RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 1-FEB-1998 15:34:04.00

SUBJECT: Revised rollout remarks

TO: Steven N. Braun (CN=Steven N. Braun/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
========== ATTACHMENT 1 ==========
ATT CREATION TIME/DATE: 0 00:00:00.00

TEXT:
Unable to convert ARMS_EXT:[ATTACH.D35]MAIL486865131.026 to ASCII,
The following is a HEX DUMP:

STATEMENT OF CEA CHAIR JANET L. YELLEN ON THE ECONOMIC ASUMPTIONS OF THE FY 1999 BUDGET

My job this afternoon is to tell you about the budget's economic assumptions. For the past 5 years, this Administration has built a record of conservative and credible economic assumptions. Comparing our earlier projections with the economy's actual performance therefore shows that to the extent we have erred, we have done so on the side of underestimating real growth. The assumptions in this year's budget coincide closely with the views of a consensus of economic forecasters.

The news over the past two years has been very, very good. Real GDP grew 3.8 percent for 1997 as a whole--the highest growth rate in nine years, and measures of income have been growing even faster. The unemployment rate has fallen from 7½ percent in 1992 to 4.7 percent in the fourth quarter. Over 14 million jobs have been created during this Administration. And all this has been accomplished while inflation has declined to its lowest level since 1965.

Although growth has exceeded our expections in recent years, we believe that for budgetary purposes we should not count on a continuation of growth at its recent extraordinary pace. We are projecting that real GDP will continue to grow--but at a slower 2 percent annual rate over the four quarters of 1998, and this 2 percent pace is projected to persist for a further 2 years. At the same time, the unemployment rate is assumed to edge up about about two tenths of a percentage point per year. Inflation, as measured by the CPI, is assumed to edge up only

slightly over the next three years.

After 2000, real GDP growth is projected to resume its trend growth rate of 2.4 percent, and the unemployment rate stabilizes at 5.4 percent.

This shift to more moderate growth assumed in this budget recognizes that, by conservative, mainstream assumptions, growth has exceeded the pace that can be maintained on a sustained basis without an eventual tendency for upward inflationary pressure. Our assumed real growth rates are not the *best* that the Administration believes the economy can achieve--the outcome could be better.

Let me conclude by saying that the growth-oriented economic strategy adopted by this Administration has clearly paid off. The Administration's 1993 deficit reduction plan created the conditions necessary for the vibrant economic performance we are now enjoying; our economy is the strongest in a generation. We have in place a solid foundation for sustained economic growth and rising living standards for all Americans.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 1-FEB-1998 17:28:18.00

SUBJECT: draft testimony on GCC

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
---------- Forwarded by Jeffrey A. Frankel/CEA/EOP on 02/01/98
05:27 PM ----------

Jeffrey A. Frankel
02/01/98 05:28:38 PM
Record Type: Record

To: ORSZAG_P @ A1 @ CD @ LNGTWY
cc: Joseph E. Aldy/CEA/EOP, Randall W. Lutter/CEA/EOP, Adele C. Morris/CEA/EOP
Subject: draft testimony on GCC

========== ATTACHMENT 1 ==========
ATT CREATION TIME/DATE: 0 00:00:00.00

TEXT:
Unable to convert ARMS_EXT:[ATTACH.D10]MAIL47633613G.026 to ASCII,
The following is a HEX DUMP:

Close hold JF 2/1/98

DRAFT TESTIMONY:
ECONOMIC ANALYSIS OF KYOTO AGREEMENT

[Expressions in square brackets need to be discussed, and in some cases deleted. Additional technical passages may also need to be simplified or cut, even for purposes of written testimony, let alone oral. Numbers will need to be rounded off, to avoid a false sense of precision. But I would suggest holding such suggestions at the first round of vetting, or entering them into a parallel document, and concentrating for the moment on making this document an accurate Economic Analysis and well-crafted statement of our position.]

The President has said that we can work to avert the dangers of climate change, while at the same time maintaining the strength in our economy. I am pleased to have this opportunity to elaborate.

Basic Economic Rationale of the Kyoto Treaty

What is the basic rationale, from an economist's perspective, for the Kyoto Agreement?

The earth's surface is warming from the accumulation of greenhouse gases from myriad sources worldwide, none of which presently pay the cost to others of warming's ill effects. As a result of these distorted incentives, disruption of the Earth's climate is likely to proceed at an excessive pace and if left uncontrolled may pose substantial costs in terms of disruption to commerce and the environment alike.

Costs of Climate Change

The Intergovernmental Panel on Climate Change (IPCC) jointly established by the World Meteorological Organization and the United Nations Environment Programme, concluded in 1995 that "the balance of evidence suggests that there is a discernible human influence on global climate." Current concentrations of carbon dioxide, methane, nitrous oxide, and the other so-called greenhouse gases have reached levels well above those of preindustrial times. Of these, carbon dioxide (CO_2) is the most important: net cumulative CO_2 emissions resulting from the burning of fossil fuels and deforestation account for about two-thirds of potential warming from changes in greenhouse gas concentrations related to human activity. If growth in global emissions continues unabated, the atmospheric concentration of CO_2 will likely double, relative to its preindustrial level, midway through the next century. The IPCC estimates that global temperatures will increase by between 2.5 to 6 degrees Fahrenheit in the next 100 years, with a best guess of about 3.5 degrees F [ADD C TOO?].

The accumulation of greenhouse gases poses significant risks to the world's climate and

to human well-being. Potential consequences include a rise in sea levels, greater frequency of severe weather events, shifts in agricultural growing conditions from changing weather patterns, threats to human health from increased range and incidence of diseases, changes in availability of freshwater supplies, and damage to ecosystems and biodiversity.

While scientists believe that human activites are leading to a gradual warming of the average temperature of the earth, the change in temperature in a given region at a given time may differ substantially from this average. Indeed, models predict warming will be greater in high latitudes than in the tropics, and greater over land than ocean. Many models predict larger increases in evaporation than in precipitation over midlatitude land areas, which would result in drier conditions in those regions, especially during summer in North America and Europe.

The derivation of quantitative or monetary estimates of the damages from such climate changes taxes today's forecasting models. Nonetheless, respected researchers have developed estimates of the monetary damages expected were there to be an average worldwide temperature increase of approximately 2.5 degrees Centigrade, or approximately 4.5 degrees Farenheit. For example, William Cline, while at the Institute for International Economics, estimated that such a temperature change for the U.S. economy today, would impose annual damages of more than $60 billion per year. Of these the biggest categories of monetary damages would be $18 billion in lost agricultural production, $11 billion in additional electricity costs, and $7 billion in new costs to maintain the existing supply of fresh water. [All these are 1990 $: convert to 1997 $] Other researchers have developed similar estimates. For example, William Nordhaus of Yale University [originator of the Integrated Assessment models that do seek to monetize the effects of global warming], has developed comparisons of estimates of the dollar income loss attributable to doubling of carbon dioxide concentrations. He finds that the Cline estimate is in the center of three estimates for the U.S. and that the high estimate is only 1.3 times greater than the low estimate. It must be noted however that this similarity of estimates masks the true uncertainty associated with forecasts of the damages from given increases in global warming.

Although categories of damages like disease incidence and sea level increase are uncertain they are in principle subject to quantification and valuation using standard methods. Far more difficult to include in an analysis of the benefits of climate change protection is the small and unknown possibility of large-scale and potentially irreversible discrete events with potentially catastrophic consequences. Two such possibilities serve as illustrations. [check these "facts"] Warming of Northern tundra may release very large amounts of methane currently frozen into the subarctic permafrost, thereby leading to potentially devastating acceleration of an otherwise controllable global warming process. Second, evidence from climate models suggests that some types of climate change may lead to displacement of the Gulf Stream that warms Western Europe. Evidence from ocean core samples suggests that such reversals of ocean currents have occurred in previous ice ages. Reductions in the risk of such catastrophic outcomes must be considered in addition to the costs and benefits that can be reasonably quantifiable. Indeed since American families are averse to risk, such

possibilities are especially important in evaluating whether the benefits of a particular climate control policy justify the costs.

Need for Global Action

Climate change is a complex, long-term problem requiring global cooperation and a long-term solution. It is a unique economic problem in that emissions of different gases anyplace in the world will have very similar effects on global climate at a given date in the future. No single country has an incentive to reduce emissions sufficiently to protect the global environment against climate change. Each has an economic incentive to "free ride" on the efforts of others. Even if the United States sharply reduced its emissions unilaterally, greenhouse gas emissions from all other countries would continue to grow, and the risks posed by climate change would not be significantly abated.

The threat of disruptive climate change has led to coordinated international efforts to reduce the risks of global warming by reducing emissions of greenhouse gases. The first international agreement to address global warming was the Framework Convention on Climate Change signed during the Earth Summit in Rio de Janeiro in 1992. This convention established a long-term objective of limiting greenhouse gas concentrations and encouraged the established industrial countries to return their emissions to 1990 levels by 2000. Since then it has become clear that the United States and many other participating countries will not meet this goal.

To address the lack of progress among many industrialized countries toward meeting this first target, the United States and approximately 160 other nations, in negotiations held in Kyoto, Japan, last December, agreed to take substantial steps to stabilize atmospheric concentrations of greenhouse gases. The Kyoto agreement, which requires the advice and consent of the Senate, would place binding limits on industrial countries' emissions of the six principal categories of greenhouse gases: CO_2, N_2O, methane, sulfur hexafluoride, perfluorocarbons, and hydrofluorocarbons. Each industrial country's "1990 baseline" is actually based on its 1990 emissions of CO_2, methane, and N_2O and its choice of 1990 or 1995 levels of the other three categories of gases. The United States agreed to a target of 7 percent below 1990 levels over 2008-12. To meet that target, net U.S. emissions of greenhouse gases--all emissions minus removals of CO_2 by certain forestry-related activities--must average no more than 1,484 million metric tons of carbon equivalent per year during that period. The targets for the European Union and Japan are 8 percent and 6 percent below 1990 levels, respectively. Australia, New Zealand, Norway, and the countries of the former Soviet Union all have less stringent limits. In sum, over the period from 2008 to 2012, the industrial countries are expected to reduce their average emissions of greenhouse

gases to about 5 percent below their 1990 levels. [PERHAPS BELONGS ONLY IN EIZENSTAT TESTIMONY?]

Flexibility and Market Mechanisms

The nature of the climate change problem suggests some methods to lower costs of achieving given levels of environmental protection. Such methods have long been championed by economists interested in increasing the efficiency of protection. They were the sort of thing that 2600 economists had in mind last year when they signed a letter, urging action on climate change:
"Economic studies have found that there are many potential policies to reduce greenhouse gas emissions for which the total benefits outweigh the total costs...The most efficient approach to slowing climate change is through market-based policies." What are these methods and policies? They can be characterized in three categories of flexibility: "when flexibility," "what flexibility," and -- perhaps most important of all -- "where flexibility."

First is "when flexibility" (timing). Since climate change is a long-term problem, the exact timing of emissions reductions is in some sense not important. Thus the freedom to delay or accelerate reductions within an agreed upon time frame that ensures credibility of emissions reductions also lowers costs. The Kyoto Protocol incorporates this principle in three ways. First, the cuts to be made in the first period are less severe than those that had been proposed by many other countries, most notably the Europeans. By imposing relatively milder cuts [relative to the business-as-usual path] in the early years, we can greatly reduce costs such as those from prematurely scrapping coal-fired electricity plants still in the prime of their operating lives, while attaining the same environmental goals in terms of ultimate atmospheric concentrations of carbon in the year 2100. [IS THAT SENTENCE OK?] Second, the [medium-term] emissions target is not specified in terms of a specific year, but rather in terms of an average over a five-year period (2008-2012). Averaging over five years, instead of requiring countries to meet a specific target each year, can lower costs, especially given an uncertain future. The averaging can smooth out the effects of short-term events such as fluctuations in the business cycle and energy demand, or hard winters and hot summers that would increase energy use and emissions. Further, if firms perceive that a new technology will soon be usable that will reduce the costs of redcing emissions, they can emit more greenhouse gases in the beginning of the period and less at the end. And third there is allowance for "banking" emission reductions within the 2008-2012 commitment period, for use in a subsequent commitment period [although the emission targets of the next period have not yet been specified].

Second is "what flexibility" (six gases). Emissions of different kinds of gases, not just carbon dioxide, contribute to the greenhouse effect. Since the IPCC has developed conversion factors for all greenhouse gases by estimating their global warming potentials, reductions in emissions of one pollutant can be used to substitute for increases in emissions of another by an amount that causes equivalent environmental effects. The Kyoto Protocol stipulates that

countries with binding targets are expected to reduce their total greenhouse gas emissions by certain percentages, but does not require specific reductions for specific gases. Since a molecule of sulfur hexafluoride is 23,900 times more potent over 100 years than a molecule of CO2, it may be cheaper to achieve the same environmental benefit by eliminating one [molecular] unit of SF6 than nearly 24,000 units of CO2. Our initial rough analysis indicates that a strategy of reducing non-CO2 greenhouse gases by *more* than 7% below their 1990/1995 baseline levels while reducing CO2 by *less* than 7% below its 1990 level could reduce all emission permit prices by more than 10%. [This analysis is based on the integrated SGM/non-CO2 cost curve.] Thus allowing countries flexibility in what gases they reduce -- essentially trading emissions reductions across gases -- can help lower significantly the costs of meeting their targets. Another source of "what flexibility" is the treatment of sinks, i.e., land use activities that promote the removal of carbon from the atmosphere through the growth of plants. Promoting such sinks may reduce atmospheric concentrations of CO2 at much lower costs than reducing emissions.

Third [and most importantly] is "where flexibility" (international). Emissions have the same environmental consequences regardless of where in the world they occur. Therefore the least-cost approach to controlling climate change is to reduce emissions wherever such reductions are cheapest. The Kyoto agreement includes two important cost-saving provisions of this nature. First, it provides for industrial countries to trade rights to emit greenhouse gases with each other. This market in emissions permits will ensure that emission reductions occur where they are least expensive within the industrial countries. In particular, U.S. companies could purchase emissions reductions in other participating countries when doing so would lower their costs. This arrangement will lower costs without affecting the level of environmental protection. Second, the agreement allows industrial countries to invest in "clean development" projects in the developing world and use these projects' certified emissions reductions toward meeting their targets. Many such clean-development projects may be quite cheap in terms of the cost per ton of emissions avoided. Details of these provisions will be worked out in negotiations in Buenos Aires later this year.

