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CHAPTER FOUR

SAVING THE PLANET COST-EFFECTIVELY: THE ROLE OF ECONOMIC ANALYSIS IN CLIMATE CHANGE MITIGATION POLICY

Joseph E. Aldy

No environmental problem likely poses a more significant policy challenge to decision makers than global climate change. The characteristics of the global climate change problem illustrate the difficulty in developing policy. The earth's atmosphere is a global public good: any successful effort to reduce the flow of greenhouse gas emissions to the atmosphere will likely require a coordinated international effort. Firms and individuals will incur the costs of mitigating climate change in the near term, but the benefits will accrue to future generations. Substantial uncertainty affects estimates of benefits and costs of mitigating climate change and also hampers our understanding of the effectiveness of various policy instruments. The risks of climate change have inspired many in the environmental community to focus their energy on this issue, while the costs of mitigating climate change have likewise motivated many in industry who fear future regulatory costs.

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The significant complexities of global climate change reveal the need for informed policy deliberation and development. Decision makers can benefit from a better understanding of scientific, economic, technological, diplomatic, and political factors related to global climate change. Economic analysis can inform decision makers on a variety of important issues, including costs and benefits, characterization of uncertainty, and distributional effects. Such analysis can inform decisions on both the setting of policy goals and the means of achieving these goals.

The Clinton administration decided to present its own economic analysis of the Kyoto Protocol in congressional testimony by Janet Yellen, chair of the Council of Economic Advisers (CEA), three months after the Kyoto negotiations. The administration elucidated the results of the analysis underlying Yellen's testimony in a July 1998 report titled *The Kyoto Protocol and the President's Policies to Address Climate Change: Administration Economic Analysis* (hereafter referred to as AEA). The AEA bore significant criticism on two important assumptions: international emissions trading and developing-country participation. These assumptions, however, did not relate to economics, but to the outcomes of subsequent negotiations.

These criticisms are consistent with broad concerns about the limited practical influence of economics in practice on global climate change policy.[1] For example, several economists have criticized the Kyoto Protocol for failing a benefit–cost test (Nordhaus and Boyer 1999; Nordhaus 2001), for imposing greater costs than necessary for achieving possible long-term concentration targets (Manne and Richels 1999), for creating inadequate incentives for participation and compliance (Barrett 1998), and for forgoing cost-effective emissions reductions in developing countries (Bernstein et al. 1999). Achieving an agreement that may suffer from such economic flaws may be all the more surprising given the significant amount of economic research undertaken in academia, the private sector, nonprofit organizations, and government agencies prior to the Kyoto negotiations (e.g., Gaskins and Weyant 1993; Novak 1997; Alliance to Save Energy et al. 1997; and IAT 1997).

The administration's economic analysis of the Kyoto Protocol reflected the history leading up to the Kyoto negotiations, including domestic policy development, international negotiations, and preceding economic analyses. More interesting, subsequent policy efforts reflected the administration's economic analysis, or, to be more exact, the cost-effective policy objectives underlying the analysis. The economic analysis raised the cost of changing administration policy and constrained those who suggested that

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the administration take a path of less resistance, which usually implied unnecessary costs or "doing it dumb." This chapter assesses the effects of the administration's economic analysis to illustrate the role that a published economic analysis can have on subsequent decision making.

THE ROAD TO THE KYOTO NEGOTIATIONS

> "A great, great deal has been said about the weather, but very little has ever been done."
>
> —Mark Twain[2]

The road to Kyoto began with the 1992 Earth Summit in Rio de Janeiro, Brazil, where about 150 countries signed the Framework Convention on Climate Change (FCCC). Among other provisions, the treaty specified nonbinding emissions goals for the end of that decade for 40 industrialized countries[3] (Article 4) and an ultimate objective of stabilizing greenhouse gas concentrations at a "level that would prevent dangerous anthropogenic interference with the climate system" (Article 2). The FCCC made an important distinction between industrialized and developing countries, noting their "common but differentiated responsibilities and respective capabilities" (Article 3). Within the FCCC, this differentiation translated into nonbinding goals for industrialized countries and no goals for developing countries, developed-country financing of developing-country investments in climate-friendly technology, and more extensive and frequent reporting requirements for industrialized countries. Ratified with the advice and consent of the U.S. Senate in October 1992, the FCCC entered into force in 1994. By February 2004, 187 countries had become parties to the FCCC.

At the first conference of the parties to the FCCC in 1995, the world came to agreement on the so-called Berlin Mandate.[4] This mandate provided for a new round of negotiations for emissions commitments beyond 2000. Consistent with the precedent in the original treaty for "differentiated responsibilities," this process focused on commitments exclusively for the industrialized world. With the aim of achieving an agreement on a new set of emissions commitments by the third conference of the parties in 1997, the parties initiated an intense series of negotiations. At the 1996 conference in Geneva, the Clinton administration announced its willingness to accept binding emissions commitments under the Berlin Mandate

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process. Diplomatic efforts focused on the path toward binding emissions quotas for industrialized countries.

As the negotiations proceeded in 1996, the administration initiated an interagency process to assess the economic effects of emissions abatement policies. Dubbed the Interagency Analytical Team (IAT), this group of government analysts used four different models to evaluate the economic effects of various climate change policies, with a focus on the United States (see IAT 1997).[5] Whereas the academic literature at that time included a variety of analyses to determine the optimal climate change policy (e.g., Cline 1992; Nordhaus 1994) and the least-cost emissions path to a concentration stabilization goal (e.g., Wigley et al. 1996; Weyant 1997), the IAT focused on evaluating the costs of specific emissions targets for 2010.[6] The IAT presented results in terms of the price for a greenhouse gas tradable permit, energy prices, gross domestic product (GDP) loss, and unemployment.

In spring 1997, the administration compiled a "blue ribbon" panel of economists from academia, the private sector, and nongovernmental organizations (NGOs) to review the work of the IAT. A majority of the panel was very critical of the IAT's draft report, including its focus on a limited number of policy scenarios, its optimistic technology assumptions,[7] its lack of a benefit–cost analysis, and particular weaknesses of the models supporting the report.[8] In light of the critical peer review and growing pressure from Congress for the administration's economic analysis, the Clinton administration decided to release the IAT's draft report at a July 1997 hearing before the House of Representatives' Energy and Power Subcommittee (1997). In the first of her 10 appearances at congressional hearings on climate change policy, Janet Yellen testified on the IAT report and the administration's approach to economic analysis. Yellen discussed the lessons learned from the IAT and cautioned that attention should focus on the common results from the breadth of the modeling literature and avoid concentrating on the specific outputs of any one model.

One aspect of the IAT work merits additional comment. The IAT evaluated tradable emissions permit programs only. This reflected a strong interest within the administration for market-oriented implementation policies. The focus on tradable permits as the primary mechanism for achieving emissions quotas in lieu of technology or performance standards under a more traditional command-and-control regulatory approach represented a significant departure from previous environmental policy debates. Cost-effective implementation became a central principle of the administration's climate change agenda in both domestic and international arenas.[9] In

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terms of international policy, the IAT effort complemented previous research (Manne and Richels 1992; Bruce et al. 1996; Nordhaus and Yang 1996) that showed the potential for substantial cost savings through international emissions trading, both within Annex I countries and in a global system. These findings strengthened the hand of the advocates for international emissions trading, an idea that faced very little dissent within the administration.

From a political perspective, the IAT report was considered an incomplete and unsuccessful attempt to quantify the economic effects of U.S. climate change policies. The abandonment of more than a year of work on the report affected the policy development process in two ways. First, it frustrated members of Congress who were waiting for the administration's economic analysis. Second, it created a large hole: the Clinton administration did not have a public analysis to inform the debate over the negotiating position it would take to the Kyoto conference.

