

# **NEW HOPE**

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### **Assessment of Potential Climate Impacts of Alternative Northeastern U.S. Electric Utility CO<sub>2</sub> Caps**

**Prepared by New Hope Environmental Services  
August 2003**

To assess the potential impacts on global climate from alternative carbon dioxide emissions caps on Northeastern U.S. electric utilities, we performed an analysis similar to that performed by Wigley (1998) in which the climate impact of emissions reductions prescribed by the Kyoto Protocol was assessed. The Wigley (1998) study is widely cited as an accurate representation of the potential for carbon dioxide emissions regulations to affect the future course of global temperatures and sea levels.

In our analysis, we employ the same climate model, we start with the same baseline emissions scenario (i.e. the IS92a scenario from *the Second Assessment Report* of the Intergovernmental Panel on Climate Change [IPCC]), and run the model under the same set of assumptions (e.g., the temperature sensitivity to a doubling of the atmospheric carbon dioxide levels is taken as 2.5°C, see Wigley, 1998, for more details) as in Wigley (1998) to estimate the potential sea level and mean global temperature impacts of regional caps on CO<sub>2</sub> emissions by electric generators in an 11-state region of the Northeast (New England plus Mid-Atlantic states).

We performed a series of 5 different model runs, each based incorporating slight modifications to the IPCC IS92a emissions scenario in order to examine the potential impacts of a series of emissions regulations. Our initial run serves as the baseline condition, the second runs examines the potential impacts of the original Kyoto Protocol, the third run examines the potential impacts of the Kyoto Protocol without the involvement of the United States, and the fourth and fifth runs examine the potential impacts of the Kyoto Protocol without the official involvement of the United States, but with the employment of one of two alternative emission caps only on Northeastern U.S. electric utilities. The first of the two scenarios assumed a cap of the carbon dioxide emissions from the Northeastern utilities at 1990 emission levels, and the second scenario assumed a cap at a level 25 percent beneath the level of the 1990 emissions. Energy Ventures Analysis, Inc. provided base case electric utility emission projections for the region to 2025.

The details and results from each model run are described below.

Run 1:

The first run uses the IS92a scenario as described in the IPCC *Second Assessment Report* and slightly modified by Wigley (1998) (this is the IPCC *Second Assessment Report* “business as usual” scenario). This scenario produces a temperature rise in global temperatures from 1990 to 2100 of 2.068°C and a rise in globally averaged sea level during the same period of 49.5cm. These are the same numbers reported in Wigley (1998).

Run 2:

This run shows the effects of the full adherence to the original Kyoto Protocol by all nations of the world to which it would apply (Annex-B countries including the United States). This is also a duplicate of the central scenario of Wigley (1998). It assumes that the Kyoto targets are reached by 2010 and that the emissions of the Annex-B countries stay constant from that point on. The emissions from the rest of the world follow the IS92a pathway. This results in a global temperature rise of 1.917°C by 2100 and a sea level rise of 46.9cm. The “Kyoto savings” are thus 0.151°C and 2.6cm of sea level rise by 2100 (as reported in Wigley, 1998).

Run 3:

This run shows the effects of the United States not being part of the Kyoto Protocol. U.S. emissions to the year 2025 follow those projected by the Energy Information Administration in its *Annual Energy Outlook 2003*. These U.S. emissions are removed from the IS92a Annex-B emissions, and the remainder (presumably the non-U.S. portion of the Annex-B emissions) are reduced to 95 percent of their 1990 emissions by 2010 and remain constant thereafter (as prescribed by the Kyoto Protocol). The U.S. emissions after 2025 remain a constant percentage of the IS92a Annex-B emissions pathway. The non-Annex-B countries emit as prescribed by IS92a. This scenario results in a temperature rise of 2.007°C by 2100 and a sea level rise of 48.4cm. Thus the “Kyoto savings without the U.S. participation” are 0.061°C and 1.1cm of sea level rise by the year 2100.