Developing Country participation

The President has made clear that his support of the agreement is dependent on meaningful participation of key developing countries, i.e., countries outside the 38 industrialized Annex I countries that agreed to binding emissions reductions. He will not submit the Treaty to the Senate without such participation.

There are several reasons why such meaningful participation is essential. First, developing countries are projected to contribute a majority of total emissions by 2030 under a continuation of business as usual. Thus without their participation emissions reductions by the industrialized countries will not achieve necessary protection from climate change. Second, principles of basic fairness suggest all countries should do their part, depending on their ability to

contribute to the solution. Thus even poor countries should contribute, although the existence of more pressing social needs in such countries will inevitably limit the magnitude of their contributions. Third, their participation may serve to limit emissions increases in such countries that might otherwise be an unintended consequence of the Kyoto agreement [so-called leakage]. For example, as Annex I countries compy with their targets, their demand for oil will fall, perhaps causing the price of oil to fall on world markets, and encouraging non-participating countries to use more oil and emit more carbon than they otherwise would have. Similarly, the most energy-intensive activities in US manufacturing might relocate to non-participating countries, again raising emissions there. Fourth, developing country participation would permit cheaper emissions reductions achieved in these countries to be internationally recognized as a substitute for more expensive emissions reductions that might otherwise by achieved by U.S. companies domestically.

So far I have not mentioned the word "competitiveness," the most commonly feared locus of adverse effects from going ahead without developing country participation. On the one hand, if "loss of competitiveness" refers to predictions of negative effects on the aggregate trade balance, as I have seen in one study, then I must say that I see no reason why this should happen. On the other hand, if it refers to adverse effects on some individual manufactured exporting industries -- those that are especially energy-intensive [such as aluminum...] -- I must confess that such effects are possible. It is difficult to undergo as thorough a structural change in the economy as required here without having the effect of expanding some sectors and contracting others. But energy constitutes only 2.2 percent of total costs to US industry. Two-thirds of all emissions are not in manufacturing at all, but in transportation and buildings. I believe it more accurate to say that we need developing country participation for the reasons I outlined above, than to say that we need it to avoid adverse effects on competitiveness.

Difficulties of economic analysis

Now that we have a protocol, even if it is not yet complete nor ready for the President's submission to the Senate, the time has come to explain to you in more detail our economic analysis. This includes rough estimates of the range of some of the possible costs and benefits of our climate change policy, under various possible assumptions. But before I mention a single number, I wish to emphasize some of the limitations to any such estimates [-- the ways in which they are necessarily uncertain and problematic]. The difficulties associated with economic analysis of this issue fall into three broad categories. They are: the impossibility of putting a single monetary number on the long-term benefits of climate change mitigation, uncertainties that still remain over the terms of the ultimate treaty, and inherent limitations of the models of even short-term costs and benefits.

Impossibility of reliably estimating the monetary benefits of climate change mitigation

The goal of the entire exercise, of course, is to begin to move to a path of emissions that implies lower levels of atmospheric concentrations of greenhouse gases future in centuries, and

thereby mitigates the likely extent of global climate change. Estimates of the economic damages from climate change [for example, in the Integrated Assessment models of Nordhaus, Cline, and other economists] fall into the following areas: agriculture, sea-level rise, air conditioning and heating, water supply, human life and health, air pollution, and other costs (hurricanes, migration costs, human amenity, construction, leisure activities, urban infrastructure, and ecological damages such as forest loss and species loss). One must have at least some sympathy with those who critique the economists on the grounds that these costs are extremely difficult to quantify, particularly when it comes to possible catastrophe scenarios to which the scientists cannot assign a reliable probability.

A subject of great uncertainty and sensitivity is the "discount rate" that is applied to the benefits of averting future climate change. Such a discount rate is needed if benefits are to be expressed in monetary terms, because the economic costs of the policies under discussion occur over the next few decades, whereas the prime benefits of averting climate change occur in coming centuries. How do we weigh short-term costs against long-term benefits? There is little agreement, even among economists, on the appropriate discount rate applicable to a question so great in import as the future climate of the planet. Cline, for example, explicitly adopts a low discount rate (and a high aversion to possible catastrophe) in getting his conclusion that the benefits of early and strong action outweigh the costs. [RANDY WARNS THAT THIS PARAGRAPH MIGHT BE USED TO UNDERMINE GOOD OMB PRACTICE IN OTHER AREAS OF REGULATION.]

A similar point concerns risk-aversion. To what extent are we willing to take chances with our planet? The point applies particularly to catastrophe scenarios. Scientists have thought of many possible scenarios, most of which they are fortunately not yet prepared to pronounce as high-probability based on current evidence, but which might be truly catastrophic for the Planet if they were to occur. There is a strong argument for the Kyoto agreement as Planet insurance. But what numerical weight should one assign to these risks? It is difficult for an economist, or anyone, to know.

Finally, and most importantly, even if we were confident of our ability to quantify the effects of emissions cuts on the environment, measured by CO2 concentrations or average temperatures, we would then need to make arbitrary assumptions about future international agreements to limit emissions beyond the 2012 window. The reason is that the emission cuts agreed upon at Kyoto are only a first step on a long journey. International conferences have not begun to talk about specific emissions paths after 2012. Yet these are the paths on which atmospheric concentrations in the year 2100 and beyond -- and thereby the major climate effects entirely depend. The first step that we propose to take over the next 15 years is critical. But it is not critical because it will in itself go far to solving the climate change problem -- emissions during any given decade are small compared to the cumulative concentrations in the atmosphere. Rather it is critical because we can't take the second and third steps until we have taken the first. And we don't yet know how big will be those future steps to which the nations of the world agree.

It is evident that the benefits of averting climate change are potentially enormous. But

we have chosen not to try to quantify them in monetary terms, in light of the difficulties I have enumerated: the quantitative uncertainty of these benefits, their timing (in future centuries, far outside the 15-year horizon covered by the treaty), and the need to make arbitrary guesses regarding the post-2012 path of cuts in emissions of greenhouse gases cuts in order to produce large reductions in future concentrations in the atmosphere. We have opted for an attempt to add up the various possible costs and benefits of emissions policy *excluding* climate change. To give away the punch line, our conclusion is as follows: "the net costs of our policies to reduce emissions are likely to be small [under certain assumptions regarding, for example, domestic and international trading], even before taking into account the benefits of averting climate change itself."

Terms of the treaty

Although we know a lot more than we did before Kyoto about the proposed terms of the international effort and what they would mean for the United States, there is still much that we don't know. First, as is often the case in a legal document of this length and complexity, there are some provisions of which the proper legal interpretation is not yet clear to simple economists such as ourselves. [Okay to say?] Of particular concern here is the treatment of so-called sinks. This refers to activities that affect the rate at which carbon is removed from the atmosphere and "sequestered," specifically by the planting of trees. Second, a number of items, concerning international trading and developing countries, which had not been definitively settled by the end of the last all-night session of the Kyoto talks were explicitly assigned to future negotiations [in Buenos Aires next fall]. [?] The Kyoto Protocol provides opportunities for the industrial countries to trade rights to emit greenhouse gases with each other. Countries may also invest in "clean development" projects in the developing world and use these projects' certified emissions reductions toward meeting their targets. [This provision embraces the President's proposal known as "Joint Implementation" -- JI.] Both of these mechanisms allow for emissions reductions to occur where they are least expensive. But in both cases, the all-important details of the provisions remain to be worked out at Buenos Aires. This makes projections difficult.

The third and final category of parameters yet to be determined pertains to the actions of future administrations and Congresses. This includes, first, pre-2008 domestic policy measures, such as future R&D programs to extend the work that President Clinton has proposed in the current budget. It includes, second, important aspects of how the tradable emissions-permit plan is implemented in 2008-2012, such as where in the energy economy permit requirements are imposed, how permits are distributed, and -- if all or some are auctioned -- what is done with revenues. [And it includes, third, any agreements that might be entered into regarding further steps to address climate change post-2012, which might have effects on prices and technological change even pre-2012.]

Inherent limitations of models

Even within a given model, answers depend critically on the precise nature of the

question asked. For example, I will illustrate momentarily how the costs of emissions reductions depend critically on the extent of global participation and international trading that a treaty is assumed to feature. Even when all the features are specified, different models can give different answers -- a concrete illustration of the range of uncertainty to which we must assign the predictions of any one model. One area where the uncertainty is particularly great is the pace of technological progress, and the extent to which it will accelerate in response to government programs for R & D and dissemination. Economics does not offer a good understanding of how technological progress is determined, in part because it is the stuff of experimentation, brainstorms, genius, breakthroughs, perceptions and habits. Invention is largely determined by inspiration -- notwithstanding Edison, who assigned a 99% share to perspiration -- and inspiration is difficult to fit into a mathematical formula or economic model. Models and experts on climate change policy tend to have a wider range of disagreement on the speed with which technology can be changed than on any other single issue.

Furthermore, each model has strengths and weaknesses; each has questions to which it is better or worse suited to answer. Some, for example, model the energy sector in detail. Some allow for the fact that a coal-fired power plant cannot costlessly be converted to one that runs on natural gas. Some have enough tax policy detail to distinguish alternative ways of redistributing revenues that might be raised if emission permits were to be auctioned. Some are capable of showing short-term macroeconomic disequilibria. Some include a long-term "carbon cycle" model that can keep track of the accumulation of GHG concentrations in the atmosphere and their climatological effects. Some break down the rest of the world into regions and so can model international trade. No one model does everything. [JOE AND RANDY FEAR THIS SUB-SECTION MAY SOUND TOO APOLOGETIC REGARDING THE USEFULNESS OF MODELS.]

The basis of our analysis

The existence of modeling difficulties does not mean that we can abandon rigorous economic analysis. Rather, we have employed a broad set of economic tools to analyze the policy options. Such tools include models of the energy sector and economy over the next 25 years, including but not limited to the models that have been used in Energy Modeling Forum exercises, the IPCC's review of the economic and social dimensions of climate change, and in the Interagency Analytical Team (IAT) effort last year. [I have already referred to the Integrated Assessment class of models, those that are designed to operate on the longer time frame that is relevant for thinking about climatological effects.] Other tools include simple relevant statistics, "meta-analyses" of existing models, historical and sectoral examples, and basic economic reasoning. Drawing on this broad array of analytical tools allowed an intelligent evaluation of the policy alternatives.

To our knowledge, no model -- whether used inside the government or not -- was as of December set up precisely to analyze the parameters of the agreement that was reached in Kyoto. Even we in the Administration did not know exactly what we would get until the end of the negotiations [e.g., the 2008-2012 commitment window, a target 7 % below 1990 levels, six gases, etc.], while most of the model-builders outside the government tend to require a lag as

long as several years to incorporate the current policy parameters into their models. No model is currently designed to assess sinks, let alone all six gases.

Since Kyoto, the Council of Economic Advisers [in collaboration with the Treasury and other agencies] has sought to evaluate the implications of what was agreed to with a particular model, the Second Generation Model of Battelle Laboratories. [Of the models readily available to us on short notice,] the SGM was the one best positioned to analyze the role of international trade in emission permits, which we consider to be a critical element of the Kyoto Treaty. Thus the SGM is the basis of the estimates that I am about to give you. (We dealt with the problem of the six gases by integrating the SGM model results with cost analyses of the others by EPA.) But, mindful of the limitations that any one model has, we are eager to feed the Kyoto parameters into other models, to get a better feel for the range of possible effects. Much of this work will have to go on outside the government. For example, we have had discussions with the Energy Modeling Forum, based at Stanford University. The EMF is a long-running exercise in which many of the leading models participate [giving predictions as to the effects of a commonly specified set of policy parameters]. We have given them some advice on how features of the Kyoto legal language can be translated into terms recognizable to an economist. Unfortunately, the Energy Modeling Forum believes that its members will need until mid-year to produce reliable results [check].

How Trading Brings Down Costs

I said in Congressional testimony last July that we can do this smart or we can do this dumb. To elaborate, the costs of cutting emissions can be much reduced if flexible, market mechanisms are used. As regards domestic implementation, the President's program has two key aspects: a $6.3 billion commitment over the next five years for research and development spending ($2.7 billion) and tax incentives to mobilize cutting-edge technology ($3.6 billion), and a plan to require tradable permits for greenhouse gas emissions during the period 2008-2012. It is critical that the permits are to be tradable. This will allow emissions automatically to be cut in the sectors and regions of the economy where it is cheapest to do so.

The same principle holds internationally. In some countries, where energy use is high and tilted toward carbon-producing sources, it should be relatively easy to enact large reductions. In others, where energy use has already been reduced and made cleaner, it is expensive to enact further reductions in carbon emissions. If the latter kind of countries can achieve their targets by paying the former to reduce emissions in their place, the same aggregate reduction in emissions can be achieved at lower costs. This is the same as saying that the same climate benefits can be achieved at lower costs, since the global climate effect of a ton of carbon is the same regardless where it is emitted.

Estimated reduction in costs from Annex I trading

In the language of the treaty, "Annex I" is the set of countries that have agreed to take on binding limitations in emissions of greenhouse gases. They are basically the set of industrialized countries, defined to include Russia, Ukraine, and most other Eastern European countries. Even in the case where participation is limited to this set of countries, costs can be

reduced substantially by trading among the group. (To illustrate, Russia and the Ukraine consume six times as much energy per dollar of output as does the United States [where we in turn consume more than Europe or Japan].)

The estimate we derived from the SGM [integrated with the government cost analysis regarding the other five gases] was that, under certain base-case assumptions [AEEI=1% + no sinks], trading among Annex I countries reduces the cost to the United States of achieving its targets for 2008-2012 emissions by about [43%-55%], relative to a situation where we had to achieve all these reductions at home. This concept of costs is meant to capture aggregate resource costs to the US economy, including the cost to domestic firms of purchasing emission permits from Russia and other countries where emission reductions are cheaper than in the United States [or in other major industrialized countries].

A useful rough check on this estimate can be obtained from other model[s], notwithstanding that they are likely to be more distant approximations to the parameters of the Kyoto Treaty. The G-cubed model, for example, says that trading among Annex I countries reduces US permit prices by roughly 40 percent, and reduces overall costs by roughly 20 percent [CHECK]. [The G-cubed model is better designed than most to analyze trading of permits in a system where the usual international trade in goods and services is also important.]