On this first point, the Senate responded soon after the demise of the IAT with a 95 to 0 vote for the Byrd–Hagel resolution (Senate Resolution 98). Although it was not binding, this resolution expressed the Senate's view that it would not provide its advice and consent to any agreement that did not meet the following two conditions: (1) developing countries must agree to emissions commitments in the same compliance period as industrialized countries and (2) the agreement must not cause serious harm to the U.S. economy. Further, the resolution requested that a report on the costs of implementing the climate change agreement accompany the protocol when submitted to the Senate for its advice and consent to ratification. Both the second condition and the request for an economic analysis demonstrated the frustration Congress had with the administration regarding the failure to present a climate policy analysis. Moreover, the Senate had been able to frame the policy debate in terms of developing-country participation and the economy. The domestic politics, focused on concurrent participation by developing countries, strikingly conflicted with the ongoing international negotiations under the Berlin Mandate.

On the second point, halting the IAT process created a void, and nature abhors a vacuum. Several of the Department of Energy's national labs collaborated to produce a report on possible emissions scenarios that essentially dressed up a technology inventory and some wishful thinking in economic jargon.[10] The so-called "5 Labs Study" made the claim that with a "vigorous national commitment" the United States could reduce its carbon dioxide emissions to its 1990 level by the year 2010 with no net cost to the

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economy (IWG 1997). Although this analysis lacked any representation of economic behavior, the macroeconomy, or for that matter, any identification or description of the policies that might constitute a "vigorous national commitment," it provided ammunition for advocates of ambitious climate change policies.[11]

In October 1997, President Clinton announced the administration's climate change policies. These included the administration's positions going into the Kyoto negotiations—1990 emissions target for the 2008–2012 commitment period, international emissions trading, and "meaningful participation by key developing countries"—as well as a set of domestic policies to promote emissions abatement and sequestration. The target certainly reflected the influence of the optimistic technologists. Including international emissions trading and pressing for more participation by developing countries, however, reflected a concern for cost-effectiveness. The domestic policies also reflected a split: in the near term, largely voluntary activities represented the technologists' view; for the 2008–2012 period, the proposal focused on a domestic emissions trading program. Given the world's response to this proposal in pre-Kyoto negotiations in November 1997, and the significant distance between negotiating blocs on virtually every issue on the table, the prospects for an agreement at Kyoto appeared dim.

THE ADMINISTRATION'S ECONOMIC ANALYSIS OF THE KYOTO PROTOCOL

> "I am particularly pleased the agreement strongly reflects the commitment of the United States to use the tools of the free market to tackle this difficult problem. There are still hard challenges ahead, particularly in the area of involvement by developing nations. It is essential that these nations participate in a meaningful way if we are to truly tackle this global environmental challenge. But the industrialized nations have come together, taken a strong step, and that is real progress."
>
> —President William J. Clinton, commenting on the Kyoto Protocol[12]

In December 1997, the Clinton administration had a hard-fought international agreement to address climate change but no public analysis about its effects on the U.S. economy. The economic team had undertaken a number of analyses "on the fly" during the last week of the negotiations as new proposals were tabled, but the final agreement had not been fully evaluated, in large part because several of the provisions in the protocol were not imme-

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diately amenable to the energy-economic models (e.g., inclusion of carbon sinks and non–carbon dioxide greenhouse gases). The administration quickly recognized that an informed public debate over the Kyoto Protocol could not proceed without an economic analysis of the agreement. Even if the administration did not present its own economic analysis, advocates on both sides of the issue would likely do so (and they did: see Novak 1998; DRI 1998; and Geller et al. 1999). The administration, therefore, decided to fill the void and undertake its own economic evaluation of the Kyoto Protocol.

The decision to conduct this economic analysis did not reflect any U.S. treaty law obligation, legislative mandate, or executive branch policy. The administration had the discretion to release a public analysis of the economic effects of the Kyoto Protocol. After the Kyoto negotiations, senior policymakers discussed how the administration would approach the ensuing debate on the agreement. It was decided that an economic analysis would play a central role in the administration's efforts to inform Congress and the public about the Kyoto Protocol. Although the administration could have opted against a public analysis, and possibly referenced the 5 Labs Study as justification for the Kyoto Protocol, it made the right decision to go forward with the AEA.

The administration's economic analysis included contributions by a number of agencies, although CEA took the lead and Chair Yellen served as the administration's spokesperson on the economics of the Kyoto Protocol. Yellen presented the results of the administration's economic analysis at a March 1998 congressional hearing.[13] The written testimony described the economically relevant elements in the Kyoto Protocol, reviewed the literature on the benefits of mitigating climate change, surveyed many of the key findings in the economics literature (such as the cost savings from trading), and provided an illustration of potential economic effects from a global economic model. Not surprisingly, attention focused on the numbers provided in two "illustrative scenarios": $14 to $23 per ton of carbon equivalent for a tradable permit in 2010. To complement the March testimony, in July 1998 the administration released the AEA. This analysis elicited criticism for being overly optimistic about the costs of implementing Kyoto.[14] The analysis arrived at a tradable permit price of $23 per ton, depending on several critical assumptions; these merit detailed discussion, especially in light of how they influenced subsequent policymaking.[15] The two key assumptions driving the analysis were efficient international emissions trading and "meaningful participation by key developing countries."

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The administration constructed its estimated permit prices from a modified version of the second generation model (SGM).[16] The SGM, like virtually every global energy-economic model, solves for a carbon price by seeking the lowest-cost emissions abatement opportunities in all countries with emissions commitments. Effectively, it assumes that all countries with emissions commitments implement frictionless domestic tradable permit systems integrated with a frictionless international emissions trading system. All countries face the same price for carbon, and compliance with emissions commitments occurs at least cost.

How plausible is this frictionless trading assumption? The protocol provided limited guidance on this issue, as the international trading article consisted of three sentences. Hahn and Stavins (1999), Wiener (1999a), and others discuss the pitfalls in designing international emissions trading systems, and how a myriad of domestic programs could evolve over time that would complicate the attainment of global least-cost emissions abatement. It is not, however, immediately obvious how to incorporate inefficiencies in program design into a top-down global energy-economic model. Although virtually all economists who have developed global energy-economic models note that their tools assume frictionless trading, none had at that time (or subsequent to then) analyzed an international emissions trading system with frictions. For example, the Stanford Energy Modeling Forum's evaluation of the Kyoto Protocol published in a special issue of the *Energy Journal* in 1999 (MacCracken et al.) included 13 global energy-economic models; none of them modified their trading assumptions to account for potential inefficiencies in trading.[17]

Creating an asset worth hundreds of billions of dollars annually and then developing the rules for international trade in this asset over a decade is a daunting, formidable task. The world has spent more than half a century on rules for trade in goods and services, and the work still continues. Getting it right the first time around on international emissions trading will be difficult. Absent more detailed models of domestic economies and a better understanding of the emissions abatement programs countries will implement, however, the best modelers are likely to do is to bound their estimates with autarky on the high end and frictionless international trading on the low end.[18]

Given that the analysis assumes efficient international emissions trading, what countries are assumed to participate in trading? What does the phrase "meaningful participation by key developing countries" mean? In the case of the economic modeling, the analysis assumed that China, India,

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Korea, and Mexico adopted emissions targets equal to their 2010 business-as-usual emissions levels (see the Subcommittee on Energy and Power 1998b, *296*). The administration interpreted a first-period emissions commitment as sufficient, but not necessary, for meaningful participation. Although the administration never compiled a list of key developing countries, many recognized these four as very important. (As a former colleague put it, any country that takes on an emissions commitment is a key developing country.) The model also facilitated the analysis of these countries: the SGM has five developing-country modules—China, India, Korea, Mexico, and the rest of the world. Including these four countries, especially China, significantly reduces the costs of complying with the Kyoto targets for the United States and other developed countries. Coupling efficient international emissions trading with developing-country commitments would reduce the marginal cost of compliance with the Kyoto Protocol by nearly 90 percent in our analysis. Subsequent research by the Energy Modeling Forum (EMF) showed comparable gains. The 12 EMF models evaluating the U.S. emissions commitment under no international emissions trading and full global trading found on average an 80 percent decrease in marginal cost, while several showed cost savings in excess of 90 percent (Weyant and Hill 1999).

