BEFORE THE
SURFACE TRANSPORTATION BOARD

FINANCE DOCKET NO. 33407

DAKOTA, MINNESOTA & EASTERN RAILROAD CORPORATION
CONSTRUCTION INTO THE POWDER RIVER BASIN

COMMENTS OF
MINNESOTANS FOR AN ENERGY EFFICIENT ECONOMY and
MINNESOTA CENTER FOR ENVIRONMENTAL ADVOCACY

ON THE

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

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Pursuant to the schedule adopted by the Surface Transportation Board ("STB") or ("Board"), Minnesotans for an Energy Efficient Economy (hereinafter "ME3") and Minnesota Center for Environmental Advocacy (hereinafter "MCEA") submit their joint comments on the April 15, 2005 Draft Supplemental Environmental Impact Statement ("DSEIS").

I. The time frame of 20 years, utilized in the DSEIS for the analysis of the impacts of the project, is too short, in view of the Court's requirement of a study of the effects of the project on the long term demand for coal.

The Eighth Circuit Court of Appeals opinion, which required the DM&E EIS to be redone because of its failure to analyze the impacts of the project on the long-term demand for coal and long-term air quality, realized that the short-term effects of the project may be slight, but the long term effects will certainly be more pronounced. The Court stated:

> The increased availability of inexpensive coal will at the very least make coal a more attractive option to future entrants into the utilities market when compared with other potential fuel sources, such as nuclear power, solar power, or natural gas. Even if this project will not affect the short-term demand for coal, which is possible since most existing utilities are single-source dependent**,** it will most assuredly affect the nation's **long-**

> **term demand for coal** as the comments to the DEIS explained.[1] (Emphasis added)

The air quality impact of the long-term demand for coal are principally related to carbon dioxide emissions and the predicted impact those emissions will have on global average temperatures. Future concerns of the Federal Government,[2] and state and local governments, will be focused on emissions of carbon dioxide and the contributions that gas is making and will continue to make to the problem of global warming.[3] The long-term phenomenon of climate alteration due to human activities is not typically analyzed in time frames of 20 years. The effects of human-caused global warming are usually analyzed in a time frame which stretches to the end of the century.[4] Carbon introduced into the atmosphere now will

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[1] Mid-States Coalition for Progress v. STB, 345 F. 3d 520, 549 (Eighth Circuit, 2003).

[2] While the U.S. has not ratified the Kyoto treaty, a major federal report on climate, issued in August of 2004, acknowledges that the recent increases in global temperatures cannot be explained by natural forces alone, and must be in part attributed to "anthropogenic forcings." or human caused emissions. See "Our Changing Planet, A Report by the Climate Change Science Program and the subcommittee on Global Change Research (A supplement to the President's Budget for 2004 and 2005) at p. 74.

[3] See Attachment 1, Synapse Energy Economics, Inc, "Taking Carbon into account in Utility Planning: Zero is the Wrong Carbon Value." at pp. 9-15, The report discusses at length efforts that are being undertaken by governments at all levels, and globally, to reduce carbon emissions.

[4] IPCC, 2001: Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 398 pp. (hereinafter "IPCC 2001"). See also, Intergovernmental

remain for a hundred years or more.[5] In light of the Court's admonition, quoted above, that the long term impacts of the project should be modeled, and in light of the growing concern at all levels of government about carbon dioxide levels and global warming, the time frame of the analysis of increased coal usage and resulting effects on air quality should be examined over a much longer period, preferably to the year 2100. At a minimum, the time period should include the operating life of a coal plant, which comes on line in 2020, and operates for at least 50 years, to 2070. [6]

Panel on Climate Change, "Introduction to the Intergovernmental Panel on Climate Change." 2003 edition. Available at www.ipcc.ch/about/beng.pdf. and "16 Years of Scientific Assessment in Support of the Climate Convention." IPCC. December 2004. Available at http://www.ipcc.ch/about/anniversarybrochure.pdf

IPCC 2001, supra, note 4, at p. 21: "Global average surface temperature is estimated to increase 1.2 to 3.5°C by the year 2100 for profiles that eventually stabilize the concentration of CO 2 at levels from 450 to 1,000 ppm. Thus, although all of the CO2 concentration stabilization profiles analyzed would prevent, during the 21st century, much of the upper end of the SRES projections of warming (1.4 to 5.8°C by the year 2100), it should be noted that for most of the profiles the concentration of CO 2 would continue to rise beyond the year 2100. The equilibrium temperature rise would take many centuries to reach, and ranges from 1.5 to 3.9°C above the year 1990 levels for stabilization at 450 ppm, and 3.5 to 8.7°C above the year 1990 levels for stabilization at 1,000 ppm."

[6] Id. at p. 19, "Reductions in greenhouse gas emissions and the gases that control their concentration would be necessary to stabilize radiative forcing. For example, for the most important anthropogenic greenhouse gas, carbon cycle models indicate that stabilization of atmospheric CO 2 concentrations at 450, 650, or 1,000 ppm would require global anthropogenic CO2 emissions to drop below the year 1990 levels, within a few decades, about a century, or about 2 centuries, respectively, and continue to decrease steadily thereafter (see Figure SPM-6). These models illustrate that emissions would peak in about 1 to 2 decades (450 ppm) and roughly a century (1,000 ppm) from the present. Eventually CO 2 emissions would need to decline to a very small fraction of current emissions. The benefits of different stabilization levels are discussed later in Question 6 and the costs of these stabilization levels are discussed in Question 7. " Graphs extended

II. The analysis of the price impact of the project should be remodeled to reflect a scenario wherein current prices are artificially high due to the market power of the competitors, so that the reduction in price due to the competition from D,M & E would be greater.

There are currently two railroads carrying coal from Powder River Basin (PRB) to Eastern markets. Those existing carriers (BNSF Railway and Union Pacific) currently haul more than 400 million tons of PRB coal, much of this over a triple-track main line. The DM&E proposal would introduce a third carrier into this market with a potential capacity of 100 million tons per year. This new connection will reduce the rail haulage distance to some markets by 5.8%. Based on estimated market shares, SEA has calculated that this distance savings will have a proportional impact on transportation costs in various coal markets ranging from 1.9% to 3.6%. It is also possible that competitive pressures could produce a greater level of cost savings up to a full 5.8% based on haulage distance, or even greater if current transport prices reflect some exercise of market power. As reported in the May 22 EIA Coal News and Markets Report, the Western Coal Traffic League filed suit in the U.S. District Court in Dallas, asking that the current tariff rates published by BNSF and UP be abolished and that any overcharges be refunded. Thus there are reasons to believe that the proposed DM&E rail line extension could reasonably have greater impacts than those modeled in the "Low4pct" case. [7]

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to the year **2300** showing various scenarios of CO2 emissions and the results for global temperatures are set forth at p.20 of the same document.

[7] Bruce Biewald and David White, of Syapse Energy Economics, Cambridge MA, assisted in the analysis of the DSEIS and in the preparation of these comments.

III. The results of the modeling have produced unreasonable and counterintuitive results, suggesting that the model used is not sufficiently detailed and accurate for this task.

Another concern is whether a national all-purpose energy model like NEMS can fully capture the impacts of a new rail line for the transportation of Western coal. The approach used, reducing the overall transportation costs to certain regions, is admittedly an approximation. A more detailed and accurate modeling of the transportation network should result in different transportation cost savings and thus different changes in coal usage.

The results show the model to be lumpy and sometimes counter intuitive. Table 4-8 on page 4-25 of the DSEIS, for example, shows no change in the reference case national total generation from coal across four scenarios: the Low4pct, AEO2005, High4pct, and High7pct cases all have exactly 2,285 billion kilowatt-hours generated from coal in the year 2015. The results in that same table for the last year modeled, 2025, show a result that appears to be incorrect, or least counterintuitive and perplexing: that lowering the price of coal causes the amount of generation from coal to decrease. Specifically, the Low7pct case, surprisingly, shows coal generation to be 5 billion kilowatt-hours ***lower than*** the Low4pct case. This sort of result raises questions about the ability of the model to reasonably represent the effect of the DM&E coal train project upon US electric system.

The correspondence between STB and EIA (see Appendix F) also suggests that NEMS may not be an appropriate model to analyze the effect of the DM&E project. For example, the June 4 letter from Guy Caruso to Roger Nober, which states “Rail capacity is modeled generically, so the impacts of a particular rail line on coal transportation costs cannot be directly represented.”

IV. Aggressive Government Policies to limit carbon emissions are likely to be imposed relatively early in the life of the project, and should be taken into account in alternative projections of coal demand.

Government policies to limit the amount of carbon that may be emitted to the atmosphere are already being imposed by governments at state and local levels as well as globally.[8] It is possible to predict, within a reasonable range, the costs that are likely to occur in the future in order to meet carbons constraints such as carbon caps or carbon taxes.[9] In this context, it is imprudent for decision makers to ignore the cost of future carbon reductions.[10]

Future carbon policies will affect coal usage. That is, in part, their intent. Carbon policies to address climate change can be expected to affect the projections of coal usage and coal prices in the context of this DSEIS. To the extent that the EIA's NEMS reference case does not include a carbon policy and its effect on the development of energy resources in the US, that reference case is unrealistic. In a corrected, more reasonable, reference case, the carbon policy would influence the type, timing, and location of new generating capacity as well as the amount of energy efficiency and clean resources that will be built and operated. These will obviously influence the amount of coal that this line can be expected to carry over

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8 See Attachment 1, Synapse Energy Economics, Inc, “Taking Carbon into account in Utility Planning: Zero is the Wrong Carbon Value.” at pp. 7-16.

9 Id. at pp. 16-33.

10 Id. at p. i.

its lifetime, the incremental amount of coal coming from PRB, and the development of renewable energy (and other sources) that would ace the electricity that would otherwise be generated by that coal. Because such a scenario can be predicted within a reasonable range, it should be analyzed in the DSEIS.

Respectfully submitted,

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ATTORNEY FOR MIINNESOTANS FOR AN ENERGY-EFFICIENT ECONOMY A AND MINNESOTA CENTER FOR ENVIRONMENTAL ADVOCACY

ATTACHMENT 1

Synapse
Energy Economics, Inc.

Taking Climate Change in Electric Resource Planning: Zero is the Wrong Carbon Value

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Revision 1
June 4, 2005

Executive Summary

The earth's climate is determined by concentrations of greenhouse gases in the atmosphere. International scientific consensus, expressed in the Third Assessment Report of the Intergovernmental Panel on Climate Change, is that climate will change due to anthropogenic emissions of greenhouse gases. Projected changes include temperature increases, changes in precipitation patterns, increased climate variability, melting of glaciers, ice shelves and permafrost, and rising sea levels. These changes have already been observed and documented in a growing body of scientific evidence. All countries will experience social and economic consequences, with disproportionate negative impacts on 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 of industrialized nations and economies in transition. Despite being the single largest contributor to global emissions of greenhouse gases, the United States remains one of a very few industrialized nations that have not signed the Kyoto Protocol. Nevertheless, individual states, regional groups of states, shareholders and corporations are making serious efforts and taking significant steps towards reducing greenhouse gas emissions in the United States. Efforts to pass federal legislation addressing carbon, though not yet successful, have gained ground in recent years. These developments, combined with the growing scientific understanding of, and evidence of, climate change, mean that establishing federal policy requiring greenhouse gas emission reductions is just a matter of time.