Run 4:

This run shows the effects of the cap on Northeastern power plant emissions at the 1990 level. All the assumptions are as in Run 3, except that the total U.S. emissions are reduced in accordance to the values provided by Energy Ventures Analysis to the year 2025. From 2025 to 2100, Northeastern power plant emissions are assumed to grow at a rate similar to that of overall U.S. emissions (as calculated in Run 3), and thus the reductions are calculated from those numbers.

The table below shows the base emissions out to 2100, with the related caps at 1990 and 1990 less 25 percent. (Note that in IS92a, there is no total emissions growth from 2025 to 2050 in Annex-B countries).

Base Case and Capped Northeast CO2 Emissions  
(Millions of tons of CO2/yr.)

<u>Year</u>	<u>Base</u>	<u>1990 Cap</u>	<u>1990 less25%</u>
1990	283	283	212
2000	287	283	212
2010	314	283	212
2020	359	283	212
2025	396	283	212
2050	396	283	212
2075	430	283	212
2100	465	283	212

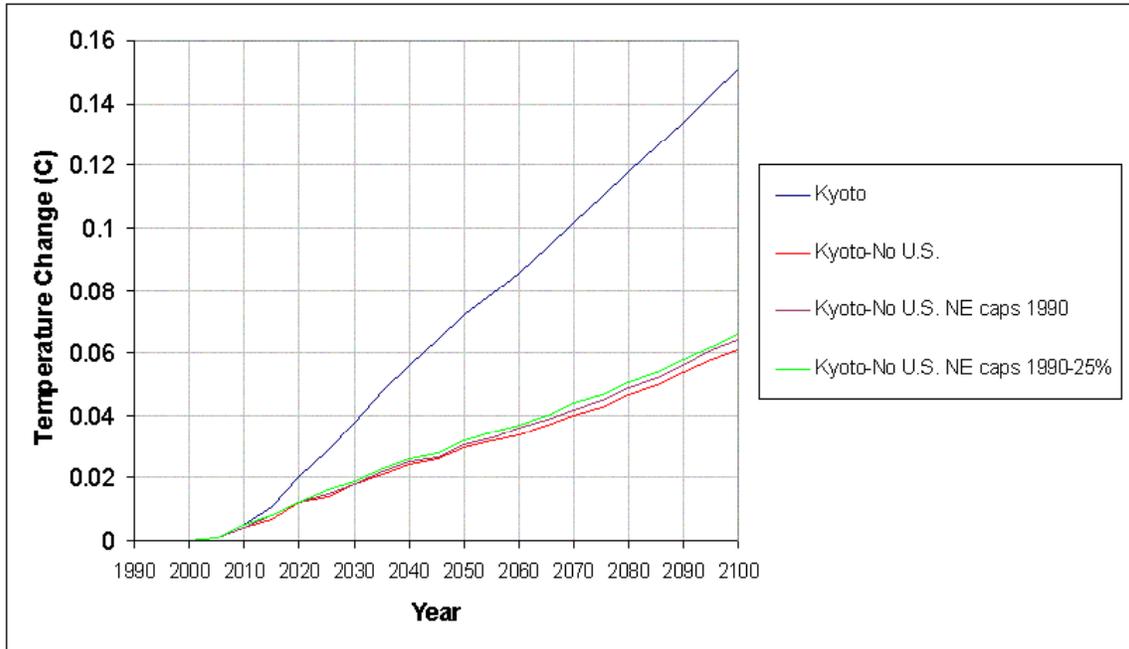
This scenario results in a temperature rise from 1990 to 2100 of 2.004°C and a sea level rise during the same period of 48.4cm. Thus, the additional savings, over and above the Kyoto savings without U.S. participation, resulting from the Northeastern power plant emissions cap at 1990 levels is 0.003°C and 0.0cm of sea level rise.