The assumption that these four developing countries would adopt emissions commitments contrasted with the reality of the Kyoto negotiations. The developing-country negotiating bloc opposed a mechanism to allow countries to voluntarily adopt emissions commitments in the negotiations. These countries did not have commitments and did not express an interest in adopting commitments, nor did the protocol provide them with a way to take on a commitment. Shogren (1998b, *11*) notes that this "broad and deep" assumption about participation explains the "modest" cost estimates in the AEA. He questions this assumption, stating that "these estimates might be plausible if all goes exactly right with the world; a big 'if.'" Nonetheless, this developing-country participation assumption did conform broadly with the administration policy seeking more ambitious efforts by developing countries.

Some critics of the administration's analysis have claimed that it relied on an optimistic assumption about technological progress. The IAT incorporated an optimistic energy efficiency improvement assumption. The SGM, like many similar models, operates with an autonomous energy efficiency improvement rate (i.e., a rate chosen by the modeler). Whereas the IAT modeling runs reflected a choice of an optimistic rate of technological

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change, the AEA reflected a standard assumption made by many modelers. The analysis presented in Yellen's testimonies and the July 1998 report employs the baseline energy efficiency improvement value (about 0.9 percent per year improvement) used by the Energy Information Administration (EIA), which is broadly accepted in the modeling community.[19]

Critics claim that the economic analysis was overly optimistic and that the assumptions of efficient international emissions trading and developing-country participation were different from the likely outcome of negotiations. The analysis showed, however, that attainment of specific diplomatic policy goals was necessary to ensure that the Kyoto agreement would impose only "modest costs" on the U.S. economy. It raised the bar for the ratification package that the administration presumably would submit to the Senate at some point in the future.[20]

In contrast to private analysis for decision makers, in which economic analysis shows primarily economic tradeoffs, public analysis reveals economic and political tradeoffs. These tradeoffs in public analysis may not be so transparent to the casual observer, but they exist and are substantial. With a public economic analysis, changing a policy position requires more than fancy rhetoric, repackaging and rephrasing bullet points, and spinning the new policy. The new policy position may conflict with the existing analysis and require either a new economic analysis or an explanation of the policy change's effects on the conclusions of the existing economic analysis. This raises the political cost of changing the course of policy and creates a bias toward maintaining the cost-effective policies underlying the economic analysis. For example, consider a hypothetical case in which the administration had submitted the Kyoto Protocol to the Senate for its advice and consent to ratification and claimed that a joint statement with China about energy efficiency and renewable energy constituted meaningful participation.[21] The Senate would (should) force the administration to (1) defend the claim that this action is meaningful and (2) describe how it affects the cost estimates in its public economic analysis. Absent the economic analysis, the administration would have only to fight a battle of words over the definition of "meaningful."

The AEA may not have represented a textbook economic analysis such as those students read about in a public policy class. For example, the report did not provide a full benefit–cost analysis. Although some would argue that such an analysis should be undertaken,[22] several significant uncertainties would make drawing conclusions from such an assessment very difficult. First, a benefit–cost analysis would require an assessment of the emis-

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sions reductions from policies over the next hundred-plus years. The international community had specified emissions commitments only through 2012. Any assessment would then require arbitrary assumptions about future emissions paths for both Annex I and non–Annex I countries. Second, such an analysis would require the discounting of future benefits and costs. Given the very long time horizon for the benefits, the choice of a discount rate is critical. Recent research illustrates that such uncertainty should influence the choice of discount rate and significantly affect the present value of long-term benefits (Newell and Pizer 2001, 2003; Weitzman 2001).

In addition, some observers noted that the report did not provide an evaluation of alternative policies. Although assessments of domestic legislation and regulation certainly benefit by a consideration of alternatives, the value of such a comparison of options may be less for an international treaty. In some sense, a negotiated multilateral agreement offers only two options: take it or leave it. Such an evaluation of alternatives certainly would have been valuable *before* the Kyoto negotiations, but unfortunately, the ill-fated IAT addressed only three (very similar) policy options. Certainly, domestic climate change mitigation policies should be subject to an evaluation of alternatives. The Clinton administration, however, did not prepare an evaluation of alternatives when proposing several near-term policies to address climate change, such as the Climate Change Technology Initiative.

Despite these warts, the AEA did inform the public about the key elements underlying "modest cost" attainment of the Kyoto commitments. Although critics may have wanted more from an analysis, the Clinton administration provided more information on the economics of the protocol than most other governments. Whereas the Clinton administration chose to publish an economic analysis, the European and Japanese governments did not present any public economic analyses of the Kyoto Protocol over the 1998–2000 period. Having conducted and published the AEA, policymakers had some ammunition to advocate cost-effective policies on the domestic front, with the EU on international emissions trading, and with developing countries on their potential participation.

DEVELOPING DOMESTIC CLIMATE CHANGE POLICIES

> "[C]osts depend critically on how emission reduction policies are implemented, and it boils down to this: If we do it dumb, it could cost a lot, but if

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> we do it smart, it will cost much less, and indeed it could produce net benefits in the long run."
>
> —CEA chair Janet Yellen, testifying at a 1997 congressional hearing[23]

How does one define "doing it smart"? In the case of the Kyoto Protocol, economists would likely envision a "smart" policy as one that facilitated cost-effective attainment of the Kyoto target. Any evaluation of a proposed emissions abatement or sequestration policy would necessarily involve a comparison with other alternatives to determine whether the proposal passes a cost-effectiveness test. By publicly stating that the Kyoto Protocol could cost $23 per ton, and reinforcing it with claims of "modest" costs, the administration had effectively established the standard by which to judge domestic policy proposals. "Could" easily became "would" as interpreted inside the Beltway, so any policy that would result in a marginal cost of abatement less than $23 per ton would be cost-effective. Any policy exceeding that value would not be cost-effective. Or put another way, policies with marginal costs below $23 per ton would be "smart," and those exceeding $23 per ton would be "dumb."

This simple characterization of cost-effectiveness potentially influenced domestic policy through both external pressure and internal deliberation. The administration's proposed policies on tax credits and research and development (R&D) funding for renewable energy and energy efficiency, referred to as the Climate Change Technology Initiative (CCTI), failed to garner congressional support in part because of questions about cost-effectiveness. In 1997, the president had announced the CCTI as a way to "prime the pump" for technological development and deployment, and this served as the core of the first part of his three-stage plan to address climate change.[24] Elements of the CCTI package included tax credits for electric and fuel cell vehicles, rooftop solar photovoltaic systems, and wind-based electricity generation, as well as R&D funding for combined heat and power systems, renewable electricity sources, and energy-efficient housing. The president originally proposed $5 billion over five years for the program, although the administration requested more than $6 billion for these tax credits and R&D for fiscal year 1999.