In this scientific and policy context, it is imprudent for decision-makers in the electric sector to ignore the cost of future carbon reductions or to treat future carbon reduction merely as a sensitivity case. Treating carbon emissions as zero cost emissions could result in investments that prove quite costly in the future.

Regulatory uncertainty associated with climate change clearly presents a planning conundrum; however, it is not a reason for proceeding as if no costs will be associated with carbon emissions in the future. The challenge is to forecast a reasonable range of expected 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 reduction requirements. Available sources include market transactions, values used in utility planning, and modeling analyses.

Carbon markets associated with implementation of the Kyoto Protocol as well as voluntary emissions reductions have emerged. In the carbon markets, carbon traded in January 2005 at a range of $30-63/metric ton carbon ($8-17 per ton CO_2).

Some electric utilities in the United States are already incorporating carbon values into their resource planning. The values range from $4-44/metric ton carbon ($1-12 per ton CO_2). In December 2004, the California Public Utilities Commission directed utilities to include carbon at a value between $30-93/metric ton carbon ($8-25 per ton CO_2) in their long term resource planning.

There are numerous studies that estimate the possible costs of carbon allowances under various policy scenarios, many of which are identified in this report. Projections of carbon costs for the year 2010 range from $4/metric ton carbon to $401/metric ton carbon

(\$1 and \$99/ton CO_2) under different policy scenarios. Projections for carbon costs between 2020-2025 range from \$27/metric ton carbon to \$486/metric ton carbon (\$7 and \$120/ ton CO_2). Modeling results are sensitive to several factors including (1) the emissions reduction target; (2) projections of future emissions in the absence of a greenhouse gas reduction target; (3) geographic scope of trading; and (4) flexibility mechanisms such as offsets and allowance banking.

The sensitivity of the carbon price levels to the emissions reduction target can be seen by grouping the results for 2010 into two groups based upon the level of the target. For studies that analyze the costs associated with returning to the emissions levels of the year 2000 by the year 2010 or thereabouts, costs in 2010 are projected to be between \$4/metric ton carbon and \$179/metric ton carbon (\$1/ton CO_2 and \$44/ton CO_2). Studies that analyze the costs associated with a somewhat more aggressive goal of reducing emissions to near 1990 levels reveal costs in 2010 between \$4/metric ton carbon and \$401/metric ton carbon (\$1/ton CO_2 and \$99/ton CO_2).

These sources of information permit a broad assessment of potential carbon allowance prices. Indeed, incorporating reasoned assessment of future costs associated with greenhouse gas emissions is likely to be an increasingly important component of corporate success.

Table of Contents

1. Introduction

A 2002 report from the investment community identifies climate change as representing a potential multi-billion dollar risk to a variety of U.S. businesses and industries.[11] 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 emission from large point sources (such as power plants) is easier 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 substantial 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
- Growing pressure from customers and shareholders to address emissions contributing to climate change.[12]

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.[13] Participants in this dialogue found that greenhouse gas emissions, including carbon dioxide emissions, will be regulated in the U.S.; 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."[14] 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.

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. Even under conservative scenarios, additional costs

[11] Innovest Strategic Value Advisors; "Value at Risk: Climate Change and the Future of Governance;" The Coalition for Environmentally Responsible Economies; April 2002.
[12] Ibid., pages 45-48.
[13] CERES; "Electric Power, Investors, and Climate Change: A Call to Action;" September 2003.
[14] Ibid., p. 6

could exceed 10 percent of 2002 earnings, though there are also significant opportunities. While utilities and non-utility generation owners have many options to deal with the impact of increasing prices on CO_2 emissions, doing nothing is the worst option. By making astute changes to the fuel mix and investments to refurbish existing assets, profits may also increase.[15]

Increased air emissions from fossil-fired power plants will not only increase environmental damages, they will also increase the costs of complying with future environmental regulations, costs that are likely to be passed on to all customers. Power plants built today can generate electricity for as long as 60 years or more into the future.[16]

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 be including carbon cost in all resource planning.

The purpose of this report is to identify a reasonable basis for evaluating the likely cost of future mandated carbon reductions for use in long-term resource planning decisions. Section 2 and 3 discuss the role of greenhouse gases in climate. Section 4 presents information on U.S. carbon emissions. Section 5 describes international efforts to address the threat of climate change. Section 6 summarizes various initiatives at the state, regional, and corporate level to address climate change. Finally, section 7 presents information that can form the basis for forecasts of carbon allowance prices for use in utility planning.

2. The earth's climate is determined by concentrations of greenhouse gases in the atmosphere.

The earth's atmosphere serves as a kind of greenhouse. Radiation from the sun passes through the atmosphere, is absorbed by the earth, and is converted to heat. The heat causes the emission of long wave radiation back to the atmosphere. Concentrations of certain gases in the atmosphere determine how much of the long wave radiation escapes through the atmosphere. These gases are known as "greenhouse gases"; they include carbon dioxide, methane, nitrous oxide and others. Such gases have always been part of the atmosphere; however, since the industrial revolution in the 1700's concentrations of

[15] Innovest Strategic Value Advisors; "Power Switch: Impacts of Climate Change on the Global Power Sector;" WWF International; November 2003

[16] Biewald et. al.; "A Responsible Electricity Future: An Efficient, Cleaner and Balanced Scenario for the U.S. Electricity System;" prepared for the National Association of State PIRGs; June 11, 2004.

greenhouse gases in the atmosphere have risen, gradually at first and steeply since about 1850. These rising levels are due to human activities such as burning fossil fuels, deforestation, and others. Greater concentrations of greenhouse gases reduce the amount of heat that passes through the atmosphere, leading to warming of the earth (Global Warming). This warming can also cause associated changes in the earth's climate (Climate Change).

3. The earth's climate is changing due to human activities

International scientific consensus is that the world is warming, the climate system is changing in other ways, and that most of the warming observed over the past 50 years is due to human activities (primarily fossil fuel combustion).[17] For more than twenty years scientists from around the world have studied the potential effects on climate of the change in atmospheric greenhouse gas concentrations. These efforts are described in the next section of this report. In the past 15 years scientific consensus has emerged that increasing concentrations of greenhouse gases in the atmosphere will lead to a general warming of the earth's climate, that this general warming pattern can distort natural patterns of climate, and – most recently – that there is ample evidence that global warming is occurring.

While there are sporadic reports and articles disputing climate change, denying human contributions to climate change, or stating that global warming and climate will bring benefits, these viewpoints are outside the scientific mainstream. "Among those with the training and knowledge to penetrate the relevant scientific literatures, the debate about whether global climate is now being changed by human-produced greenhouse-gases is essentially over. Few of the climate-change "skeptics" who appear in the op-ed pages of *The Washington Times* and *The Wall Street Journal* have any scientific credibility at all."[18]

The scientific consensus is expressed in a report issued in 2001 by the Intergovernmental Panel on Climate Change (IPCC). The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the IPCC in 1988. The purpose of the IPCC is to serve as an objective source of the most widely accepted scientific, technical and socio-economic information available about climate change, its environmental and socio-economic impacts including costs and benefits of

[17]Y. Ding, J.T. Houghton, et al. editors, Climate Change 2001: The Scientific Basis (Contribution of Working Group I to the Third Assessment Report of the IPCC). Intergovernmental Panel on Climate Change. 2001. Available at: http://www.grida.no/climate/ipcc_tar/wg1/index.htm

[18] Professor John P. Holdren, "Risks from Global Climate Change. What do we know? What should we do?" Presentation to the Institutional Investors Conference on Climate Risk, November 21, 2003.

action versus inaction, and possible response options. These international organizations determined that, because the stakes are so high and the system complex, policymakers cannot rely on popular interpretations of the evidence or on the views of an individual expert. The Panel does not conduct new research or monitor climate-related data. Its mandate is to assess, on a comprehensive, objective, open and transparent basis, the scientific, technical and socio-economic information on climate change that is available around the world in peer-reviewed literature, journals, books and, where appropriately documented, in industry literature and traditional practices. Hundreds of scientists from around the world participate in preparing the IPCC's periodic reports.[19]

The first IPCC report, issued in 1990, confirmed that climate change is a threat and served as the basis for negotiating the overall framework for intergovernmental efforts to address climate change-the United Nations Framework Convention on Climate Change (UNFCCC).[20] The Second Assessment Report, Climate Change 1995, provided key input to the negotiations that led to the adoption of the Kyoto Protocol to the UNFCCC in 1997. The Third Assessment Report, described below, was issued in 2001. The Fourth Assessment Report is anticipated in 2007.

In 2001 the IPCC issued its Third Assessment Report (TAR). The Report reaches a number of important conclusions regarding forecasted and observed climate change. The TAR states that:

The earth's climate will change:

- Climate will change more rapidly than previously expected.
- Global mean surface temperatures are projected to increase by 1.4–5.8 degrees C by 2100 (the fastest rate of change since end of the last ice age).
- Global mean sea levels are expected to rise by 9–88 cm by 2100.
- Rainfall patterns will change.
- Variability of the climate will increase—resulting in greater threat of extreme weather events.
- Extreme events that are likely to increase include maximum temperatures, precipitation events, drying and drought, cyclone intensity, and precipitation intensities.
- There is a possibility of threshold events and irreversible events (changing Gulf Stream, collapse of large ice sheets, and others)exists
- Stopping growth in greenhouse gas emission concentrations is expected to lead to different equilibrium temperatures, depending on the stabilization level. For example, stabilization of atmospheric greenhouse gas concentrations at 450ppm is likely to lead to equilibrium

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[19] Intergovernmental Panel on Climate Change, "Introduction to the Intergovernmental Panel on Climate Change." 2003 edition. Available at www.ipcc.ch/about/beng.pdf. See also, "16 Years of Scientific Assessment in Support of the Climate Convention." IPCC. December 2004. Available at http://www.ipcc.ch/about/anniversarybrochure.pdf

[20] The United States ratified the UNFCC in 1992.

temperature increases from 1990 levels of between 1.5 ^{o}C and 3.9 ^{o}C. Stabilization at 1000ppm is would lead to equilibrium temperature increases from 1990 levels of 3.5 ^{o}C and 8.7 ^{o}C. Stabilization at these levels requires a reduction from 1990 emission levels within a few decades or two centuries, respectively. The greater the global temperature rise, the greater will be the impacts on climate as a whole, not just temperatures.