Estimated reduction in costs from umbrella trading

One possibility that emerged in Kyoto, which none of us foresaw, was the idea that the United States might undertake trading with a subset of Annex I countries, dubbed the "umbrella," that would exclude the European Union. [The initial list of proposed participants includes the United States, Australia, Canada, Japan, New Zealand and Russia, with strong indications of interest from some others.] The motivation for this idea was that the Europeans have been reluctant to agree to the sort of international trading that we want (preferring that they achieve their goals collectively in a group of their own, called the "EU bubble"). It is too early to say whether the umbrella concept will in fact be accepted by the parties. But it is an important concept to consider, for three reasons. First, it is conceivable that it will be formally agreed to in future negotiations. Second, even if the final treaty does not explicitly include the umbrella, but rather allows trading among all signatories (as the United States has proposed all along), it is conceivable that umbrella countries will agree, outside the treaty, to trade only among themselves. Third, the aversion toward international trading that the Europeans have expressed suggests that they might refrain from making the trades to which they would be entitled.

The significance of the umbrella idea in the present context is that it has the potential to further reduce costs to the United States. The reason is that if the Europeans are not bidding against us for the cheap emission rights that the Russians and other Eastern Europeans have to sell, then the price will be even lower. Our SGM results suggest that, relative to the situation in which we must make all our reductions at home, the umbrella arrangement would reduce costs by an estimated 61-75 per cent, depending on whether the former Warsaw Pact countries are classed with the EU, or are instead assumed to fall within the umbrella. The G-cubed model estimates that an umbrella that includes the Warsaw Pact countries would reduce permit prices by roughly 70 percent and reduce overall costs by roughly 50 percent. [CHECK]

Estimated reduction in costs from LDC participation

The next consideration is participation by developing countries. The President has said that he will not submit the treaty for ratification without such participation. It is by no means certain that we will be able to sign up all developing countries for full binding commitments inside the same commitment window as the rich countries. A moderate version of developing country participation is Joint Implementation. JI cannot realistically be expected to yield all the gains of full participation, but it might shave costs by roughly another 23 percent, on top of the reduction from trading among Annex I countries. Another possibility is that we persuade some of the key developing countries that are the largest emitters to commit to targets, and allow us to buy emission reductions from those paths. The model estimate is that this would cut 55 percent off costs, on top of Annex I trading. [The four countries included in this particular estimate are China, India, Brazil and Korea.] Once these savings have been attained, the estimated benefits of persuading the rest of the developing world to go along with full commitments are relatively small. [No difference, in the 1/23/98 table.] The combination that gives the best possible result for the United Sates would be an umbrella that excludes the EU, but that otherwise includes full worldwide participation and trading. The cumulative reduction in costs relative to obtaining all reductions domestically is an estimated 88 percent.

I offer these numbers because they show the potential effectiveness of trading at reducing costs dramatically. But it is important that I repeat three caveats: First, as always, there is a wide range of uncertainty around all these estimates. Second, they apply to an idealized version of trading, one that assumes no problems of enforcement or transactions costs. Third, it is unlikely that we will get all our partners to agree in Buenos Aires to the very most optimistic or ambitious case. But the numbers show major savings even without getting the most optimistic case. And if we don't get enough of what we want, we won't sign/submit the treaty.

Non-climate Benefits

As I have indicated, achieving emission-reductions efficiently means using market mechanisms, which means raising the prices of fossil fuels and other sources of greenhouse gases. We recognize that such price increases are not without pain. But there are some partially-offsetting benefits, in three areas: air pollution, traffic congestion, and highway accidents.

Reductions in carbon emissions also lead to reductions in emissions of pollutants that contribute to excess concentrations of fine particulate matter and low-level ozone. **[Quantification forthcoming]**

[We have just learned of an EIA error that has the effect of rendering earlier estimates illegitimate. We hope to have something on Monday:

Jeff: The cost-savings from ancillary emissions reductions need more work. On Friday I learned from EIA that one of their columns was mislabeled, and the correct estimated Nox emissions reduction fell by half to 1.6 million tons. I also learned that their baseline excludes the EPA's November 1997 OTAG SIP call proposal, which would have reduced Nox emissions by 1.6 million tons. If we take as a baseline the OTAG SIP call proposal (some form of which is necessary to meet the final ozone and PM rules) then there are no net reductions that would result from $20/ton or $30/ton carbon prices. EPA has promised me new analyses of the same issue by Monday, and they may help us out. However it is not clear that they will be able to construct a baseline that provides estimates of ancillary benefits that avoid double counting with the NAAQS costs and benefits. RL]

Traffic congestion hurts motorists by causing delays and inconvenience. Higher fuel prices will lead to reductions in congestion as motorists choose other means of travel, share rides, or even forgo less important trips. We estimate that higher fuel prices resulting from carbon permit prices of $20/ton will reduce travel delays associated with congestion, and that the value of such time savings to consumers would be about $0.4 billion per year.

Vehicle use leads to costly accidents and to highway injuries including fatalities. Higher fuel prices will reduce vehicle use. Assuming that accidents fall proportionately with vehicle use, the savings from reduced accidents and the value of reduced mortality risk is approximately $0.3 to $2.7 billion/ year [depending on whether lighter cars are less crashworthy] given a $20/ton carbon price.

Finally, a variety of other benefits that are harder to quantify are likely to result from reductions in carbon emissions. With respect to transportation, reduced vehicle use will also reduce the cost of road repair and maintenance. Second, reduced coal use will reduce the cost of sulfur dioxide controls, as utilities switch to enrgy sources other than coal. Reduced coal use will also lower mercury emissions. Finally, reduced energy use will also increase U.S. energy independence. Our inability to estimate these effects quantitatively does not imply that they are necessarily small or unimportant.

One caveat: Since these benefits (especially those related to transportation) result from policies that have the effect of raising fuel prices, they are unlikely to apply to the extent that non-price mechanisms are used to achieve emissions cuts.

Summary: Range of estimated costs for a particular case

By way of summary, I will focus on a particular case: the case of trading under umbrella, together with full participation by key LDCs. [While this is a fairly ambitious/optimistic case, it is more attainable than is early worldwide participation.] Our estimate is that the net costs of attaining our Kyoto targets for emission reductions is $5 to $7 billion (depending on whether Eastern Europe is included in the umbrella and on which measure of benefits is used).

A more tangible measure of costs is estimated effects on energy prices. The SGM-based estimate [integrated with the non-Co2 analysis] is that the price of emissions would be in the range $12 to $16 per ton of carbon equivalent. We expect that energy prices at the household level would rise by about 3 percent under the Kyoto accords [CHECK. 4 % if the permit price is $20. 5% if $30.] . Fuel oil prices would rise by about 5 percent, natural gas prices by 4 percent, gasoline prices by 3 percent, and electricity prices by 2 percent.

Estimated effects on a family of four

The 3 percent increase in energy prices at the household level would raise the average family's energy bill by about $75 [This assumes permit price of $15. For other permit prices, just scale up or down linearly]. On the other hand, the expected 10 percent deline in electricity prices resulting from industry restructuring will reduce the average household's electricity bill by about $80 offsetting most of the rise in the total energy bill.

[*Would these price increases be regressive?* Some economic studies have shown that energy taxes --and, presumably, increases in energy prices --are regressive when measured against current income. This means that poorer people pay more as a percentage of their current income than richer people. But current income is not a very stable measure, and so may not give a true picture. For example, students or retirees usually have lower current income than those now in the labor force. This means that current household expenditure may be a better measure of well-being than current household income. To address this concern, some studies have measures energy expenditures against all current expenditures, and found that energy taxes, or equivalently, higher energy prices, would not be very regressive.]

Electricity restructuring

These estimates do not mean that households energy expenses will in fact be higher in 2010 than today. In the first place, energy prices fluctuate year-by-year for all sorts of reasons. They could go either up or down. But even if we leave out unpredictable fluctuations, a complete analysis of the Administration's energy policies would include the effects of the federal electricity restructuring bill that the President plans to propose. An electricity sector freed from government regulation would be a more efficient energy sector. Costs to consumers will fall. Effects on the environment are of several sorts, both positive or negative. A reasonable overall estimate of the effects of adding federal electricity restructuring to the rest of the President's program to address climate change is to achieve the same environmental goals at a cost saving of some $16 billion [check the range]. This benefit is enough to offset the rest of the costs of climate change policy estimated above.

[Randy asks CAN WE ANNOUNCE DOLLAR ESTIMATES OF SAVINGS FROM A POLICY PROPOSAL WHERE WE HAVE NOT YET IDENTIFIED THE SPECIFIC? IN ADDITION, IF THE ELECTRICITY RESTRUCTURING INCLUDES A MORE STRINGENT RPS, OR CARBON CAP AND TRADE, THEN THE COST SAVINGS ESTIMATES WOULD BE INAPPLICABLE. CAN'T THE ELECTRICITY POLICY BE DECIDED IN TIME FOR TESTIMONY?]

Effects on employment and aggregate output

You may have noticed that I have said nothing about job losses resulting from climate change policy. There will be some losses of employment in some industries. [For example, it is inevitable, if we are to reduce carbon emissions, that there will be fewer people working in the coal industry 15 years from now than there would otherwise be.] But a large number of jobs will be created in other sectors [many of them high-tech jobs paying high wages]. By analogy, energy restructuring will eliminate jobs in some companies and create jobs in others.

We are not predicting any substantial negative effect on aggregate employment. The

overwhelming majority of models that address climate change do not predict aggregate job losses. Admittedly, these are models that incorporate full employment of the labor force by design. But this is probably the right sort of model to apply, in the case of a structural change that is to be determined and publicly known 15 years in advance. Workers will be able to plan ahead, and move into expanding fields rather than contracting ones. The same is true of capital and technology.

Given a 15-year lead time, monetary policy [by which I mean to include the actions of the Federal Reserve together with the price-setting behavior of the private economy] will be able to adjust to avoid any losses in aggregate demand [which might otherwise result from a contraction of the real money supply]. Thus there need be no negative effects on output and employment.

The situation might be different if a large energy shock were to hit the economy with no warning, as happened in the oil crisis of 1973-74, when the real money supply, output and employment all contracted sharply. The reassuring conclusion regarding aggregate output might also be different if the policy were to be implemented inefficiently (e.g., by command-and-control style regulations of the sort put in place in that oil crisis), rather than efficiently (i.e., by market mechanisms of the sort that the President has proposed to use).

I have seen one study that claims large losses in output and employment from climate change policy [EPI, 8/14/97]. But it did not in my view take into account the points I have made about the ability of the economy to adjust to structural change when there is 15-year warning. Furthermore, it did not take into account such cost-reducing elements of the agreement and of our proposed implementation as international and domestic trading. [Nor did it take into account provisions of the Kyoto agreement such as those pertaining to sinks and six gases.]

Estimates Are Conservative in Several Ways

These estimates are conservative in three very important ways [: sinks, technology, and climate change benefits]. The first point, sinks, concerns a provision of the Kyoto Protocol that has received less attention than it merits. It is only *net* emissions -- emissions to the atmosphere minus sequestration -- that are to be reduced 7 percent below 1990 levels, not gross emissions. The United States plants many trees every year, and would receive credit for this activity under the Protocol. Very preliminary estimates suggest that sinks can reduce the costs of meeting the Kyoto target by 45 to 77 percent [1/23/98]. (This is on top of the gains from trading among Annex I countries). But neither we nor other analysts are yet sure exactly how to interpret the legal language. Because the quantitative uncertainty is still large, we have not yet opted to include this effect into the net cost numbers that I cited earlier. But we know that the effect is likely to be favorable as well as large.

Our estimates are also conservative regarding the payoff to the President's Climate Change Technology Initiative. The logic is somewhat analogous to the rationale behind the macroeconomic assumptions that we feed into our budget forecasts: in the presence of uncertainty, we are conservative in our estimates of the speed with which the economy will grow, tax receipts will rise, and the budget will improve. That way, any revisions or surprises that

occur are likely to be in the pleasant direction.

The nature of our conservatism here is that we assume in our modeling that, because of lags, most of the payoff from new technology research and dissemination expenditures (as opposed to those in the past) comes after 2012. The parameter that figures most prominently [and controversially] in analysis of technological progress in the energy field is the rate of improvement in the so-called Autonomous Energy Efficiency Index (AEEI), that is the rate at which the total use of energy falls relative to GDP. In our base-case analysis, the basis of the numbers I have reported to you, we took an AEEI of 1.0 percent per year, just above the number in the Energy Information Administration's Annual Energy Outlook.

A little optimism regarding the effects on the discovery and adoption of new technologies would boost this number to 1.25 percent. This alternative optimistic view of technology reduces the estimated permit price in 2010 by 20 to 31 percent, and reduces the estimated total resource cost 23 to 33 percent (depending how wide a set of countries is assumed to participate in trading). Overall costs come out to only $ 9 - $14 billion in the cases of trading under the umbrella [depending whether Eastern Europe falls under the umbrella], or $5 - $6 billion with participating key LDCs. Net of non-climate benefits, the costs are $ 4 to 11 billion. Measured in more familiar terms, the effects of the "technology optimism" case would to reduce the increase in gasoline prices to only 3 cents per gallon [check all these numbers!], in electricity prices to 0.2 cents per kWh, and in total energy bill for a typical family to $50. (These estimates would be even lower, if we took into account either sinks or the benefits of electricity restructuring.)

This "technology optimism" case is far from the most optimistic outcome that might occur. Some estimates coming from engineering models predict even higher rates of AEEI improvement, and thus even lower costs.