The CCTI drew significant criticism from Congress. Some of the opposition reflected the antipathy some members of Congress felt toward anything potentially related to the implementation of the Kyoto Protocol; other members raised legitimate questions about how much "bang for the buck" the CCTI would deliver.[25] To determine the cost-effectiveness of the CCTI proposals, Congressmen James Sensenbrenner and David McIntosh

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requested that EIA conduct analyses of the administration's FY2000 and FY2001 CCTI proposals.[26] The results of the EIA (2000a) analysis make for imperfect comparisons with the administration's analysis of the Kyoto Protocol, as EIA estimated the average revenue reduction per ton of CO_2 abated, whereas the administration estimated the marginal cost of the last ton reduced to comply with the Kyoto target. Nevertheless, the EIA analysis can provide some sense of the relative cost-effectiveness of the CCTI proposals.

Three aspects of the EIA analysis illustrate how the CCTI would not promote cost-effective emissions abatement. First, the average revenue reduction per ton abated exceeds the Kyoto Protocol economic analysis permit price of $23 per ton for every tax credit evaluated. None of the proposed tax credits cost less than double the $23 value per ton, and some cost 15 to 20 times more per ton.[27] Second, the average revenue reduction per ton varies by a factor of 10 across various proposed tax credits.[28] If the variation in revenue reduction for the marginal ton abated is comparable to the variation in this average, this implies that some of the proposals should receive more funding (the low cost per ton tax credits) and others should receive less (the high cost per ton tax credits). Shifting the funding around could increase the amount of emissions abatement for the same overall funding package, thereby improving cost-effectiveness. Third, EIA estimates that for a majority of the proposed tax credits, more than half of the tax credit recipients would have invested in the targeted technology even without the tax credit. For example, 80 percent or more of tax credits for wind energy, rooftop solar panels, and electric and fuel cell vehicles would go to individuals who would have made the investment anyway. That's not much bang for the buck.

Focusing on the comparison of the CCTI with the administration's economic analysis, Congressman McIntosh challenged several agencies to defend the proposed funding for the CCTI. He submitted questions to the administration asking whether any element of the CCTI passed the Yellen Standard. A policy proposal would pass this "Yellen Standard," named in reference to Yellen's Kyoto Protocol testimony with the illustrative estimate of $23 per ton, if it cost less than $23 per ton. As evidenced in the EIA analysis, none of the proposed tax credits would pass the Yellen Standard. Although the administration proposed several versions of the CCTI over three budget cycles, Congress refused to enact any of the tax credits. The phoenixlike quality of bad policy ideas inside the Beltway applies in the case of some of these tax credits, as the Bush administration proposed similar ineffective and costly tax credits as a part of its 2002 climate change proposal.

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PROMOTING EFFICIENT INTERNATIONAL EMISSIONS TRADING

> "I can say that we will not accept such a limitation, period."
> —Undersecretary of State Stuart Eizenstat, responding to a question about a German proposal to restrict international emissions trading at a 1998 congressional hearing[29]

The rules governing international emissions trading likely served as the most contentious climate policy issue between the United States and the European Union over the 1997–2000 period. The United States supported unfettered trading for several reasons. First, based on the U.S. experience with sulfur dioxide emissions trading, as well as other environmental trading programs, the United States believed that emissions trading could achieve the greatest environmental benefit for a given economic cost. Second, the United States advocated free trade in principle, and this translated to pressing for unrestricted trading in emissions allowances. Third, international emissions trading could provide the incentive for developing countries to take on emissions targets and enjoy economic benefits from selling emissions allowances into the international market. Fourth, economic analyses undertaken before, during, and after the Kyoto negotiations showed substantial cost savings from trading. For example, the AEA estimated that efficient trading among Annex I countries could reduce the marginal cost of abating greenhouse gas emissions in the United States by nearly 75 percent.

The EU opposed unrestricted trading for several possible reasons. First, it considered international emissions trading as a weakening of the Kyoto targets, because the EU claimed such trading allowed the so-called Russian "hot air" [30] to be used by other countries and thereby increase aggregate Annex I emissions above what they otherwise would have been without trading.[31] Second, some within the EU opposed trading on ideological grounds. Some left-leaning environmentalists believed that trading constituted an inappropriate "commoditizing" of the environment. Some who favored climate change policy as a mechanism to advance their social engineering goals believed that countries should comply with their targets exclusively through domestic abatement.[32] Third, the EU may have advocated restrictions on trading as a way to gain competitive advantage against countries with higher domestic abatement costs, such as Japan and the United States.

Although the United States supported international emissions trading, it was not clear whether this provision would be sacrificed as a part of a com-

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promise deal in the Kyoto negotiations. I was surprised at the clear, concise, and explicit statement in opposition to restrictions on emissions trading made by Undersecretary Eizenstat at the March 4, 1998, hearing. At that time, the international consensus on the trading rules consisted of no more than three sentences in the Kyoto Protocol and a promise to elaborate on the rules at subsequent negotiations. The AEA would make acceptance of any restriction on trading costly in economic and political terms. Since the $23 per ton case reflected purchases of emissions allowances representing 75 percent of the effort necessary to comply with our target,[33] any restriction on trading that would have satisfied the Europeans would have forced more domestic abatement and placed higher costs on the United States. Any EU-supported restriction on trading would have made $23 per ton impossible with virtually every respected economic model of U.S. climate change mitigation, absent a creative compliance mechanism (e.g., a safety valve that capped the price on tradable permits) or renegotiation of targets (e.g., large carbon sinks). A ratification battle on a protocol with restrictions on trading could not depend on the AEA. Further, the AEA (and the nearly 300 pages of documents published in the record of the March 4, 1998, hearing) could be used to show that the costs of an agreement with trading restrictions would significantly exceed $23 per ton.

Fortunately, the administration maintained a strong position for unrestricted trading in spite of the EU's efforts to the contrary. Its analysis of the EU's May 1999 proposal to restrict both the buying and selling sides of the international emissions trading market indicated that the restrictions could bind so severely, especially on net-selling countries, that they could eliminate virtually all cost savings from trading for the United States. This proposal also provided us with an opportunity to highlight the absurd hypocrisy of the EU position. The administration evaluated the emissions transfers under the EU "bubble" with the EU proposal to restrict trading. The "bubble" provision under the Kyoto Protocol allows a group of countries to transfer emissions allowances once before the commitment period and assesses compliance on the basis of all participating countries' emissions (all those under the "bubble"). Although these transfers represented political trades of emissions, the EU decided to exclude this flexibility mechanism from its proposal that restricted international emissions trading, joint implementation, and the Clean Development Mechanism (CDM). Using the EU's own emissions inventories and forecasts, our assessment showed that 10 of the 15 EU countries' political trades would violate either the buying or selling restrictions in its own proposal (see CEA 2000, Box 7-7). The

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EU proposal never gained the support of the rest of Annex I, and negotiators at the Bonn and Marrakech conferences in 2001 reached agreement on the rules for trading that excluded any quantitative restrictions on trading.

PROMOTING DEVELOPING-COUNTRY PARTICIPATION

> "In the developed world, only two people ride in a car, and yet you want us to give up riding on a bus."
>
> —reported response by a Chinese negotiator to a proposal for developing-country commitments at the 1997 Kyoto Conference[34]

Immediately after the Kyoto negotiations, it was obvious that the role of developing countries in climate change policy fell well short of "meaningful participation," not to mention the Byrd–Hagel resolution. The Kyoto negotiations also clearly revealed that the administration's position on "meaningful participation" did not enjoy support among developing countries. Although the developing countries, as a negotiating bloc, stridently opposed the New Zealand proposal for a Kyoto Mandate for developing-country commitments, the administration did assume in its economic analysis that some "key developing countries" would take on emissions targets and engage in international emissions trading. The analysis assumed that China, India, Korea, and Mexico adopted emissions targets for 2010. Excluding these countries from efficient international emissions trading would increase the marginal cost in the United States by 130 percent, from $23 to $54 per ton (Clinton Administration 1998, *52*).

