, the Commission finds it practicable to quantify and establish a range of environmental costs for specific pollutants as follows:¹

		Urban	Metropolitan Fringe	Rural	Within 200 Miles of Minnesota
SO ₂	\$/ton	112 - 189	46 - 110	10 - 25	10 - 25
PM ₁₀	\$/ton	4,462 - 6,423	1,987 - 2,886	562 - 855	562 - 885
CO	\$/ton	1.06 - 2.27	0.76 - 1.34	0.21 - 0.41	0.21 - 0.41
NO _x	\$/ton	371 - 978	140 - 266	18 - 102	18 - 102
Pb	\$/ton	3,131 - 3,875	1,652 - 1,995	402 - 448	402 - 448

¹ The figures listed in this table are the values recommended by the ALJ, updated to 1995 dollars using a methodology proposed by the Department.

CO ₂	\$/ton	.30 - 3.10	.30 - 3.10	.30 - 3.10	.30 - 3.10
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III. UTILIZATION OF THE RANGES ESTABLISHED IN THIS ORDER

The range of environmental costs adopted by the Commission in this Order will now be used by utilities, in conjunction with other external factors (including socioeconomic costs) when evaluating and selecting resource options in all proceedings before the Commission, including resource plan and certificate of need proceedings. Minn. Stat. § 216B.2422, subd. 3 (a). These values will not apply to decisions regarding the dispatch of electric power from existing facilities.

In their petitions in such matters, the utilities will be required to provide three cost analyses for each generation option provided: one using the values at the low end of the range established for the environmental externalities associated with the electric power generation option in question; one using values at the high end of the adopted range; and one using zero environmental externalities values, i.e. reflecting direct costs only. Ordering Paragraph 2.

In the context of particular petitions and based on the record developed in proceedings addressing those petitions, the Commission will evaluate the merits of the energy resource options proposed therein. In so doing, the Commission will consider not only the environmental externalities quantified in this proceeding, but any evidence of other relevant environmental externalities (costs) not specifically quantified in this proceeding (e.g. mercury), as well as other external factors, including socioeconomic costs that the record developed in that proceeding indicates is associated with the resource option in question.

IV. COMMISSION ANALYSIS

In the course of this proceeding, various parties have 1) raised constitutional challenges to Minnesota's environmental externalities statute, 2) objected to the inclusion and exclusion of various elements of the record adopted by the Commission in deciding this matter, and 3) objected to specific values proposed by the ALJ and adopted by the Commission for various environmental impacts. In this part of the Order, the Commission will address the parties' objections.

A. Constitutional Challenges

1. Facial Challenges

Several parties argued that the statute purporting to authorize the Commission to act on this subject is unconstitutional *on its face*, i.e. without need of any factual record to demonstrate its unconstitutionality. These parties argued the "facial" unconstitutionality of the statute on two grounds:

- 1) that the statute conflicts with the Supremacy Clause of the U.S. Constitution,

Article VI, Clause 2; and

2) that the statute constitutes an unconstitutional delegation of authority.

Minnesota law is clear, however, that neither an administrative body such as the Commission nor an Administrative Law Judge (ALJ) has the authority to declare that a statute is unconstitutional on its face. Neeland v. Clearwater Memorial Hospital, 257 N.W.2d 366, 368 (Minn. 1977); Holt v. Board of Medical Examiners, 431 N.W.2d 905, 906 (Minn. Ct. App. 1989). This is appropriate because, as a creature of the state, an agency has no authority to determine that the legislature lacked authority to delegate certain powers to it. Therefore, the Commission will not undertake to examine the grounds urged as the basis for finding the statute unconstitutional on its face.²

2. Unconstitutional "As Applied"

The Commission, of course, is required to apply statutes in a manner consistent with the Constitution. In considering what is a constitutional application of the statute, the Commission considers relevant court decisions bearing on the constitutionality of the Commission's application of the statute. The time for doing so, however, is not at hand. In this Order, the Commission is simply establishing externality values, as directed by the statute. While this action is not entirely academic, it does not act upon utilities in a manner that can be properly characterized as "applying" the statute to them.

In subsequent cases, when a utility brings forward specific energy choice proposals for review, the Commission will be "applying" the statute, deciding what weight should be given to the various economic analyses (one that used the high end of the range figure, one using the low end figure and one using a zero value) when considered together with other external factors, including socioeconomic costs.

Given the limited scope of this proceeding and a record molded to that purpose, the Commission finds that challenges that the statute is unconstitutional "as applied" are not ripe for consideration.

B. Content of the Record Issues

² The Commission does not necessarily accept that the parties' Supremacy Clause challenge is properly classified as a facial challenge. Until a resource planning decision or certificate of need is considered, it cannot be determined whether there is an actual conflict between state and federal law. Regardless of how the Supremacy Clause challenge is classified, the Commission does not accept it. If it is a facial challenge, it is clear that the Commission is without authority to determine its validity; in the more likely event that it is an "as applied" challenge, the Commission finds it is premature, as discussed in the next section regarding the "as applied" challenges.

The Commission has reviewed all of the ALJ's rulings in his November 16, 1995 Post-Hearing Ruling on Evidentiary Motions, finds them well-reasoned, and affirms them.

Subsequent to the ALJ's Ruling, two requests to add items to the record were received. For the reasons stated below, the Commission will reject both such requests.

These decisions leave the evidentiary record in this matter as it was at the end of the contested case hearing before the ALJ (June 28, 1995), except as modified by the ALJ's November 16, 1995 Ruling.

Several content-of-the-record issues deserve comment, as follows:

1. Request to Take Official Notice of an IPCC Report

In its Reply to Exceptions filed April 26, 1996, the Environmental Coalition requested that the Commission take official notice of the IPCC's Second Assessment Report Synthesis "as an acknowledgment that the ALJ's findings are consistent with the IPCC's most recent conclusions regarding the increasingly certain link between anthropogenic carbon emissions and potentially catastrophic climate change." Reply Brief of the Environmental Coalition on Exceptions, page 4.

Western Fuels, CEED, LEC, the State of North Dakota, and Otter Tail opposed the Environmental Coalition's request. These parties stated:

The Environmental Coalition's use of the purported IPCC report in its Reply Brief on Exceptions demonstrates a cavalier disregard for the integrity of the administrative process. The contents of the report obviously are not subject to official notice by this Commission.

The objecting parties asserted that the facts within the IPCC report are neither judicially cognizable facts nor "general, technical, or scientific facts" within the specialized knowledge of this Commission. They further asserted that the state of the record with respect to the work of the IPCC is wholly objectionable from an evidentiary standpoint and to allow the new IPCC report to become part of the record through official notice would be a breach of due process. They further noted that under Minn. Stat. § 14.60, subd. 4, the Commission cannot take official notice of the IPCC report without affording the parties "an opportunity to contest the facts so noticed."

Requests that the Commission take administrative notice of general, technical, or scientific facts within its specialized knowledge pursuant to Minn. Stat. § 14.60, subd. 4 (1994) are directed to the sound discretion of the Commission. In this case, the Commission declines to take the requested notice for several practical reasons:

- first, some finality must be accorded an evidentiary record that has been established over an extensive period of time and has long been closed;

- second, the time involved in allowing parties to contest the facts to be noticed would interrupt the deliberation phase and would unnecessarily prolong an already extensive proceeding; and
- third, the information proposed is not necessary to the resolution of any issue before the Commission. As stated by the proponents of this information (the Environmental Coalition), the information merely corroborates the ALJ's findings regarding climate change issues. As indicated more fully below, the Commission finds that the current record adequately supports the ALJ's findings in this regard. The untimely-proffered additional evidence is simply offered for its "consistency" with the ALJ's conclusions, which in turn have been based upon the 1990 IPCC Report (Exhibit 72) and the 1992 IPCC Supplement (Exhibit 70). As such, the offered evidence is much akin to cumulative or repetitious evidence that the Commission is authorized to exclude under Minn. Stat. § 14.60, subd. 1 (1994).

2. Request to Take Official Notice of an EPA Report and Newsletter

In its Exceptions to the ALJ's Report filed April 15, 1996, the MPCA requested that the Commission take official notice of the following items:

Regarding SO₂: the actual SO₂ emissions from phase I sources for 1995 as reported in an EPA March 26, 1996 press release, and the 1994 allowance auction average clearing price as reported in an article entitled "Utilities Well Below SO₂ Reduction Mandates, Prices Hit New Lows" from Inside EPA's Clean Air Report, v. 7, No. 7 at 18-19 (April 4, 1996); and

Regarding mercury: a letter from EPA Assistant Administrator Mary D. Nichols explaining that a “significant” delay is needed to allow completion of the EPA’s final report on mercury emissions, health effects, and control technologies and an associated article in a special edition of Inside EPA’s Clean Air Report, dated April 5, 1996.

The Commission will deny this request, for many of the same reasons cited above in declining to take administrative notice of the IPCC Report.

Regarding the SO₂ information: the Commission views the record as adequately developed on this subject to permit a reasonable decision, as set forth in further detail when the Commission specifically addresses valuation of that pollutant. In addition, it appears that information regarding SO₂ emissions raises factual and evidentiary issues more properly the subject of an adjudicative process than to the comment process available if the Commission were to take administrative notice of this SO₂ information.

Finally, after the considerable time devoted to developing the record in this matter it is desirable and reasonable to finalize the record so that some decisions can be made. Due to the scientific and regulatory interest in SO₂ emissions, it is inevitable that new information on this subject will continue to be developed, at least in the foreseeable future.³ At some point, the Commission must allow the record to remain closed so that a decision can be made with respect to that record rather than continuously opening it to receive new information, with the attendant mandatory receipt of counter-analyses of that information.

Regarding the mercury information: the only new information proposed for administrative notice regarding mercury is that the EPA’s study of mercury will not be forthcoming for some time. In addition to the finality of the record considerations already mentioned, it is difficult to imagine that such information (that EPA’s final mercury study will not be available for a long time) would add any weight to the MPCA’s case for adopting an externality value for mercury based on the current record. Evidence to date either is strong enough to support a value for mercury or it is not. The fact that additional evidence (the EPA’s final mercury study) is unavailable could add nothing to the case for adopting a value for mercury and in fact would suggest the wisdom of refraining from establishing such a value at this time.

3. Admissibility of Department Witness Davis’ Testimony

In his Post-Hearing Ruling on Evidentiary Motions, the ALJ granted the motions of Western Fuels, NSP, LEC, the Cooperatives and Otter Tail and struck all of the testimony of Department witness Davis on the grounds that he did not qualify as an expert witness. The Commission gives great weight to the ALJ’s determination regarding the admissibility of expert opinion. It is within the ALJ’s discretion to determine whether a particular witness is qualified to testify as an expert. The Commission finds that the record contains adequate

³ In fact, parties mentioned that several other arguably relevant pieces of evidence have been developed by the EPA since the record was closed.

support for the ALJ's concern that the witness did not demonstrate an adequate familiarity with and background knowledge regarding several of the subjects of his testimony. Accordingly, the Commission will not overrule the ALJ's exclusion of such testimony.

4. Admissibility of Witness Falkenberg's Testimony

In his Post-Hearing Ruling on Evidentiary Motions, the ALJ denied the motions of Otter Tail, LEC and Dairyland to strike the testimony of Randall Falkenberg regarding the risk of regulation method of calculating the value of externalities. The ALJ did so on the grounds that there is at least an arguable logical connection between environmental damages and the risk of regulation.

In its exceptions to the ALJ's report, Dairyland renewed its objection to the inclusion of Falkenberg's testimony in the record. Dairyland claimed that financial risk, quantified by the risk of regulation method, is not included in this proceeding and that there is no authorization in the statute for the Commission to establish monetized values representing any such financial risks.

The Commission finds that the ALJ was justified in determining that there is a connection that can be argued between the risk of regulation methodology and environmental damage. The Commission will not exclude this information from the record, as requested by Dairyland.

C. Statutory Interpretations

1. "To the Extent Practicable"

The Commission agrees with the ALJ that the common and approved usage of the term "practicable" is what the Legislature intended. Citing to Webster's New Universal Unabridged Dictionary, the ALJ defined "practicable" to mean "feasible" or "capable of being accomplished."

Some parties argued, unpersuasively, that the statutory requirement that the Commission quantify and establish environmental costs "to the extent practicable" involved some additional screening steps beyond determining whether it was possible to set such values. Additional screens suggested were to determine 1) whether it would be constitutional to do so and 2) whether the application of such values in resource decisions would be reasonable. In the relevant context, the "quantifying and establishing" phase of the statute, the Commission finds that these other considerations (constitutionality and reasonableness of the ultimate application

of the values) improperly complicate and distort what the legislation places before the Commission at this time.⁴

In short, the Commission finds that the term “practicable,” as used in the Environmental Costs Statute, means “feasible” or “capable of being accomplished.”