The third, and most important, respect in which the estimates I have presented are conservative is that they leave out the benefits of mitigating Climate Change itself. A full cost-benefit analysis would include mitigation in the benefits column. [The only reason we have not done so, as I have explained, is the difficulty in coming up with a number to capture the monetary benefits.] But I trust that nobody will lose sight of our objective -- keeping our planet the hospitable home that we enjoy today.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 1-FEB-1998 17:57:36.00

SUBJECT: outline of GCC testimony

TO: ORSZAG_P (ORSZAG_P @ A1 @ CD @ LNGTWY [UNKNOWN]) (OPD)
READ:UNKNOWN

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

CC: jonathan.gruber (jonathan.gruber @ treas.sprint.com @ inet [UNKNOWN])
READ:UNKNOWN

CC: Randall W. Lutter (CN=Randall W. Lutter/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

CC: Ben.jones (Ben.jones @ treas.sprint.com @ inet [UNKNOWN])
READ:UNKNOWN

CC: Adele C. Morris (CN=Adele C. Morris/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

CC: Joseph E. Aldy (CN=Joseph E. Aldy/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
This may help to digest the full draft of the testimony.========== ATTACHMENT 1
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ATT CREATION TIME/DATE: 0 00:00:00.00

TEXT:
Unable to convert ARMS_EXT:[ATTACH.D63]MAIL481256139.026 to ASCII,
The following is a HEX DUMP:

Close hold JF 1/29/98+

DRAFT OUTLINE FOR TESTIMONY: ECONOMIC ANALYSIS OF KYOTO AGREEMENT

Basic Economic Rationale of the Kyoto Treaty

Effects of Climate Change
- Net emissions and Concentrations
- Economic Effects of high concentrations in future centuries,
  - with some illustrative estimates of some costs

The need for joint action: Global externality

Flexibility and market mechanisms
- "When flexibility"
  - Less drastic early cuts than some proposals (AOSIS and EU)
  - Multiple periods
  - Multi-year averages for targets
  - Banking
- Market mechanisms (more on trading below)

LDCs
- Why we need them in
  - "Competitiveness:" Fears that without them...
    - Trade balance will worsen? No. But:
    - Loss of demand for US energy-intensive tradable goods
  - The main problem: Won't accomplish much without them
  - Leakage
- President won't submit until they agree to meaningful participation

Difficulties of economic analysis (cost-benefit)

Impossibility of putting a single monetary number on benefits of CC mitigation
- Uncertainties and risk-aversion, especially regarding catastrophe scenarios
- Effects come in future centuries; how do we weight them against short-term costs?
- International negotiations have not begun to talk about emissions path after 2012,
  - on which GCC effects entirely depend;
  - agreed-upon emission cuts are only a first step on a long journey

What are the terms of the treaty exactly?
- We know more than we did in the Fall:
  - Timetable: 2008-2012 average
  - Target: for us, 7% below 1990 levels (plus sinks)
  - Six gases
- But we still don't know
  - Items to be settled in Buenos Aires:
    - Trading (e.g., umbrella, bubble...)
    - JI and other LDC participation
  - Items needing clarification
    - Sinks
  - Domestic actions of future administration
    - Pre-2008 measures, like R&D
    - Implementation of tradable emissions-permit plan in 2008-2012

Inherent limitations of models
- Each has different strengths and weaknesses
- Uncertainty, especially over technology

The basis of the estimates to follow
- SGM
- We've drawn on many other models and sources of analysis as well
- But other models will take time to incorporate features relevant to Kyoto Treaty (e.g., 6 gases)

How Trading Brings Down Costs (permit prices and resource costs)

The economic case for trading
Estimated percentage reduction in costs from Annex I trading
Estimated percentage reduction in costs from umbrella trading (with and without E.Eur.)
Estimated percentage reduction in costs from some LDC participation: JI or key LDCs
Estimated percentage reduction in costs from full world participation
Reminders:
1) range of uncertainty around estimates
2) It is very unlikely that we get the most optimistic case in Buenos Aires.
But if we don't get enough of what we want, we won't sign/submit the treaty

Non-climate Benefits

Pollution

Congestion

Accidents

Summary: Range of Estimates Corresponding to a particular case: Umbrella with key LDCs

Even with all these assumptions and caveats, the costs vary depending (e.g.) on whether Eastern Europe is in the EU bubble vs. the umbrella, and whether we get JI (and how it works)

Net cost estimate

Estimated effects on energy prices

Estimated effects on a family of four

How those estimates change if federal electricity restructuring is included

Why no job loss like some models claim: planning ahead

These Estimates Are Conservative in Several Very Important Ways

They leave out sinks.

They are conservative on the President's Climate Change Technology Initiative
- Assumes most of the benefits come after 2012
- A more optimistic assumption is AEEI=1.25% by 2010. Effect on estimates...
- Some engineering estimates run even higher...

And, of course, it leaves out the benefits of mitigating Climate Change itself.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Michele Jolin (CN=Michele Jolin/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 2-FEB-1998 11:45:40.00

SUBJECT: your statement

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
Attached========== ATTACHMENT 1 ==========
ATT CREATION TIME/DATE: 0 00:00:00.00

TEXT:
Unable to convert ARMS_EXT:[ATTACH.D56]MAIL49854423G.026 to ASCII,
The following is a HEX DUMP:

STATEMENT OF CEA CHAIR JANET L. YELLEN ON THE ECONOMIC ASSUMPTIONS OF THE FY 1999 BUDGET

My job this afternoon is to tell you about the budget's economic assumptions. For the past 5 years, this Administration has built a record of conservative and credible economic assumptions. The Administration's economic forecasting team was committed to ensuring that our budget balancing efforts would be based on realistic assumptions about the economy's performance. The assumptions in this year's budget are similarly credible and are consistent with the views of a consensus of economic forecasters.

Over the past year, our economy's performance has been steady and strong. Real GDP grew 3.8 percent for 1997 as a whole--the highest growth rate in nine years, and measures of income have been growing even faster. The unemployment rate has been below 5 percent for the last 8 months. Over 3 million jobs were created just this past year. And all this has been accomplished while inflation has declined to its lowest level since 1965.

Although growth has exceeded our expectations in recent years, we believe that for budgetary purposes we should not count on a continuation of growth at its recent extraordinary pace. For this reason, in this budget we are projecting that real GDP will continue to grow--but at a slower 2 percent annual rate over the four quarters of 1998, and this 2 percent pace is projected to persist for another 2 years. At the same time, the unemployment rate is assumed to edge up about two tenths of a percentage point per year. And, inflation, as measured by the

CPI, is assumed to edge up only slightly over the next three years. After 2000, real GDP growth is projected to resume its trend growth rate of 2.4 percent, and the unemployment rate stabilizes at 5.4 percent.

The shift to more moderate growth assumed in this budget recognizes that, by conservative, mainstream assumptions, growth has exceeded the pace that can be maintained on a sustained basis without an eventual tendency for upward inflationary pressure. It is important to note that our assumed real growth rates are not the *best* that the Administration believes the economy can achieve--the outcome could be better.

Let me conclude by saying that the growth-oriented economic strategy adopted by this Administration has clearly paid off. The Administration's 1993 deficit reduction plan created the conditions necessary for the vibrant economic performance we are now enjoying; our economy is the strongest in a generation. We have in place a solid foundation for continued sustained economic growth and rising living standards for all Americans.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Peter R. Orszag (CN=Peter R. Orszag/OU=OPD/O=EOP [OPD])

CREATION DATE/TIME: 2-FEB-1998 15:35:30.00

SUBJECT: Preliminary, incomplete draft of Janet's testimony (which she has not read or approved)

TO: Sally Katzen (CN=Sally Katzen/OU=OMB/O=EOP @ EOP [OMB])
READ:UNKNOWN

TO: Michele Jolin (CN=Michele Jolin/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: David B Sandalow (CN=David B Sandalow/OU=CEQ/O=EOP @ EOP [CEQ])
READ:UNKNOWN

TO: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Peter A. Weissman (CN=Peter A. Weissman/OU=OPD/O=EOP @ EOP [OPD])
READ:UNKNOWN

TO: Gene B. Sperling (CN=Gene B. Sperling/OU=OPD/O=EOP @ EOP [OPD])
READ:UNKNOWN

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Todd Stern (CN=Todd Stern/OU=WHO/O=EOP @ EOP [WHO])
READ:UNKNOWN

TO: JONATHAN.GRUBER (JONATHAN.GRUBER @ MS01.DO.treas.sprint.com @ INET @ LNGTWY [UNKNOWN])
READ:UNKNOWN

TEXT:
It is possible that we will have a meeting tomorrow morning on the economic analysis. Therefore, I wanted to circulate the attached today. It reflects a veryrough first draft of Janet's testimony, which she has not yet reviewed or approved.

As it stands, it is clearly too long to be oral testimony. But following Jeff's advice, I thought we should keep it long for now and worry about cutting down later...

Kudos to Jeff and his team (Joe Aldy and Randy Lutter) for getting this material together. The re-ordering and editing that I have attempted should not be blamed on them...========== ATTACHMENT 1 ==========
ATT CREATION TIME/DATE: 0 00:00:00.00

TEXT:
Unable to convert ARMS_EXT:[ATTACH.D79]MAIL494085234.026 to ASCII,

The following is a HEX DUMP:

TESTIMONY OF DR. JANET YELLEN
CHAIR, COUNCIL OF ECONOMIC ADVISERS
BEFORE THE SENATE FOREIGN RELATIONS COMMITTEE
ON THE ECONOMICS OF THE KYOTO AGREEMENT
FEBRUARY 11, 1998

Thank you, Mr. Chairman. The President has said that we can work to avert the grave dangers of climate change, while at the same time maintaining the strength in our economy. I am pleased to have this opportunity to appear before the Committee to elaborate on the President's statement and the Administration's economic analysis of the Kyoto Agreement.

I. Basic Economic Rationale of the Kyoto Treaty

What is the basic rationale, from an economist's perspective, for the Kyoto Agreement?

The earth's surface is warming from the accumulation of greenhouse gases from myriad sources worldwide. None of these sources presently pays the cost to others of warming's adverse effects -- a classic externality in the language of economists. As a result of these distorted incentives, disruption of the Earth's climate is likely to proceed at an excessive pace and if left uncontrolled may pose substantial costs in terms of disruption to commerce and the environment alike. The fundamental economic logic of the Kyoto agreement is thus that without such an international agreement, individual nations will not have the proper incentives to address the threats from global climate change.

II. Costs of Climate Change

In evaluating efforts to address climate change, the first step is to study the costs that are likely if we fail to take any action -- for these costs provide the primary motivation for reducing greenhouse gas emissions. What, then, are the costs associated with allowing global climate change?

The Intergovernmental Panel on Climate Change (IPCC) jointly established by the World Meteorological Organization and the United Nations Environment Programme, concluded in 1995 that "the balance of evidence suggests that there is a discernible human influence on global climate." Current concentrations of carbon dioxide, methane, nitrous oxide, and the other so-called greenhouse gases have reached levels well above those of preindustrial times. Of these, carbon dioxide (CO_2) is the most important: net cumulative CO_2 emissions resulting from the burning of fossil fuels and deforestation account for about two-thirds of potential warming from changes in greenhouse gas concentrations related to human activity.

Climatic Impact

If growth in global emissions continues unabated, the atmospheric concentration of CO_2 will likely double relative to its preindustrial level by midway through the next century. As a result of the increased concentration of CO_2, the IPCC estimates that global temperatures will increase by between 2.5 to 6 degrees Fahrenheit in the next 100 years, with a best guess of about 3.5 degrees Fahrenheit. While scientists believe that human activites are leading to a gradual warming of the *average* temperature of the earth, the change in temperature in a given region at a given time may differ substantially from this average. Indeed, models predict warming will be greater in high latitudes than in the tropics, and greater over land than ocean. Many models predict larger increases in evaporation than in precipitation over midlatitude land areas, which would result in drier conditions in those regions, especially during summer in North America and Europe.

Potential consequences associated with this shift in climate include a rise in sea levels, greater frequency of severe weather events, shifts in agricultural growing conditions from changing weather patterns, threats to human health from increased range and incidence of diseases, changes in availability of freshwater supplies, and damage to ecosystems and biodiversity.

Economic and Monetary Damages

The derivation of quantitative or monetary estimates of the damages from such climate changes is extremely difficult given the capacity of today's forecasting models. Estimates of the economic damages from climate change fall into the following broad areas: agriculture, sea-level rise, air conditioning and heating, water supply, human life and health, air pollution, and other costs (hurricanes, migration costs, human amenity, construction, leisure activities, urban infrastructure, and ecological damages such as forest loss and species loss). One must have at least some sympathy with those who critique economists on the grounds that these costs are extremely difficult to quantify.

A subject of great uncertainty and sensitivity is the "discount rate" that is applied to the benefits of averting future climate change. Such a discount rate is needed if the analysis is to be expressed in monetary terms, because a dollar today is not worth the same as a dollar tomorrow. And since the benefits of stemming future climate change accrue over not only decades but centuries, small changes in the discount rate can produce substantial changes in the results. But the precise discount rate that should be used to evaluate questions as important as the future climate of the planet remains a subject of intense debate. It is safe to say that there is, as of yet, no professional consensus on the issue.

A similar point concerns risk aversion. To what extent are we willing to take chances with our planet? The point applies particularly to catastrophe scenarios. Scientists have

thought of many possible scenarios, most of which they are fortunately not yet prepared to pronounce as particularly likely based on current evidence, but which might be truly catastrophic for the planet if they were to occur. There is a strong argument for the Kyoto agreement as a form of planet insurance. But what numerical weight should one assign to these catastrophic risks? In other words, what is the value of the insurance policy? It is difficult for an economist, or anyone, to know.

Despite these shortcomings and potential problems, respected researchers have developed estimates of the monetary damages expected from an average worldwide temperature increase of approximately 4.5 degrees Farenheit. For example, William Cline, then a Senior Fellow at the Institute for International Economics, estimated that such a temperature change would impose annual damages of more than $70 billion per year on the U.S. economy today. These damages include $22 billion in lost agricultural production, $13 billion in additional electricity costs, and $8 billion in new costs to maintain the existing supply of fresh water. (Cline's original estimates are quoted in 1990 dollars. The figures given above translated those numbers into 1997 dollars using the annual GDP price index.)

Other researchers have developed similar estimates. For example, William Nordhaus of Yale University has compared estimates of the dollar income loss attributable to a doubling of carbon dioxide concentrations. He finds that the Cline estimate is in the center of three estimates for the U.S., and that the high estimate is only 1.3 times greater than the low estimate.

It must be noted, however, that this similarity of aggregate estimates masks the true uncertainty associated with forecasts of the damages from given increases in global warming -- the estimates are all fundamentally based on extrapolations from current and past experience, and may not fully incorporate effects that will unfortunately become apparent only with future experience. In particular, the estimates may not fully reflect potential non-linearities in the relationships between carbon dioxide concentrations and temperature, between temperature and economic damages, or in the various other complicated relationships governing interactions between greenhouse gas emissions, the climate, and the economy. Current quantitative analyses do not, and can not, accurately reflect the small and unknown possibility of large-scale and potentially irreversible discrete events with potentially catastrophic consequences.