Developing countries opposed emissions commitments because they considered such commitments synonymous with constraints on economic growth. The form of the Kyoto commitments, with targets below emissions levels at the time of the Kyoto negotiations for a majority of Annex I countries, reinforced the developing countries' perception. Certainly, no developing country could adopt an emissions commitment below its current emissions level and expect this not to inhibit its economic development. Further, some countries also believed that because the industrialized countries consumed fossil energy as the basis for their development, this entitled developing countries to do the same. Finally, developing countries in general did not support emissions growth targets because of concerns about the difficulty of forecasting future economic and emissions growth.[35]

Many European countries also were lukewarm to the idea, and several opposed U.S. efforts to enlist developing countries. Some countries (and

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environmental NGOs) expressed concern that the United States sought developing-country commitments padded with "hot air," or, as the term evolved, "tropical hot air." If developing countries adopted "tropical hot air" targets, so their argument went, then the United States could purchase surplus emissions allowances from these countries, thereby undermining the environmental benefits of the Kyoto agreement. The EU did not like emissions growth targets set below forecast business-as-usual emissions for developing countries out of concern that a Russian-like fall in emissions would create tropical hot air. In diplomatic circles, rumors abounded that European countries actively dissuaded some developing countries that the United States had talked to about emissions commitments.

In light of the concerns of developing countries and the EU, the administration faced the challenge of how to promote more active participation by developing countries. With a public analysis premised on developing countries adopting emissions targets, this participation needed to take the form of binding first-period emissions commitments for at least some countries. As the administration worked on its economic analysis, Yellen challenged her staff to think about how to provide an incentive for developing countries to adopt emissions commitments.

The constraints on the developing-country commitment problem can be summarized as follows: to attract participation, commitments needed to be consistent with economic development; to attract the support of European countries, commitments needed to deliver real emissions abatement from business as usual; and to facilitate U.S. compliance with its commitment at a low cost, developing-country commitments needed to be of a form that would allow them to participate in international emissions trading.

A failure to comply with the first constraint would result in developing countries not joining the community of countries with emissions commitments. A failure to comply with the second constraint would result in European countries skeptical of "tropical hot air" not supporting developing countries attempting to adopt emissions commitments. Under the consensus rules governing the negotiations, opposition from European countries would prevent developing countries from taking on commitments. A failure to comply with the third constraint would result in U.S. resources, in terms of diplomatic capital and technical support, being expended with no economic benefit in terms of compliance costs. Further, international emissions trading appeared to be the only way to make the prospect of emissions commitments economically appealing to developing countries.[36]

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The concerns of developing countries and the EU reflected the same fundamental aspect of emissions commitments: uncertainty over future economic growth and energy development makes the stringency of any commitment uncertain. Developing-country rhetoric revolved around what would happen if their economies grew faster than expected, a mirror image of the EU's concern over what would happen if the developing-country economies grew more slowly than expected. From their own perspectives, both groups viewed emissions commitments through worst-case-scenario lenses.

To address these concerns about uncertainty, CEA proposed developing-country emissions growth targets indexed to indicators of economic growth (see CEA 2000, Box 7-6; Lutter 2000). Such commitments would allow a country's emissions to grow from current levels as an explicit function of economic growth. Countries that experienced rapid development would have a larger emissions target; those with more modest development would have a smaller target. The key to a selecting such an indexed target lies in identifying a function that results in a reasonable below–business-as-usual emissions commitment. Constructing such an indexed target, however, should not create perverse incentives. For example, historic carbon dioxide emissions predict future emissions well. Creating an indexed emissions target based on emissions from a previous year (or years) would give countries an incentive to increase their emissions until the beginning of the first commitment period instead of implementing policies to abate emissions.

Based on our analyses on the prospects for this type of commitment, and the strong desire within the administration to break the deadlock with developing countries, CEA began introducing the idea to developing countries in spring 1998. Over the next two-plus years, we took a very active role in the administration's developing-country diplomacy at both political and staff levels. We had scores of discussions with non–Annex I countries about indexed targets in bilateral and multilateral settings. These included meetings with reluctant countries, such as China, Mexico, and Korea, and those considering more proactive actions, such as Argentina and Kazakhstan.

The first non–Annex I countries to come forward and propose to take on emissions commitments were Argentina and Kazakhstan at the 1998 climate change conference in Buenos Aires, Argentina. The administration worked with both countries, providing technical support for their efforts to develop emissions commitments. This included support for emissions inventories, economic and emissions forecasts, and evaluation of emissions abatement policies.

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Kazakhstan expressed interest in joining Annex I (as had five other former Soviet republics) and adopting an emissions target similar to Russia's.[37] Although several developing countries initially put up diplomatic roadblocks under the FCCC to Kazakhstan's accession to Annex I, the parties to the 2001 conference in Marrakech, Morocco, agreed to Kazakhstan's request.

In contrast, Argentina wished to set an example of a third way for developing countries to contribute to the global effort to address climate change. At the 1999 climate change conference in Bonn, Germany, Argentina announced its intention to adopt a binding emissions target indexed to economic growth for the first commitment period if the parties to the FCCC would develop a mechanism for Argentina to participate in international emissions trading.[38] Unfortunately, although economics can inform the design of policy instruments to address concerns about uncertainty (indexing) and provide an economic incentive for participation (trading), the developing-country negotiating bloc, led by China and India, refused even to allow debate about a voluntary accession mechanism in the negotiations. Without a legal way to join international emissions trading, Argentina no longer has an economic incentive to implement policies to abate emissions. Moreover, the latest economic crisis in Argentina has most likely diverted attention away from virtually all noneconomic questions, although it may also be reducing greenhouse gas emissions.

Beyond Kazakhstan and Argentina, administration officials spoke with representatives of many other developing countries about emissions commitments, although probably none as frequently or at as high a level as China. Congress had focused on China out of concern that energy-intensive industries, and associated jobs, would relocate to China, as well as to other developing countries. Some also made the very legitimate point about the limited benefits of any climate agreement that excludes the world's second-largest emitter from policy action. Obviously, China headed the list of "key developing countries," so the administration expended significant efforts to illustrate the potential benefits to China of adopting an emissions commitment. On the president's 1998 trip to China, Yellen held several meetings with senior Chinese officials to discuss climate change policy, including the potential for indexed targets. Administration officials pressed the case in subsequent staff and political-level meetings with their Chinese counterparts. In 1999, CEA drafted an analysis of the potential gains from emissions trading for China and details about constructing an indexed emissions target.[39] The administration transmitted this report to the Chinese government at the highest level. Despite these efforts, China

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repeatedly refused to adopt emissions commitments and erected barriers where possible to slow U.S. efforts to enlist other developing countries.