2. “Costs Associated With Each Method of Generation”

Several of the parties argued and the Commission finds that identification and valuation of all environmental costs, while theoretically desirable, would be arduous, if not impossible. Nevertheless, some parties argued that it would be improper for the Commission to set **any** environmental costs unless it sets them comprehensively. For these parties, costs are comprehensive only if they include

1. full fuel cycle costs, i.e. those that reflect **upstream costs** such as costs to the environment due to the extraction and transportation of the fuel used and **downstream costs** such as decommissioning of a plant and burial of wastes, as well as the environmental impacts resulting from the electrical generation itself;
2. **all** the associated costs, not just the most significant and relevant impacts; and
3. all such costs for **every** electric generating method, not just those likely to be most relevant in Minnesota.

The Commission finds that the statute imposes no such unreasonable demands.⁵ Instead of

⁴ The Commission notes that the Environmental Externalities Statute (Minn. Stat. § 216B.2422, subd. 3(a) prescribes a two-stage process: Stage 1 -- quantification and establishment of a range of environmental costs to the extent practicable and Stage 2 -- use or application of the values in conjunction with other external factors (including socioeconomic costs) when evaluating and selecting resource options in all proceedings before the Commission. The current Order addresses Stage 1. Reasonable application of the range of environmental costs set in this Order will be addressed in future proceedings that address resource options. In those proceedings, the parties will address and the Commission will determine the reasonableness or practicality of applying environmental costs in the circumstances of those cases. To underscore the fact that the environmental costs established in this Order will simply be **part** of the record considered in evaluating future resource options, the Commission will require that utilities include as part of their resource procurement submissions a base-case analysis considering direct costs only, i.e. attributing a zero value to externality costs. The base-case analysis will facilitate consideration of the ratemaking and other socioeconomic implications, if any, of accepting either of the other two analyses. See Ordering Paragraph 2

⁵ No study as comprehensive as demanded by these parties has come to the Commission’s attention during the extensive course of this proceeding.

requiring absolute comprehensiveness, the statute requires that costs be established “to the extent practicable.” With respect to upstream and downstream costs, no party has proposed environmental cost values in this proceeding that reflect the full fuel cycle, not even the parties who argued so strongly that it is essential to consider such costs. Likewise regarding the quantification of **all** environmental impacts, however slight, difficult to measure, or irrelevant, the Commission again notes that no party has undertaken such a bottomless and highly speculative task. The Commission finds that the absence of record evidence supporting values for this category of impacts conclusively shows the impracticability of establishing values for such impacts but does not preclude the Commission from quantifying costs for which there is reasonable record support.

Some parties argued that the statutory reference to “method of generation” requires the Commission to establish values that apply to each generic method of generation, i.e. for coal, hydro-electric, wind, natural gas, nuclear, etc. The Commission finds that this would be an unreasonable reading of the statute. The Commission finds it impracticable to establish environmental values based strictly on the method of generation because the level of environmental impact is not uniform from site to site for each method of generation. The level of damage will vary greatly depending on the circumstances of plant. For example, the amount of pollutant emitted by Plant A may be much less than that emitted by Plant B despite the fact that they use the same method of generation (e.g. coal) because Plant A has superior, cleaner burning equipment and uses a superior (lower polluting) grade of fuel.

A preferable way to proceed was proposed by the Department:

1. The Commission should not directly establish a range of environmental costs for each generic method of generating electricity. The Commission should instead quantify the costs attributable to as many effects of by-products of generation as practical. The appropriate range of costs will then be assigned to any given generation addition, based on its own unique effects, and/or by-products. This is similar to the approach used in the interim stage of this proceeding.
2. The Commission should focus on the effects of by-products that cause the most significant costs. For example, modest noise pollution at a remote, non-recreational site probably imposes a lower environmental cost than ozone formation in large urban areas or acidic deposition in popular lakes.
3. The Commission should concentrate on the impacts that are easiest to quantify.

4. The Commission should emphasize effects attributable to the most likely resource decisions over the resource -planning horizon (15 years).

Based on these criteria, the Commission has chosen to concentrate on the most significant by-products of generation (EPA's six criteria pollutants plus mercury and carbon dioxide) and has quantified costs for them "to the extent practicable." The list of pollutants thus quantified is reasonably comprehensive and consistent with the statutory mandate. See discussion of each of these pollutants, below.

The Commission acknowledges the relevance of evidence regarding costs of other pollutants in a subsequent proceeding that addresses the merits of a particular company's resource options but does not view their quantification essential at this time. The relative unimportance of the comprehensiveness demanded by some parties becomes clear when we understand

- the limited nature of what the statute requires the Commission to decide in this Order (the quantification stage) and
- what it will be considering (in addition to the range of environmental costs established in this Order) when it evaluates particular resource options in future proceedings.

Adopting a range of environmental costs for certain pollutants does not preclude the submission of quantified evidence (other external factors, including socioeconomic costs) on those pollutants and any other pollutants for which costs have not been established in this Order in future proceedings. Nor does it preclude the consideration of unquantified impacts on a qualitative basis.

In short, this Order quantifies environmental impacts "to the extent practicable," as required by the statute, and leaves to future dockets the job of developing a record that focuses on the specific environmental cost-related circumstances of the resource options proposed in those dockets.

D. Standard for the Burden of Proof

Minn. Rules, Part 1400.7300, subp. 5 states the burden of proof to be used in administrative hearings as follows:

The party proposing that certain action be taken must prove the facts at issue by the preponderance of the evidence, unless the substantive law provides a different burden or standard.

The MPCA argued that substantive law does establish a different standard. The MPCA asserted that in requiring the Commission to establish environmental costs "to the extent

practicable,” the environmental externality statute establishes that phrase as the standard, in place of the preponderance of the evidence standard.

The ALJ rejected the MPCA’s proposition and so does the Commission. The Commission finds that the Legislature did not intend to override the rule establishing the preponderance of evidence test in administrative proceedings.

As applied in these proceedings, then, parties proposing environmental cost values have the burden of showing, by the preponderance of the evidence, that it is practicable to adopt the proposed values. Parties opposed to the adoption of any particular proposed value must counter the proposer’s evidence with a greater weight of evidence demonstrating the incorrectness of or impracticability of adopting the proposed value.

E. Principles Guiding Quantification of Environmental Cost Values

1. The Damage-Cost Approach Preferred

There are several methods for estimating environmental cost values including:

- Damage-cost method, which attempts to place an economic value on the net damage to the environment created by an energy resource.
- Willingness-to-pay method, which measures the amount that society would be willing to pay for reduced emissions.
- Cost-of-control method, which uses the costs of avoiding or reducing an environmental effect at the source to estimate the value of the externality.
- Mitigation cost method, which uses the costs of eliminating the harm or impact of an externality. An example is planting trees to offset emissions of CO₂.
- Risk of regulation method, which estimates future taxes or costs that a utility might incur due to additional regulation.

The two methods used most often to establish a range of values for environmental costs are the damage-cost approach and the cost-of-control approach. Between those two approaches, the Commission finds that the damage-cost approach is superior because it appropriately focuses on actual damages from uncontrolled emissions. By contrast, the cost-of-control method does not attempt to measure directly residual damages and instead estimates the cost of reducing an emission at the source.

Despite the general theoretical shortcomings of the cost-of-control method, the Commission finds that this method may be reasonable in certain circumstances. In some instances, it may be much easier or less expensive to estimate control costs than to estimate actual damages.

2. Ranges Appropriately Take into Consideration a Certain Level of Unavoidable Scientific Uncertainty

Quantification of environmental values necessarily involves the consideration of scientific evidence that generally does not provide definitive answers. The statute implemented here requires the Commission to establish a range of values. Using a range of values appropriately acknowledges the uncertainty attending the quantification of environmental costs. Using a range also permits the testing of resource plans for sensitivity to changes in environmental values.

3. Geographically Sensitive Values

It is not possible for the Commission to establish environmental values that apply perfectly to every potential resource option. As noted previously, such a goal is beyond what is required in the quantification stage. The Commission does find it possible and appropriate, however, to adopt some refinements in the quantification process at this time to reflect the following factor: proximity to population centers.

- The amount of damage imposed by many pollutants depends largely on site-specific factors, including the number of people likely impacted by the emission.
- In addition, the level of geographic sensitivity is not uniform for each pollutant but varies from pollutant to pollutant.

Recognizing that environmental impacts will vary depending on the circumstances of the particular resource option in question, the Commission has adopted **ranges** of values for the various pollutants and, in addition, has found it appropriate to adopt ranges that differ depending on the location of the proposed generation site: urban, metropolitan fringe, and rural. The Commission's adopted values also reflect that the level of geographic sensitivity of each emission is not uniform but varies from emission to emission.

No further pinpointing of emission levels or costs per unit of emissions is necessary or possible at this time. In future proceedings, the parties addressing particular resource options will establish a record for the Commission's evaluation.

4. General Focus on Damage Occurring in Minnesota

With the exception of the values adopted for CO₂, which causes damages globally rather than regionally or locally, the Commission has quantified the costs of environmental damage occurring in Minnesota. This is consistent with the approach recommended by the Department and found reasonable by the Commission that the Commission focus on the effects of by-products that cause the most significant costs. With respect to CO₂, this means assessing damage globally; for all other pollutants for which values are established in this Order, it means quantifying the damage they cause in Minnesota.

5. Damages in Minnesota From In-State and Out-of-State Generation Sources

The general proposition that emissions generated in another state can do environmental damage in Minnesota appears indisputable. But since the level and amounts of damages are a function

of distance, at some distance from the Minnesota border, generating plant emissions lose their ability to damage the Minnesota environment.

With respect to all the pollutants quantified in this Order except CO₂, for which global damages are addressed below, the Commission finds that the record supports finding in-state damages from a generating plant located up to 200 miles from the state border, but that it is not practicable (on the current record) to establish values for damages caused by emissions originating in plants beyond that point. Accordingly, the Commission has set values for emissions originating within the 200 mile band, as recommended by the Department and the ALJ. Environmental cost values for emissions from generating sites located beyond the 200 mile band are deemed to be zero.⁶

The State of North Dakota argued that Minnesota's externalities statute cannot be interpreted as extending to electric generation facilities located beyond Minnesota's boundaries because to do so would violate the U.S. Constitution. The Natural Gas Utilities countered that failure to apply the statute to out-of-state generation would give that generation a significant advantage over Minnesota-based generation during the resource planning process.

The Commission notes that the statute on its face does not differentiate between in-state generation and out-of-state generation and, as noted previously, the Commission is not in a position to decide Constitutional claims. The Commission, therefore, has executed its mandate under the statute to quantify all generation-related damages occurring in Minnesota, regardless of the location of the generating site in question, to the extent that it is feasible to do so.

5. Relationship of NAAQS to Externality Costs

Under sections 108 and 109 of the Federal Clean Air Act, the U.S. Environmental Protection Agency (EPA) is required to issue National Ambient Air Quality Standards (NAAQS) for the criteria pollutants: sulfur dioxide (SO₂), particulate matter less than 10 microns in diameter (PM₁₀), nitrogen oxides (NO_x), ozone (O₃), carbon monoxide (CO), and lead (Pb). The EPA is supposed to set its standards with an adequate margin of safety to protect the public health.

Some parties argued that there can be no damages/costs to the environment as long as emissions do not cause ambient air concentrations to exceed the NAAQS. However, the EPA has not been able to keep the NAAQS updated. They do not reflect the latest scientific knowledge. Based on the record established in this matter, it is clear that the NAAQS currently are not necessarily set at no-cost levels. The Commission finds the Minnesota-specific state of the art damage cost

⁶ Unlike all the other pollutants quantified in this Order, the per ton damage attributed to CO₂ is calculated by a method that estimates the damage that any given ton of CO₂ does to the globe, rather than to Minnesota in particular. Nevertheless, in order to treat CO₂ emissions similarly with the other pollutants whose damages are found to be zero unless they originate within 200 miles of the Minnesota border, the Commission will treat CO₂ emissions the same way, i.e. as having no environmental costs if they originate more than 200 miles from the Minnesota border. To do otherwise would overly complicate an already highly complex analytical process.

study sponsored by NSP, the Triangle Economic Research (TER) Study, more dependably reflects environmental costs in Minnesota.

6. Dependability of the TER Study, as Modified

NSP submitted a state of the art damage study by Triangle Economic Research (TER). Dr. William Desvousges, the lead author of the TER Study, is an expert in valuing natural resources and preparation of damage cost studies. In order to capture the relevant effects and the magnitude and location of potential damages, the TER Study examined the effects of the six criteria pollutants in Minnesota⁷ and developed environmental costs for three planning scenarios: a rural scenario, a metropolitan fringe scenario, and an urban scenario.

The TER Study modeled emissions for over sixty resources in each scenario and determined estimated damages at the zip code level (618 zip codes) for each hour of the year (8,760 hours). A total of 32.5 million concentrations were estimated for each scenario.