Two such possibilities serve as illustrations [check]. Warming of Northern tundra may release very large amounts of methane currently frozen into the subarctic permafrost, thereby leading to potentially devastating acceleration of an otherwise controllable global warming process. We do not know at what point, if any, such unstable activity would be triggered. Second, evidence from climate models suggests that some types of climate change may lead to displacement of the Gulf Stream that warms Western Europe. Evidence from ocean core

samples suggests that such reversals of ocean currents have occurred in previous ice ages. Reductions in the risk of such catastrophic outcomes must be considered in addition to the costs and benefits that can be reasonably quantifiable. Since human beings are typically averse to risk, such possibilities are especially important in evaluating whether the benefits of a particular climate control policy justify the costs.

III. Addressing Global Climate Change in an Efficient Manner

The costs of unabated climate change may thus be difficult to quantify, but they are nonetheless real and provide the motivation for reducing greenhouse gas emissions. In taking action to reduce those emissions, economic analysis suggests that two elements are absolutely essential:

- The effort must be global, to address the externality inherent in the global nature of the problem.

- The effort must be flexible and market-based, to ensure that we achieve our objectives in the most efficient manner possible.

Need for Global Action

Climate change is a global problem requiring a global solution. As I mentioned earlier, no single country has an incentive to reduce emissions sufficiently to protect the global environment against climate change. Each has an economic incentive to "free ride" on the efforts of others. Even if the United States sharply reduced its emissions unilaterally, greenhouse gas emissions from all other countries would continue to grow, and the risks posed by climate change would not be significantly abated. It is important to emphasize that emissions of different gases anyplace in the world have very similar effects on global climate.

The threat of disruptive climate change has led to coordinated international efforts to reduce the risks of global warming by reducing emissions of greenhouse gases. The first international agreement to address global warming was the Framework Convention on Climate Change signed during the Earth Summit in Rio de Janeiro in 1992. This convention established a long-term objective of limiting greenhouse gas concentrations and encouraged the established industrial countries to return their emissions to 1990 levels by 2000. Since then, it has become clear that the United States and many other participating countries will not meet this voluntary goal.

To address the lack of progress among many industrialized countries toward meeting the Rio objective, the United States and approximately 160 other nations agreed in negotiations held in Kyoto, Japan, last December, to take substantial steps to stabilize atmospheric concentrations of greenhouse gases. The Kyoto Agreement, which requires the advice and consent of the Senate, would place binding limits on industrial countries' emissions of the six principal categories of greenhouse gases: CO_2, N_2O, methane, sulfur hexafluoride, perfluorocarbons, and hydrofluorocarbons.

Under the Kyoto agreement, each industrial country's "1990 baseline" is actually based on its 1990 emissions of CO_2, methane, and N_2O and its choice of 1990 or 1995 levels of the other three categories of gases. The United States agreed to a target of 7 percent below 1990 levels by the period between 2008 and 2012. To meet that target, net U.S. emissions of greenhouse gases -- all emissions minus removals of CO_2 by certain forestry-related activities -- must average no more than 1,484 million metric tons of carbon equivalent per year during that period. The targets for the European Union and Japan are 8 percent and 6 percent below 1990 levels, respectively. Australia, New Zealand, Norway, and the countries of the former Soviet Union all have somewhat less ambitious limits. In sum, over the period from 2008 to 2012, the industrial countries are expected to reduce their average emissions of greenhouse gases to about 5 percent below their 1990 levels.

The President has made clear that his support of the Kyoto Agreement is dependent on meaningful participation from key developing countries (developing countries are those outside the 38 industrialized Annex I countries that agreed to binding emissions reductions). The President has also made clear that he will not submit the Treaty to the Senate without such participation.

There are several reasons why meaningful participation from developing countries is essential. First, developing countries are projected to contribute a majority of total emissions by 2030 under a continuation of business-as-usual. Without the participation of developing economies, emissions reductions by the industrialized countries will therefore not achieve necessary protection from climate change. Indeed, if developing countries do not participate in in the international regime, their emissions could potentially increase by *more* than under their business-as-usual baselines. The mechanism for such an unintended consequence is as follows. As Annex I countries comply with their targets, their demand for oil will fall, perhaps causing the price of oil to fall on world markets, and encouraging non-participating countries to use more oil and emit more carbon than they otherwise would have.

Second, developing country participation is crucial because it would permit relatively low-cost emissions reductions to be internationally recognized. Again, greenhouse gas emissions have the same basic impact on the climate regardless of where they occur. So

reductions in developing countries have the same environmental benefit as reductions domestically, even though the reductions in developing countries are often much less costly. It thus makes sense, from both an environmental and an economic perspective, to incorporate emissions reductions in developing countries into the international system.

Third, principles of basic fairness suggest all countries should do their part, depending on their ability to contribute to the solution. Thus even poor countries should contribute, although the existence of more pressing social needs in such countries will inevitably limit the magnitude of their contributions.

So far I have not mentioned the word "competitiveness." One of the difficulties in analyzing concerns related to competitiveness is that the term itself is used to mean many different things. I have seen at least one study that uses "loss of competitiveness" to refer to predictions of negative effects on the *aggregate* trade balance. As a professional economist, I do not accept the logic upon which that particular argument is predicated: the aggregate trade balance is determined by macroeconomic forces -- the difference between saving and investment -- and not by our environmental policies.

On the other hand, if competitiveness refers to adverse effects on a few specific manufacturing industries -- those that are especially energy-intensive, such as aluminum, paper, and chemicals -- the situation may be more complicated. It is difficult to undergo a significant structural change in the economy without having the effect of expanding some sectors and contracting others. But to provide some perspective on this issue, consider the following facts. First, on average, energy constitutes only 2.2 percent of total costs to U.S. industry. Second, energy prices already differ significantly between the U.S. and countries such as Venezuela [give gas price differential], and yet U.S. industry is not generally fleeing to Venezuela. Third, two-thirds of all emissions are not in manufacturing at all, but in transportation and buildings. I therefore believe it more accurate to say that we need developing country participation for the reasons I outlined above, than to say that we need it to avoid adverse effects on competitiveness.

Flexibility and Market Mechanisms

A global solution is thus critical to the global problem of climate change. But a global solution is not, however, enough by itself. We must also ensure that our efforts achieve their objectives in the most efficient manner possible. The nature of the climate change problem suggests some methods to lower costs of achieving given levels of environmental protection. Such methods have long been championed by economists interested in increasing the efficiency of protection. They were the sort of thing that 2,600 economists had in mind last year when they signed a letter, urging action on climate change:

> "Economic studies have found that there are many potential policies to reduce greenhouse gas emissions for which the total benefits outweigh the total costs...The most efficient

approach to slowing climate change is through market-based policies."

What are these methods and policies? They can be characterized in terms of three categories of flexibility: (1) "when" flexibility; (2) "what" flexibility; and (3) "where" flexibility, which may the most important of all.

1. When flexibility (timing)

First is "when flexibility" or timing. Since climate change is a long-term problem, the exact timing of emissions reductions is in some sense not of primary importance. Thus the freedom to delay or accelerate reductions within an agreed upon time frame -- while ensuring credibility of emissions reductions -- lowers costs.

The Kyoto Protocol incorporates this principle of "when flexibility" in three ways:

- First, the cuts to be made in the first period are less severe than those that had been proposed by many other countries, most notably the Europeans. By adopting a gradual and credible path of reductions in the early years, we can greatly reduce costs such as those from prematurely scrapping coal-fired electricity plants still in the prime of their operating lives, while attaining the same ultimate environmental goals.

- Second, under the Kyoto agreement, the emissions target is not specified in terms of a specific year, but rather in terms of an average over a five-year period (2008-2012). Averaging over five years, instead of requiring countries to meet a specific target each year, can lower costs, especially given an uncertain future. The averaging can smooth out the effects of short-term events such as fluctuations in the business cycle and energy demand, or hard winters and hot summers that would increase energy use and emissions.

- Third, there is allowance for "banking" emission reductions within the 2008-2012 commitment period, for use in a subsequent commitment period [although the emission targets of the next period have not yet been specified].

2. What flexibility (gases)

The second type of flexibility is "what flexibility" (six gases). Emissions of different kinds of gases, not just carbon dioxide, contribute to the greenhouse effect. Since the IPCC has developed conversion factors for all greenhouse gases by estimating their global warming potentials, reductions in emissions of one pollutant can be used to substitute for increases in emissions of another by an amount that has equivalent environmental effects. The Kyoto Protocol stipulates that countries with binding targets are expected to reduce their *total* greenhouse gas emissions by certain percentages, but does not require specific reductions for

specific gases. Since a molecule of sulfur hexafluoride is 23,900 times more potent over 100 years than a molecule of CO2, it may be cheaper to achieve the same environmental benefit by eliminating one molecular unit of SF6 than nearly 24,000 units of CO2.

Our initial rough analysis indicates that a strategy of reducing non-CO2 greenhouse gases by *more* than 7 percent below their 1990/1995 baseline levels while reducing CO2 by *less* than 7 percent below its 1990 level could reduce greenhouse gas emission permit prices by more than 10 percent. [This analysis is based on the integrated SGM/non-CO2 cost curve.] Thus allowing countries flexibility in what gases they reduce -- essentially trading emissions reductions across gases -- can help lower significantly the costs of meeting their targets.

Another source of "what flexibility" is the treatment of sinks, i.e., land use activities that promote the removal of carbon from the atmosphere through the growth of plants. Promoting such sinks may reduce atmospheric concentrations of CO2 at much lower costs than reducing emissions.

3. Where flexibility (international)

The third type of flexibility, and perhaps the most important, is "where flexibility" (international). As I have already emphasized, emissions have the same environmental consequences regardless of where in the world they occur. Therefore, the least-cost approach to controlling climate change is to reduce emissions wherever such reductions are cheapest. The Kyoto agreement includes two important cost-saving provisions of this nature. First, it provides for industrial countries to trade rights to emit greenhouse gases with each other. This market in emissions permits will ensure that emission reductions occur where they are least expensive within the industrial countries. In particular, U.S. companies could purchase emissions reductions in other participating countries when doing so would reduce their costs -- lowering costs without affecting the level of environmental protection. Second, the agreement allows industrial countries to invest in "clean development" projects in the developing world and use these projects' certified emissions reductions toward meeting their targets. Many such clean-development projects may be quite cheap in terms of the cost per ton of emissions avoided. Details of these provisions will be worked out in negotiations in Buenos Aires later this year.

IV. Difficulties of Economic Analysis of Kyoto Agreement

Now that we have a Protocol -- even if it is not yet fully complete nor ready for the President's submission to the Senate -- it is possible to explain in more detail our economic analysis. This analysis includes rough estimates of the range of some of the possible costs and benefits of our climate change policy, under various assumptions. But before I mention a single number, I wish to emphasize once again the inherent limitations to any such estimates. Such limitations should not be surprising to you: we have a difficult enough time projecting the behavior of the economy over the next quarter or year, let alone over the next two decades. The

scale of the forecasting exercise is therefore daunting, and any specific results should be treated with substantial caution.

The difficulties associated with economic analysis of climate change fall into three broad categories. First is the uncertainties that still remain over the terms of the ultimate treaty. Second is the inherent limitations of available models to analyze even short-term costs and benefits. And finally is a topic I discussed earlier: the impossibility of putting a single monetary number on the long-term benefits of climate change mitigation.

Uncertainties over Certain Provisions in International Effort to Combat Climate Change

The Kyoto Agreement was an historic accomplishment, delineating the broad terms of the international effort to address climate change. But although we know a lot more than we did before Kyoto about how that international system will work, there is still much that we don't know.

First, as is often the case in a legal document of the length and complexity of the Kyoto Protocol, there are many provisions that require further clarification and interpretation. Of particular concern here is the treatment of so-called sinks -- activities that affect the rate at which carbon is removed from the atmosphere and "sequestered," specifically by the planting of trees.

Second, the details of a number of items -- primarily concerning international trading and developing countries -- are the subject of further negotiations in Buenos Aires next fall, because they had not been definitively settled by the end of the last all-night session of the Kyoto talks.

Finally, and most importantly, we have not yet negotiated international agreements to limit emissions beyond the 2012 window. The emission cuts agreed upon at Kyoto are only a first step on a long journey. The first step that we propose to take over the next 15 years is critical. But the reason it is critical is *not* that, by itself, it will solve the climate change problem -- emissions during any given decade are small compared to the cumulative concentrations in the atmosphere. Rather, the first step is critical because we can't take the second and third steps until we have taken the first. At the same time, our analysis is complicated because we don't yet know what the subsequent steps will be.

Inherent Limitations of Models

In addition to these uncertainties about the details of the international effort to address climate change, I must also note the inherent limitations of the models used to evaluate that effort. Even within a given model, answers depend critically on the precise nature of the question asked. For example, I will illustrate momentarily how the costs of emissions reductions depend critically on the extent of global participation and international trading that a

treaty is assumed to feature. But in addition to the dependence of the results from a given model on the precise assumptions, different models can give different answers even when all the assumptions are specified to be the same -- a concrete illustration of the range of uncertainty to which we must assign the predictions of any one individual model.

One area in which the uncertainty is particularly large is the pace of technological progress, and the extent to which it will accelerate in response to government programs for R&D and dissemination. Economics does not offer a good understanding of how technological progress is determined, in part because it is the stuff of experimentation, brainstorms, genius, breakthroughs, perceptions and habits. Invention is largely determined by inspiration -- notwithstanding Edison, who assigned a 99 percent share to perspiration -- and inspiration, in my experience, is difficult to fit into mathematical formulae or economic models. Models and experts on climate change policy tend to have a wider range of disagreement on the speed with which technology can be changed than on any other single issue.

Furthermore, each model has strengths and weaknesses; each has questions to which it is better or worse suited to answer. Some, for example, model the energy sector in detail. Some allow for the fact that a coal-fired power plant cannot costlessly be converted to one that runs on natural gas. Some have enough policy detail to distinguish alternative ways of redistributing revenues that would result if emission permits were to be auctioned. Some are capable of showing short-term macroeconomic disequilibria. Some include a long-term "carbon cycle" model that can keep track of the accumulation of greenhouse gas concentrations in the atmosphere and their climatological effects. Some break down the rest of the world into regions and so can model international trade. No one model does everything, and therefore we must not rely blindly on the results of any one model or set of models. Professional judgement and economic intuition are also crucial.