Climate change is already evident

- Global average surface temperature has increased 0.6^{o}C (±0.2°C) in the last century.
- The 1990s was the warmest decade and 1998 the warmest year in the instrumental record, which began in 1861.
- Snow cover and ice extent, both polar and in glaciers, have decreased.
- Global average sea level has risen.
- Most of the warming observed over the last 50 years is attributable to human activities.
- Other aspects of climate that have changed in certain areas of the globe include increased precipitation, increased frequency of heavy precipitation events, increase in cloud cover, and increases in the frequency and intensity of droughts in parts of Asia and Africa.
- Observed changes in regional climate have affected many physical and biological systems, and there are preliminary indications that social and economic systems have been affected.

Climate change will lead to greater cost and suffering than benefits. Poorer people and countries are the most vulnerable.

- Humans will be directly affected by climate. Increasing rain, temperature, storms, and climate variability will all affect individual lives as well as socio-economic systems.
- Humans will be indirectly affected by climate change through changes in ranges of disease, water-borne pathogens, water quality, and air quality.
- Humans will be affected by changes in food availability and quality, crop yields, water shortages and disruption of ecosystems.

Since the release of the IPCC's Third Assessment Report in 2001, additional scientific evidence has provided further evidence of global warming. Last year, 2004, was the fourth warmest year in the temperature record since 1861 just behind 2003. 1998 is the warmest year. With the exception of 1996, the years from 1995-2004 were among the warmest 10 years on record.[21] NASA has determined that 2004 was the fourth-warmest year since temperature

[21] World Meteorological Organization, "Global Temperature in 2004 Fourth Warmest," December 15, 2004. Press release on occasion of WMO annual Statement on the Status of the Global Climate in 2004.

measurement began in the 19th century, marked by particularly warm weather in Alaska, the Caspian Sea region and the Antarctic Peninsula. According to NASA, last year's temperatures continued a 30-year rise that is caused primarily by increasing greenhouse gases in the atmosphere.[22] Other reports indicate that:

- The percentage of Earth's land area stricken by serious drought more than doubled from the 1970s to the early 2000s.[23]
- The arctic is warming almost twice as fast as the rest of the world.[24]
- Storm & flood damages are soaring.[25] While some of this is known to be due to increasing construction in flood plains and beach fronts, insurers more and more frequently identify climate change as a major risk factor in property damage.

Other observed changes include: evaporation and rainfall are increasing; more of the rainfall is occurring in downpours; permafrost is melting; corals are bleaching; glaciers are retreating; sea ice is shrinking; sea level is rising; and wildfires are increasing.[26]
Taken together, the TAR, and subsequent scientific analyses indicate a clear pattern of global warming and on-going climate change. According to results of climate modeling, these changes are only the beginning of things to come. The TAR emphasizes that decision making "has to deal with uncertainties including the risk of non-linear and/or irreversible changes, entails balancing the risks of either insufficient or excessive action, and involves careful consideration of the consequences (both environmental and economic), their likelihood, and society's attitude towards risk."[27]

4. U.S. carbon emissions.

The United States contributes more, by far, to global greenhouse gas emissions than any other nation on both a total and a per capita basis. The United States

[22] NASA Global Temperature Trends: 2004 Summation. Released February 8, 2005. Available at: http://www.nasa.gov/vision/earth/lookingatearth/earth_warm.html
[23] National Center for Atmospheric Research – National Science Foundation, "Climate change major factor in drought's growing reach" January 10, 2005 press release.
[24] Arctic Council – "Impacts of a Warming Arctic – Arctic Climate Impact Assessment" November 2004.
[25] See, e.g. Munich Re, *Topics Geo*, "Annual Review of Natural Catastrophes 2003," stated that economic losses due to natural hazards in 2003 rose to over $65 billion (up from $55 billion in 2002).
[26] The Natural Resources Defense Council has a useful compilation of scientific studies organized by date at www.nrdc.org/globalWarming/
[27] IPCC; "Climate Change 2001: Synthesis Report – Summary for Policy Makers;" 2001. Page 3.

contributes 23 percent of the world CO_2 emissions from fossil fuel consumption, but has only 4.6 percent of the population.

Table 2: U.S. Population and CO_2 emissions for 2002

	World		United States
CO_2 Emissions (million metric tons)	24,533		5,749
U.S. percentage of world emissions		23.4%	
Population	6,417,784,929		287,941,220
U.S. percentage of world population		4.5%	
Per capita CO_2 emissions	3.93		19.97

Sources: EIA International Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels 1980-2002, 2004;[28] *US Census Bureau population estimate for 2002.*

In 2002 the U.S. electric sector emitted 2,256.4 million metric tons CO_2.[29] These emissions represent 39 percent of U.S. total CO_2 emissions. Coal-fired power plants were responsible for 83 percent of US electric sector emissions.

Recent analysis has shown that in 2002, power plant CO_2 emissions were 25 percent higher than they were in 1990.[30] Furthermore, while the carbon intensity of the U.S. economy fell by 12 percent between 1991 and 2002, the carbon intensity of the electric power sector held steady. 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 air 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 NOx and CO_2 emissions, and nearly 40 percent of its SO2 and mercury emissions.

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[28] EIA Table H.1co2 World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1980-2002 (posted June 9, 2004).

[29] EIA; "Emissions of Greenhouse Gases in the United States 2003;" Energy Information Administration; December 2004. Table 11.

[30] Goodman, Sandra; "Benchmarking Air Emissions of the 100 Largest Electric Generation Owners in the U.S. - 2002;" CERES, Natural Resources Defense Council (NRDC), and Public Service Enterprise Group Incorporated (PSEG); April 2004.

5. Governments worldwide have agreed to respond to climate change by reducing greenhouse gas emissions

The prospect of global warming and associated climate change has triggered one of the most comprehensive international treaties on environmental issues.[31] 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.

The United Nations Framework Convention on Climate Change has almost worldwide membership (including the U.S.); and, as such, is one of the most widely supported of all international environmental agreements. Parties to this Convention agree 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."[32] The Convention establishes an objective and principles, and includes commitments for different groups of countries according to their circumstances and needs.[33] Industrialized nations and Economies in Transition, known as Annex I countries in the UNFCCC, agree to adopt climate change policies to reduce their greenhouse gas emissions. 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.

After over two years of negotiations through the Conference of Parties (COP), 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.[34] The Protocol also includes various

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[31] For comprehensive information on the UNFCC and the Kyoto Protocol, see UNFCC, "Caring for Climate: a guide to the climate change convention and the Kyoto Protocol," issued by the Climate Change Secretariat (UNFCC) Bonn, Germany. 2003. This and other publications are available at the UNFCCC's website: http://unfccc.int/.

[32] From Article 3 of the United Nations Framework Convention on Climate Change.

[33] For example, one of obligations of the U.S. and other industrialized nations is to submit National Report describing actions it is taking to implement the Convention

[34] Greenhouse gases covered by the Protocol are CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.

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 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 February 2005.[35] 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 U.S. 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. Still others have already demonstrated success in addressing climate change.

Table 1: Emission reduction targets under the Kyoto Protocol[36]

Country	**Target**: reductions from 1990** levels by 2008/2012
EU-15*, Bulgaria, Czech Republic, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia, Switzerland	-8%
US***	-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 EITs have a baseline other than 1990.*

**** The US and Australia have indicated their intention not to ratify the Kyoto Protocol.*

[35] 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.

[36] Background information at: ttp://unfccc.int/essential_background/kyoto_protocol/items/3145.php

6. State governmental agencies, shareholders, and corporations are working to reduce greenhouse gas emissions from the U.S.

The Federal Government in the United States has failed to act with regard to climate change, despite compelling scientific consensus and this country's disproportionate contribution to greenhouse gas emissions. There have been some initiatives at the federal level to adopt carbon reduction goals; however they have not yet had sufficient support within the Administration and Congress. Landmark legislation that would regulate carbon was introduced by Senators McCain and Lieberman in 2003 -- the Climate Stewardship Act (S.139). This legislation received 43 votes in the Senate in 2003. A companion bill was introduced in the House by Congressmen Olver and Gilchrest. The bill was reintroduced in the 109th Congress on February 10, 2005, and other legislative initiatives on climate change are also under debate in the Spring of 2005. As currently proposed, the Act would create a national cap and trade program to reduce CO_2 to year 2000 emission levels over the period 2010 to 2015. Legislation proposed by the Bush Administration, that would set a national cap on emissions of sulfur dioxide, nitrogen oxides, and mercury (titled "Clear Skies"), has met with stiff resistance due to its failure to address carbon dioxide.

As of February 16, 2005, when the Kyoto Protocol went into effect, U.S.-based companies that have subsidiaries in the EU are "subject to CO_2 emissions caps, but cannot take advantage of low-cost emission reductions at their facilities in the United States or elsewhere."[37] American companies that are consequently disadvantaged in the EU may start to put pressure on the Administration for a national greenhouse gas policy.

Some individual states and regions, however, are leaders on this policy issue and are adopting greenhouse gas mitigation policies. Many corporations are also taking initiative in the form of shareholder resolutions and corporate policies, in anticipation of mandates to reduce emissions of greenhouse gases. These efforts are described below.

6.1 State and regional policies

In the absence of Federal initiative on climate change, individual states in this country have been the leaders on climate change policies:

- In 1997 **Oregon** established the first formal standard for CO_2 emissions from new electricity generating facilities in North America.[38] The standard holds any proposed new or expanded

[37] Fontaine, Peter, "Greenhouse –Gas Emissions: A New World Order," Public Utilities Fortnightly, February 2005.
[38] Anne Egelston, "Oregon, Massachusetts Lead the Way in GHG Reductions," *Environmental Finance*, July-August 2001.

power plant to a CO_2 emissions rate of 0.675 pounds per kWh, which is 17 percent less than the most efficient natural gas-fired plant currently operating in the U.S. At the same time, the state also created a non-profit corporation known as the Climate Trust to implement CO_2 offset projects with funds provided by the electric generating industry. A generator can choose to either meet the emissions standard or donate funds to the Climate Trust. The donation level was originally set at $0.57 per ton of CO_2, but is subject to change based on the actual cost of CO_2 offsets.