The TER Study examined three main categories of potential effects: human health effects in the form of morbidity and mortality risks, agricultural effects in the form of reduced crop yields, and material damages in the form of stone and metal corrosion and surface soiling. The TER Study reviewed over four hundred studies related to health, materials, soiling and agriculture.

The Department's expert witness Dr. Mark Thayer reviewed the TER Study and determined that the results of the study are consistent with the results and general trends found in recent research using the damage cost methodology to estimate the environmental costs of air emissions. Dr. Thayer's critique also included several recommendations that were adopted by Dr. Desvousges and incorporated into TER's final recommendations. For example, Dr. Desvousges and Dr. Thayer agreed that the effects of secondary particulates should be assigned to the original emissions, NO_x and SO₂. Using Dr. Thayer's calculations, Dr. Desvousges adjusted his NO_x values upward to account for the effects of nitrates. Dr. Desvousges also agreed with Dr. Thayer that TER's original calculations for PM₁₀ underestimated soiling and visibility damages and revised his PM₁₀ values upward consistent with Dr. Thayer's conclusions.

In short, the Commission finds that the TER Study provides a sound basis for adopting the environmental cost values for the six pollutants addressed in that study, as modified in response to Dr. Thayer's comments. The existence of such a quality Minnesota-specific study makes it "practicable" to establish such values.

F. Quantification of the Cost of Specific Pollutants

Several parties recommended establishing and quantifying a range of environmental cost values for the criteria pollutants: sulfur dioxide (SO₂); particulate matter less than ten microns (PM₁₀);

⁷ The TER Study is the only study presented in this proceeding that focused on effects in Minnesota and, therefore, is the primary source of information in this record regarding effects specific to Minnesota.

nitrogen oxides (NO_x); ozone (O₃); carbon monoxide (CO) and lead (Pb). These were chosen because they have been the major focus of air quality regulations and they are factors for which significant amounts of information exist. The TER Study also indicated that previous studies have shown that these pollutants account for the majority of potential environmental damages.

In addition to the criteria pollutants, various parties recommended values for other emissions which are considered to have environmental effects: carbon dioxide (CO₂), volatile organic compounds (VOCs), mercury, and methane. This section addresses each of the pollutants for which values were proposed and explains why, with respect to each, the Commission did or did not quantify a range of environmental cost values.

I. Sulfur Dioxide (SO₂)

a. Harm Associated

Through chemical reactions, emissions of SO₂ result in acid deposition. SO₂ may also contribute to particulate matter through the formation of sulfates, resulting in the exacerbation of respiratory and cardiovascular problems, decreased visibility, the corrosion of structures, and the acidification of waterways.

b. SO₂ Values Proposed

NSP stated that the TER Study showed midpoint damages from sulfur dioxide (SO₂) emissions to be \$21 (1993 \$) per ton for resources in rural locations, \$54 per ton for resources in metropolitan fringe locations, and \$126 per ton for resources in urban locations. NSP proposed ranges between zero and \$21, \$54, and \$126 for the three scenarios (rural, fringe, and urban) respectively. MP supported adopting those values.

Using the endpoints of the ranges developed in the TER Study, EC, the MPCA, and the RUD-OAG proposed the following values for SO₂:

Urban	106 - 178
Fringe	43 - 104
Rural	9 - 24

MP, NSP, the Department and the RUD-OAG argued that beginning in the year 2000, a nationwide cap on emissions of SO₂ together with an allowance trading program mandated by the Clean Air Act Amendments will reduce the amount of net new emissions to zero. With the cap and trading program in place, any increase from a new source will require a corresponding reduction from another existing source, yielding no net new emissions of SO₂. Under these conditions, SO₂ related damages will be internalized and no values should apply for SO₂ after 2000.

EC and the MPCA argued that the record does not support a finding that the sulfur dioxide emission cap will end damage to human health and the environment from that pollutant.

c. The ALJ's Recommendation

The ALJ recommended that the range of environmental costs proposed by the RUD-OAG, EC, and the MPCA should be applied to those resources not currently included in the emission allowance trading program until the year 2000, but that no dollar value should be applied to SO₂ after that date.

d. The Commission's Decision Regarding SO₂

The Commission will adopt the ALJ's recommended ranges, updated to 1995 dollars.⁸ The ALJ's ranges are the ranges proposed by the TER Study, EC, MPCA, and the RUD-OAG. The Commission finds that these ranges are reasonable, well supported in the record, and preferable to those proposed by MP and NSP. Theoretically, there is a ninety percent chance that the true externality value for a given pollutant lies in the indicated range adopted by the Commission. In contrast, there is only a fifty percent chance that the range proposed by NSP and supported by MP includes the true value of a given pollutant. The companies' proposed range suffers from other infirmities as well:

- For the high end of each of their proposed ranges, the companies chose the median figure from among the thousands of estimated damage points generated by the TER model for the scenario/pollutant in question.⁹ The median is not a reasonable figure to serve as the high end of the range because mathematically speaking it is just as likely that the actual damage experienced will exceed the median than it is that the damage will be lower than the median. The Companies gave no reasonable explanation for ignoring the higher half of the damage points calculated by the TER Study.

⁸ All of the ranges in the TER Study and recommended by the ALJ are stated in terms of 1993 dollars. In this Order, the values adopted by the Commission and listed in the Ordering Paragraphs are stated in terms of 1995 dollar figures.

⁹ As previously noted, for each scenario/pollutant combination (e.g. rural/SO₂) the TER Study generated thousands of estimated damage "points," one for every hour of the year. The median figure for those points is the point at which there is an equal number of estimated damage points higher and lower.

- Likewise it is unreasonable to adopt zero as the bottom of the range, as recommended by the companies. To do so unjustifiably ignores the findings of the TER Study with respect to the lower end of the range. Reasons given by the companies for introducing zero as the bottom of the range are unpersuasive: 1) that the Commission needs the zero figure there to give it the flexibility (discretion) to impose no values if to do so would be unfairly drive the regulated company's rates higher relative to less-regulated energy suppliers and 2) that establishing environmental values is such an uncertain undertaking that zero must be available. No such step is needed at this point to give the Commission the discretion to apply a "zero option" when it examines a resource planning petition. The Commission already has discretion under the statute to effectively discount environmental values (assigning them a zero value) if, in light of other external factors, including socioeconomic considerations, the Commission finds it appropriate to do so. As to the uncertainty argument, the Commission is aware of the scientific difficulties involved in establishing environmental values, but is convinced that the TER Study provides a sound basis for establishing the ranges adopted in his Order. No additional down-shifting of the TER ranges, "just in case," is appropriate.

Regarding post-2000 issue, the Commission finds that SO₂ damages will be internalized after 2000 and, therefore, applying externality costs would be unwarranted.

2. Nitrogen Oxides (NO_x)

a. Harm Associated

Nitrogen oxides contribute to the formation of ozone, acid deposition and the creation of PM₁₀. The health effects on adults of ozone exposure are increased lung irritation and lower resistance to respiratory infections.

b. NO_x Values Proposed

NSP and MP proposed the following ranges of NO_x environmental values for the rural, fringe, and urban scenarios: \$0 - 61, \$0 - 190, and \$0 - 718, respectively. The companies' high end figures again represent the median of the TER damage calculations.

EC, the MPCA, and the RUD-OAG proposed the following ranges, as recommended by the TER Study. The TER Study found the formation of ozone (O₃) to be more closely associated with NO_x than with volatile organic compounds (VOCs), and therefore included the ozone externalities values with the NO_x values and did not value ozone separately.

Rural	\$ 17 - 96
Fringe	\$132 - 251
Urban	\$350 - 922

The Department proposed a slightly higher set of ranges: rural -- \$18-102; fringe -- \$140 - 266; and urban -- \$371 - 978. The difference between the Department and the TER Study figures is due to the fact that the Department's figures are stated in 1995 dollars.

The MPCA generally supported the TER ranges, but argued that the TER Study's NO_x value for the rural scenario was too low because it failed to reflect the agricultural damages for ozone depletion due to NO_x emissions.

c. The ALJ's Recommendation

The ALJ recommended the ranges for nitrogen oxides (NO_x) found in the TER Study and recommended by EC, the RUD-OAG, the Department (updated to 1995 dollars) and (except with respect to the rural scenario as discussed above) the MPCA.

d. The Commission's Decision Regarding NO_x

The Commission finds that the ranges recommended in the TER Study are reasonable and soundly supported in the record of this proceeding. In Ordering Paragraph 1, the Commission updates those figures and states them in terms of 1995 dollars.

The Commission rejects the companies' proposed ranges for the reasons stated with respect to their recommendations regarding SO₂: 1) the median of the TER damage calculations is an inappropriate high point for the NO_x damage range and 2) zero is too low for the low end, as discussed previously.

The MPCA's proposed adjustment to the rural scenario was also not accepted. The MPCA did not perform ozone modeling to calculate its proposed values and did not base its damage estimates on Minnesota specific agricultural data. By contrast, Mr. Ballantine, the modeler whose ozone data was used in the TER study, relied on crop-specific dose-response functions, used county level ozone and agriculture data, and employed state of the art valuation techniques. Mr. Ballantine explained that any decrease in ozone indicated in the rural scenario is likely due to statistical "noise," i.e. concentrations indistinguishable from zero in the statistical sense. Consequently, the TER ozone model did not show a lowering of ozone concentrations when power plant emissions are present.

3. Carbon Monoxide (CO)

a. Harm Associated

CO inhibits the blood's ability to carry oxygen.

b. CO Values Proposed

The EC, MPCA, and the RUD-OAG recommended the following ranges, based on the TER Study:

Rural	\$.20 - .39
Fringe	\$.72 - 1.26
Urban	\$ 1.00 - 2.14

The Department proposed ranges reflecting the same figures, but stated in terms of 1995 dollars. MP and NSP proposed that the Commission quantify no externality values for carbon monoxide

because, in their view, the small damage-cost estimates associated with CO did not justify the administrative burden associated with incorporating those values.

c. The ALJ's Recommendation

The ALJ recommended the ranges in the TER Study.

d. The Commission's Decision Regarding CO

The Commission will adopt the ranges from the TER Study and recommended by the ALJ, updated to 1995 dollars using the updating methodology used by the Department. The Commission finds that although the costs of CO are small, the record demonstrates that it is practicable to quantify them as required by the statute and the Commission has done so. The administrative burden referenced by the companies is minimal.

4. Particulate Matter Smaller Than 10 Microns (PM₁₀)

a. Harm Associated

Particulate emissions smaller than 10 microns can: (1) exacerbate existing respiratory problems; (2) cause respiratory illness and damage lungs; (3) reduce the body's defenses against foreign material; (4) cause cancer; (5) impair visibility; and (6) damage materials.

b. PM₁₀ Values Proposed

EC, the MPCA, and the RUD-OAG proposed PM₁₀ values based on the TER Study. The Department proposed the same values, updated to 1995 dollars. The values from the TER Study are as follows:

Rural	\$ 530 - 806
Fringe	\$1,873 - 2,720
Urban	\$4,206 - 6,054

NSP and MP proposed ranges with zero dollars at the low end and the median of the TER study damage estimates for PM₁₀ at the high end: rural \$0 - 668; fringe \$0 - 2,295; and urban \$0 - 5,128.

OTP asserted that the Commission cannot establish environmental cost values for any of the criteria pollutants, including PM₁₀, because the present and likely future levels of those pollutants are far below the levels that the EPA has designated as posing a potential health hazard. The Commission has considered and rejected that argument, as explained previously in this Order.

OTP also objected that Dr. Desvousges was unqualified to interpret the epidemiological studies that he relied on to conclude that PM₁₀ is contributing to elevated mortality rates. OTP also asserted that Dr. Thayer lacked the background and personal knowledge needed to support his allegations about the health effects of PM₁₀.

c. The ALJ's Recommendation

The ALJ recommended the ranges proposed by the EC, the MPCA, and the RUD-OAG. As previously stated, the same values were the basis for the 1995 dollar ranges proposed by the Department.

d. The Commission's Decision Regarding PM₁₀

The Commission finds that it is practicable to quantify environmental values for PM₁₀ based on the TER Study and has done so. The ranges recommended by NSP and MP are improper, as discussed previously. The zero figure improperly inserts into the quantification phase considerations relevant only to the application phase and choice of the median as the high point improperly disregards the environmental damage estimated in excess of that point.

The Commission finds that OTP's challenges to the reliability of the testimony of Drs. Desvouges and Thayer are without merit. The record clearly indicates that these witnesses are experts in valuing natural resources and have extensive experience in assigning values to the environmental costs of electric power generation. These experts are clearly able to draw upon the studies they cite. OTP submitted no critique of the studies cited.