Benefits of Averting Climate Change

As I discussed above, it is evident that the benefits of averting climate change are potentially immense. But we have chosen not to try to quantify them in monetary terms, in light of the difficulties I have enumerated -- including the quantitative uncertainty of these benefits, and their timing and therefore the extreme sensitivity of the results to the chosen discount rate.

Instead, we have opted for an attempt to add up the various possible costs and benefits of emissions policy *excluding* climate change. To give away the punch line, our conclusion is as follows: the net costs of our policies to reduce emissions are likely to be small, if those reductions are undertaken in an efficient manner, *even before taking into account the benefits of averting climate change itself.* It is worth emphasizing again that the numbers I will present below assume no benefit from averting climate change itself.

V. Models of the Kyoto Agreement

The existence of modeling difficulties means that we should treat any model results with the caution that is warranted -- not that we should abandon rigorous economic analysis. Indeed, we have employed a broad set of economic tools to analyze the policy options. Such tools include models of the energy sector and economy over the next 25 years, including but not limited to the results of the Stanford Energy Modeling Forum exercises, the IPCC's review of the economic and social dimensions of climate change, and the staff-level Interagency Analytical Team effort last year. Other tools include simple relevant statistics, "meta-analyses" of existing models, historical and sectoral examples, and basic economic reasoning. Drawing on this broad array of analytical tools allowed an intelligent evaluation of the policy alternatives.

To our knowledge, as of December, no model -- whether used inside the government or not -- had been set up precisely to analyze the parameters of the agreement that was reached in Kyoto. For example, most of the model-builders outside the government tend to require a lag as long as several years to incorporate changes in policy parameters into their models. And no model is currently designed to assess sinks, let alone all six greenhouse gases included in the treaty.

Since Kyoto, the Council of Economic Advisers -- in collaboration with the Treasury Department and other agencies -- has sought to evaluate the implications of what was agreed to with a particular model, the Second Generation Model of Battelle Laboratories. The SGM is perhaps the model best positioned to analyze the role of international trade in emission permits, which we consider to be a critical element of the Kyoto Treaty. Thus the SGM is the basis of the estimates that I am about to give you. (The SGM does not cover all six gases included in the Kyoto agreement. We therefore integrated the SGM model results with cost analyses of the other gases by EPA.)

Mindful of the limitations that any one model has, however, we are eager to feed the Kyoto parameters into other models, to get a better feel for the range of possible effects. Much of this work will have to go on outside the government. For example, we have had discussions with the Energy Modeling Forum, based at Stanford University. The EMF is a long-running exercise involving many of the leading climate models. We have given the EMF advice on how features of the Kyoto legal language can be translated into terms recognizable to an economist. Unfortunately, the Energy Modeling Forum believes that its members will need at least until mid-year to produce reliable results.

VI. Economic Analysis

With all of that as important background, let us now turn to the task at hand. As we do so, let me emphasize once again that the figures presented below do <u>not</u> incorporate the benefits of starting to mitigate climate change.

I said in Congressional testimony last July that we can do this smart or we can do this dumb. To elaborate, the costs of cutting emissions can be much reduced if flexible, market mechanisms are used. Our economic analysis highlighted the importance of such flexible, market-based mechanisms -- which are therefore reflected, at the President's insistence, in the Kyoto Agreement and our approach to the effort.

Domestically, the President has endorsed a market-based system of *tradeable* emissions permits -- to ensure that we achieve reductions wherever they are least expensive. The same principle holds internationally. In some countries, where energy use is high and tilted toward carbon-producing sources, it should be relatively easy to achieve large reductions. In other countries, where energy use has already been reduced and made cleaner, it is relatively expensive to reduce carbon emissions further. If emissions permits can be traded across these two types of countries, the same aggregate reduction in emissions can be achieved at lower costs.

Estimated Reduction in Costs from Annex I Trading

In the language of the treaty, "Annex I" is the set of countries that have agreed to take on binding limitations in emissions of greenhouse gases. They are basically the set of industrialized countries, defined to include Russia, Ukraine, and most other Eastern European countries. Even without developing country participation -- which, again, the President has emphasized as essential before the treaty could be ratified -- costs can be reduced substantially by trading among the Annex I countries. To provide some indication of the possible efficiency improvements, Russia and the Ukraine consume six times as much energy per dollar of output as does the United States.

The estimate we derived from the SGM was that, under certain base-case assumptions [AEEI=1 percent per year plus no sinks], trading among Annex I countries reduces the cost to the United States of achieving its targets for 2008-2012 emissions by about half -- more specifically, somewhere between 43 percent and 55 percent -- relative to a situation in which such trading was not available. This concept of costs is meant to capture aggregate resource costs to the US economy, including the cost to domestic firms of purchasing emission permits from Russia and other countries where emission reductions are cheaper than in the United States. The dramatic reduction in costs available from Annex I trading within the SGM model -- cutting in half the costs involved -- highlights why the President insisted that international trading be part of the Kyoto Agreement.

A useful rough check on this estimate can be obtained from other model[s], notwithstanding that they are likely to be more distant approximations to the parameters of the Kyoto Treaty. The G-cubed model, for example, is better designed than the SGM model to analyze trading of permits in a system where the usual international trade in goods and services is also important. The G-cubed model indicates that trading among Annex I countries reduces US permit prices by roughly 40 percent, and reduces overall costs by roughly 20 percent [CHECK].

Twelve leading models that participate in the Stanford Energy Modeling Forum show that trading among industrialized countries reduces estimated costs -- defined as lost consumption -- by an average of 56 percent, although the results vary from model to model.

Estimated reduction in costs from umbrella trading

One possibility that emerged in Kyoto, which none of us foresaw, was the idea that the United States might undertake trading with a subset of Annex I countries, dubbed the "umbrella," that would exclude the European Union. The initial list of proposed participants in the umbrella includes the United States, Australia, Canada, Japan, New Zealand and Russia, with strong indications of interest from some others.

The motivation for this idea was that the Europeans have been reluctant to agree to the sort of international trading that we want (preferring that they achieve their goals collectively in a group of their own, called the "EU bubble"). It is too early to say whether the umbrella concept will in fact be accepted by the parties. But it is an important concept to consider, for three reasons. First, it is conceivable that it will be formally agreed to in future negotiations. Second, even if the final treaty does not explicitly include the umbrella, but rather allows trading among all signatories (as the United States has proposed all along), it is conceivable that umbrella countries will agree, outside the treaty, to trade only among themselves. Third, the aversion toward international trading that the Europeans have expressed suggests that they might refrain from making the trades to which they would be entitled -- which would mean that the umbrella would operate in practice, if not in formal international agreement.

The significance of the umbrella idea in the present context is that it has the potential to further reduce costs to the United States. The reason is that if the Europeans are not bidding against us for the cheap emission rights that the Russians and other Eastern Europeans have to sell, then the price will be even lower. Our SGM results suggest that, relative to the situation in which there is no trading at all, the umbrella arrangement would reduce costs by an estimated 61-75 per cent, depending on whether the former Warsaw Pact countries are classed with the EU, or are instead assumed to fall within the umbrella. Thus, the umbrella arrangement raises the benefit to international trading significantly relative to full Annex I trading, reducing costs from roughly half their no-trading level to as low as one-quarter their no-trading level.

The G-cubed model estimates that an umbrella that includes the Warsaw Pact countries would reduce permit prices by roughly 70 percent and reduce overall costs by roughly 50 percent [CHECK].

Estimated reduction in costs from LDC participation

The next consideration is participation by developing countries. The President has said that he will not submit the treaty for ratification without such participation -- which would

further reduce the costs involved.

A moderate version of developing country participation is the Clean Development Mechanism, modelled after Joint Implementation (JI). JI cannot realistically be expected to yield all the gains of binding targets for developing countries, but it might shave costs by roughly another 20 to 25 percent from the reduced costs that result from trading among Annex I countries.

Another possibility is that we persuade some of the key developing countries that are the largest emitters to commit to targets, and allow us to buy emission reductions from those paths. The model estimate is that this would cut 55 percent off the reduced costs that result from Annex I trading. [The four countries included in this particular estimate are China, India, Brazil and Korea.] Once these savings have been attained, the estimated benefits of persuading the rest of the developing world to go along with full commitments are relatively small.

Summary

The combination that is most advantageous for the United Sates would be an umbrella that excludes the EU, but that otherwise includes full worldwide participation and trading. In this case, the cumulative reduction in costs relative to obtaining all reductions domestically is an estimated 88 percent.

I offer these numbers because they show the potential effectiveness of trading in reducing costs dramatically. But it is important that I repeat three caveats: First, as always, there is a wide range of uncertainty around all these estimates. Second, they apply to an idealized version of trading, one that assumes no problems of enforcement or transactions costs. Third, it seems relatively unlikely that we will get all our partners to agree in Buenos Aires to the very most optimistic or ambitious case. Nonetheless, despite these caveats, the numbers do show major savings even without getting the most optimistic case.

VII. Non-Climate Benefits

The costs of undertaking greenhouse gas emission reductions must be compared to the benefits. As I have indicated, for various reasons our analysis does not quantify the benefits from averting climate change itself. But the relative price shifts that are necessary to reduce emissions should produce benefits in three areas: air pollution, traffic congestion, and highway accidents. These benefits are quantifiable.

Reductions in carbon emissions also lead to reductions in emissions of pollutants that contribute to excess concentrations of fine particulate matter and low-level ozone. **[FORTHCOMING.]**

Traffic congestion hurts motorists by causing delays and inconvenience. More efficient pricing -- which recognizes the externalities involved -- should lead to reductions in congestion as motorists choose other means of travel, share rides, or even forgo less important trips. We estimate that carbon permit prices of $20 per ton will reduce travel delays associated with congestion, and that the value of such time savings to consumers would be about $0.4 billion per year.

Vehicle use also leads to costly accidents and to highway injuries including fatalities. Assuming that accidents fall proportionately with vehicle use, the savings from reduced accidents and the value of reduced mortality risk is approximately $0.3 to $2.7 billion per year for a $20 per ton carbon price.

A variety of other benefits that are harder to quantify are likely to result from reductions in carbon emissions. With respect to transportation, reduced vehicle use will also reduce the cost of road repair and maintenance. Second, reduced coal use will reduce the cost of sulfur dioxide controls, as utilities switch to enrgy sources other than coal. Reduced coal use will also lower mercury emissions. Finally, reduced energy use will also increase U.S. energy independence. Our inability to estimate these effects quantitatively does not imply that they are necessarily small or unimportant.

A final factor in the analysis is electricity restructuring, which the President identified as part of his domestic climate change package in his address to the National Geographic Society on October 22. A complete analysis of the Administration's energy policies would thus include the effects of the federal electricity restructuring legislation that the President plans to propose. An electricity sector freed from government regulation would be a more efficient energy sector. Costs to consumers would fall. A reasonable overall estimate of the effects of adding federal electricity restructuring to the rest of the President's program to address climate change is to achieve the same environmental goals at a cost saving of roughly $16 billion per year.

VIII. Estimated Net Effects For a Specific Case

We can now combine the various benefits and costs delineated above. By way of summary, I will focus on a particular case: the case of trading under umbrella, together with full participation by key LDCs. In this case, our estimate is that the net costs of attaining our Kyoto targets for emission reductions -- excluding the benefits from electricity restructuring and from beginning to reduce the threats of climate change -- is $5 to $7 billion, or roughly 0.05 percent of projected GDP.

A more tangible measure of costs is the estimated effects on energy prices. Again

excluding the impact of electricity restructuring, the SGM-based estimate is that the price of emissions would be in the range $12 to $16 per ton of carbon equivalent -- and that energy prices at the household level would rise by about 3 percent under the Kyoto accords [CHECK]. Fuel oil prices would rise by about 5 percent, natural gas prices by 4 percent, gasoline prices by 3 percent, and electricity prices by 2 percent. The 3 percent increase in energy prices at the household level would raise the average family's energy bill by about $75. [This assumes permit price of $15. For other permit prices, just scale up or down linearly].

These estimates do *not* mean that households' energy expenses will in fact be higher in 2010 than today, however. In the first place, energy prices fluctuate year-by-year for all sorts of reasons. They could go either up or down. But even if we leave out unpredictable fluctuations, the energy price declines from Federal electricity restructuring would be enough to offset the impact estimated above.

Effects on employment and aggregate output

You may have noticed that I have said nothing about job losses resulting from climate change policy. That is because I do not anticipate any significant aggregate effect. Some jobs may be lost in energy-intensive sectors, but a large number of jobs will be created in other sectors -- many of them high-tech jobs paying high wages.

Let me emphasize: The overwhelming majority of models that address climate change do not predict any change in aggregate employment. Admittedly, these are models that incorporate full employment of the labor force by design. But this is probably the right sort of model to apply, in the case of a structural change that is to be determined and publicly known 15 years in advance. Most workers will be able to plan ahead, and move into expanding fields rather than contracting ones. The same is true of capital and technology. And given a 15-year lead time, monetary policy will be able to adjust to avoid any losses in aggregate demand. Thus there need be no negative effects on output and employment.

The situation might be different if a large energy shock were to hit the economy with no warning, as happened in the oil crisis of 1973-74, when the real money supply, output and employment all contracted sharply. In addition to hitting with no warning, the oil shocks of the 1970s also entailed large transfers from the U.S. and other oil-importing countries to OPEC, thus depressing real income and spending in the former. A self-imposed shift in the relative price of carbon-intensive energy to address global climate change, on the other hand, need not entail such a transfer of purchasing power. Thus there are critical differences between the oil price shocks and the effort to reduce carbon emissions. Our reassuring conclusion regarding aggregate output might, however, be different if the policy were to be

implemented inefficiently (by command-and-control style regulations of the sort put in place in that oil crisis) rather than efficiently (by market mechanisms of the sort that the President has proposed to use).

I have seen one study that claims large losses in output and employment from climate change policy [EPI, 8/14/97]. But it did not in my view take into account the points I have made about the ability of the economy to adjust to structural change with a 15-year warning. Furthermore, it did not take into account many cost-reducing elements of the agreement and our proposed implementation -- such as international and domestic trading.