The U.S. policy for "meaningful participation by key developing countries" did not result in a long list of developing countries coming forward to take on emissions commitments. Without the administration's economic analysis, the administration (and CEA) likely would have expended fewer resources to promote developing-country climate mitigation policies. Despite the lack of developing-country commitments, these efforts have provided benefits, some of which will likely be reaped in the future. First, involving the economic agencies helped frame discussions with developing countries more in terms of their development (which they care about) instead of the global environment (which we care about). Second, the efforts to promote developing-country policies increased the human capital in some developing countries. These countries can tap more sophisticated technical staff for work on climate mitigation policies. This may facilitate CDM projects (although it is difficult to be optimistic about the CDM). More important, this may help prepare these countries to adopt emissions commitments in the future. Third, the discussions with developing countries, even those solidly opposed to our position, such as China, allowed the U.S. government to explain how emissions trading works. At one time in the negotiating process, the developing-country bloc supported the EU call for restrictions on trading. The education and information exchange of our developing-country strategy helped weaken the resolve for such restrictions.

Finally, introducing indexed targets had two effects. It showed an innovative way for developing countries to adopt emissions commitments. It also introduced in concrete terms for the first time flexibility in the construction of an emissions commitment.[40] Although many economists support an emissions tax or a hybrid tax-trading system (sometimes referred to as the safety valve) to provide flexibility,[41] this idea faced a variety of political obstacles and gained little traction over the 1997–2000 period. Interestingly, the idea of an emissions commitment indexed to economic growth gained acceptance by the Bush administration when it proposed its alternative to the Kyoto Protocol for the United States.

THE BUSH ADMINISTRATION CLIMATE CHANGE POLICY

> "When a person is accustomed to one hundred and thirty-eight in the shade, his ideas about cold weather are not valuable."
>
> —Mark Twain[42]

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In a March 13, 2001, letter to several members of the U.S. Senate, the Bush administration announced that it opposed the Kyoto Protocol.[43] The letter cited concerns about developing-country participation and the costs of the Kyoto agreement as the basis for its decision. Upon rejecting the Kyoto framework, the Bush administration convened a cabinet-level policy process to develop a new climate change policy. As the Bush administration deliberated over its policy options, the rest of the world proceeded with the international negotiations to finalize Kyoto's implementation rules. At meetings in Bonn, Germany, and Marrakech in summer and fall 2001, the rest of the world resolved its disagreements about the implementation of Kyoto. As of November 2003, 32 Annex I and 87 non–Annex I countries had ratified the Kyoto Protocol, and the agreement will enter into force if Russia (or the United States) ratifies the protocol.

Nearly one year after rejecting the Kyoto Protocol, the Bush administration announced its climate change policy. In contrast to the binding emissions quota approach embodied in the Kyoto agreement, the Bush administration proposed a greenhouse gas intensity goal. Noting that the U.S. economy currently emits about 183 metric tons of greenhouse gases (in carbon equivalent) per million dollars of output, the administration proposed a goal of reducing this emissions intensity to 151 metric tons per million dollars of output by 2012. This goal represents an 18 percent improvement in emissions intensity over the next decade. Absent any new climate or energy policies (under a business-as-usual forecast), however, the economy's emissions intensity would improve 14 percent over the next 10 years. The Bush administration's proposal represents an improvement of 4 percent in emissions intensity, or a reduction of about 100 million metric tons from what the output would be otherwise, given current economic projections.[44]

Several aspects of this policy proposal deserve mention. First, as an interesting historical comparison, the current Bush administration proposal appears to be less ambitious than the nonbinding goal accepted by President George H. W. Bush in the Framework Convention on Climate Change. The FCCC established a nonbinding goal for industrialized countries, including the United States, of stabilizing greenhouse gas emissions at their 1990 level starting in 2000. Based on the 1993 Climate Change Action Plan, attaining such a goal in the United States would have required an emissions abatement of 113 million metric tons from the 2000 business-as-usual forecast (U.S. DOS 1997, Table 4-5).[45] If the U.S. economy grew faster over the subsequent decade than projected in the early 1990s, as it

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did, then the country would need to undertake even more emissions abatement to comply with that goal. In contrast, the current Bush administration established a unilateral nonbinding emissions commitment that would require 106 million metric tons of abatement (based on White House–released data), and even less if the economy grows faster than expected. Promoting less stringent goals would make sense if we had learned over the past 10 years that abatement costs were exceeding previous forecasts. The very limited experience with voluntary programs, however, does not provide a basis for that claim.[46]

Second, the Bush administration has not published an analysis that illustrates how its suite of climate change policies will result in attaining the proposed intensity goal. One would prefer at least an assessment of the costs and emissions reductions from the various policies to allow for an evaluation of cost-effectiveness, if not a whole benefit–cost analysis. This could illustrate a consideration of alternatives (something congressional Republicans requested of the Clinton administration) and explain the choice of an 18 percent improvement in emissions intensity. Such an analysis could also address some concerns the public may have about the intensity goal. For example, the annual rate of improvement in carbon dioxide emissions intensity over the 1929–1998 period averaged 1.9 percent.[47] The Bush administration proposal implies a rate of improvement in greenhouse gas emissions intensity over the next decade of 1.9 percent per year. Obviously, forecasting involves more than a mere extrapolation of the past. Nevertheless, an assessment of why the next 10 years, forecast under business as usual to improve by less than 1.4 percent per year, would differ from the average of the past 70 years may better inform the public about the Bush administration's proposal and how it would require real abatement effort.

Third, complying with the greenhouse gas intensity goal could impose greater emissions reductions and higher costs in recession, and fewer emissions reductions and lower costs in an economic boom. One might design a climate mitigation policy such that if the country became wealthier, it would undertake more emissions abatement. The opposite holds for the Bush administration proposal. If the U.S. economy grew faster than expected, then the country would need to undertake less emissions abatement to attain the goal. The Bush administration used EIA's 2001 emissions and economic forecasts, noting that the EIA economic forecast matched the most recent budget's economic forecast. In addition to its reference case with 3 percent economic growth rate through 2020, EIA also conducted a

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forecast with a higher annual rate of 3.4 percent. I used the economic and emissions forecast from this higher economic growth case and found that faster growth *reduced* the necessary emissions abatement by 40 to 50 percent.[48] If the economy were to grow more slowly than expected, say at a rate of 2.4 percent per year over the next two decades (EIA's low economic growth case), then attaining the emissions intensity target would require about 25 to 33 percent *more* emissions abatement.[49] It does not appear to make much sense to develop a policy that would require more abatement expenditures when the country has less income than it would if the country had more income than expected. This explains in part why the Argentine government proposed an emissions target indexed to the square root of economic output. With a square root function instead of a simple linear function (the Bush administration's ratio), the emissions abatement required to comply with the target increases with economic growth. A Bush administration analysis could also explain the choice of the form of indexing and characterize potential alternatives.

Fourth, the Bush administration proposal appears to illustrate strong bipartisan support for relatively painless and ineffective policies. The proposed policies in the February 2002 announcement reflect in large part repackaged Clinton administration policies. The policies the Bush White House highlights in its policy book—tax credits, R&D funding, voluntary industry consultations and agreements, promising "credit" to firms that undertake early emissions abatement, and so on—served as the core components of the first stage of the Clinton administration climate change policy.[50] The significant difference, at least in principle, reflects the Clinton administration policy for a domestic tradable permit system that would ensure compliance with the Kyoto target. More important, this likely would help drive some of the technology development and diffusion and complement some of the voluntary actions. The Clinton administration did not develop a tradable permit system, but this reflected as much the successful efforts of congressional Republicans to forbid any work on implementing Kyoto in the executive branch as it did the lack of appetite within the administration for a potentially large policy debate.[51]

The Bush administration had the opportunity to advocate reasonable policies to promote real emissions reductions. For example, it could have supported a policy similar to the Resources for the Future economywide trading with safety valve program (Kopp et al. 1999). Some critics would have liked the administration's support for a four-pollutant utility cap-and-trade program instead of the three-pollutant program in its Clear Skies

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Initiative. Instead, the climate change proposal reflects the easy short-term solution of voluntary measures. Unfortunately, the Bush administration has not provided a public analysis to inform the debate over its proposal. Although the current White House may not want to be constrained by such an analysis, good policymaking should inform the public about the economic implications of the policy in question.