5. Lead (Pb)

a. Harm Associated

Lead affects the physiological processes and damages organs. It can be inhaled and ingested from contaminated food and water.

b. Pb Values Proposed

EC, the MPCA, and the RUD-OAG proposed lead (Pb) values based on the TER Study. The Department proposed the same values, updated to 1995 dollars. The TER Study ranges are as follows:

Rural	\$ 379 - 422
Fringe	\$1,557 - 1,881
Urban	\$2,951 - 3,653

NSP and MP recommended that the Commission adopt no values for lead. The companies argued that the total damages associated with lead emissions were extremely small and that the administrative burden of applying values for lead outweigh any benefit gained in improved decision quality.

c. The ALJ's Recommendation

The ALJ recommended that the Commission adopt the TER Study values.

d. The Commission's Decision Regarding Pb

The Commission accepts the lead values found in the TER Study, updated to 1995 dollars. The TER Study and accompanying testimony provides a record that made it practicable to establish such values and the Commission has done so. Contrary to the assertions by NSP and MP which seek to minimize the impact of lead emissions, the Commission finds that lead emissions are significant, relevant, and should be valued in this proceeding. The record shows that lead damages are second only to PM_{10} on a per ton basis and the Twin Cities metropolitan area exceeds the NAAQS for lead. The administrative burden required by the companies is minimal.

6. Volatile Organic Compounds (VOCs) and Ozone (O₃)

Volatile organic compounds (VOCs) contribute to ozone (O₃) formation and ozone-related damages. The Commission finds that VOCs are appropriately reflected as a component of ozone. Further, as noted previously in the discussion of NO_x, ozone damage has been reflected in the damage values adopted for NO_x. Accordingly, no separate values need be established for either VOCs or ozone.

7. Carbon Dioxide (CO₂)

a. Harm Associated

The basic theory underlying global warming is that greenhouse gasses (including CO₂)¹⁰ trap heat that would have otherwise radiated into space within the earth's atmosphere. This heat-trapping action keeps the earth's surface about 33 degrees Celsius warmer than it would be if the natural greenhouse effect were not present. Concerns over global warming, or the enhanced greenhouse effect attributable to human activities, arise because the amount of carbon dioxide in Earth's atmosphere has already risen from its preindustrial level of about 275 to 280 parts per million (ppm) to over 350 ppm, with the majority of this increase occurring since 1950.

In 1988, the United Nations Environment Program and the World Meteorological Organization created the Intergovernmental Panel on Climate Change (IPCC) to evaluate the environmental impacts associated with **anthropogenic** emissions of greenhouse gasses such as CO₂.¹¹

IPCC reports are the most authoritative sources available for information on climate change issues. Before publication, IPCC research reports are developed by technical committees composed of experts throughout the international scientific community and are subject to a rigorous multi-level peer review process. According to the IPCC, doubling CO₂ concentrations

¹⁰ CO₂ is one of the several gasses known as greenhouse gasses because they have the effect of warming the earth. Energy emitted from the sun passes through the atmosphere, is absorbed by the earth, and then is radiated from the earth's surface. When the radiated energy, instead of radiating directly into space, is absorbed and re-emitted towards the earth by greenhouse gasses, the surface and lower atmosphere of the planet are warmed.

¹¹ Anthropogenic emissions are those generated by human activity.

in the atmosphere would lead to an increase in global average temperature that is likely to lie in the range of 1.5 to 4.5 degrees Celsius, which is 2.7 to 8.1 degrees Fahrenheit.¹²

According to the IPCC, climate change in the predicted range could involve a number of potentially catastrophic impacts, including a rise in sea level, heightened climatic variability, and changes in vegetation. Current limitations on the general circulation models (GCMs) relied upon by the IPCC make it difficult to draw definitive conclusions about shifts in the distribution of precipitation, agricultural output, and frequency and severity of extreme weather events for any specific location or even a given region. While some studies predict agricultural benefits to Minnesota from warming of the climate, others show the grain belts of the Northern hemisphere shifting north by hundreds of kilometers and significant die-back of the spruce/pine/fir forests found in parts of northern Minnesota.

b. CO₂ Values Proposed

EC initially proposed a value of \$25 per ton for CO₂, based on the testimony of Dr. Stephen Bernow, who used an emissions target or environmental target approach. In its exceptions to the ALJ's Report, EC indicated that it could accept the following range: \$2.92 to \$14.29 per ton.

The MPCA originally proposed a range of \$4.28 to \$28.57 per ton for CO₂ emissions, based on the testimony of Peter Ciborowski who used a damage cost methodology. In its Exceptions to the ALJ's Report, the MPCA revised its proposal, recommending a range of \$2.14 to \$14.29 per ton.

The RUD-OAG did not provide any testimony, but proposed a range of costs for CO₂ emissions of \$1.00 to \$11.00 per ton, based on information in the record.

The Department initially proposed values based on testimony that was subsequently removed from the record. Thereafter, the Department recommended that the Commission order additional proceedings to allow the setting of environmental cost values for CO₂ based on a risk of future regulation approach.

Other parties have proposed that no value be set for CO₂ emissions on the basis that it is not practicable to do so because existing data is insufficient or unreliable.

c. The ALJ's Recommendation

The ALJ recommended a range of costs for CO₂ emissions of \$0.28 to \$2.92, based on Ciborowski's lower damage function (1 percent of global GDP) discounted at rates of 5 percent (lower end \$0.28) to 3 percent (higher end \$2.92).

¹² Based on past emission trends, equivalent CO₂ concentrations are expected to double from preindustrial levels before 2030 and to quadruple before 2100.

d. The Commission's Decision Regarding CO₂

The Commission will adopt the range recommended by the ALJ as appropriate for all three scenarios: rural, fringe, and urban.¹³ The Commission finds that the ALJ's calculation is well-reasoned and firmly based in the record. See ALJ's Report, Findings 102 - 114. The Commission will update the estimates to 1995 dollars, using the same method as used for the other types of emissions.

Several parties argued that it was impracticable to quantify any values for CO₂ because existing data is insufficient or unreliable. They argued that the Commission should desist from establishing values for this pollutant until clearer information is available. The Commission recognizes that there is a level of uncertainty associated with the estimates provided from the scientific community. However, the available data does provide a sufficiently reliable basis for estimating environmental damage now.

Parties further objected that it would be "impracticable" for Minnesota to adopt CO₂ values because CO₂ (and any associated global warming) could not be addressed with any appreciable impact by Minnesota alone. It is true that CO₂ emissions in Minnesota (approximately 33 million tons per year) constitutes approximately 0.1 percent of global CO₂ emissions (approximately 60 billion tons per year). The objectors' argument, however, does not really challenge the practicability (feasibility) of setting CO₂ values, but instead questions the wisdom of doing so in view of what they view as the inconsequential impact of such an effort. Their argument that nothing should be done because nothing "significant" (in the eyes of the objectors) can be done is a political argument not appropriately before the Commission. The legislature has made the appropriate political decision that the Commission should value CO₂ to the extent that this is feasible and, after rejecting some proposed ranges for CO₂, the Commission has done so.¹⁴

Rejected Ranges

EC's proposed range (\$2.92 to \$14.29 per ton) is based on discounts of 3 and 1 percent, respectively. As indicated below, the Commission finds that a 3 percent discount is supported in the record, but for the high end of the range, rather than the low end as proposed by EC and the 1 percent discount (which produces EC's high end recommendation of \$14.29) is not.

Regarding the RUD-OAG's proposed \$1 - \$11 range, the Commission finds that support in the record for either endpoint is too weak to be accepted. The RUD-OAG did not sponsor a witness advocating any range.

¹³ The damage caused by CO₂ emissions is experienced globally. It is not geographically sensitive as discussed previously with respect to, for example, the criteria pollutants. There is no quantifiable diminution of effect the farther the emitting plant is located from population centers. Hence, one range is appropriate for all three scenarios: rural, fringe, and urban.

¹⁴ As indicated previously, the overall wisdom of choosing a particular set of resource options will be evaluated in resource plan and certificate of need proceedings.

Finally, despite approving the general approach taken by MPCA witness Ciborowski, the Commission has also rejected the MPCA's proposed range for CO₂, for reasons explained in the following section.

The Acceptable Range

The environmental values for CO₂ quantified in this Order follow MPCA witness Ciborowski's general methodology. First, Ciborowski estimated **long-term global costs** based on the existing economic literature and **discounted** them to current values. Then, he divided that amount by the amount of long-term CO₂ emissions to arrive at an average cost per ton. Ciborowski essentially converted published damage estimates made by economists from percentages of gross domestic product (GDP) into costs per ton of CO₂.

Two factors account for the difference between the MPCA's recommended values and those adopted by the Commission: 1) the estimate of damage and 2) the discount rate used to reduce the stream of estimated damages to present value.

Estimate of Global Damage -- Ciborowski provided two damage figures: a "lower damage function" equal to 1 percent of global GDP and a "higher damage function" equal to 2 percent of global GDP. The MPCA used the higher function (2 percent) in calculating its proposed values. The Commission finds that the assumption that damages can be estimated at 2 percent of global GDP is factually unsupported by the record and is highly speculative given the available evidence. By contrast, the Commission finds that Ciborowski's "lower damage function" (1 percent) is well supported in the record, including the studies of Nordhaus and Frankhauser. The CO₂ values adopted in this Order, therefore, are calculated using a 1 percent damage function.

Discount Rate -- Once a damage stream has been estimated, it is necessary to select an appropriate discount factor to adjust the damage stream figures downward to present value. Ciborowski calculated the damage estimates using discount rates of 1, 2, 3, and 5 percent. He proposed a discount rate of approximately 1.5 percent based on a study performed by Cline.

Although Cline maintained that low discount rates are appropriate when discounting across generations, the Commission agrees with the ALJ that there is insufficient support for that position in the record. The weight of authority in the record supports a range of at least 3 - 5 percent for reducing future environmental damages to present value.¹⁵ Therefore, the range of CO₂ values adopted in this Order are calculated using 3 percent to calculate the high end figure and 5 percent to calculate the low end figure.

¹⁵ The New York State Environmental Cost Study valuing environmental externalities used a 3 percent rate. The DICE model uses a 6 percent discount rate, declining to about 3 percent as growth slows. The Lind model recommends a 4.6 percent discount rate. Nordhaus contends that rates of 4 - 6 percent are appropriate. The Academy of Sciences used discount rates of 3, 6, and 10 percent without recommending any single rate as being most appropriate.

8. Methane

a. Harm Associated

Methane is a greenhouse gas with a 100 year global warming potential 22 times greater than that of CO₂.

b. Methane Values Proposed

The only party to propose an environmental cost range for methane was EC: \$64.24 - \$314.38.¹⁶

c. The ALJ's Recommendation

The ALJ recommended that the Commission establish no range of values for methane.

d. The Commission's Decision Regarding Methane

Noting that methane's 100 year global warming potential is 22 times greater than that of CO₂, EC argued that it would be reasonable to calculate the range for methane by multiplying the range for CO₂ by 22. The Commission is unwilling to set a range for methane based on such a formula. In the absence of more direct evidence that methane causes this range of damage, the Commission finds that such an arithmetic approach unreasonably increases the impact of any miscalculation in the CO₂ range. In short, there is insufficient evidence in the record to support an environmental cost for methane.

9. Mercury (Hg)

a. Harm Associated

Mercury is a neurotoxin that effects the functioning of the central nervous system. No knowledgeable witness either denied or disputed that mercury causes damage to the environment or has consequences that people care about.

Approximately three-fourths of the mercury deposited in Minnesota can be ascribed to human-generated sources. Coal-fired plants are estimated to be the source of one-sixth to one-fourth of the anthropogenic mercury emissions in the state. With the effects of the 1991 federal ban on mercury in paints and fungicides, coal burning has become the leading source of mercury emissions to the air in Minnesota.

b. Mercury Values Proposed

While proposing different values earlier in the proceeding, EC, the MPCA, and the RUD-OAG ultimately proposed a range of \$1,429 to \$4,359 for each scenario. All the other parties opposed establishing values for mercury or were silent on the issue.

¹⁶ The range cited is from EC's Exceptions to the ALJ's Report. Prior to that, EC's proposal was to value methane at \$550 per ton.

c. The ALJ's Recommendation

The ALJ recommended that the Commission defer adoption of an environmental cost value for mercury until better information becomes available. The ALJ further recommended that, until it has adopted a numerical value, the Commission require utilities to explain in their filings subject to the Environmental Externalities Statute how they considered mercury.

d. The Commission's Decision Regarding Mercury

The Commission finds that the record does not support the practicability of quantifying values for mercury. In light of the concern about mercury established in the record, however, the Commission will require utilities to explain in their filings subject to the statute how mercury emissions were considered in evaluating the resource options identified in the filing. The Commission's decision is based on the following analysis.