- In 2001 **Massachusetts** was the first state to establish a cap on CO_2 emissions from fossil fueled power plants. The Massachusetts Department of Environmental Protection issued "Emissions Standards for Power Plants" (310 CMR 7.29) in April 2001. This multi-pollutant legislation requires emission reductions including CO_2 reductions from the six highest emitting power plants in the state. The CO_2 standard of 1,800 lbs/MWh by 2006 represents a 10 percent reduction from the historic baseline (1997-1999). Facilities are allowed to meet their reduction requirements through offsite CO_2 reductions, subject to DEP approval. The compliance deadline is extended to October 2008 for any facility that undergoes repowering. In addition to this legislation, the state's Energy Facilities Siting Board requires *new* power plants with a capacity greater than 100 MW to offset 1 percent of the facility's CO_2 emissions for the next 20 years, as long as the cost of offsets does not exceed $1.50 per ton.
- In July 2002, **California** adopted a first-of-a-kind law (AB 1493) to limit the emissions of CO_2 from new cars and trucks sold in the state. The law requires the California Air Resources Board to write regulations to achieve the maximum feasible reduction in CO_2 emissions from cars and trucks, beginning with the 2009 model year. Since that time, New York, New Jersey, Rhode Island, Connecticut, Massachusetts, Maine, and Vermont have each agreed to adopt this standard. An Executive Order in June 2005 calls for reducing the state's emissions of greenhouse gases to 2000 levels by 2010, 1990 levels by 2020, and 80 percent below 1990 levels by 2050.
- The **New Hampshire** "Clean Power Act" (HB 284), approved in May 2002, requires CO_2 reductions from the three existing fossil-fuel power plants in the state. The law requires the plants to stabilize their CO_2 emissions at 1990 levels (approximately three percent below their 1999 levels) by the end of 2006. This CO_2 emission reduction is consistent with the Climate Change Action Plan adopted by the New England Governors and Eastern Canadian Premiers (see below). Plants have the option to reduce their emissions on site or to purchase emissions credits from outside of the state.
- In **New Jersey**, the Department of Environmental Protection released the New Jersey Sustainability Greenhouse Gas Action Plan in April 2000. The Plan provides a framework for reducing

greenhouse gas emissions to 3.5 percent below their 1990 levels by 2005. Under the Plan, Public Service Enterprise Group, the state's largest utility, pledged to reduce total emissions from all of its fossil fuel-based plants by 15 percent below 1990 levels by 2005. This would require its fossil fuel-fired units to limit their CO_2 emissions to 1450 lbs/MWh in 2005, compared to 1706 lb/MWh in 1990. If PSEG fails to achieve the goal, it must pay the DEP $1 per pound/MWh it falls short of its goal, up to $1.5 million. The fund will be used to support CO_2 reduction projects within New Jersey.

- The state of **Washington** recently passed a law requiring that new power plants either mitigate or pay for a portion of their carbon emissions. Representative Jeff Morris, the bill's primary sponsor, said "Washington State is not going to solve global warming, but we are doing our part." [39]
- The **New York** Greenhouse Gas Task Force was created by Governor Pataki in June 2001. The purpose of the Task Force is to develop recommendations for ways to significantly reduce the state's emissions of greenhouse gases, and New York is currently considering whether to adopt the recommendations of the Greenhouse Gas Task Force. The 2002 State Energy Plan also recommends that the state commit to a goal of reducing greenhouse gas emissions by five percent below 1990 levels by 2010, and 10 percent below 1990 levels by 2020.[40]
- In addition to the regulations and programs described above, 25 states are working with the U.S. Environmental Protection Agency ("EPA") to develop **climate action plans** that identify cost-effective options for reducing greenhouse gas emissions at the state level. At least 19 states have completed an action plan to date.
- Many states have other policies such as renewable portfolio standards and energy efficiency programs that serve to reduce CO_2 emissions from the electricity sector; and many state energy plans and initiatives cite greenhouse gas mitigation as a policy rationale or specific objective.

Action by individual states has been enhanced by several regional initiatives to reduce greenhouse gas emissions:

- **Nine Northeast and Mid-Atlantic states** (DE, ME, MA, NH, NJ, NY, RI, VT) have formed "The Regional Greenhouse Gas Initiative" (RGGI) in a cooperative effort to discuss the design of a regional cap-and-trade program initially covering CO_2 emissions from power plants in the region. Collectively, these states contribute to 9.3

[39] Washington House of Representatives Press Release, *Governor Signs Morris Bill to Clean Up Air Pollution,* March 31, 2004.
[40] New York State Energy Research and Development Authority, *2002 State Energy Plan and Final Environmental Impact Statement*, June 2002.

percent of total US CO_2 emissions and together rank as the fifth highest CO_2 emitter in the world. Pennsylvania, Maryland, the District of Columbia, the Eastern Canadian Provinces, and New Brunswick are official "observers" in the RGGI process. The states are discussing adoption of a Memorandum of Understanding and a Model Rule in 2005. In this process, CO_2 emissions from fossil fuel fired electricity generating units will be capped at specific levels.[41]

- In September 2003, the Governors of **California, Washington, and Oregon** established the West Coast Governor's Climate Change Initiative, stating that "global warming will have serious adverse consequences on the economy, health, and environment of the west coast states, and that the states must act individually and regionally to reduce greenhouse gas emissions and to achieve a variety of economic benefits from lower dependence on fossil fuels."[42] Emissions in these three states are comparable to those of the RGGI states. RGGI and the West Coast Governors' Initiative have been communicating with regard to potentially linking their cap and trade programs.[43]
- The Governors of **California** and **New Mexico** proposed that 18 western states generate 30,000 MW of electricity from renewable source by 2015. This proposal was unanimously adopted in June 2004.[44]
- In July 2004, **California, Connecticut, Iowa, New Jersey, New York, Rhode Island, Vermont, and Wisconsin** filed a suit against five power plant owners, which together, emit 10 percent of the nation's annual CO_2. This suit seeks CO_2 emissions reductions of three percent per year for the next ten years rather than financial penalties.[45]
- In August 2001, in the first action of its kind in North America, the **New England Governors and Eastern Canadian Premiers** signed an agreement for a comprehensive regional Climate Change Action Plan.[46] The plan centers on three main goals. The short-term goal of the Plan is to reduce regional greenhouse gas emissions to 1990

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[41] Information on this effort is available at www.rggi.org

[42] See letter from the California Energy Commission and the California Environmental Protection Agency to interested parties, April 16, 2004, at: ttp://www.energy.ca.gov/global_climate_change/westcoastgov/.

[43] Fontaine, Peter, "Greenhouse –Gas Emissions: A New World Order," *Public Utilities Fortnightly*, February 2005.

[44] Jacobson, Sanne, Neil Numark and Paloma Sarria, "Greenhouse – Gas Emissions: A Changing US Climate," *Public Utilities Fortnightly*, February 2005.

[45] Id.

46 New England Governors and Eastern Canadian Premiers, *Climate Change Action Plan: 2001*, August 2001.

levels by 2010. The mid-term goal is to reduce regional GHG emissions by at least 10 percent below 1990 levels by 2020, and establish an interactive, five-year process, starting in 2005, to adjust the goals if necessary and set future emission reduction goals. The long-term goal of the Plan is to reduce regional greenhouse gas emissions in proportions consistent with reductions necessary worldwide to eliminate any dangerous threat to the climate, which recent science suggests will require reductions of 75-85 percent below current levels. The Plan also provides for the establishment of a regional standardized inventory and registry of greenhouse gas emissions.

Actions by cities: Many cities are also adopting climate change policies. The Cities for Climate Protection Campaign (CCP), begun in 1993, is a global campaign to reduce the emissions that cause global warming and air pollution. By 1999, the campaign had engaged more than 350 local governments in this effort, who jointly accounted for approximately seven percent of global greenhouse gas emissions.[47] Over 150 cities in the U.S. have adopted plans and initiatives to reduce emissions of greenhouse gases, setting emissions reduction targets and taking measures within municipal government operations. Climate change is expected to be a major issue at the annual U.S. Conference of Mayors convention in June.[48]

All of these recent activities demonstrate that there has been growing pressure within the U.S., to adopt regulations to reduce the emissions of greenhouse gases, particularly CO_2. This pressure is likely to increase further over time, as climate change issues and measures for addressing them become better understood by the scientific community, by the public, and particularly by elected officials.

6.2 Investor and corporate action

Investors and corporate leaders have taken steps to manage risk associated with climate change and carbon policy. Many investors are 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 production, real estate firms, manufacturers, financial institutions and auto makers.[49] The resolutions request financial risk disclosure and plans to reduce greenhouse gas emissions. Four electric utilities-AEP, Cinergy, TXU and Southern-all agreed to shareholder

[47] Information on the Cities for Climate Protection Campaign, including links to over 150 cities that have adopted greenhouse gas reduction measures, is available at http://www.iclei.org/projserv.htm#ccp

[48] Kathy Mulady, *Seattle Post-Intelligencer*, Feb. 17, 2005.

[49] "US Companies Face Record Number of Global Warming Shareholder Resolutions on Wider Range of Business Sectors," CERES press release, February 17, 2005.

requests in 2004 by promising climate risk reports. Only Southern's report has yet to be completed.

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. State and city treasurers, labor pension fund officials, and foundation leaders have formed the Investor Network on Climate Risk (INCR). The INCR issued a 10-point "Call for Action" at the Institutional Investor Summit on Climate Risk at the United Nations Headquarters on Nov. 21, 2003. It urges pension and endowment trustees, fund managers, securities analysts, corporate directors and government policymakers to increase their oversight and scrutiny of the investment implications of climate change.[50] This report cites analysis indicating that carbon constraints affect market value - with modest greenhouse gas controls reducing the market capitalization of many coal-dependent U.S. electric utilities by 5 to 10 percent, while a more stringent reduction target could reduce their market value 10 to 35 percent.[51] 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 coordinating secretariat for collaboration regarding climate change. 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. In 2003, the first Carbon Disclosure Project report (CDP1) gathered the support of 35 institutional investors representing some $4.5 trillion in managed assets.

The release of the second report (CDP2), in 2004, reflected even greater participation with signatories from Africa, Asia, Europe and North America. Signatories now represent over $10 trillion in assets, and total emissions from operations reported to CDP across all sectors were roughly 13 percent of all emissions from fossil fuel combustion worldwide. The CDP2 report indicated the escalation in scope and awareness-on behalf of both signatories and respondents-can be traced to an increased sense of urgency with respect to climate risk and carbon finance in the global business and investment community. The report attributes this to developments over the past 18 months that have highlighted the social and economic costs of climate change and the

[50] 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.

[51] Cogan 2004, citing Frank Dixon and Martin Whittaker, "Valuing Corporate Environmental Performance: Innovest's Evaluation of the Electric Utilities Industry," New York, 1999.

risks and opportunities being created worldwide by emissions reduction policies.[52]

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.[53]

Some electric company CEO have determined that inaction on climate change issues is not good corporate strategy, and individual electric companies have also taken steps to reduce greenhouse gas emissions. Their actions reveal increasing initiative in the electric industry for addressing the threat of climate change and managing 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." [54] In addition, Cinergy has been quite vocal on its support of mandatory national carbon regulation. Cinergy's current target is to produce 5 percent below 2000 levels by 2010 – 2012. AEP has a similar target. FPL Group and PSEG are both aiming to reduce total emissions by 18 percent between 2000 and 2008.[55] The President of Duke Energy President urges a federal carbon tax, and states that Duke should be a leader on climate change policy.[56]

6.3 Carbon inventories

With increased attention to climate change issues comes an increasing desire and need to quantify and track greenhouse gas emissions. The California Climate Action Registry (the Registry) was established by the California Legislature as a non-profit voluntary registry for greenhouse gas (GHG) emissions.[57] The purpose of the Registry is to help companies and organizations with operations in the state to establish GHG emissions baselines against which any future GHG emission reduction requirements may be applied.