Run 5:

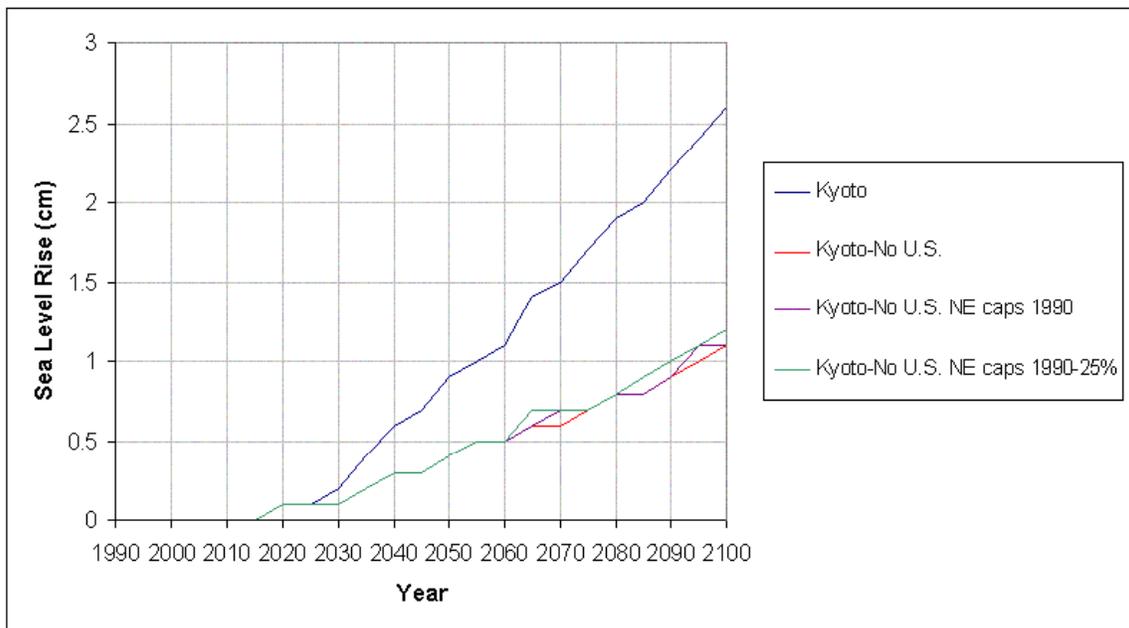
This run examines the effects of a cap of Northeastern power plant emissions at a level that is 25 percent below the 1990 level. All calculations are similar to the ones in Run 4. This results in a global average temperature rise from 1900 to 2100 of 2.002°C and a global sea level change of 48.3cm. The savings resulting from this scenario, over and above the Kyoto saving without the U.S. participation, are 0.003°C and 0.1cm of sea level rise.

**Observations**

Figure 1 shows the temperature savings for each of the four policy scenarios over the baseline of IS92a, and Figure 2 shows the reduction in projected sea level rise resulting from the same four policy scenarios.



**Figure 1. Temperature savings from the IS92a baseline for each of the four policy scenarios examined.**



**Figure 2. Reduction in sea level rise below the IS92a baseline for each of the four policy scenarios examined.**

These results are relatively scalable to different temperature rise projections. For instance, if one were to argue that the global temperature rise from IS92a of 2.068 was too low, and suggested that the rise should be twice that, then the temperature savings values would also double. Therefore, these results can be used to get a good idea of the potential impacts from the alternative caps on Northeastern electric utilities against a background of a range of possible future emissions scenarios.

However, despite the choice of emission scenario, it is obvious from these simulations that under no circumstance would either of these alternative emissions caps result in a measurable impact on the future course of global temperatures or sea level rise. As such, even the values calculated for the 25 percent reduction below 1990 emission levels are insufficient to result in any noticeable impacts on other climate-related environmental variables (e.g., rainfall, drought, species migration and extinction, etc.).

## **References**

Energy Information Administration, 2003. *Annual Energy Outlook 2003 with Projections to 2025*, U. S. Department of Energy, <http://www.eia.doe.gov/oiaf/aeo/index.html>

Houghton, J.T., et al., (eds.) 1996. *Climate Change 1995: The Science of Climate Change*. Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, 572pp.

Wigley, T.M.L., 1998, The Kyoto Protocol: CO<sub>2</sub>, CH<sub>4</sub>, and climate implications, *Geophysical Research Letters*, **25**, 2285-2288.