While mercury is a pollutant of concern, there are significant omissions and uncertainties in record data regarding the effect of mercury emissions from electrical generators:

- Current models do not exist to account for the complexity of the atmospheric chemistry of mercury and its deposition.
- The record contains insufficient data regarding the amount and form of mercury emissions from coal combustion. The form of mercury emitted not only determines how much of the mercury may be removed, but it also determines the fate, health effects and risk assessment of the mercury emissions.
- A third area of omissions and uncertainty in data is the amount and form of mercury emissions from natural as compared to anthropogenic sources.
- Also missing are data and models to estimate accurately the effect of changes in mercury concentration on fish.

In addition to the forementioned uncertainties arising from the behavior of mercury in the environment, there are major uncertainties about valuation. No model has been developed to quantitatively link mercury based fishing advisories to recreation choices. The record contains anecdotal suggestions of the link, but there is no quantitative evidence of the amount of recreational activity deterred by the advisories. Likewise, no data has been developed that allows monetization of health damages from mercury emissions.

The Commission notes that the TER Study concluded that the absence of adequate data and models and the resulting level of uncertainty make it impossible to quantify the potential damages from mercury emissions. Having reviewed the record, the Commission finds that the mercury values proposed by the EC, MPCA, and the RUD-OAG are not sufficiently reliable for planning purposes.

EC: EC initially proposed to value mercury at \$50 million per ton/\$25,000 per pound based on an asserted but not proven relationship between the losses estimated to be experienced by the Alaska salmon industry due to the Exxon Valdez oil spill and damage predicted to be

experienced by the Minnesota recreational fishing industry due to mercury contamination. The record contains no evidence that there has been, or will be, any significant stigmatization to Minnesota's recreational fishing industry resulting from mercury contamination.

EC's final position, expressed in its exceptions to the ALJ's Report, is that the Commission should adopt the MPCA's values as revised by the RUD-OAG (\$1,429 to \$4,359) as interim values and establish a final environmental cost value for mercury within two years of the final Order in this docket.

MPCA: The MPCA initially proposed a range of \$4,359 to \$9,781 based on a benefits transfer analysis that estimated mercury damages based on mercury's position on the air toxics index vis a vis other pollutants whose damages have been established in the TER Study, such as SO₂, NO_x, and PM₁₀. However, based on the current state of scientific knowledge reflected in this record, the Commission cannot conclude that it is reasonable to rely on the technique of benefit transfer (using the air toxics index and its underlying fugacity model) with respect to mercury due to mercury's known unique properties, specifically its ability to cycle through the environment, taking on different chemical forms at different times.

As its final position, expressed in its exceptions to the ALJ's Report, the MPCA accepted the RUD-OAG's downward adjustment of the MPCA's mercury values (\$1,429 to \$4,359) and urged the Commission to adopt them on a temporary basis.

RUD-OAG: The RUD-OAG proposed a range based on a recalculation of MPCA's range for mercury. The RUD-OAG used MPCA witness McCarron's method but eliminated the PM₁₀ related values that Mr. McCarron had used in calculating MPCA's initially proposed range. The RUD-OAG's resulting range was \$1,429 to \$4,359. This was the range ultimately supported by EC and the MPCA.

The RUD-OAG acknowledged that there was a level of uncertainty associated with its proposed range but urged the Commission to adopt it nevertheless and simply factor in the uncertainty as the Commission exercised its discretion in applying the values in future resource selection proceedings.

The Commission recognizes that there are varying levels or depths of uncertainty, a continuum of uncertainty involved in the science underlying the valuation of externalities. At some levels of uncertainty it is still practicable (feasible) to quantify environmental values. The Commission found such levels of uncertainty (reasonable uncertainty) in connection with the pollutants for which it has established values in this Order, e.g. SO₂ and CO₂. However, there is also a point on the uncertainty continuum where it becomes infeasible to quantify environmental costs even though the Commission is convinced that such costs exist.¹⁷

In considering the record with respect to mercury, the Commission finds that the level of reasonable uncertainty has been exceeded, primarily due to the unreliability of MPCA's attempt

¹⁷ Similarly, not all fogs are of the same thickness: in some fog, it is still possible to land an airplane without instrumentation while in thicker fog, this task becomes impossible despite the certainty that both land and airplane exist.

to extrapolate mercury damages in reference to the air toxics index, as discussed previously. In these circumstances, the Commission is unable to quantify the damage resulting from mercury emitted from electric generating plants and will not do so.

The MPCA has argued the urgency of the situation, urging the Commission to quantify values on the basis of this record. The MPCA warned that failure to take environmental cost into planning considerations today will lead to expensive, sometimes irreversible, environmental losses in the future. The MPCA predicted that placing mercury emission costs at zero will result in relatively high mitigation or cleanup costs in the future.

However enticing the MPCA's calls to immediate action may be, they do not add information that makes it any more practicable to quantify damages on the basis of this record nor do they alter the legislature's directive that the Commission is to quantify values only if (to the extent) it is feasible (practicable) to do so.¹⁸

Moreover, the absence of a basis in the record of this proceeding for quantifying values for mercury does not mean that mercury's effect upon the environment will be ignored when resource options are evaluated. In this Order, the Commission has clarified that utilities will be required to explain in all filings subject to the Environmental Externalities Statute how mercury emissions were considered in the resource options identified in the filing. In addition, mercury's impact on the environment will be considered on a qualitative basis in such proceedings.

Finally, when better information on the valuation of mercury (or any other major pollutant) becomes available, any party believing that such information warrants quantifying and establishing a range of values for mercury may petition the Commission to initiate a new proceeding to do so.

G. Miscellaneous Clarifications

1. Issues Related to Cogeneration Facilities

The Natural Gas Utilities requested that the Commission determine how the values would apply to cogeneration facilities in future proceedings. The Natural Gas Utilities recommended that the environmental costs of cogenerated electricity be determined based on the additional emissions solely produced as a result of generating electricity, and that none of the environmental costs related to producing useful thermal energy should be allocated to the electric generation process.

The Commission finds that this is a resource planning process issue that should be considered in the Commission's rulemaking for the resource planning process, Docket No. E-999/R-94-649.

¹⁸ Due to the statute's "practicability" standard, the ALJ's suggestion (but not recommendation) that the Commission could adopt the RUD-OAG's mercury range to "send a message" to the utilities about the seriousness of mercury pollution cannot be accepted. The Commission trusts, however, that such a message is carried by the discussion of mercury in the text of this Order and the directive in Ordering Paragraph 3 that utilities address the mercury problem in their resource option filings.

2. Order of Dispatch

The Commission clarifies that the values established in this Order do not apply to decisions regarding the dispatch of electric power from existing facilities.

3. Revisiting the Values

The Department recommended that the ranges of the values set in this proceeding be updated periodically with the Commission opening a new proceeding about two years after it issues a Final Order in this proceeding.

Some parties objected to the Department's recommendation, preferring that the values established in this proceeding be retained until the Commission determines that there is new information of sufficient importance to justify a new proceeding.

The Department indicated that it does not object to reasonable alternatives to a mandatory hearing after two years. However, the Department added that a potential disadvantage to waiting until another proceeding is necessary is that it encourages the natural inclination to continually postpone future hearings, even if significantly better information is available. Therefore, the Department suggested that the adopted values be revisited no later than four years after this proceeding is concluded.

The Commission finds that it is not necessary to set a specific date for revisiting the values set in this Order. The Commission will, of course, entertain motions to do so based on new evidence and may initiate such proceedings in response to such motions or on their own motion, as appropriate.

4. Mercury Advisory Committee

The MPCA requested that the Commission assign a Commission staff member to head an advisory group to inform the Commission of developments in the mercury research cited by the ALJ and other research that may also be useful in further assessing mercury emissions.

In light of the fact that the MPCA already has a mercury task force in place, it appears that formation of a Commission taskforce on the same subject would be duplicative. Given the concern and interest in mercury demonstrated by various parties in this proceeding, it is unlikely that development of the mercury issue would appreciably benefit from direct Commission staff participation between proceedings. As indicated previously in this Order, the Commission believes its Order adequately emphasizes the importance it attaches to the mercury issue and will count on the parties to bring the issue forward again when scientific developments justify further consideration of this issue, consistent with statute's "practicability" standard.

5. Request for Filing of Specific Mercury Information

The MPCA requested that the Commission require utilities to include the following items in their resource planning submissions:

- total annual mercury emissions for each feasible resource alternative, expressed in kilograms; and
- mercury emission rates for each feasible alternative, expressed as micrograms per kilowatt hour, including the effects on those rates of control equipment, installed voluntarily or required by permit or regulation.

The Commission declines to impose these specific filing requirements. The Commission realizes that various parties may wish to develop their critique of the utilities' plans based on different kinds of information and will leave this to be developed by the parties in their Requests for Information to the utilities. To highlight the importance of the mercury issue generally, however, the Commission has imposed a more general requirement, i.e. that the utilities explain in their filings how mercury emissions were considered in their evaluation of resource options.

ORDER

1. The Commission hereby quantifies and establishes environmental values, stated in terms of 1995 dollars, as follows:

		Urban	Metropolitan Fringe	Rural	Within 200 Miles of Minnesota
SO ₂	\$/ton	112 - 189	46 - 110	10 - 25	10 - 25
PM ₁₀	\$/ton	4,462 - 6,423	1,987 - 2,886	562 - 855	562 - 885
CO	\$/ton	1.06 - 2.27	0.76 - 1.34	0.21 - 0.41	0.21 - 0.41
NO _x	\$/ton	371 - 978	140 - 266	18 - 102	18 - 102
Pb	\$/ton	3,131 - 3,875	1,652 - 1995	402 - 448	402 - 448
CO ₂	\$/ton	.30 - 3.10	.30 - 3.10	.30 - 3.10	.30 - 3.10

2. Utilities shall use the values adopted in this Order in resource selection proceedings by providing estimates of cost of resource options at the following three levels:
 - (1) the direct cost of resources without regard to environmental externalities,
 - (2) the direct cost plus the minimum values in the ranges specified in this proceeding, and
 - (3) the direct cost plus the maximum values in the ranges specified in this proceeding.

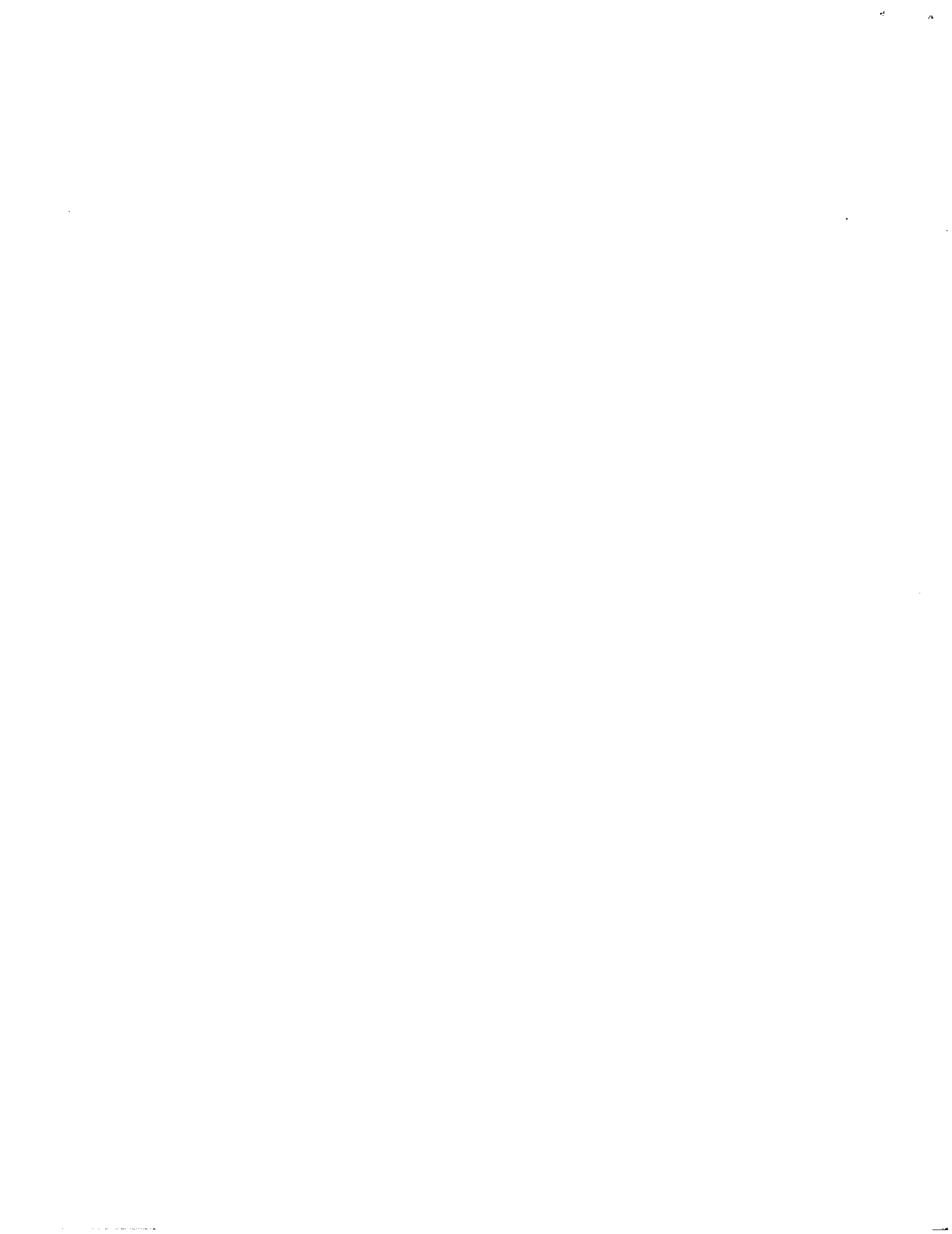
3. In their filings subject to the Environmental Externalities Statute, utilities shall explain how mercury emissions were considered in their evaluation of resource options.
4. These values shall not apply to decisions regarding the dispatch of electric power from existing facilities.
5. To the extent not separately addressed in this Order, the Commission adopts the decisions and analysis in ALJ's Report.
6. This Order shall become effective immediately.