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[52] 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.

[53] *Greenwire*, February 16, 2005

[54] Jacobson, Sanne, Neil Numark and Paloma Sarria, "Greenhouse Gas Emissions: A Changing US Climate," *Public Utilities Fortnightly*, February 2005.

[55] Ibid.

[56] Paul M. Anderson Letter to Shareholders, March 15, 2005.

[57] The California Climate Action Registry (the Registry) was established by SB1771, with technical changes to the statute in SB527. SB 527 was signed by Governor Gray Davis on October 13, 2001, finalizing the structure for the Registry.

The Registry encourages voluntary actions to increase energy efficiency and decrease GHG emissions. Participants can record their GHG emissions inventory using any year from 1990 forward as a base year. The State of California promises its best efforts to ensure that participants receive appropriate consideration for early actions in the event of any future state, federal or international GHG regulatory scheme.

The Global GHG Register, launched in January 2004, is a web-based platform that allows companies to disclose their worldwide GHG emission inventories and reduction targets. It gives multinational companies the opportunity to show how much greenhouse gases their operations produce, and what they are doing about it.[58] Its structure is based on the California Climate Action Registry.[59] Other states in the U.S. have GHG registries including New Hampshire, Wisconsin, and New Jersey, and many states have registries under development.[60]

7. Many sources are available to inform a reasonable estimate of carbon emission reduction costs.

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 a carbon cost of $0 in planning decisions. 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 the primary elements of any regulatory plan. In this context and policy climate, utilities and non-utility generators must develop a reasoned assessment of the costs associated with potential required emissions reductions.
This is particularly important in an industry where capital stock has a lifetime of 30 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

58 For more information see: http://www.weforum.org/site/homepublic.nsf/Content/Global+Greenhouse+Gas+Register

59 California Climate Action Registry, "California Registry's Online Tool To Serve As Foundation for Global Greenhouse Gas Register," December 9, 2003 press release.

60 More information on state GHG registries is available at the Greenhouse Gas State Registry Collaborative (Northeast States for Coordinated Air Use Management). http://www.nescaum.org/Greenhouse/Registry/

decision to invest in or decommission large pieces of physical capital stock.[61] Failure to adequately assess market conditions, including the potential cost increases associated with likely regulation, poses a significant investment risk for utilities. It simply doesn't make sense for a company investing in plants in the electric sector, where capital costs are high and assets are long-lived, to ignore policies that are likely in the next twenty years.

Evidence suggests that a utility's overall compliance decisions will be more efficient if its strategy considers 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.[62] The study found that the total costs of a set of actions is less than a piecemeal approach, that plant owners will adopt different control strategies if they are aware of multiple pollutant requirements, and that combined SO_2 and carbon reduction options lead to further air emission reductions.[63] Similarly, in one of several studies on multi-pollutant strategies, the Energy Information Administration (EIA) found that using an integrated approach to NO_x, SO_2, and CO_2, is likely to lead to lower total costs than addressing pollutants one at a time.[64] 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 developed through scenario modeling.

7.1 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. Traded volumes in the EU ETS totaled approximately 600,000 tons of CO_2 in 2003, with prices ranging from about 5-13 euros per ton CO_2. Most of these trades were on a forward basis with payment on delivery.

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[61] Lempert, Popper, Resitar and Hart, "Capital Cycles and the Timing of Climate Change Policy." Pew Center on Global Climate Change, October 2002. page

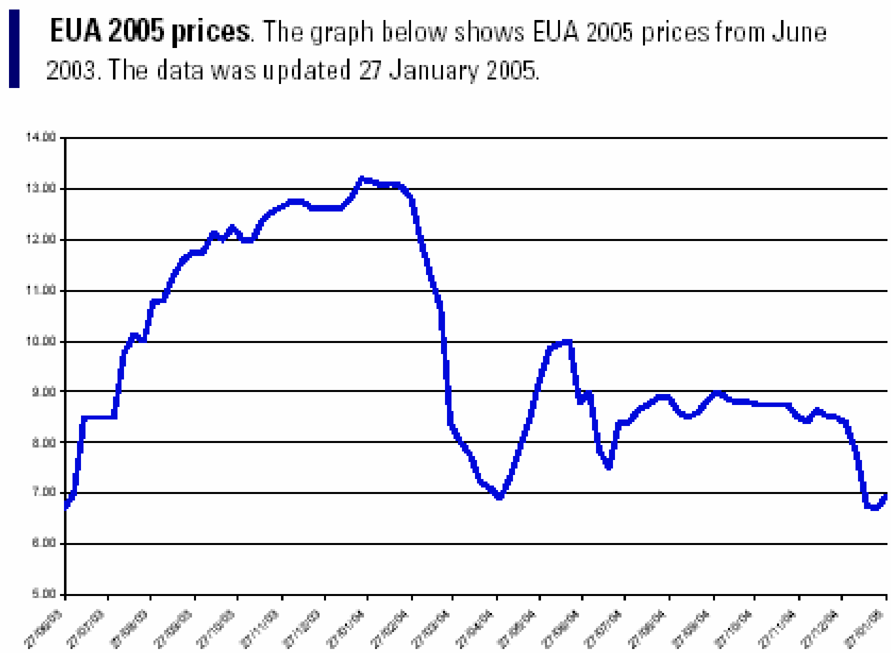
[62] US EPA, *Analysis of Emissions Reduction Options for the Electric Power Industry*, March 1999.

[63] US EPA, *Briefing Report*, March 1999.

[64] EIA, *Analysis of Strategies for Reducing Multiple Emissions from Power Plants: Sulfur Dioxide, Nitrogen Oxides, and Carbon Dioxide*. December 2000.

Trading volumes have increased steadily throughout 2004 and totaled approximately 8 million tons CO_2 in that year. [65]
Eight exchanges and 11 brokerages are planning to take active roles in the acceleration of the carbon market. One financial index for EU allowances (EUA) is called the Carbon Market Index. Figure 1 shows Carbon Market Index data as of January 27, 2005.

Figure 1. The Carbon Market Index for EU Allowances as of January 27, 2005 – Euros per ton CO_2.[66]



During the second half of 2004, carbon trades ranged between 6.75 to just over 13 euros per ton CO_2. This is equivalent to approximately $8–17 US. Volume in the carbon market is high-more than 5 million tons were traded in the month of January 2005 alone. Trading volume is most liquid in the near term (2005-2007), yet trades do exist out to the year 2008, priced at approximately 9 euros/ton CO_2 ($11.50 US). [67, 68]

[65] "What determines the Price of Carbon," Carbon Market Analyst, *Point Carbon*, October 14, 2004.
[66] Allan, Andrew, op. cit.
[67] Andrew, "Point Carbon to launch volume-wieghted EU ETS index," Carbon Market Europe, *Point Carbon*, January 28, 2005.
[68] Conversion as of February 9, 2005, wherein 1 Euro = 1.27 US dollars..

Table 3: Closing prices of CO_2 allowances as of January 27, 2005. [69]

Delivery Date	Last Price
EU 2005	€6.95
EU 2006	€6.98
EU 2007	€7.05

7.2 Values in utility planning

The concept of considering the possible costs of complying with greenhouse gas emission reduction targets is receiving renewed attention in electric company planning. Most recently, the California Public Utility Commission has directed utilities to determine an appropriate value, within an identified range, for purposes of long term planning. Several utilities have already included a value to reflect the financial risk of future carbon reduction requirements.

The California PUC has developed an imputed cost for GHG emissions, for use in long term utility planning.[70] The Commission's decision requires the state's largest electric utilities (PG&E, SCE, and SDG&E) to factor the financial risk associated with greenhouse gas emissions into new long-term power plant investments, and long-term resource plans. The Commission has told utilities to include a value between $8–25/ton CO_2 in their submissions, and to justify their selection of a number. In its decision, the Commission cites various estimates of carbon compliance costs submitted in the proceeding. The various estimates, ranging from $8/ton CO_2 in 2004 to a high of $36/ton CO_2 in 2020, are presented in Table 4, below.

Table 4: Values submitted to CPUC for CO_2 in long term planning

Name of source of	Value
Final E3 Avoided Cost Report	$8/ton C02 2004
	$12.50 by 2008
	$17.50 by 2013
PG&E internal RFO review	$8
PacifiCorp 2003 IRP -	$8
NRDC opening brief -	$12 beginning 2008
Idaho Power Co IRP -	$12.30 beginning 2008
EIA analysis of proposed legislation143	$15-$25 in 2010
	$14-$36 in 2020

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 U.S. carbon regulation policy. Table 5 illustrates the range of carbon cost values, both in $/metric ton C and $/ton CO_2, that are currently being used in

[69] Allan, Andrew, op. cit..
[70] California Public Utilities Commission, Decision 04-12-048, December 16, 2004

the industry for both resource planning and modeling of carbon regulation policies.

Table 5: CO_2 costs in long term resource plans[71]

Company	CO_2 emissions trading assumptions for various years	$/metric ton carbon
PG&E	$8/ton (2008)	$29
Avista	$1-11/ton (2004-2023)	$5-40
Portland's General Electric	$10/ton (2010)	$37
Xcel	$6-12/ton (2009)	$22-44
Idaho Power	$12.30/ton (2008). Also evaluated scenarios with carbon dioxide at $12.30 per ton and $49.21 per ton.	$45. Highest scenario is $180
Pacificorp – subsidiary of Scottish Power	$8/ton in 2003 IRP, also evaluated scenarios with carbon dioxide at $2, $25, and $40/ton.	$29 up to a high off $147

These early efforts by utilities lay the groundwork for the increased use of carbon value estimates in utility planning and in other elements of corporate strategy in the electric sector.

7.3 Analyses of carbon reduction costs

There have been several studies and analyses that project the cost of reducing carbon emissions to meet various emissions targets. Some of these analyses focus on the Kyoto Protocol, reviewing a 7 percent reduction from 1990 level emissions in the U.S. Other studies focus on the McCain Lieberman Bill as proposed in 2003, which would require that emissions levels in 2010 be the same as emissions levels in 2000 in the U.S. Another study is designed to analyze the impacts of allowance allocation methods, rather than to project carbon costs of a particular emissions reduction goal. These studies reveal a wide range of estimates. While it is not possible, given current uncertainties about the goal and design of carbon regulation, to pinpoint carbon reduction costs, the studies provide a useful source of information. In addition to establishing ranges of reduction cost, the studies give a sense of which factors affect future costs of reducing carbon emissions.
Table 6 presents results for several of these studies in $2004/metric ton Carbon. A similar table in $2004/ton CO_2 is contained in the Appendix to this report.

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[71] Wiser, Ryan and Mark Bolinger, *An Overview of Alternative Fossil Fuel Price and Carbon Regulation Scenarios*, Lawrence Berkeley National Laboratory, October 2004. See, also, PacificCorp, *Integrated Resource Plan 2003*, pages 45-46.,and Idaho Power Company, *2004 Integrated Resource Plan Draft*, July 2004, page 59.