VIII. Estimates Are Conservative in Several Ways

I should emphasize that the estimates I have presented are conservative in three very important ways: sinks, technology, and climate change benefits. The first point, sinks, concerns a provision of the Kyoto Protocol that has received less attention than it merits. It is only *net* emissions -- emissions to the atmosphere minus sequestration -- that are to be reduced 7 percent below 1990 levels, not gross emissions. The United States plants many trees every year, and would receive credit for this activity under the Protocol. Very preliminary estimates suggest that sinks can reduce the costs of meeting the Kyoto target by 45 to 77 percent (on top of the gains from trading among Annex I countries). But neither we nor other analysts are yet sure exactly how to interpret the legal language of the Protocol. Because the quantitative uncertainty is still large, we have not included this effect into the net cost numbers that I cited earlier. But we do know that the effect is likely to be both favorable and large -- so that, on this account, the numbers I have given you are likely to be quite conservative.

Our estimates are also conservative regarding the payoff to the President's $6.3 billion Climate Change Technology Initiative. The logic is somewhat analogous to the rationale behind the macroeconomic assumptions that we feed into our budget forecasts: in the presence of uncertainty, we are conservative in our estimates of the speed with which the economy will grow, tax receipts will rise, and the budget will improve. That way, any revisions or surprises that occur are likely to be in the pleasant direction.

The nature of our conservatism here is that we assume in our modeling that, because of lags, most of the payoff from new technology research and dissemination expenditures (as opposed to those in the past) comes after 2012. The parameter that figures most prominently in analysis of technological progress in the energy field is the rate of improvement in the so-called Autonomous Energy Efficiency Index (AEEI), that is the rate at which the total use of energy falls relative to GDP. In our base-case analysis, the basis of the numbers I have reported to you, we took an AEEI of 1.0 percent per year, just above the number in the Energy Information Administration's Annual Energy Outlook.

A little optimism regarding the effects on the discovery and adoption of new technologies

would boost this number to 1.25 percent. This alternative and somewhat more optimistic view of technology would reduce the estimated permit price in 2010 by 20 to 31 percent, and the estimated total resource cost by 23 to 33 percent (depending how wide a set of countries is assumed to participate in trading). Gross costs -- before including any of the benefits -- come out to only $9 to $14 billion with trading only under the umbrella, and $5 to $6 billion with key developing country participation. Net of non-climate benefits, but again not including climate benefits, the net effect amounts to somewhere $4 to $11 billion -- or roughly 0.1 percent of the U.S. economy, which is expected to be roughly $10 trillion in today's prices by then. Measured in more familiar terms, the effects of the "technology optimism" case would reduce the increase in gasoline prices to only 3 cents per gallon [check all these numbers!], in electricity prices to 0.2 cents per kWh, and in total energy bill for a typical family to $50. And after taking into account the impact of electricity restructuring, the net impact on the typical family's energy bill would be to reduce it.

This "technology optimism" case is far from the most optimistic outcome that might occur. Some estimates coming from engineering models predict even higher rates of AEEI improvement, and thus even lower costs.

The third, and most important, respect in which the estimates I have presented are conservative is that they leave out the benefits of mitigating climate change itself. A full cost-benefit analysis would include mitigation in the benefits column. The only reason we have not done so, as I have explained repeatedly above, is the difficulty in coming up with a number to capture the monetary benefits. But I trust that nobody will lose sight of our ultimate objective -- keeping our planet the hospitable home that we enjoy today.

CONCLUSION

In conclusion, the Kyoto Agreement and the President's general approach to climate change reflect the insight of economic analysis. The Kyoto Agreement includes key provisions on international trading and clean development projects. The President's approach relies on market incentives -- first, with a system of tax cuts and R&D, and then later with a market-based system of tradeable permits -- to ensure that our objectives are achieved as efficiently as possible.

I look forward to continuing to work with members of this Committee, as well as other interested parties, in further analyzing the Kyoto Agreement and evaluating the net effects of reducing greenhouse gas emissions. It is my hope that economic analysis will continue to play a key role in designing policies in this area.

I welcome your questions.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 3-FEB-1998 09:21:19.00

SUBJECT: Re: Comments on President's introduction to the ERP

TO: Joseph J. Minarik (CN=Joseph J. Minarik/OU=OMB/O=EOP @ EOP [OMB])
READ:UNKNOWN

TEXT:
Many thanks for the comments on the President's introduction and also for the comments on Chapter 1, which we have incorporated into the current draft.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Michele Jolin (CN=Michele Jolin/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 3-FEB-1998 14:55:48.00

SUBJECT: Galleys of ERP Chapters

TO: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Rebecca M. Blank (CN=Rebecca M. Blank/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
Cathy will be giving you copies of the Galleys of the ERP Chapters. You may or may not want to look at them. The authors will be checking them by reading out load to another staff person.
They will then be given to Mike Treadway. And then at 9AM tomorrow, Cathy will bring the Chapters back to the publishers for the final revisions and then it will go to the printer.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 3-FEB-1998 09:22:31.00

SUBJECT: Comments on President's introduction to the ERP

TO: Michele Jolin (CN=Michele Jolin/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
I agree with Joe's comments and think we should make the suggested changes. Will you get these to Mike?
---------- Forwarded by Janet L. Yellen/CEA/EOP on 02/03/98 09:21 AM ----------

Joseph J. Minarik

02/03/98 06:24:56 AM
Record Type: Record

To: Todd Stern/WHO/EOP, Janet L. Yellen/CEA/EOP, Michele Jolin/CEA/EOP
cc:
Subject: Comments on President's introduction to the ERP

Three comments, one of them trivial.

1. Page one, second paragraph: "When I first took office in 1993 ... we took a new approach, putting in place a bold economic strategy designed to balance the budget ..." This is a judgment call, but in 1993, our stated goal was to cut the deficit in half as a percent of GDP; the President prominently presented charts that showed the deficit rising again at the end of the five-year window (there is a photo in Gene's office); and we talked about next steps to get the deficit ultimately under control. I would replace "balance the budget" with "bring down the deficit."

2. Page two, first paragraph: "This year the deficit will fall to just $10 billion...leaving the deficit today smaller in relation to the size of the economy than it has been since 1970." The 1970 deficit was 0.3 percent of GDP; the 1998 deficit will be 0.1 percent. In fact, even the 1997 final deficit was fractionally lower than 1970. Technically, I would replace "1970" with "1969" or "the last time the budget was balanced, in 1969."

3. Page one, very first line: Spell out "5" as "five."

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Joseph E. Aldy (CN=Joseph E. Aldy/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 3-FEB-1998 23:26:54.00

SUBJECT: analysis with latest sink definition

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Randall W. Lutter (CN=Randall W. Lutter/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: jonathan.gruber (jonathan.gruber @ treas.sprint.com @ inet [UNKNOWN])
READ:UNKNOWN

TO: Adele C. Morris (CN=Adele C. Morris/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
Happy dining.

========== ATTACHMENT 1 ==========
ATT CREATION TIME/DATE: 0 00:00:00.00

TEXT:
Unable to convert ARMS_EXT:[ATTACH.D72]MAIL40345833R.026 to ASCII,
The following is a HEX DUMP:

Summary of Trading Bloc Scenarios, U.S. Sinks = 50 MMTCE, AEEI = 1.0

Scenario	Permit Price	% Reduced at Home	Total Cost (Capital Transfer)
Annex I	$44/ton	52%	$18.4 b ($12.7 b)
Umbrella (no EU)	$23/ton	37%	$10.7 b ($8.7 b)
Umbrella (no EU, EE)	$36/ton	47%	$15.6 b ($11.4 b)
Umbrella (no EU) + 20% JI	$17/ton	31%	$8.2 b ($7.0 b)
Umbrella (no EU, EE) + 20% JI	$25/ton	39%	$11.4 b ($9.1 b)

Summary of Trading Bloc Scenarios, U.S. Sinks = 50 MMTCE, AEEI = 1.25

Scenario	Permit Price	% Reduced at Home	Total Cost (Capital Transfer)
Annex I	$31/ton	53%	$12.9 b ($8.7 b)
Umbrella (no EU)	$15/ton	38%	$6.9 b ($5.6 b)
Umbrella (no EU, EE)	$26/ton	49%	$11.1 b ($8.0 b)
Umbrella (no EU) + 20% JI	$12/ton	34%	$5.7 b ($4.8 b)
Umbrella (no EU, EE) + 20% JI	$19/ton	44%	$8.4 b ($6.4 b)

- All scenarios assume that the U.S. achieves 8.3% of its domestic reductions through sinks (50 MMTCE), while no other countries reduce through sinks.
- 20% JI scenarios assume that joint implementation is equal to 20% of the gains from ideal worldwide trade.
- The U.S. marginal abatement curve is such that the slope increases after a certain price (that price varies by AEEI) because there are very few inexpensive abatement opportunities among non-CO2 gases above $20 (actually, there is a step in the non-CO2 supply curve, where the next large gain in emissions reductions is at $50/ton). Thus, the percent abated per $/ton is higher at lower permit prices than it is at higher permit prices.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Steven N. Braun (CN=Steven N. Braun/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 3-FEB-1998 17:42:13.00

SUBJECT: Conversation with Ed Keane on rising unemployment

TO: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Michele Jolin (CN=Michele Jolin/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
Ed Keane said that it was strange for an Administration to project rising unemployment, and wondered why we were being so conservative. (I said, off the record, that this was intended to be an accurate forecast and one that did not differ much from the professional concensus.)

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Joseph J. Minarik (CN=Joseph J. Minarik/OU=OMB/O=EOP [OMB])

CREATION DATE/TIME: 3-FEB-1998 06:25:03.00

SUBJECT: Comments on President's introduction to the ERP

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP@EOP [CEA])
READ:UNKNOWN

TO: Michele Jolin (CN=Michele Jolin/OU=CEA/O=EOP@EOP [CEA])
READ:UNKNOWN

TO: Todd Stern (CN=Todd Stern/OU=WHO/O=EOP@EOP [WHO])
READ:UNKNOWN

TEXT:
Three comments, one of them trivial.

1. Page one, second paragraph: "When I first took office in 1993 ... we took a new approach, putting in place a bold economic strategy designed to balance the budget ..." This is a judgment call, but in 1993, our stated goal was to cut the deficit in half as a percent of GDP; the President prominently presented charts that showed the deficit rising again at the end of the five-year window (there is a photo in Gene's office); and we talked about next steps to get the deficit ultimately under control. I would replace "balance the budget" with "bring down the deficit."

2. Page two, first paragraph: "This year the deficit will fall to just $10 billion...leaving the deficit today smaller in relation to the size of the economy than it has been since 1970." The 1970 deficit was 0.3 percent of GDP; the 1998 deficit will be 0.1 percent. In fact, even the 1997 final deficit was fractionally lower than 1970. Technically, I would replace "1970" with "1969" or "the last time the budget was balanced, in 1969."

3. Page one, very first line: Spell out "5" as "five."

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 3-FEB-1998 19:23:17.00

SUBJECT: rept. on Tarullo EA mtg.

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
The mtg. was mostly on Russia, how to communicate to the leadership that we think there are some things they should do.
A bit on the "we love you" packages for Thailand and Indonesia (ex-im etc.) Tarullo and Steinberg plan to wrap up some aspects of it (I think the food aid) at the NSC Principals mtg. (to which you have been invited.)
JF

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 4-FEB-1998 18:56:17.00

SUBJECT: current draft

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

CC: Randall W. Lutter (CN=Randall W. Lutter/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

CC: Joseph E. Aldy (CN=Joseph E. Aldy/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
========== ATTACHMENT 1 ==========
ATT CREATION TIME/DATE: 0 00:00:00.00

TEXT:
Unable to convert ARMS_EXT:[ATTACH.D11]MAIL47543743M.026 to ASCII,
The following is a HEX DUMP:

TESTIMONY OF DR. JANET YELLEN
CHAIR, COUNCIL OF ECONOMIC ADVISERS
BEFORE THE SENATE FOREIGN RELATIONS COMMITTEE
ON THE ECONOMICS OF THE KYOTO AGREEMENT
FEBRUARY 11, 1998

[BOLD-FACE HENCEFORTH INDICATES EXPRESSIONS OF SUBSTANCE THAT I HAVE ADDED TO PETER'S LAST VERSION (SOME OF WHICH WERE IN MY EARLIER DRAFT). JANET SHOULD DECIDE THUMBS UP OR DOWN ON THEM, BEFORE WE CIRCULATE MORE WIDELY. -- JF]

Thank you, Mr. Chairman. The President has said that we can work to avert the grave dangers of climate change, while at the same time maintaining the strength in our economy. I am pleased to have this opportunity to appear before the Committee to elaborate on the President's statement.

The international agreement that was reached in Kyoto this past December is a crucial first step in addressing global climate change. But it is only a first step. Since the international effort to reduce greenhouse gas emissions is more of a work-in-progress than a completely finished product, it is not yet possible to provide a full authoritative analysis of it. Many of the specifics in several crucial areas are not completely resolved in the diplomatic arena, forcing analysts to make a variety of assumptions about the ultimate form of the international regime. In my testimony today, I will attempt to identify many of the most important elements to ensuring that reductions in global greenhouse gas emissions are consistent with continuing the strong economic performance that we have experienced over the past several years. **I will do my best also to relay to you some ballpark estimates of costs and benefits.**

The Administration is strongly committed to ensuring that these critical elements -- including global participation and a reliance on flexible, market-based mechanisms -- are reflected in our domestic and international climate change policies. We are firmly committed to meaningful developing country participation, as well as emissions trading both domestically and internationally. And as you know, the President's FY 1999 budget includes a $6.3 billion package of tax cuts and R&D over the next 5 years to jumpstart our efforts.

I. Basic Economic Rationale of the Kyoto Treaty

To begin our analysis, it may be worth stepping back and examining the larger question of the basic rationale, from an economist's perspective, for the Kyoto Agreement.

The earth's surface is warming from the accumulation of greenhouse gases from myriad

sources worldwide. None of these emitters presently pays the cost to others of warming's adverse effects -- a classic externality in the language of economists. As a result of these distorted incentives, disruption of the Earth's climate is likely to proceed at an excessive pace and if left uncontrolled may pose substantial costs in terms of disruption to commerce and the environment alike. The fundamental economic logic of the Kyoto agreement is thus that without such an international agreement, individual nations will not have the proper incentives to address the threats from global climate change.