BY ORDER OF THE COMMISSION

Burl W. Haar
Executive Secretary

(S E A L)

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**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA**

Docket No. EL 05-022

In the Matter of Otter Tail Power Company on
Behalf of Big Stone II Co-Owners for an
Energy Conversion Facility Permit for the
Construction of the Big Stone II Project

**BIG STONE II CO-OWNERS'
OBJECTIONS AND RESPONSES TO
FIRST SET OF REQUESTS FOR
ADMISSIONS**

The Big Stone II Co-owners (hereinafter referred to as “Applicant”), by and through their attorneys of record, make the following objections and responses to the First Set of Requests for Admissions propounded by Minnesotans For An Energy-Efficient Economy, Izaak Walton League of America – Midwest Office, Union of Concerned Scientists, and Minnesota Center for Environmental Advocacy (“Propounding Intervenors”) dated March 22, 2006.

GENERAL OBJECTIONS

Applicant objects to all the requests for admission served by Propounding Intervenors on the grounds that the requests seek admissions as to matters which are irrelevant to the issues to be determined by the Commission. In these requests, Propounding Intervenors seek admissions regarding the qualifications and work performed by committees and working groups assembled by the United Nations and other organizations. Such requests are annoying, oppressive, vexatious and burdensome and would require the Applicants to expend significant time and expense to research and consider the work of these organizations.

Furthermore, Propounding Intervenors employ vague and ambiguous definitions for the phrases “climate change” and “greenhouse gas(es)” which further render responses to the requests oppressive, annoying, vexatious and burdensome.

Ultimately, the requests for admissions of Propounding Intervenors seek to pose the following sorts of issues to be litigated at the hearing scheduled for June 26-30:

- Whether, in fact, the Earth is undergoing a climate change.
- If a climate change is occurring, what is the cause(s) of the change.
- Whether, to the exclusion of other possible causes of a climate change, the proposed Big Stone II Project significantly contributes to that change.

Applicant submits that these inquiries are irrelevant under SDCL Ch. 49-41B and therefore beyond the scope of SDCL 15-6-26(b) and would waste the time of the Commission and the parties.

SPECIFIC OBJECTIONS

In addition to the general objections, Applicant makes the additional objections to specific requests, by reference to the heading, as follows:

Relevance Objection. The request seeks a response to a matter which is beyond the proper scope of discovery as defined by SDCL 15-6-26(b) because the request is not relevant to the subject matter involved in the pending action and/or are not reasonably calculated to lead to the discovery of admissible evidence. Furthermore, SDCL 1-26-19(1), which is applicable to this proceeding, requires that all irrelevant, incompetent, immaterial or unduly repetitious evidence shall be excluded from contested cases.

Vagueness and Burdensome Objection. The request is overly broad and vague, annoying, oppressive and vexatious and imposes an undue burden upon Applicant to undertake investigation and research beyond the reasonable inquiry required by SDCL 15-6-36(a). Additionally, the direct and indirect costs of locating, reviewing, evaluating, and analyzing information to respond to the request will impose unreasonable financial and administrative burdens on the Applicant, or one or more of the individual Applicants, and these burdens will significantly outweigh the probative value of the information sought.

Legal Conclusion Objection. Applicant objects to the request on the grounds that the request improperly calls for Applicant to make an admission of the truth of a matter relating to something other than statements or opinions of facts or the application of law to fact contrary to SDCL 15-6-36(a). The request requires Applicant to admit or deny a statement of law.

Any responses provided are made subject to the general and specific objections and by providing any responses, Applicant does not waive any objections.

REQUEST FOR ADMISSION NO. 1

Admit that in order to obtain a permit under SDCL Chapter 49-41B Co-owners must prove that the Big Stone II unit will not pose a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION: Legal Conclusion Objection.
Relevance Objection.

RESPONSE: Notwithstanding any objections, Applicant admits that SDCL 49-41B-22(2) states: “The facility will not pose a threat of serious injury to the environment nor to the social and economic condition of inhabitants or expected inhabitants in the siting area.”

REQUEST FOR ADMISSION NO. 2

Admit that climate change would pose a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION:Legal Conclusion Objection.

Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 3

Admit that the increased concentration of greenhouse gases in the atmosphere would pose a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION: Legal Conclusion Objection.
Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 4

Admit that carbon dioxide (CO₂) is a greenhouse gas that is increasing in concentration in the global atmosphere.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 5

Admit that CO₂ is the primary greenhouse gas causing climate change.

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 6

Admit that the Big Stone II unit would emit between four and five million tons of CO₂ into the atmosphere every year it operates, as indicated by the graph labeled Big Stone I and II Carbon Dioxide Intensity (JCO 0001731), provided in your response in this docket to Mary Jo Stueve's Request for Production of Documents No. 12.

OBJECTION: Relevance Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 7

Admit that emissions from the Big Stone II unit would add to the increased concentration of CO₂ in the global atmosphere.

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 8

Admit that Co-owners are required under ARSD 20:10:22:13 to provide estimates of changes in the existing environment which are anticipated to result from operation of the proposed facility, and identification of irreversible changes which are anticipated to remain beyond the operating lifetime of the facility.

OBJECTION: Legal Conclusion Objection.
Relevance Objection.

RESPONSE: Notwithstanding any objections, Applicant admits ARSD 20:10:22:13 requires, among other things, “estimates of changes in the existing environment which are anticipated to result from construction and operation of the proposed facility, and identification of irreversible changes which are anticipated to remain beyond the operating lifetime of the facility.”

REQUEST FOR ADMISSION NO. 9

Admit that the annual emission of between four and five million tons of CO₂ from the Big Stone II unit, as indicated by the graph labeled Big Stone I and II Carbon Dioxide Intensity (JCO 0001731) provided in your response in this docket to Mary Jo Stueve’s Request for Production of Documents No. 12, would constitute a change in the existing environment under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection.
Relevance Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 10

Admit that the emissions of between four and five million tons of CO₂ from the Big Stone II unit, as indicated by the graph labeled Big Stone I and II Carbon Dioxide Intensity (JCO 0001731) provided in your response in this docket to Mary Jo Stueve’s Request for Production of Documents No. 12, would contribute to an increase in CO₂ in the atmosphere that would persist for decades after the operating lifetime of the facility.

OBJECTION: Relevance Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 11

Admit that climate change will result in irreversible changes that are anticipated to remain beyond the operating lifetime of the facility.

OBJECTION: Legal Conclusion Objection.
Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 12

Admit that Co-owners are required under ARSD 20:10:22:13 to provide information about the environmental effects of the facility calculated to reveal and assess demonstrated or suspected hazards to the health and welfare of human, plant and animal communities which may be cumulative or synergistic consequences of siting the proposed facility in combination with other operating energy conversion facilities, existing or under construction.

OBJECTION: Legal Conclusion Objection.

RESPONSE: Applicant admits that ARSD 20:10:22:13 states, in part: “The environmental effects shall be calculated to reveal and assess demonstrated or suspected hazards to the health and welfare of human, plant and animal communities which may be cumulative or synergistic consequences of siting the proposed facility in combination with any operating energy conversion facilities, existing or under construction.”

REQUEST FOR ADMISSION NO. 13

Admit that climate change is a demonstrated or suspected hazard to the health and welfare of human, plant and animal communities under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection.
Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 14

Admit that the CO₂ emissions from the Big Stone II unit, combined with those from other energy conversion facilities, existing or under construction, would contribute to increasing concentration of CO₂ in the atmosphere.

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 15

Admit that the CO₂ emissions from the Big Stone II unit, combined with those from other energy conversion facilities, existing or under construction, increase the likelihood of climate change.

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

REQUEST FOR ADMISSION NO. 16

Assuming proper intervention and pleading under SDCL 34A-10-2, admit that under SDCL 34A-10-8 any alleged pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein caused by the Big Stone II unit must be determined by the South Dakota PUC in considering the Big Stone II unit siting permit application.

OBJECTION: Legal Conclusion Objection.
Relevance Objection.

RESPONSE: No response will be provided at this time pursuant to the objections. Furthermore, because Propounding Intervenors are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

REQUEST FOR ADMISSION NO. 17

Assuming proper intervention and pleading under SDCL 34A-10-2, admit that under SDCL 34A-10-8 the South Dakota PUC is prohibited from approving the construction of the Big Stone II unit if it determines the unit has or is likely to have the effect of pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein so long as there is a feasible and prudent alternative consistent with the reasonable requirements of the public health, safety and welfare.

OBJECTION: Legal Conclusion Objection.

Relevance Objection.

RESPONSE: No response will be provided at this time pursuant to the objections. Furthermore, because Propounding Intervenors are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

REQUEST FOR ADMISSION NO. 18

Admit that climate change will have or is likely to have the effect of pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein.

OBJECTION: Legal Conclusion Objection.
Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: No response will be provided at this time pursuant to the objections.

**INTERROGATORY NO. 1 AND
REQUEST FOR PRODUCTION OF DOCUMENTS NO. 1**

If your response to any of Requests for Admissions 1 through 18 is a denial or anything other than an unqualified admission, then set forth in detail for each:

- a. the factual and legal reasons for your denial and/or your failure to provide an unqualified admission, including a detail of each and every fact supporting the same;
- b. the identity of each and every witness who supports your denial and/or your failure to provide an unqualified admission; and
- c. the identity of each and every document tending to support or relate in any way to your denial and/or failure to provide an unqualified admission, and identify by the name and address of each person having knowledge, facts or custody of such documents.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection.

RESPONSE: Pursuant to the objection, no response is forthcoming at this time.

Intergovernmental Panel on Climate Change Third Assessment Report, Working Group I

REQUEST FOR ADMISSION NO. 19

Admit that the Intergovernmental Panel on Climate Change (IPCC) was formed by the United Nations Environment Programme and the World Meteorological Organization in 1988. [See

IPCC 2004 document, “Sixteen Years of Scientific Assessment in Support of the Climate Convention,” hereafter “IPCC 2004,” <http://www.ipcc.ch/about/anniversarybrochure.pdf>]

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 20

Admit that the 43rd United Nations General Assembly passed a resolution in 1988 endorsing the establishment of the IPCC and requesting that the IPCC provide “a comprehensive review and recommendations with respect to: (a) the state of knowledge of the science of climate and climatic change;”. [IPCC 2004, p. 3]

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 21

Admit that the United Nations General Assembly in 1990 noted the findings of the IPCC first comprehensive review of the science of climate change and initiated negotiations on the Framework Convention on Climate Change. [IPCC 2004, p. 4]

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 22

Admit that in 1992 the United Nations Framework Convention on Climate Change (hereafter Framework Convention) was adopted. [IPCC 2004, p 5]

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 23

Admit that the United States ratified and is bound by the Framework Convention. [http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php]

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.
Legal Conclusion Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document, assess the work of its authors or determine whether the government of the United States ratified the Framework Convention or the effect of such ratification as it may pertain to these proceedings. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 24

Admit that the Conference of the Parties to the Framework Convention has asked the IPCC to provide full assessments of the climate science every 4-5 years, and to prepare various technical papers related to specific aspects of climate science, technology, and socio-economics. [IPCC 2004, p. 5].

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 25

Admit that the most recent Assessment Report released by the IPCC is the Third Assessment Report (TAR), released in 2001, and that part of the TAR is the report of Working Group I of the IPCC, entitled “Climate Change 2001: The Scientific Basis.”
[http://www.grida.no/climate/ipcc_tar/wg1/index.htm]

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 26

Admit that “Climate Change 2001: The Scientific Basis,” describes in its preface how it was prepared, stating: “This report was compiled between July 1998 and January 2001, by 122 Lead Authors. In addition, 515 Contributing Authors submitted draft text and information to the Lead Authors. The draft report was circulated for review by experts, with 420 reviewers submitting valuable suggestions for improvement. This was followed by review by governments and experts, through which several hundred more reviewers participated. All the comments received were carefully analysed and assimilated into a revised document for consideration at the session of Working Group I held in Shanghai, 17 to 20 January 2001. There the Summary for Policymakers was approved in detail and the underlying report accepted.”