Table 6: Estimates of U.S. Allowance Costs ($US2004/metric ton Carbon)

Study	2010 Emissions Goal	2010 Allowance Price Range	2020-2025 Allowance Price Range**
		$2004/metrictC	**$2004/metrictC**
SEMF -Rice 98	7% below 1990 levels 2008-2012	4-191	-
SEMF -Asia Pacific	7% below 1990 levels 2008-2012	48-85	-
SEMF -MS MRT	7% below 1990 levels 2008-2012	36-323	42-369
SEMF - Pacific Northwest	7% below 1990 levels 2008-2012	33-313	-
SEMF -MIT Emissions	7% below 1990 levels 2008-2012	137-325	-
EIA '98	24% above 1990 levels to 7% below 1990 levels 2008-2012	77-401	-
EIA ‘99	24% above 1990 levels to 7% below 1990 levels 2008-2012	71-364	-
ICF ‘04	1990 levels in 2010	47-50	79-84
Springer summary of 25 models*	Kyoto targets in 2010	4-324	-
EIA '03	2000 levels 2010, 1990 levels in 2016	43-93	167-314
EIA '04	2000 levels 2010 and beyond	58	113
MIT '03	2000 levels 2010 and beyond	19-184	61-500
Tellus ‘03	2000 levels 2010, 1990 levels 2016	27-31	58-85
Tellus ‘04	2000 levels 2010 and beyond	35	81
CRA	2000 levels starting 2010, with safety valve	17	17-28
EIA ‘03b	2001 emissions in 2013	4-70	27-143
ICF ‘04b	2000 levels in 2010	13	21
RFF***	6% reduction from BAU scenario, starting 2008	26-41	-

** Springer summary allowance prices are global rather than U.S.*
*** MIT '03, MS MRT, CRA, Tellus, results for 2020; EIA '03, EIA ‘03b, and ‘04 results for 2025.*
**** RFF results for 2012. Study focuses relative costs of allocation methods.*

The Stanford Energy Modeling Forum organized a comparative set of analyses, published in 1999, of the economics and energy sector impacts of the Kyoto Protocol on Climate Change.[72] The objectives of this study, were to (1) identify policy-relevant insights and analyses that are robust across a wide range of models, (2) provide explanations for differences in results from different models, and (3) identify priorities for future research. Nine teams of modelers participated in this effort. Each team ran the same four “core” scenarios, and also ran other scenarios that their models were well suited to explore. The four “core” scenarios were (1) a modeler’s reference case (assumptions determined by each team), (2) no emissions trading, (3) full Annex I trading, and (4) full

[72] International Association for Energy Economics, “The Costs of the Kyoto Protocol: A Multi-Model Evaluation,” *The Energy Journal*, 1999.

global trading. All of the “core” scenarios assumed that the Kyoto targets would be in place for 2010 and beyond.

The studies produced a wide range of estimates for the cost of meeting the Kyoto Protocol emissions reductions targets. This range is due to differing assumptions about the geographical scope of emissions trading as well as other elements of program implementation. The range of estimates is also due to features of the models. One of the major determinants of the cost of achieving reductions in each region in the reference case is the level of emissions projected in the reference case for each region. The variation in projected emissions stems from different assumptions about economic growth, fuel costs, capital stock turnover and other factors.

Most of the reference case runs project a 30 percent increase in U.S. carbon emissions from 1990 to 2010 (range is 21 percent-36 percent). The price projections range from $36-$180/metric ton carbon for scenarios with full global trading ($25/metric ton carbon to $125/metric ton carbon in 1990 dollars). Projections for “no trading” scenarios range from $108 to $585/metric ton carbon ($75-$405/metric ton carbon in 1990 dollars). Virtually all the teams were uncomfortable with the “full global trading” scenario since they considered it an unrealistic outcome of the negotiation process.

In 2003, Urs Springer of the University of St. Gallen in Switzerland compiled a summary of results from 25 models of the market for tradable greenhouse gas emission permits under the Kyoto Protocol.[73] Springer provides an overview of the results and methods used in the studies. Results (in USD2000) range from $1 to 22 per ton CO_2 under global trading scenarios where all countries have to meet Kyoto targets in 2010 (rather than on average between 2008 and 2012 – as in the Protocol). Results (in USD2000) range from $3 to $74 per ton CO_2 in scenarios with Annex B CO_2 trading only. (See, e.g. Tables 1 and 2.)

The United States Energy Information Administration (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.[74] In 1999 EIA performed a very similar study, but looked at phasing in carbon prices beginning in 2000 instead of 2005 as in the original study.[75]

There have also been several studies in the U.S. of the costs to comply with legislation proposed by Senators McCain and Lieberman. As originally proposed, the McCain Lieberman legislation would cap 2010 emissions at 2000 levels, and would reduce allowed emissions in 2016 to 1990 levels. In 2003, the Energy Information Administration conducted a study of the McCain

[73] Springer, Urs; “The Market for Tradable GHG Permits Under the Kyoto Protocol: a Survey of Model Studies;” *Energy Economics* 25 (2003) 527-551.

[74] EIA, “Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity,” October 1998. SR/OIAD/98-03

[75] EIA, “Analysis of the Impacts of an Early Start for Compliance with the Kyoto Protcol,” July 1999. SR/OIAF/99-02.

Lieberman legislation. EIA ran several sensitivity cases exploring the impact of technological innovation, gas prices, allowance auction, and flexibility mechanisms (banking and international offsets). The current version of the legislation would cap emissions in 2010 at 2000 levels, with no further ratchet. EIA conducted a further analysis of the McCain Lieberman legislation in comparison with the Administration's Clear Skies Act and the Clean Air Planning Act of 2003.[76] The Clean Air Planning Act would cap 2013 emissions at 2001 levels.

The Massachusetts Institute of Technology also analyzed potential costs of the McCain Lieberman legislation in 2003. 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, MIT 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 Climate Stewardship Act and the Climate Stewardship Act Amendment (July 2003 and June 2004).[77] In its analysis of the Climate Stewardship Act, Tellus relied on a modified version of NEMS to model all sectors with Base Case using data from 2003. 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" includes a more aggressive oil savings policy that would start at 25 mpg in 2005, increasing to 45 mpg in 2025.

In 2003 ICF was retained by the state of Connecticut to model a carbon cap across the 10 northeastern states. This analysis modeled a carbon cap on electrical generation in a ten-state region in the Northeastern U.S. The cap is set at 1990 levels in 2010, 5 percent below 1990 levels in 2015, and 10 percent below 1990 levels in 2020. The use of offsets is phased in with entities able to offset 5 percent or their emissionsin 2015 and 10 percent in 2020. The CO_2 allowance price, in $US2003, for the 10-state region increases over the forecast period in the policy case, rising from $7.38/metric ton in 2010 to $9.59/metric ton in 2015 to $12.11/metric ton in 2020 (page 3.3-27).   This equates to $28/metric ton carbon in 2010 ($US2004) and $48/metric ton carbon

[76] 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.

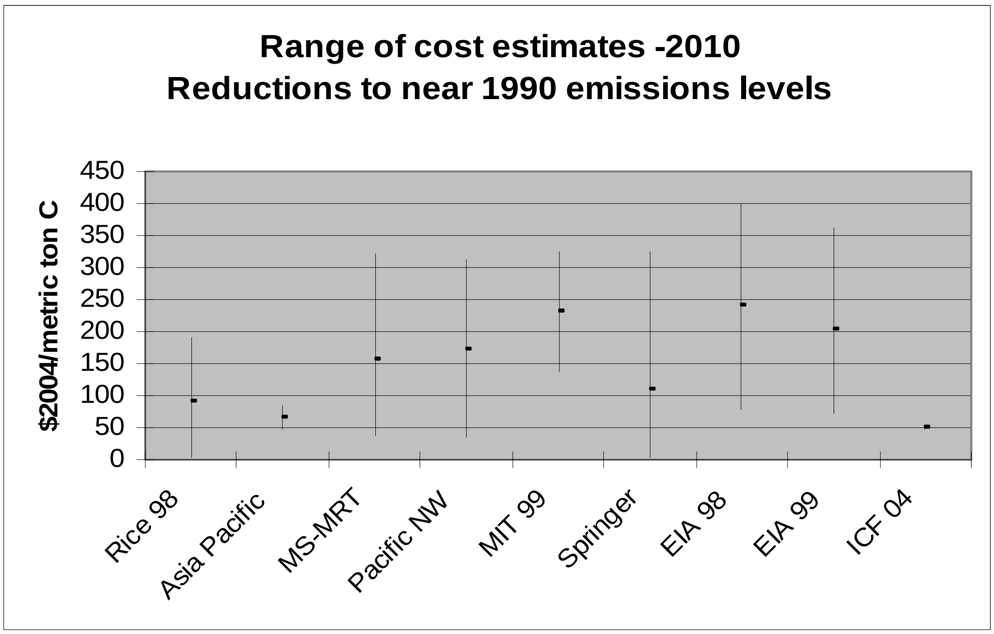
[77] Bailie et al., *Analysis of the Climate Stewardship Act,* July 2003; Bailie and Dougherty, *Analysis of the Climate Stewardship Act Amendment*, Tellus Institute, June, 2004. Available at http://www.tellus.org/energy/publications/McCainLieberman2004.pdf

($US2004) (Short ton values: projected carbon allowance costs at: $6.70/ton in 2010, $8.70 in 2015 and $11.00 in 2020.)[78]

Other studies have focused on specific issues associated with implementing a carbon cap. Resources for the Future (RFF) analyzed the effect of various allowance allocation methods on the cost of carbon emission trading.[79] Charles River Associates analyzed the McCain Lieberman legislation with a safety valve of $15/metric ton carbon.[80] The Federal Laboratories conducted a study of emissions reductions associated with carbon permit costs of $25 and $50 per metric ton of carbon.

The results of these analyses are presented in graphic form below. The charts below show values in $2004/metric ton carbon. Charts showing the values in $2004/ton CO_2 are included in the Appendix. The first chart presents the estimates for the year 2010 for analyses that examine reductions to near 1990 levels.

Figure 1: Cost estimates for 2010 – reductions to near 1990 levels



The next chart presents the estimates for the year 2010 for analyses that examine reductions to near 2000 levels.

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[78] Center for Clean Air Policy, *Connecticut Climate Change Stakeholder Dialogue: Recommendations to the Governors' Steering Committee*, January 2004, p. 3.3-27.

