The GTAP Advisory Board Meeting, April 2000

Electric Power Research Institute (EPRI)

GTAP activities of EPRI

The Global Climate Research area is part of EPRI's Environmental Research Division. Global climate change policies could have extensive ramifications for both economic and environmental systems, impacting energy producers and consumers throughout the world. Preliminary analyses of recent proposals such as those adopted in the Kyoto Protocol suggest that the economy-wide costs of reducing U.S. CO_2 emissions could exceed $100 billion per year. Given these large costs and the substantial uncertainties associated with climate change predictions, potential impacts on market and nonmarket systems, and the benefits of proposed policies, decisions about adopting climate change management strategies are difficult. A better understanding of the costs of climate change management proposals is essential for policymakers if they are to make balanced judgments.

Also needed is the ability to compare economic costs to estimates of damages or benefits. However, traditional approaches for interpreting the significance of research results are not likely to yield many of the answers society needs in developing effective climate change policy alternatives. This is because evaluating the implications of each policy proposal requires an understanding of numerous and complex interactions within and between different elements of the natural and human systems. Properly accounting for these interactions when evaluating costs and benefits of proposed climate change management policies requires a consistent and comprehensive integrated assessment approach.

Thus EPRI's research activities center around the following three main areas:

1. Global Climate Policy Cost Analysis

The overall thrusts of this target are (1) to develop objective information for policymakers on the costs of alternative greenhouse gas management policies; and (2) to perform integrated assessments that compare the costs of policy proposals with the benefits that may be gained from their adoption. Given the enormous stakes of the climate issue, both in terms of the cost of reducing emissions and the possible climate impacts, these analyses are a necessary prerequisite to informed policymaking. The research value is enhanced through tight integration with research performed in other two research areas, *Assessment of the Potential Impacts of Global Climate Change*, and, *Least-Cost Options for Meeting Greenhouse Gas Emission Reduction Requirements*. It is also highly leveraged through links with other domestic and international research and policy analysis programs, allowing EPRI to fill critical gaps and serve as a catalyst for investigating emerging issues of concern.

The costs of reducing CO_2 emissions are being estimated for both the domestic and global economies. The current focus of much of this research is on the implications of proposals being put forward during the international negotiations process. Alternative proposals for distributing

emission reductions across regions of the globe and sectors of the economy will also be examined. For the United States, cost impacts are being estimated for the economy as a whole, specific economic sectors, and various regions of the country. In addition, the influence of estimated economic impacts on U.S. competitiveness is being examined.

Integrated assessment frameworks are being developed cooperatively with the National Science Foundation, the U.S. Department of Energy, and others. The frameworks integrate many disparate pieces of information (scientific, technological, economic, etc.) to analyze the costs and benefits of climate change management proposals; critical inputs for the benefits component are being developed in the next research component, *Assessment of the Potential Impacts of Global Climate Change*. Integrated assessments will also be used to perform value-of-information analyses to evaluate both EPRI's and the U.S. government's climate change research programs.

Here is a brief list of key publications that resulted from EPRI's supported research in this area:

1. J. Reilly, R. Prinn, J. Harnisch, J. Fitzmaurice, H. Jacoby, D. Kicklighter, J. Melillo, P. Stone, A. Sokolov, and C. Wang, "Multi-Gas Assessment of the Kyoto Protocol", *Nature*, 40, 17 October 1999

2. Special Issue of *The Energy Journal*¸398 pages, 1999
(including the following)

3. H. Jacoby and I.S. Wing, "Adjustment Time, Capital Malleability and Policy Cost", *The Energy Journal*, Kyoto Special Issue, 73-92, 1999

4. C. MacCracken, J. Edmonds, S. Kim, and R. Sands, "Economics of the Kyoto Protocol", *The Energy Journal*, Kyoto Special Issue, 25-71, 1999

5. J.J. Dooley and P.J. Runci, "Developing Nations, Energy R&D, and the Provision of a Planetary Public Good: A Long-term Strategy for Addressing Climate Change", accepted pending revision to the *Journal of Environment and Development*, August 1999