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 27

Admit that each of the following is among the findings set forth in the Summary for Policymakers adopted as part of “Climate Change 2001: The Scientific Basis”:

a. “The global average surface temperature has increased over the 20th century by about 0.6° C.” [p.2 pdf version]

b. “The atmospheric concentration of carbon dioxide (CO₂) has increased by 31% since 1750. The present CO₂ concentration has not been exceeded during the past 420,000 years and likely not during the past 20 million years. The current rate of increase is unprecedented during at least the past 20,000 years.” [p.7 pdf version] [footnote omitted]

c. “There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities....There is a longer and more closely scrutinised temperature record and new model estimates of variability. The warming over the past 100 years is very unlikely to be due to internal variability alone, as estimated by current models.” [p.10, pdf version][footnote omitted]

d. “In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations.” [p.10, pdf version][footnote]

e. “The globally averaged surface temperature is projected to increase by 1.4 to 5.8° C over the period 1990 to 2100.” [p. 13 pdf version] [reference to graph omitted].

f. “Increase of heat index over land areas” is projected to be “very likely, over most areas” during the 21st century. [p. 15, Table 1, pdf version] [footnotes omitted].

g. “More intense precipitation events” are projected to be “very likely, over many areas” during the 21st century. [p. 15, Table 1, pdf version] [footnotes omitted].

h. “Increased summer continental drying and associated risk of drought” is projected to be “likely, over most mid-latitude continental interiors” in the 21st century. [p. 15, Table 1, pdf version] [footnote omitted].

i. “Increase in tropical cyclone peak wind intensities” is projected to be “likely, over some areas” during the 21st century. [p. 15, Table 1, pdf version] [footnotes omitted].

j. “Increase in tropical cyclone mean and peak precipitation intensities” is projected to be “likely, over some areas” during the 21st century. [p. 15, Table 1, pdf version] [footnotes omitted].

k. “Anthropogenic climate change will persist for many centuries. Emissions of long-lived greenhouse gases (i.e., CO₂, N₂O, PFCs, SF₆) have a lasting effect on atmospheric composition, radiative forcing and climate. For example, several centuries after CO₂ emissions occur, about a quarter of the increase in CO₂ concentration caused by these emissions is still present in the atmosphere.” [p. 17, pdf version].

OBJECTION: Relevance Objection.

Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient

knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 28

Admit that Attachment A, attached hereto, is a true and correct copy of the Summary for Policymakers adopted as part of Climate Change 2001: The Scientific Basis. [http://www.grida.no/climate/ipcc_tar/wg1/pdf/WG1_TAR-FRONT.PDF, pages 1-20, pdf version].

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 29

Admit that the IPCC Working Group I is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere poses a threat of serious injury to the environment.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the IPCC Working Group I and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 30

Admit that the IPCC Working Group I is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere will change the existing environment, including causing irreversible changes anticipated to remain beyond the operating life of Big Stone unit II.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient

knowledge to assess the qualifications of the IPCC Working Group I and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 31

Admit that the IPCC Working Group I is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere will cause hazards to the health and welfare of human, plant and animal communities, which may be cumulative or synergistic consequences of siting Big Stone unit II in combination with other operating energy conversion facilities, existing or under construction.

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the IPCC Working Group I and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 32

Admit that the IPCC Working Group I is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere will cause pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the IPCC Working Group I and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 33

Admit that the Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere poses a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 34

Admit that the Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere will change the existing environment, including causing irreversible changes anticipated to remain beyond the operating life of the Big Stone unit II under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 35

Admit that the Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere will cause hazards to the health and welfare of human, plant and animal communities as a cumulative or synergistic consequence of siting Big Stone unit II in combination with other operating energy conversion facilities, existing or under construction, under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 36

Admit that the Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere will cause pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein under SDCL 34A-10-8.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied. Furthermore, because Propounding Intervenors are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

REQUEST FOR ADMISSION NO. 37

Admit that the environmental changes found to be occurring or projected to occur in the Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change as a result of the increased concentration of greenhouse gases in the atmosphere constitute changes that pose a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 38

Admit that the environmental changes found to be occurring or projected to occur in the Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change as a result of the increased concentration of greenhouse gases in the atmosphere constitute changes that have, or are likely to have, the effect of pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein under SDCL 34A-10-8.

OBJECTION: Legal Conclusion Objection
Relevance Objection

Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied. Furthermore, because Propounding Intervenor are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

INTERROGATORY NO. 2 AND REQUEST FOR PRODUCTION OF DOCUMENTS NO. 2

If your response to any of Requests for Admissions 19 through 38 is a denial or anything other than an unqualified admission, then set forth in detail for each:

- a. the factual and legal reasons for your denial and/or your failure to provide an unqualified admission, including a detail of each and every fact supporting the same;
- b. the identity of each and every witness who supports your denial and/or your failure to provide an unqualified admission; and
- c. the identity of each and every document tending to support or relate in any way to your denial and/or failure to provide an unqualified admission, and identify by the name and address of each person having knowledge, facts or custody of such documents.

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Pursuant to the objections, no response is forthcoming at this time.

Intergovernmental Panel on Climate Change Third Assessment Report Working Group II

REQUEST FOR ADMISSION NO. 39

Admit that part of the IPCC Third Assessment Report (TAR) is the report of Working Group II (“WGII”) of the IPCC, entitled “Climate Change 2001: Impacts, Adaptation, and Vulnerability.” [http://www.grida.no/climate/ipcc_tar/wg2/index.htm]

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the

information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 40

Admit that the preface of “Climate Change 2001: Impacts, Adaptation and Vulnerability” describes how it was prepared, stating: “The WGII report was compiled by 183 Lead Authors between July 1998 and February 2001. In addition, 243 Contributing Authors submitted draft text and information to the Lead Author teams. Drafts of the report were circulated twice for review, first to experts and a second time to both experts and governments. Comments received from 440 reviewers were carefully analyzed and assimilated to revise the document with guidance provided by 33 Review Editors. The revised report was presented for consideration at a session of the Working Group II panel held in Geneva from 13 to 16 February 2001, in which delegates from 100 countries participated. There, the Summary for Policymakers was approved in detail and the full report accepted.”

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 41

Admit that each of the following statements is made in the Summary for Policymakers of “Climate Change 2001: Impacts, Adaptation, and Vulnerability” [http://www.grida.no/climate/ipcc_tar/wg2/pdf/wg2TARspm.pdf]:

a. “Natural Systems are Vulnerable to Climate Change, and Some will be Irreversibly Damaged. Natural systems can be especially vulnerable to climate change because of limited adaptive capacity, and some of these systems may undergo significant and irreversible damage. Natural systems at risk include glaciers, coral reefs and atolls, mangroves, boreal and tropical forests, polar and alpine ecosystems, prairie wetlands, and remnant native grasslands. While some species may increase in abundance or range, climate change will increase existing risks of extinction of some more vulnerable species and loss of biodiversity. It is well-established that the geographical extent of the damage or loss, and the number of systems affected, will increase with the magnitude and rate of climate change.” [pp. 4-5, pdf version] [references omitted.]

b. “Many Human Systems are Sensitive to Climate Change, and Some are Vulnerable. Human systems that are sensitive to climate change include mainly water resources; agriculture (especially food security) and forestry; coastal zones and marine systems (fisheries);

human settlements, energy and industry; insurance and other financial services; and human health. ... Projected adverse impacts based on models and other studies include:

- A general reduction in potential crop yields in most tropical and sub-tropical regions for most projected increases in temperature
- A general reduction, with some variation, in potential crop yields in most regions in mid-latitudes for increases in annual-average temperatures of more than a few °C
- Decreased water availability for populations in many water-scarce regions, particularly in the sub-tropics
- An increase in the number of people exposed to vector-borne (e.g. malaria) and water-borne diseases (e.g., cholera), and an increase in heat stress mortality
- A widespread increase in the risk of flooding for many human settlements (tens of millions of inhabitants in settlements studied) from both increased heavy precipitation events and sea-level rise
- Increased energy demand for space cooling due to higher summer temperatures.” [p. 5, pdf version][references omitted]

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 42

Admit that Table SPM-1, entitled “Examples of impacts resulting from projected changes in extreme climate events” lists under the column “Representative Examples of Projected Impacts (all high confidence of occurrence in some areas)” each of the following impacts [p. 7, pdf version]:

- a. “Increased incidence of death and serious illness in older age groups and urban poor.”
- b. “Extended range and activity of some pest and disease vectors.”
- c. “Increased flood, landslide, avalanche, and mudslide damage.”
- d. “Increased soil erosion.”
- e. “Decreased crop yields.”
- f. “Increased damage to building foundations caused by ground shrinkage.”

- g. “Decreased water resource quantity and quality.”
- h. “Increased risk of forest fire.”
- i. “Increased risks to human life, risk of infectious disease epidemics, and many other risks.”
- j. “Increased coastal erosion and damage to coastal buildings and infrastructure.”
- k. “Increased damage to coastal ecosystems such as coral reefs and mangroves.”

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 43

Admit that Attachment B, attached hereto, is a true and correct copy of the Summary for Policymakers: Climate Change 2001: Impacts, Adaptation, and Vulnerability, A Report of Working Group II of the Intergovernmental Panel on Climate Change. [http://www.grida.no/climate/ipcc_tar/wg2/pdf/wg2TARspm.pdf].

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 44

Admit that the IPCC Working Group II is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere poses a threat of serious injury to the environment.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the IPCC Working Group II and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 45

Admit that the IPCC Working Group II is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere will change the existing environment, including causing irreversible changes anticipated to remain beyond the operating life of Big Stone unit II.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the IPCC Working Group II and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 46

Admit that the IPCC Working Group II is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere will cause hazards to the health and welfare of human, plant and animal communities, which may be cumulative or synergistic consequences of siting Big Stone unit II in combination with other operating energy conversion facilities, existing or under construction.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the IPCC Working Group II and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 47

Admit that the IPCC Working Group II is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere will cause pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the IPCC Working Group II and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 48

Admit that the Summary for Policymakers: Climate Change 2001: Impacts, Adaptation, and Vulnerability, A Report of Working Group II of the Intergovernmental Panel on Climate Change includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere poses a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 49

Admit that the Summary for Policymakers: Climate Change 2001: Impacts, Adaptation, and Vulnerability, A Report of Working Group II of the Intergovernmental Panel on Climate Change includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere will change the existing environment, including causing irreversible changes anticipated to remain beyond the operating life of Big Stone unit II under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 50

Admit that the Summary for Policymakers: Climate Change 2001: Impacts, Adaptation, and Vulnerability, A Report of Working Group II of the Intergovernmental Panel on Climate Change includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere will cause hazards to the health and welfare of human, plant and animal

communities, which may be cumulative or synergistic consequences of siting Big Stone unit II in combination with other operating energy conversion facilities, existing or under construction, under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 51

Admit that the Summary for Policymakers: Climate Change 2001: Impacts, Adaptation, and Vulnerability, A Report of Working Group II of the Intergovernmental Panel on Climate Change includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere will cause pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein under SDCL 34A-10-8.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied. Furthermore, because Propounding Intervenors are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

REQUEST FOR ADMISSION NO. 52

Admit that the environmental changes found to be occurring or projected to occur in the Summary for Policymakers: Climate Change 2001: Impacts, Adaptation, and Vulnerability, A Report of Working Group II of the Intergovernmental Panel on Climate Change as a result of the increased concentration of greenhouse gases in the atmosphere constitute changes that pose a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 53

Admit that the environmental changes found to be occurring or projected to occur in the Summary for Policymakers: Climate Change 2001: Impacts, Adaptation, and Vulnerability, A Report of Working Group II of the Intergovernmental Panel on Climate Change as a result of the increased concentration of greenhouse gases in the atmosphere constitute changes that have, or are likely to have, the effect of pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein under SDCL 34A-10-8.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied. Furthermore, because Propounding Intervenors are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

**INTERROGATORY NO. 3 AND
REQUEST FOR PRODUCTION OF DOCUMENTS NO. 3**

If your response to any of Requests for Admissions 39 through 53 is a denial or anything other than an unqualified admission, then set forth in detail for each:

- a. the factual and legal reasons for your denial and/or your failure to provide an unqualified admission, including a detail of each and every fact supporting the same;
- b. the identity of each and every witness who supports your denial and/or your failure to provide an unqualified admission; and
- c. the identity of each and every document tending to support or relate in any way to your denial and/or failure to provide an unqualified admission, and identify by the name and address of each person having knowledge, facts or custody of such documents.

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Pursuant to the objections, no response is forthcoming at this time.