[79] Burtraw et. al., *The Effect of Allowance Allocation on the Cost of Carbon Emission Trading*, Resources for the Future, August, 2001. Available at http://www.rff.org/rff/Documents/RFF-DP-01-30.pdf

[80] Smith and Bernstein, *Impacts of Implementing a Carbon Cap with a Safety Valve on Allowance Prices*, Charles River Associates, January, 2004. Available at http://www.cpc-inc.org/library/files/20_smithjan04.pdf

Figure 2: Cost estimates for 2010 – reductions to 2000 levels

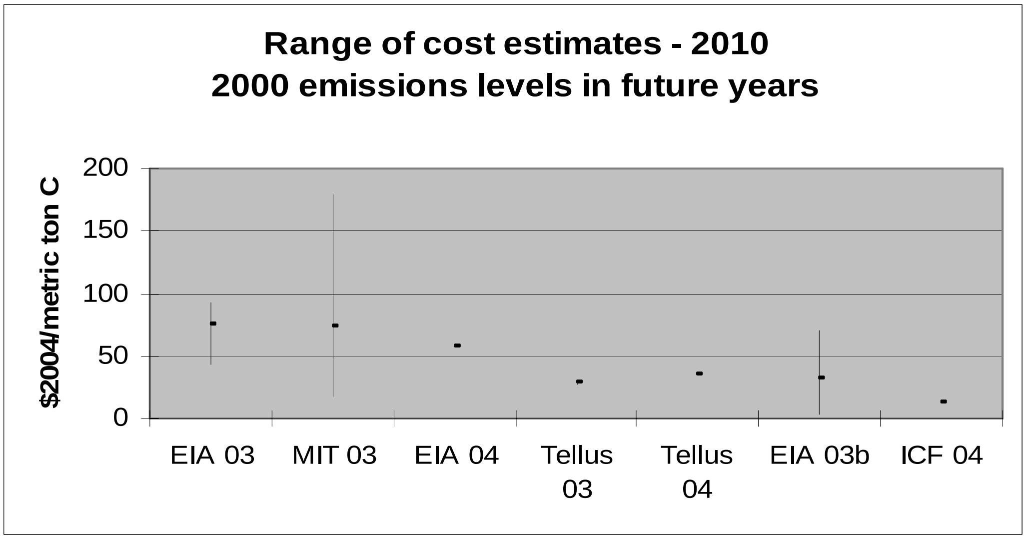
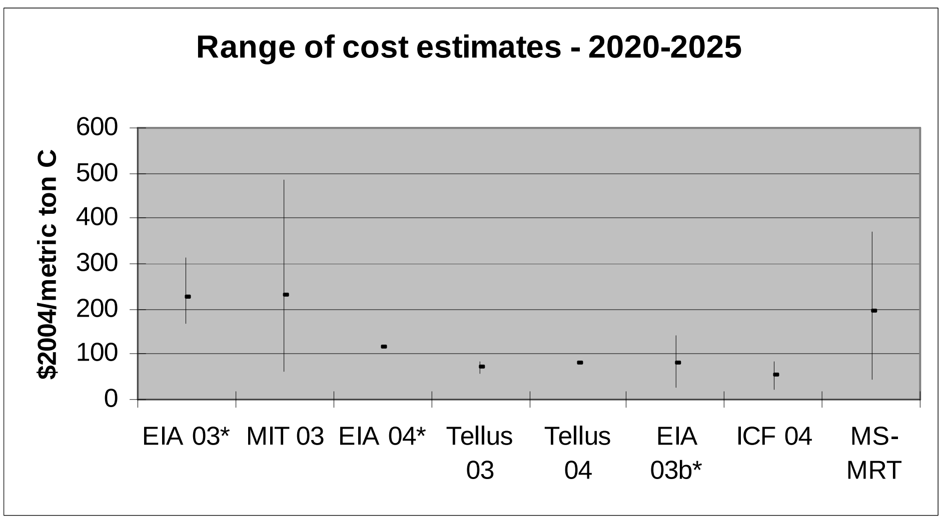


Figure 3 presents estimates for the years 2020-2025 for all emission reduction targets.

Figure 3: Cost estimates for 2020-2025 – all reduction targets



7.4 Other sources of information

Other sources of information can be useful in assessing the potential costs of carbon policies and determining how to evaluate risk associated with possible regulatory scenarios.

National Commission on Energy Policy: A bipartisan group of energy experts from industry, government, labor, academia, and environmental and consumer groups released a consensus strategy, more than two years in the making, to address major long-term U.S. energy challenges. Their report recommends mandatory economy-wide tradeable permits program to limit GHG. Costs would be capped at $7/metric ton of CO_2 equivalent reduction in 2010 with the cap rising 5 percent annually.[81] The National Commission recommendations are the basis of a legislative proposal under consideration in Spring 2005.

Innovest Strategic Value Advisors study for WWF: This study looks at relative costs of different strategies to reduce carbon emission from a portfolio, including: fuel switching, refiring, refurbishment, retiring coal and replacing it with gas combined cycle generation. The study assesses different carbon "price points" from 4 Euros to 30 Euros, based on several studies. Based on a review of carbon scenarios in different regions, the report identifies three common carbon price scenarios: $4-5 per ton carbon, $10-15 per ton carbon (for the period 2007/8 and corresponding roughly to an 8 percent reduction from 2002 emissions levels for specific utilities), and $20-25 per ton carbon (corresponding to a scenario for U.S. utilities where cumulative abatement in 2012 is 23 percent below 2002 emissions levels).[82]

Researchers at the Lawrence Berkeley National Laboratories: LBL researchers provided an overview of various carbon regulation scenarios for DOE.[83] The purpose of the analysis was to provide input to the Office of Energy Efficiency and Renewable Energy (EERE) and the Office of Fossil Energy (FE) in their exploration of options for evaluating the benefits of their R&D programs under an array of alternative futures. This analysis compares two alternative scenarios being considered by EERE and FE staff—carbon cap-and-trade and high fuel prices—to other scenarios used by energy analysts and utility planners. A Scenarios Working Group has proposed to EERE and FE staff the application of an initial set of three scenarios for use in the Working Group's upcoming analyses: (1) a *Reference Case Scenario*, (2) a *High Fuel Price Scenario*, which includes heightened natural gas and oil prices, and (3) a *Carbon Cap-and-Trade Scenario*. The immediate goal is to use these scenarios to conduct a pilot analysis of the benefits of EERE and FE R&D efforts.

The researchers reviewed several recent studies of carbon policy scenarios. The Working Group's *Carbon Cap-&-Trade Scenario* is found to be less aggressive than many Kyoto-style targets that have been analyzed, and similar in magnitude to the proposed Climate Stewardship Act. The proposed scenario is more aggressive than some other scenarios found in the literature, however, and ignores carbon banking and offsets and does not allow nuclear power to expand. The researchers were "somewhat concerned that the stringency of the proposed

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

[82] Innovest Strategic Value Advisors; "Power Switch: Impacts of Climate Change on the Global Power Sector;" WWF International; November 2003

[83] Wiser and Bolinger; An Overview of Alternative Fossil Fuel Price and Carbon Regulation Scenarios Prepared for the Office of Planning, Budget, and Analysis; Assistant Secretary for Energy Efficiency and Renewable Energy; U.S. Department of Energy; Ernest Orlando Lawrence Berkeley National Laboratory; 1 Cyclotron Road, MS 90R4000, Berkeley CA 94720-8136; October 2004. Available at http://eetd.lbl.gov/ea/ems/reports/56403.pdf

carbon regulation scenario in the 2010 to 2025 period will lead to a particularly high estimated cost of carbon reduction.

Canada: Canada has taken action on climate change. The Canadian government recently developed a plan for the country to reach its target under the Kyoto Protocol.[84, 85] The government has established a "safety valve" at $12/metric ton of CO_2.[86] Carbon emission trades in Canada, though light, have taken place. For example, Suncor agreed to buy 100,000 tonnes of CO_2 reductions from Niagara Mohawk with an option to buy an additional 10 million tonnes of emission reductions over 10 years. The purchase was valued at $6 million U.S.

New Brunswick Power is currently assuming that the Canadian Government's Kyoto policy will result in a cap and trade system, and that the costs of allowances will be $10/metric ton for the first compliance period of 2008-2012, and $15/metric ton for the second compliance period of 2013 and beyond. Both of these are assumed to escalate at 2 percent per year. Environment Canada indicates that $10/metric ton is a reasonable assumption based on international studies, price expectations from international companies, and current international permit trades.[87]

7.5 Factors that affect projections of carbon cost

Results from these studies highlight certain factors that affect projections of carbon reduction costs. While the studies cannot predict exactly what carbon reduction costs will be, they provide insight into whether the factors increase or decrease expected costs, and to the relationships among different factors. The discussion in this report is qualitative, and not intended as a detailed examination of modeling results and capabilities.[88]

Not surprisingly, two of the most important factors affecting estimates of carbon cost are projected emissions levels in the absence of a policy, and emission reduction targets. In general, higher emissions growth in the base case

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[84] According to *Point Carbon*, "the core of the newly designed plan is a $1 billion (€630 million) fund through which the Canadian Government will purchase emissions reductions. This will primarily be through sponsoring domestic emissions reduction projects, but could also be used to purchase emissions reductions from international projects using Canadian technology. This fund is estimated to reduce emissions by a total of 100 Mt CO_2e."

[85] http://www.pointcarbon.com/article.php?articleID=6195&categoryID=147

[86] National Commission on Energy Policy, *Ending the Energy Stalemate*, December 2004, page 27.

[87] http://www.climatechange.gc.ca/english/publications/canadascontribution/concluded.html.

[88] Meta-analyses do exist. See, *e.g.*, Carolyn Fischer and Richard D. Morgenstern, *Carbon Abatement Costs: Why the Wide Range of Estimates?* Resources for the Future, September, 2003. Available at http://www.rff.org/Documents/RFF-DP-03-42.pdf

examined in a study will result in higher estimates of the costs to achieve emissions reductions from that base case relative to a historic year. Thus future scenarios that reflect aggressive energy efficiency investment , higher penetration of renewables, and technology innovation produce lower estimates of carbon reduction costs than those that examine high growth scenarios with little technological innovation.[89] Similarly, aggressive emissions reductions scenarios result in higher cost estimates than scenarios with more lenient reduction requirements.

Other factors that affect carbon costs include geographic scope of trading and flexibility mechanisms (including banking and offsets). Various studies have looked at scenarios that involve global trading of allowances or permits, trading only among Annex B parties, trading only among OECD members, or no trading at all. As we see in Table 7, which shows results from one study, carbon regulation costs decrease with increased global participation. When global competition is not allowed, different regions see different carbon trading prices. Annex 1 trading lowers permit prices for most all Annex 1 regions. The inclusion of non-annex 1 countries, or global trading, further lowers prices for Annex 1 regions, but raises permit and energy prices for non-annex 1 regions. Increased trade generally helps industrial countries, but can have a negative impact on developing countries as terms of trade worsen due to higher energy costs in industrialized nations.[90]

Table 7: Carbon policy has a large impact on carbon regulation costs.