CONCLUSIONS

Although some observers criticized the AEA for its optimistic assumptions about international emissions trading and developing-country participation, the focus on results premised on these assumptions yielded two benefits. First, the AEA illustrated the substantial cost savings from both international emissions trading and expanding the international tradable permit market to include developing countries. Informing the public, Congress, and foreign policymakers about the gains from emissions trading helped mobilize support for cost-effective policy implementation. Second, highlighting that "modest costs" depend on efficient international emissions trading and developing-country participation raised the political cost of failing to attain the diplomatic objectives necessary to deliver this outcome. This motivated efforts to secure good trading rules and developing-country participation.[52] Had the administration submitted the protocol to the Senate, the analysis also would have illustrated the costs of the ratification package, even if these differed from the commonly referenced $23 per ton case.

The debate over a public policy can always benefit from public economic analysis. One can always find flaws with an economic analysis: Was it a Democratic or a Republican analysis? Was it funded by the oil industry or by environmentalists? Nevertheless, it can inform the public and spur a discussion of the economic implications of the policy. Understanding the critical elements of any policy can positively influence international negotiations as well as domestic policy design. The alternative may not improve the policy debate. An imperfect analysis may be like walking in a cave with a candle: one may prefer a flashlight to a candle, but that candle sure beats walking around in the dark.

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NOTES

The author thanks Randy Lutter, Ron Minsk, Jay Shogren, and Bob Cumby for productive discussions and helpful comments. All website citations below were current as of June 3, 2004.

1. Mike Toman's chapter in this volume explores this issue in greater detail.

2. Attributed to Mark Twain in the 1921 Ford Calendar (see www.twainquotes.com/Weather.html).

3. "Industrialized countries" refers to members of Annex I to the FCCC and Annex B to the Kyoto Protocol. With only a few minor exceptions, the memberships of both annexes are identical (Annex B includes 38 countries). The group of industrialized countries includes almost all Organization for Economic Cooperation and Development (OECD) countries and most economies in transition from the former Soviet bloc. All countries excluded from Annex I and Annex B are referred to as developing countries in the climate change policy context.

4. See decision 1/CP.1 in the report on actions taken at the 1995 Berlin conference at unfccc.int/resource/docs/cop1/07a01.pdf.

5. The models used in the IAT include the second generation model (SGM), the DRI macroeconometric model, Markal-Macro, and the Energy Information Administration's NEMS model. The draft report presented results primarily from the first three models. The SGM is the only global model in this set and was used to evaluate international emissions trading. The DRI model is the only one of the first three that could provide estimates of changes in unemployment.

6. The IAT evaluated three emissions targets: 1990 emissions by 2010; 1990 – 10% emissions by 2010; and 1990 + 10% emissions by 2010.

7. Two other contributors to this volume had critiqued these technology assumptions as comparable to the Great Leap Forward in an interagency memorandum.

8. See Subcommittee on Energy and Power (1998a, *75–134*) for the reviewers' comments.

9. Note, however, that some economists still expressed concern about a "fast train to the wrong station" (Wiener 1999b) and preferred decision makers to pursue emissions taxes (Cooper 1998; Nordhaus 2002). Since the "t" word has been considered one of the most obscene utterances one can make inside the Beltway, policymakers outside of the economic agencies never seriously considered carbon taxes.

10. This report employed what is referred to in the literature as a "bottom-up" approach.

11. See Jacoby 1999 for a critique of this study.

12. See www.state.gov/www/global/oes/971210_clinton_climate.html for the full text of President Clinton's December 10, 1997, press statement on the Kyoto Protocol.

13. Often referred to as the "CEA analysis" because Yellen testified on behalf of the administration on the economics of the Kyoto Protocol, the AEA reflected the

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contributions of multiple agencies and the administration's view of the economics of Kyoto.

14. Some in the environmental community were also concerned that the low costs implied that the United States would attempt to buy its way out of its commitment by purchasing emissions allowances from Russia and other countries in lieu of domestic abatement.

15. The remainder of this chapter will focus on the $23 per ton scenario. The $14 per ton scenario is identical except that it assumes that the European Union (EU) would not participate in international emissions trading with non-EU Annex I countries. While this possibility was under discussion during and immediately following the Kyoto negotiations, subsequent talks revealed that at least some EU countries would participate in some form of international emissions trading under the Kyoto agreement. This scenario became less relevant than the $23 per ton scenario over time.

16. See Clinton Administration 1998, Edmonds et al. 1992, and MacCracken et al. 1999 for a discussion of the SGM.

17. Although some modelers evaluated potential restrictions on trading based on the EU position on supplementarity, the modeling scenarios still assumed least-cost abatement subject to the supplementarity constraint.

18. The gains from trading presented in the AEA also reflected the inclusion of all six types of greenhouse gases. The administration evaluated the Kyoto commitments in terms of all greenhouse gases, not just carbon dioxide as had been the practice in the modeling community until then. Implicit in our modeling results is efficient intergas trading. Allowing for intergas trading reduced the price of carbon equivalent in this analysis, because many countries had much slower growth rates forecast for non–carbon dioxide greenhouse gases than for carbon dioxide. Subsequent research by the academic community substantiated this finding that accounting for all greenhouse gases can result in lower costs than a carbon dioxide–only analysis (Reilly et al. 1999; Hayhoe et al. 1999; Manne and Richels 2000).

19. The decision to maintain the EIA benchmark technology assumption confronted significant pressure while we drafted the AEA report. As the interagency discussions on the report were nearing a conclusion, the head of an environmental nongovernmental organization (NGO) wrote to Yellen, as well as other senior members of the administration, questioning the EIA benchmark technological assumption and requesting that the administration consider a more ambitious technological premise. Although such an assumption would serve some environmentalists' desires for substantial domestic emissions abatement, the more ambitious technological assumption lacked any economic justification and was rejected as the administration concluded the drafting of the report. The intervention by this environmental group also reflected a problem within the administration concerning the leaking of documents and information on internal deliberative discussions.

20. Some critics requested that the Clinton administration submit the Kyoto Protocol to the Senate in early 1998 so that it could quickly reject the agreement (see Subcommittee on Energy and Power 1998b). Although the Clinton administration did not submit the protocol to the Senate for its advice and consent to ratification, it is important to recognize that the United States was not alone. Because the negotiations about the implementation of the agreement lasted through the 2001

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Bonn climate change conference, most Annex I countries had decided to wait until the details had been finalized before considering ratification. Romania was the only Annex I country to ratify the Kyoto Protocol prior to the 2001 Bonn talks. (For a list of countries that have signed or ratified the Kyoto Protocol, refer to unfccc.int/resource/kpstats.pdf.)

21. See the May 19, 2000, Joint Statement on Cooperation on Environment and Development between the United States and China, www.usembassy-china.org.cn/press/release/2000/gore519.html.

22. See, e.g., OECD 1995.

23. Quoted in Subcommittee on Energy and Power (1998a, *13*).

24. The three-stage plan established the president's Climate Change Initiative over the 1997–2012 period. Stage one focused on voluntary efforts, including the CCTI, industry consultations, and credit for early action. Stage two involved a scientific and economic review and expansion of successful first-stage programs. Stage three (2008–2012) would implement the Kyoto Protocol through a domestic tradable permit system for greenhouse gases coupled with international emissions trading. See www.state.gov/www/global/global_issues/climate/background.html for more details on the Clinton plan.