National Academy of Sciences

REQUEST FOR ADMISSION NO. 54

Admit that the National Academy of Sciences was formed by legislation signed in 1863, and that as mandated in its Act of Incorporation it has since then served to "investigate, examine, experiment, and report upon any subject of science or art" whenever called upon to do so by any department of the government.

http://www.nasonline.org/site/PageServer?pagename=ABOUT_main_page

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 55

Admit that the National Academy of Sciences is comprised of approximately 2,000 members and 350 foreign associates, of whom more than 200 have won Nobel Prizes.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 56

Admit that members and foreign associates of the Academy are elected in recognition of their distinguished and continuing achievements in original research, and that election to the Academy is widely considered one of the highest honors that can be accorded a scientist or engineer.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 57

Admit that National Academy of Sciences is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere poses a threat of serious injury to the environment.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the National Academy of Sciences and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 58

Admit that National Academy of Sciences is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere will change the existing environment, including causing irreversible changes anticipated to remain beyond the operating life of Big Stone unit II.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the National Academy of Sciences and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 59

Admit that National Academy of Sciences is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere will cause hazards to the health and welfare of human, plant and animal communities, which may be cumulative or synergistic consequences of siting Big Stone unit II in combination with other operating energy conversion facilities, existing or under construction.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the National Academy of Sciences and admit to the foundation or accuracy of its reports.

REQUEST FOR ADMISSION NO. 60

Admit that National Academy of Sciences is qualified to assess and discuss the scientific data related to whether the increased concentration of CO₂ in the atmosphere will cause pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this request. Applicant is without sufficient knowledge to assess the qualifications of the National Academy of Sciences and admit to the foundation or accuracy of its reports.

Joint Academies' Statement

REQUEST FOR ADMISSION NO. 61

Admit that the U.S. National Academy of Sciences along with national science academies of Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, and the United Kingdom issued a statement in 2005 entitled "Joint Science Academies' Statement: Global Response to Climate Change," [hereafter "Joint Science Academies Statement"] [<http://nationalacademies.org/onpi/06072005.pdf>] which included each of the following statements:

a. Under the heading "Climate change is real," the statement says: "There will always be uncertainty in understanding a system as complex as the world's climate. However, there is now strong evidence that significant global warming is occurring. The evidence comes from direct measurements of rising surface air temperatures and subsurface ocean temperatures and from phenomena such as increases in average global sea levels, retreating glaciers, and changes to many physical and biological systems. It is likely that most of the warming in recent decades can be attributed to human activities (IPCC 2001). This warming has already led to changes in the Earth's climate." [footnotes omitted]

b. "The existence of greenhouse gases in the atmosphere is vital to life on Earth – in their absence average temperatures would be about 30 centigrade degrees lower than they are today. But human activities are now causing atmospheric concentrations of greenhouse gases – including carbon dioxide, methane, tropospheric ozone, and nitrous oxide – to rise well above pre-industrial levels. Carbon dioxide levels have increased from 280 ppm in 1750 to over 375 ppm today – higher than any previous levels that can be reliably measured (i.e. in the last

420,000 years). Increasing greenhouse gases are causing temperatures to rise; the Earth's surface warmed by approximately 0.6 centigrade degrees over the twentieth century. The Intergovernmental Panel on Climate Change (IPCC) projected that the average global surface temperature will continue to increase between 1.4 centigrade degrees and 5.8 centigrade degrees above 1990 levels, by 2100."

c. Under the heading "Reduce the causes of climate change," the statement says: "The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions."

d. "Action taken now to reduce significantly the increased concentration of greenhouse gases in the atmosphere will lessen the magnitude and rate of climate change. As the United Nations Framework Convention on Climate Change (UNFCCC) recognises, a lack of full scientific certainty about some aspects of climate change is not a reason for delaying an immediate response that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system."

e. "Carbon dioxide can remain in the atmosphere for many decades. Even with possible lowered emission rates we will be experiencing the impacts of climate change throughout the 21st century and beyond. Failure to implement significant reductions in greenhouse gas emissions now, will make the job much harder in the future."

f. "We urge all nations, in the line with the UNFCCC principles, 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. As national science academies, we commit to working with governments to help develop and implement the national and international response to the challenge of climate change." [citation omitted]

g. "G8 nations have been responsible for much of the past greenhouse gas emissions. As parties to the UNFCCC, G8 nations are committed to showing leadership in addressing climate change and assisting developing nations to meet the challenges of adaptation and mitigation."

h. "We call on world leaders, including those meeting at the Gleneagles G8 Summit in July 2005, to:

- Acknowledge that the threat of climate change is clear and increasing.

[bullet points omitted]

- Show leadership in developing and deploying clean energy technologies and approaches to energy efficiency, and share this knowledge with all other nations."

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 62

Admit that the document in Attachment C, attached hereto, is a true and accurate copy of the “Joint Science Academies’ Statement.”

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 63

Admit that the Joint Science Academies’ Statement includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere poses a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 64

Admit that the Joint Science Academies’ Statement includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere will change the existing environment, including causing irreversible changes anticipated to remain beyond the operating life of the facility under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 65

Admit that the Joint Science Academies' Statement includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere will cause hazards to the health and welfare of human, plant and animal communities as a cumulative or synergistic consequence of siting Big Stone unit II in combination with other operating energy conversion facilities, existing or under construction, under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 66

Admit that the Joint Science Academies' Statement includes information relevant to determining whether the increased concentration of CO₂ in the atmosphere will cause pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein under SDCL 34A-10-8.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied. Furthermore, because Propounding Intervenors are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

REQUEST FOR ADMISSION NO. 67

Admit that the environmental changes that the Joint Science Academies' Statement finds to be occurring or projects to occur as a result of the increased concentration of greenhouse gases in the atmosphere constitute changes that pose a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 68

Admit that the environmental changes that the Joint Science Academies' Statement finds to be occurring or projects to occur as a result of the increased concentration of greenhouse gases in the atmosphere constitute changes that have, or are likely to have, the effect of pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein under SDCL 34A-10-8.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied. Furthermore, because Propounding Intervenors are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

INTERROGATORY NO. 4 AND REQUEST FOR PRODUCTION OF DOCUMENTS NO. 4

If your response to any of Requests for Admissions 54 through 68 is a denial or anything other than an unqualified admission, then set forth in detail for each:

a. the factual and legal reasons for your denial and/or your failure to provide an unqualified admission, including a detail of each and every fact supporting the same;

b. the identity of each and every witness who supports your denial and/or your failure to provide an unqualified admission; and

c. the identity of each and every document tending to support or relate in any way to your denial and/or failure to provide an unqualified admission, and identify by the name and address of each person having knowledge, facts or custody of such documents.

OBJECTION: Relevance Objection.
Vagueness and Burdensome Objection.

RESPONSE: Pursuant to the objections, no response is forthcoming at this time.

NAS Climate Highlights Report

REQUEST FOR ADMISSION NO. 69

Admit that in its 2005 publication, “Understanding and Responding to Climate Change: Highlights of National Academies Reports,” [http://dels.nas.edu/basc/climate-change_final.pdf] the National Academy of Sciences makes each of the following statements:

a. “A growing body of evidence indicates that the Earth’s atmosphere is warming. Records show that surface temperatures have risen about 1.4° F (0.7° C) since the early twentieth century, and that about 0.9° F (0.5° C) of this increase has occurred since 1978. Observed changes in oceans, ecosystems, and ice cover are consistent with this warming trend.” [p.2]

b. “The Earth is warming.... The most striking evidence of a global warming trend is closely scrutinized data that show a relatively rapid and widespread increase in temperature during the past century [citation omitted]. The rising temperatures observed since 1978 are particularly noteworthy because the rate of increase is so high and because, during the same period, the energy reaching the Earth from the Sun had been measured precisely enough to conclude that Earth’s warming was not due to changes in the Sun.” [p. 4]

c. “Steps can be taken to reduce greenhouse gases in the atmosphere. Despite remaining unanswered questions, the scientific understanding of climate change is now sufficiently clear to justify taking steps to reduce the amount of greenhouse gases in the atmosphere. Because carbon dioxide and some other greenhouse gases can remain in the atmosphere for many decades, centuries, or even longer, the climate change impacts from concentrations today will likely continue well beyond the 21st century and could potentially accelerate. Failure to implement significant reductions in net greenhouse gas emissions will make the job much harder in the future – both in terms of stabilizing their atmospheric abundances and in terms of experiencing more significant impacts.” [p. 16].

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 70

Admit that the conclusions of the National Academy of Sciences quoted in Requests for Admission 69 are relevant to determining whether the increased concentration of CO₂ in the atmosphere poses a threat of serious injury to the environment under SDCL 49-41B-22.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 71

Admit that the conclusions of the National Academy of Sciences quoted in Requests for Admission 69 are relevant to determining whether the increased concentration of CO₂ in the atmosphere will change the existing environment, including causing irreversible changes anticipated to remain beyond the operating life of the facility under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 72

Admit that the conclusions of the National Academy of Sciences quoted in Requests for Admission 69 are relevant to determining whether the increased concentration of CO₂ in the atmosphere will cause hazards to the health and welfare of human, plant and animal communities as a cumulative or synergistic consequence of siting Big Stone unit II in combination with other operating energy conversion facilities, existing or under construction, under ARSD 20:10:22:13.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 73

Admit that the conclusions of the National Academy of Sciences quoted in Requests for Admission 69 are relevant to determining whether the increased concentration of CO₂ in the atmosphere will cause pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein under SDCL 34A-10-8.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied. Furthermore, because Propounding Intervenor are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

REQUEST FOR ADMISSION NO. 74

Admit that the environmental changes found to be occurring or projected to occur as a result of the increased concentration of greenhouse gases in the atmosphere by the National Academy of Sciences in its 2005 publication, "Understanding and Responding to Climate Change: Highlights of National Academies Reports," constitute changes that pose a threat of serious injury to the environment under SDCL 49-41B-22;

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied.

REQUEST FOR ADMISSION NO. 75

Admit that the environmental changes found to be occurring or projected to occur as a result of the increased concentration of greenhouse gases in the atmosphere by the National Academy of Sciences in its 2005 publication, "Understanding and Responding to Climate Change: Highlights of National Academies Reports," constitute changes that have, or are likely to have, the effect of pollution, impairment, or destruction of the air, water, or other natural resources or the public trust therein under SDCL 34A-10-8.

OBJECTION: Legal Conclusion Objection
Relevance Objection
Vagueness and Burdensome Objection

RESPONSE: Applicant has made reasonable inquiry and the information known to it is insufficient to enable Applicant to admit or deny this statement. Applicant is without sufficient knowledge to admit the foundation of the referenced document, assess the accuracy of the information contained in the document or assess the work of its authors. Therefore, this request is denied. Furthermore, because Propounding Intervenors are actively participating in this docket, SDCL Ch. 34A-10 is not applicable.

INTERROGATORY NO. 5 AND REQUEST FOR PRODUCTION OF DOCUMENTS NO. 5

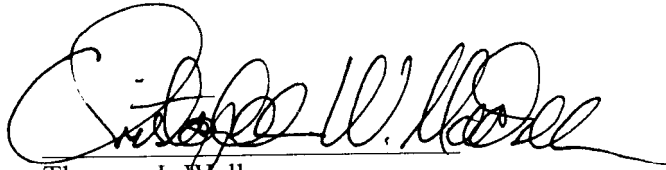
If your response to any of Requests for Admissions 69 through 75 is a denial or anything other than an unqualified admission, then set forth in detail for each:

- a. the factual and legal reasons for your denial and/or your failure to provide an unqualified admission, including a detail of each and every fact supporting the same;
- b. the identity of each and every witness who supports your denial and/or your failure to provide an unqualified admission; and
- c. the identity of each and every document tending to support or relate in any way to your denial and/or failure to provide an unqualified admission, and identify by the name and address of each person having knowledge, facts or custody of such documents.

OBJECTION: Relevance Objection
Vagueness and Burdensome Objection.

RESPONSE: Pursuant to the Objections, no response is forthcoming at this time.

Dated: April 24, 2006



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CERTIFICATE OF SERVICE

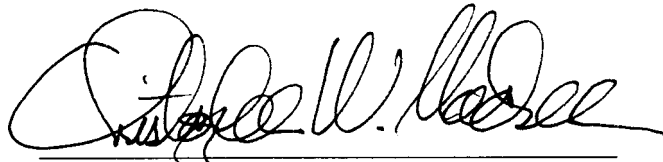
I, Christopher W. Madsen, do hereby certify that I am a member of the law firm of Boyce, Greenfield, Pashby & Welk, L.L.P., attorneys for the Co-owners of Big Stone II Project and that on the 11th day of April, 2006, true and correct copies of the Big Stone II Co-owners' Objections and Responses to First Set of Requests for Admissions were served via email on the following:

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