Policy Assumption	$/Metric ton Carbon (1990$)
Global Trading Allowed	17
Annex 1 Trading allowed	57
No trading between countries	127

Assumptions here are from the Rice 98 Model.[91]

8. Conclusion

The earth's climate is determined by concentrations of greenhouse gases in the atmosphere. International scientific consensus, expressed in the Third Assessment Report of the Intergovernmental Panel on Climate Change, is that climate will change and be disrupted due to anthropogenic emissions of

[89] While these strategies are not the focus of this paper, the effect of these strategies in reducing costs associated with a carbon constraint clearly have implications for corporate and government strategies on carbon emission reduction.

[90] Wiser, Ryan and Mark Bolinger, *An Overview of Alternative Fossil Fuel Price and Carbon Regulation Scenarios,* Lawrence Berkeley National Laboratory, October 2004.

[91] William Nordhaus and Joseph Boyer, "Requiem for Kyoto: An Economic Analysis," *The Energy Journal*, 1999.

greenhouse gases. Scientists expect increasing atmospheric concentrations of greenhouse gases to cause temperature increases of 1.4 – 5.8 degrees C by 2100 (the fastest rate of change since end of the last ice age). Such global warming is also 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. These changes have already been observed and documented in a growing body of scientific evidence. All countries will experience social and economic consequences, with disproportionate negative impacts on 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 of industrialized nations and economies in transition.

Despite being the single largest contributor to global emissions of greenhouse gases, the United States remains one of a very few industrialized nations that have not signed the Kyoto Protocol. Nevertheless, individual states, regional groups of states, shareholders and corporations are making serious efforts and taking significant steps towards reducing greenhouse gas emissions in the United States. Efforts to pass federal legislation addressing carbon, though not yet successful, have gained ground in recent years. These developments, combined with the growing scientific understanding of, and evidence of, climate change, mean that establishing federal policy requiring greenhouse gas emission reductions is just a matter of time. The question is not whether the United States will develop a national policy addressing climate change, but when and how. The electric sector will be a key component of any regulatory or legislative approach to reducing greenhouse gas emissions both because of this sector's contribution to national emissions and the comparative ease of controlling emissions from large point sources.

In this scientific and policy context, it is imprudent for decision-makers in the electric sector to ignore the cost of future carbon reductions or to treat future carbon reduction merely as a sensitivity case. Treating carbon emissions as zero cost emissions could result in investments that prove quite costly in the future. Long term resource planning 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, portfolio management, avoided costs for efficiency or renewables, and retirement of existing power plants all can be more sophisticated and more efficient with appropriate consideration of potential future costs of carbon emissions mitigation. These concerns are important for all states, although the challenge may be different and more complicated in those states that have restructured and no longer have utility-owned power plants.

Regulatory uncertainty associated with climate change clearly presents a planning conundrum; however, it is not a reason for proceeding as if no costs will be associated with carbon emissions in the future. The challenge is to forecast a reasonable range of expected 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 reduction requirements. Available sources include market transactions, values used in utility planning, and modeling analyses.

Carbon markets associated with implementation of the Kyoto Protocol as well as voluntary emissions reductions have emerged. In the carbon markets, carbon traded in January 2005 at a range of $30-63/metric ton carbon ($8-17 per ton CO_2).

Some utilities in the United States are already incorporating carbon values into their resource planning. The values range from $4-44/metric ton carbon ($1-12 per ton CO_2). In December 2004, the California Public Utilities Commission directed utilities to include carbon at a value between $30-93/metric ton carbon ($8-25 per ton CO_2) in their long term resource planning.

There are numerous studies that estimate the possible costs of carbon allowances under various policy scenarios, many of which are identified in this report. Projections of carbon costs for the year 2010 range from $4/metric ton carbon to $401/metric ton carbon ($1 and $99/ton CO_2) under different policy scenarios. Projections for carbon costs for the period 2020-2025 range from $27/metric ton carbon to $486/metric ton carbon ($7 and $120/ ton CO_2).

Modeling results are sensitive to several factors including (1) the emissions reduction target; (2) projections of future electrical load and emissions in the absence of a greenhouse gas reduction target; (3) geographic scope of trading; and (4) flexibility mechanisms such as offsets and allowance banking.

The sensitivity of the carbon price levels to the emissions reduction target can be seen by grouping the results for 2010 into two groups based upon the level of the target. For studies that analyze the costs associated with returning to the emissions levels of the year 2000 by the year 2010 or thereabouts, costs in 2010 are projected to be between $4/metric ton carbon and $179/metric ton carbon ($1/ton CO_2 and $44/ton CO_2). Studies that analyze the costs associated with a somewhat more aggressive goal of reducing emissions to near 1990 levels reveal costs in 2010 between $4/metric ton carbon and $401/metric ton carbon ($1/ton CO_2 and $99/ton CO_2).

These sources of information permit a broad assessment of potential carbon allowance prices. Indeed, incorporating reasoned assessment of future costs associated with greenhouse gas emissions is likely to be an increasingly important component of corporate success.

Appendix: Conversion and Values in $2004/ton CO2

A-1: Conversions

Original dollars were converted using Gross Domestic Product Implicit Price Deflator.

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	20
0.754	0.780	0.798	0.817	0.834	0.851	0.867	0.882	0.891	0.904	0.924	0.946	0.962	0.979	1.0

The following conversions were also used:
1 metric ton = 1.102 short tons
1 short ton = 0.907 metric tons
There are 12 g of carbon in 44 g of carbon dioxide

A-2: Allowance cost estimates in \$2004/ton CO_2

Table A-1: Estimates of U.S. Allowance Costs (\$US2004/ton CO_2)

Study	2010 Emissions Goal	2010 Allowance Price Range	2020-2025 Allowance Price Range**
		\$2004/ton CO_2	\$2004/ton CO_2
SEMF -Rice 98	7% below 1990 levels 2008-2012	1-47	-
SEMF -Asia Pacific	7% below 1990 levels 2008-2012	12-21	-
SEMF -MS MRT	7% below 1990 levels 2008-2012	9-80	10-91
SEMF - Pacific Northwest	7% below 1990 levels 2008-2012	8-77	-
SEMF -MIT Emissions	7% below 1990 levels 2008-2012	34-80	-
EIA '98	24% above 1990 levels to 7% below 1990 levels 2008-2012	19-99	-
EIA ‘99	24% above 1990 levels to 7% below 1990 levels 2008-2012	18-90	-
ICF ‘04	1990 levels in 2010	12	19-21
Springer summary of 25 models*	Kyoto targets in 2010	1-80	-
EIA '03	2000 levels 2010, 1990 levels in 2016	11-23	167-314
EIA '04	2000 levels 2010 and beyond	14	28
MIT '03	2000 levels 2010 and beyond	4-44	15-120
Tellus ‘03	2000 levels 2010, 1990 levels 2016	7-8	14-21
Tellus ‘04	2000 levels 2010 and beyond	9	20
CRA	2000 levels starting 2010, with safety valve	4	4-7
EIA ‘03b	2001 emissions in 2013	1-8	7-35
ICF ‘04b	2000 levels in 2010	3	5
RFF***	6% reduction from BAU scenario, starting 2008	6-10	-

** Springer summary allowance prices are global rather than U.S.*
*** MIT '03, MS MRT, CRA, Tellus, results for 2020; EIA '03, EIA ‘03b, and ‘04 results for 2025..*
**** RFF results for 2012. Study focuses relative costs of allocation methods.*

Figure A-1: Cost estimates for 2010 – reductions to near 1990 levels

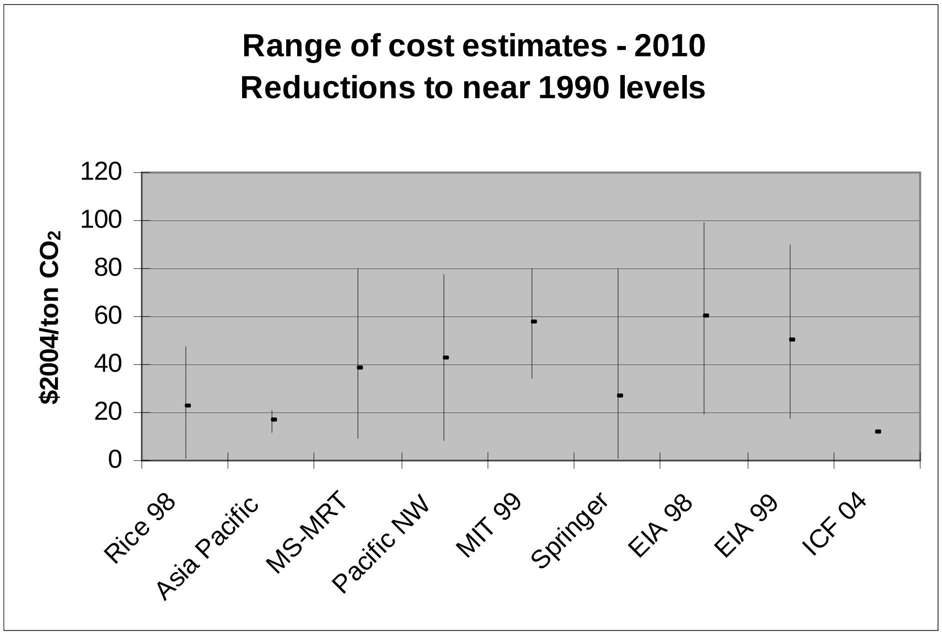

Figure A-2: Cost estimates for 2010 – reductions to 2000 levels

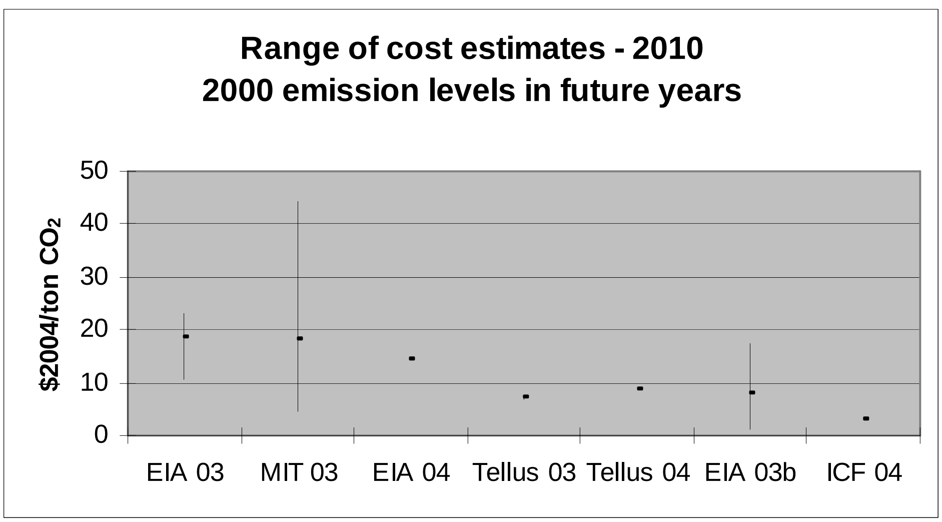

Figure A-3: Cost estimates for 2020-2025 – all emission reduction targets