25. These questions were not new; staff from economic agencies questioned the cost-effectiveness of some of these proposals during the development process within the administration. Because the administration had already decided on the size of the CCTI package, however, the goal of this policy process was to find ways to spend $5 billion or so over the next five years. This caused some to search for ways to spend the money, even if some proposals were not very effective ways to do so.

26. Congressman Sensenbrenner chaired the House Science Committee, and Congressman McIntosh chaired a subcommittee of the House Government Reform Committee. These two committees convened many hearings on climate change policy over the 1997–2000 period.

27. EIA focused primarily on the tax credit elements of the CCTI, given the difficulty in estimating the payoffs from increased R&D funding.

28. Although EIA provides a variety of measures of projected tax revenue reduction per ton of carbon abated, my discussion focuses on the scenario with forgone revenues and emissions abatement discounted at a 7 percent rate (see Table ES5 in EIA 2000a).

29. Quoted in Subcommittee on Energy and Power (1998b, *44*).

30. Russian "hot air" refers to the difference between Russia's Annex B emissions commitment (1990 level) and its forecast business-as-usual emissions for the first commitment period. As a result of transitioning from central planning to a market economy, Russia's greenhouse gas emissions are expected to be below 1990 levels during the commitment period even without any new emissions abatement policies.

31. This argument suffers from two flaws. First, the opportunity to bank emissions allowances for use in subsequent commitment periods indicates that the "hot air" tons would be emitted either by a buying Annex I country in the first commitment period or by Russia in the second or a later period. Trading, even of hot air, is

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then climate neutral, given that changes in the climate are driven by the stock, not the flow, of emissions. Second, the negotiations on emissions commitments were conditional in part on the negotiations on the Kyoto flexibility mechanisms (international trading, joint implementation, CDM). Some Annex I countries accepted more stringent targets with the assumption that unrestricted trading could reduce their costs more than they would have without the availability of trading. Trying to restrict trading then constituted a backdoor attempt to renegotiate the Kyoto targets.

32. Wiener (1999b, *777*) notes that some referred to "these pseudo-environmentalist social engineering lobbyists" as "watermelons—green on the outside, red on the inside."

33. The 75 percent figure is from the administration tables published in the record of the March 4, 1998, hearing (Subcommittee on Energy and Power 1998b, *323*). I never understood why opponents of the Kyoto agreement who tried to embarrass Yellen in hearings by trying to get her to state this figure did not just read her agency's documents. These documents were requested on a bipartisan basis, so presumably any member of Congress could have asked a colleague for them. Moreover, copies of these documents, as a part of the hearing record, were available in every government document depository in the nation by the end of 1998.

34. Reported in Climate Action Network (1997).

35. For example, in June 1998, as a member of a small delegation meeting with the government of Korea in Seoul, we raised the issue of an emissions growth target with the Korean government. Most of our meetings occurred in hot and stuffy conference rooms, which signaled the state of the Korean economy (the government shut down air-conditioning systems in its office buildings in response to the Asian financial crisis) and related challenges in forecasting economic activity. We were told that the government's forecast of economic activity over the next several quarters was highly uncertain. Given the uncertainty over forecasting the next several quarters, the Korean officials found it implausible to consider basing policy on forecasts over the next decade or two.

36. Although some of the literature on international environmental treaties considers side payments as one mechanism to promote developing-country participation, given political and budgetary constraints, such proposals were not on the table.

37. In a February 1999 meeting with the ministers for the environment and the budget of Kazakhstan, the environment minister offered this deal to the U.S. delegation: "If the U.S. gives Kazakhstan $500 million by April [1999], then Kazakhstan would give the U.S. as many emissions permits as it wants." I responded, "Unfortunately, I do not have my checkbook with me." After a stunned stare from my colleague from the State Department and a pause for the translation, fortunately followed by laughter, the environment minister repeated the deal, and I had to provide a less creative response. I am still waiting for the State Department to invite me to join the diplomatic corps.

38. The proposed Argentine target was based on this function: greenhouse gas emissions = 151.5*(GDP)1/2.

39. Virtually every global energy-economic model shows that China would have lower marginal costs to abate a given percentage of its emissions than all other major countries in the world.

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40. For further discussion of various types of developing-country commitments, see Philibert and Pershing (2001), Aldy et al. (2003a), and Bodansky (2003).

41. Proponents of such a hybrid approach include several economists formerly employed in the Clinton administration. See, e.g., Kopp et al. (1999) and Aldy et al. (2001).

42. From "Following the Equator" (see twainquotes.com/Environment.html).

43. See www.whitehouse.gov/news/releases/2001/03/20010314.html.

44. All figures in this paragraph are from the Bush administration policy briefing on the White House website (see www.whitehouse.gov/news/releases/2002/02/climatechange.html).

45. This reflects emissions of carbon dioxide, methane, nitrous oxide, and synthetic compounds. It does not include estimates of carbon sequestration to facilitate the policy comparison. Note that the 2002 climate change policy reflects gross emissions and does not account for carbon sequestration (see www.whitehouse.gov/news/releases/2002/02/addendum.pdf).

46. Proponents of these voluntary programs would claim to the contrary that emissions abatement costs less than some may have previously predicted. I think these programs do little more than subsidize corporate public relations departments and illustrate the phenomenon of adverse selection to economics students.

47. This average reflects U.S. economic output data from the Bureau of Economic Analysis and carbon dioxide emissions from the Carbon Dioxide Information Analysis Center. EIA carbon dioxide emissions data date back to 1949; emissions data for other greenhouse gases date back only to 1980.

48. EIA publishes forecasts only for energy-related carbon dioxide emissions and GDP. My range reflects two assumptions. The low end assumes that the increase in non–carbon dioxide emissions is proportional to the increase in carbon dioxide emissions in the higher GDP growth case. Since non–carbon dioxide emissions tend to track economic output less closely than carbon dioxide, the high end of the range assumes that forecast non–carbon dioxide emissions are identical under the reference and high economic growth cases. See Appendix B of EIA 2000a for the high and low economic growth cases.

49. This calculation is identical to the calculation describe in the preceding footnote. The high end of the range assumes that non–carbon dioxide emissions are identical under the reference and low economic growth cases, and the low end assumes that non–carbon dioxide emissions grow more slowly in the low economic growth case than in the reference case.

50. Interested readers may want to compare the informational materials released by the Clinton administration in 1997 on its climate change policy with the Bush administration informational materials. Clinton administration: www.state.gov/www/global/global_issues/climate/background.html. Bush administration: www.whitehouse.gov/news/releases/2002/02/climatechange.html.

51. Congress attached to several years' appropriations bills the Knowlenberg Amendment, which strictly forbade the staff at many of the relevant agencies to work on any policy related to implementing the Kyoto Protocol. Because the Senate requested implementation legislation to accompany the Kyoto Protocol when the administration decided to submit the agreement to the Senate for its advice and

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consent (under the Byrd–Hagel resolution), one may wonder how the administration could have satisfied these conflicting preferences.

52. Two years after we conducted the AEA, it had become evident that China, India, Korea, and Mexico were not going to adopt emissions targets for the first commitment period. Although the climate change issue had a lower Beltway profile at this time, the concern about costs and "insufficient" domestic emissions abatement (environmentalists do not give up easily) prompted some to suggest that we redo the AEA in 2000. In this case, the proponent of this idea wanted the new analysis to assume 100 million metric tons of emissions reductions for free as a result of the president's announced goal to triple U.S. biomass energy by 2010. The "policy" supporting this goal was an executive order convening some new government committees.