2. Assessment of the Potential Impacts of Global Climate Change

Improved modeling of the climate system and the global carbon cycle, along with detailed impact assessments, helps reduce the many uncertainties that remain with respect to the likelihood, scope, and timing of greenhouse gas-induced climate change and the potential for associated impacts on market-based systems, human health, and ecosystems. By reducing these uncertainties and quantifying the potential benefits that limitations on greenhouse gas emissions might yield, this research area ensures that key inputs are available for integrated assessment of the potential costs and benefits of climate change management proposals. It lays the foundation for rational policy decisions, and its analyses—made widely available in the peer-reviewed literature—have already proven influential in U.S. and international policy deliberations.

Global carbon cycle models and general circulation models (GCMs) are the major tools used by scientists to translate emission scenarios into projections of atmospheric greenhouse gas concentrations and resultant changes in climate variables. The current debate over limiting greenhouse gas emissions is based on predictions that (1) atmospheric concentrations of CO_2 and other gases will continue to increase; (2) increases in the concentrations of these gases will lead to changes in key climate variables such as temperature, precipitation, and storm frequency and severity; and (3) changes in climate will have significant economic effects, as well as effects that are not as easily thought of in monetary terms (e.g., on ecosystems and human health). However, all of these predictions are highly uncertain, and much remains to be learned about the processes controlling the earth's carbon cycle and climate, as well as the responses of human systems and natural ecosystems.

In order for policy makers to make informed decisions about the need for reductions in emissions, it is essential to quantify—with the goal of reducing—uncertainty concerning the factors affecting the carbon cycle, and the uncertainties concerning the magnitude, timing, and regional distribution of potential climate change. It also is critical to determine which potential impacts are significant, to estimate the nature and magnitude of the impacts, and to quantify the impacts in terms that can be compared to the costs of policy alternatives.

Here is a brief list of key publications that resulted from EPRI's supported research in this area:

1. K.E. Kunkel, R.A. Pielke Jr., and S.A. Changnon, "Temporal Fluctuations in Weather and Climate Extremes That Cause Economic and Human Health Impacts: A Review", *Bulletin of the American Meteorological Society*, 80(6), 1077-1098, June 1999

2. R. Meyer, F. Joos, G. Esser, M. Heimann, G. Hooss, G. Kohlmaier, W. Sauf, R. Voss, and U. Wittenberg, "The Substitution of High-Resolution Terrestrial Biosphere Models and Carbon Sequestration in Response to Changing CO_2 and Climate", *Global Biogeochemical Cycles*, 13(3), 785-802, September 1999

3. N.Y. Chan, M.T. Stacey, A.E. Smith, K.L. Ebi, and T.F. Wilson, "An Empirical Mechanistic Framework for Heat Related Illness", submitted to *Climate Research* on 20 December 1999

4. D. Schimel, J. Melillo, H. Tian, A.D. McGuire, D. Kicklighter, T. Kittel, N. Rosenbloom, S. Running, P. Thornton, D. Ojima, W. Parton, R. Kelly, M. Sykes, R. Neilson, B. Rizzo, and L. Pitelka, "Carbon Storage by Natural and Agricultural Ecosystems of the US 1980-1993", *Science*, accepted on 15 December 1999

3. Least-Cost Options for Meeting Greenhouse Gas Emission Reduction Requirements

This research area's in-depth analyses of flexibility mechanisms and technical options for reducing or offsetting greenhouse gas emissions helps the energy sector develop least-cost strategies for responding to proposed global climate change policies. Results of these analyses—delivered through EPRI reports, peer-reviewed articles, and electronically via the Internet—inform domestic and international policy deliberations regarding joint implementation, emissions trading, and carbon sink enhancement.

The following is a brief list of output from this research area:

1. E.J. Balistreri, P.M. Bernstein, W.D. Montgomery, A.E. Smith, and G. Yang, “Full Impacts of Hybrid GHG Controls”, submitted to the *Journal of Environmental Economics and Management* on 15 October 1999

2. Periodic updating of information on the Global Climate Change web pages on EPRIweb and EPRI.COM