II. Costs of Climate Change

In evaluating efforts to address climate change, the first step is to consider the costs that are likely if we fail to take any action -- for these costs provide the primary motivation for reducing greenhouse gas emissions. What, then, are the costs associated with allowing global climate change?

The Intergovernmental Panel on Climate Change (IPCC) jointly established by the World Meteorological Organization and the United Nations Environment Programme, concluded in 1995 that "the balance of evidence suggests that there is a discernible human influence on global climate." Current concentrations of carbon dioxide, methane, nitrous oxide, and the other so-called greenhouse gases have reached levels well above those of preindustrial times. Of these, carbon dioxide (CO_2) is the most important: net cumulative CO_2 emissions resulting from the burning of fossil fuels and deforestation account for about two-thirds of potential warming from changes in greenhouse gas concentrations related to human activity.

Climatic Impact

If growth in global emissions continues unabated, the atmospheric concentration of CO_2 will likely double relative to its preindustrial level by midway through the next century. As a result of the increased concentration of CO_2, the IPCC estimates that global temperatures will increase by between 2.5 to 6 degrees Fahrenheit in the next 100 years, with a best guess of about 3.5 degrees Fahrenheit. While scientists believe that human activites are leading to a gradual warming of the *average* temperature of the earth, the change in temperature in a given region at a given time may differ substantially from this average. Indeed, models predict warming will be greater in high latitudes than in the tropics, and greater over land than ocean. Many models predict larger increases in evaporation than in precipitation over midlatitude land areas, which would result in drier conditions in those regions, especially during summer in North America and Europe.

Potential consequences associated with this shift in climate include a rise in sea levels, greater frequency of severe weather events, shifts in agricultural growing conditions from changing weather patterns, threats to human health from increased range and incidence of

diseases, changes in availability of freshwater supplies, and damage to ecosystems and biodiversity.

Economic and Monetary Damages

The derivation of quantitative or monetary estimates of the damages from such climate changes is extremely difficult given the capacity of today's forecasting models. Estimates of the economic damages from climate change fall into the following broad areas: agriculture, sea-level rise, air conditioning and heating, water supply, human life and health, air pollution, and other costs (hurricanes, migration costs, human amenity, construction, leisure activities, urban infrastructure, and ecological damages such as forest loss and species loss).

A subject of great uncertainty and sensitivity is the "discount rate" that is applied to the benefits of averting future climate change. Such a discount rate is needed if the analysis is to be expressed in monetary terms, because a dollar today is not worth the same as a dollar tomorrow. And since the benefits of stemming future climate change accrue over not only decades but centuries, small changes in the discount rate can produce substantial changes in the results. But the precise discount rate that should be used to evaluate questions as important as the future climate of the planet remains a subject of intense debate. It is safe to say that there is, as of yet, no professional consensus on the issue.

A similar point concerns risk aversion. To what extent are we willing to take chances with our planet? The point applies particularly to catastrophe scenarios. Scientists have thought of many possible scenarios, most of which they are fortunately not yet prepared to pronounce as particularly likely based on current evidence, but which might be truly catastrophic for the planet if they were to occur. There is a strong argument for the Kyoto agreement as a form of planet insurance. But what numerical weight should one assign to these catastrophic risks? In other words, what is the value of the insurance policy? It is difficult for an economist, or anyone, to know.

Despite these shortcomings and potential problems, respected researchers have developed estimates of the monetary damages expected from an average worldwide temperature increase of approximately 4.5 degrees Farenheit (corresponding to, roughly, a doubling of pre-industrial carbon dioxide concentrations). For example, William Cline, then a Senior Fellow at the Institute for International Economics, estimated that such a temperature change would impose annual damages of more than $70 billion per year on the U.S. economy in today's terms. These damages include $22 billion in lost agricultural production, $13 billion in additional electricity costs, and $8 billion in new costs to maintain the existing supply of fresh water. (Cline's original estimates are quoted in 1990 dollars. The figures given above translated those numbers into 1997 dollars using the annual GDP price index.) William Nordhaus of Yale University has likewise computed estimates of the dollar loss attributable to a doubling of carbon dioxide concentrations. He finds that the Cline estimate is in the center of

three estimates for the U.S., and that the high estimate is only 1.3 times greater than the low estimate.

It must be noted, however, that this similarity of aggregate estimates masks the true uncertainty associated with forecasts of the damages from given increases in global warming -- the estimates are all fundamentally based on extrapolations from current and past experience, and may not fully incorporate effects that will unfortunately become apparent only with future experience. In particular, the estimates may not fully reflect potential non-linearities in the relationships between carbon dioxide concentrations and temperature, between temperature and economic damages, or in the various other complicated relationships governing interactions between greenhouse gas emissions, the climate, and the economy. Current quantitative analyses do not, and cannot, accurately reflect the small and unknown possibility of large-scale and potentially irreversible discrete events with potentially catastrophic consequences.

Two such possibilities serve as illustrations. Warming of Northern tundra may release very large amounts of methane from the subarctic permafrost, thereby leading to potentially devastating acceleration of an otherwise controllable global warming process. We do not know at what point, if any, such unstable activity would be triggered. Second, evidence from climate models suggests that some types of climate change may lead to displacement of the Gulf Stream that warms Western Europe. Evidence from ocean core samples suggests that such reversals of ocean currents have occurred in previous ice ages. Reductions in the risk of such catastrophic outcomes must be considered in addition to the costs and benefits that can be reasonably quantifiable. Since human beings are typically averse to risk, such possibilities are especially important in evaluating whether the benefits of a particular climate control policy justify the costs. One must have at least some sympathy with those who criticize economists on the grounds that the effects of climate change are extremely difficult to quantify in a single monetary number.

III. Addressing Global Climate Change in an Efficient Manner

The costs of unabated climate change may thus be difficult to quantify, but they are nonetheless real and provide the motivation for reducing greenhouse gas emissions. In taking action to reduce those emissions, economic analysis suggests that two elements are absolutely essential:

- The effort must be <u>global</u>, to address the global externality inherent in the nature of the problem.

- The effort must be flexible and market-based, to ensure that we achieve our objectives in the most efficient manner possible.

Need for Global Action

Climate change is a global problem requiring a global solution. As I mentioned earlier, no single country has an incentive to reduce emissions sufficiently to protect the global environment against climate change. Each has an economic incentive to "free ride" on the efforts of others. Even if the United States sharply reduced its emissions unilaterally, greenhouse gas emissions from all other countries would continue to grow, and the risks posed by climate change would not be significantly abated. It is important to emphasize that emissions of different gases anyplace in the world have very similar effects on global climate.

The threat of disruptive climate change has led to coordinated international efforts to reduce the risks of global warming by reducing emissions of greenhouse gases. The first international agreement to address global warming was the Framework Convention on Climate Change signed during the Earth Summit in Rio de Janeiro in 1992. This convention established a long-term objective of limiting greenhouse gas concentrations and encouraged the established industrial countries to return their emissions to 1990 levels by 2000. Since then, it has become clear that the United States and many other participating countries will not meet this voluntary goal.

To address the lack of progress among many industrialized countries toward meeting the Rio objective, the United States and approximately 160 other nations agreed in negotiations held in Kyoto, Japan, last December, to take substantial steps to stabilize atmospheric concentrations of greenhouse gases. The Kyoto Agreement, which requires the advice and consent of the Senate, would place binding limits on industrial countries' emissions of the six principal categories of greenhouse gases: CO_2, N_2O, methane, sulfur hexafluoride, perfluorocarbons, and hydrofluorocarbons. These limits apply to the 38 so-called Annex I countries, which are the industrialized countries, defined to include Russia, Ukraine, and most Eastern European countries.

Under the Kyoto agreement, each industrial country's "1990 baseline" is actually based on its 1990 emissions of CO_2, methane, and N_2O and its choice of 1990 or 1995 levels of the other three categories of gases. The United States agreed to a target of 7 percent below 1990 levels by the period between 2008 and 2012. To meet that target, net U.S. emissions of greenhouse gases -- all emissions minus removals of CO_2 by certain forestry-related activities -- must average no more than 1,484 million metric tons of carbon

equivalent per year during that period. The targets for the European Union and Japan are 8 percent and 6 percent below 1990 levels, respectively. Australia, New Zealand, Norway, and the countries of the former Soviet Union all have limits somewhat less ambitious when phrased as cuts relative to their 1990 levels. In sum, over the period from 2008 to 2012, the industrial countries are expected to reduce their average emissions of greenhouse gases to about 5 percent below their 1990 levels.

The President has made clear that his support of the Kyoto Agreement is dependent on meaningful participation from key developing countries (who are not included in Annex I). The President has also made clear that he will not submit the treaty to the Senate without such participation.

There are several reasons why meaningful participation from developing countries is essential. First, developing countries are projected to contribute a majority of total emissions by 2030 under a continuation of business-as-usual. Without the participation of developing economies, emissions reductions by the industrialized countries will therefore not achieve necessary protection from climate change. Indeed, if developing countries do not participate in the international regime, their emissions could potentially increase by *more* than under their business-as-usual baselines. One mechanism for such an unintended consequence is as follows. As Annex I countries comply with their targets, their demand for oil will fall, which will probably work to reduce the price of oil on world markets, and and perhaps to encourage non-participating countries to use more oil and emit more carbon than they otherwise would have.

Second, developing country participation is crucial because it would permit relatively low-cost emissions reductions to be internationally recognized **as a substitute for more expensive emissions reductions that might otherwise by achieved by U.S. companies domestically.** Again, greenhouse gas emissions have the same basic impact on the climate regardless of where they occur. So reductions in developing countries have the same environmental benefit as reductions domestically. But these reductions are much less costly than reductions in the U.S. or in other developed nations, because of the very inefficient and carbon-intensive uses of energy in these countries today. It thus makes sense, from both an environmental and an economic perspective, to incorporate emissions reductions in developing countries into the international system.

Third, principles of basic fairness suggest all countries should do their part, depending on their ability to contribute to the solution. Thus even poor countries should contribute, although the existence of more pressing social needs in such countries will inevitably limit the magnitude of their contributions.

So far I have not mentioned the word "competitiveness." One of the difficulties in

analyzing concerns related to competitiveness is that the term itself is used to mean many different things. I have seen at least one study that uses "loss of competitiveness" to refer to predictions of negative effects on the *aggregate* trade balance. As a professional economist, I do not accept the logic upon which that particular argument is predicated: the aggregate trade balance is determined by macroeconomic forces -- the difference between saving and investment -- and not by our environmental policies.

On the other hand, if competitiveness refers to adverse effects on a few specific manufacturing industries -- those that are especially energy-intensive, such as aluminum, paper, and chemicals -- the situation may be more complicated. It is difficult to undergo a significant structural change in the economy without having the effect of expanding some sectors and contracting others. But to provide some perspective on this issue, consider the following facts. First, on average, energy constitutes only 2.2 percent of total costs to U.S. industry. Second, energy prices already vary significantly across countries. According to the *1997 Statistical Abstract,* for example, in 1996 premium gasoline cost $1.28 in the United States -- but only 8 cents in Venezuela. Yet U.S. industry is not moving en masse to Venezuela. Third, roughly two-thirds of all emissions are not in manufacturing at all, but in transportation and buildings. I therefore believe it more accurate to say that we need developing country participation for the reasons I outlined above, than to say that we need it to avoid adverse effects on competitiveness.

Flexibility and Market Mechanisms

A global solution is thus critical to the global problem of climate change. Globalizing the solution is not, however, enough by itself. We must also ensure that our efforts achieve their objectives in the most efficient manner possible. The nature of the climate change problem suggests some methods to lower costs of achieving given levels of environmental protection. Such methods have long been championed by economists interested in increasing the efficiency of protection. They were the sort of thing that 2,600 economists had in mind last year when they signed a letter, urging action on climate change:

> "Economic studies have found that there are many potential policies to reduce greenhouse gas emissions for which the total benefits outweigh the total costs...The most efficient approach to slowing climate change is through market-based policies."

What are these methods and policies? They can be characterized in terms of three categories of flexibility: (1) "when" flexibility; (2) "what" flexibility; and (3) "where" flexibility, which may the most important of all.

1. "When flexibility" (timing)

First is "when flexibility" or timing. Since climate change is a long-term problem, the exact timing of emissions reductions is in some sense not of primary importance. Thus the

freedom to delay or accelerate reductions within an agreed upon time frame -- while ensuring credibility of emissions reductions -- lowers costs.

The Kyoto Protocol incorporates this principle of "when flexibility" in four ways:

- First, the cuts to be made in the first period are less severe, and the first period ends much later, than what had been proposed by many other countries, most notably the Europeans. By adopting a gradual and credible path of reductions in the early years, we can greatly reduce costs such as those from prematurely scrapping coal-fired electricity plants still in the prime of their operating lives, while attaining the same ultimate environmental goals.

- Second, under the Kyoto agreement, the emissions target is not specified in terms of a specific year, but rather in terms of an average over a five-year period (2008-2012). Averaging over five years, instead of requiring countries to meet a specific target each year, can lower costs, especially given an uncertain future. The averaging can smooth out the effects of short-term events such as fluctuations in the business cycle and energy demand, or hard winters and hot summers that would increase energy use and emissions.

- Third, there is allowance for "banking" emission reductions within the 2008-2012 commitment period, for use in a subsequent commitment period [although the emission targets of the next period have not yet been specified].

2. "What flexibility" (gases and sinks)

The second type of flexibility is "what flexibility", along two dimensions. The first is the inclusion in the agreement of all six greenhouse gases. Emissions of different kinds of gases, not just carbon dioxide, contribute to the greenhouse effect. Since the IPCC has developed conversion factors for all greenhouse gases by estimating their global warming potentials, reductions in emissions of one pollutant can be used to substitute for increases in emissions of another by an amount that has equivalent environmental effects. The Kyoto Protocol stipulates that countries with binding targets are expected to reduce their *total* greenhouse gas emissions by certain percentages, but does not require specific reductions for specific gases. Since a molecule of sulfur hexafluoride is 23,900 times more potent over 100 years than a molecule of CO2, it may be cheaper to achieve the same environmental benefit by eliminating one molecular unit of SF6 than nearly 24,000 units of CO2.

Some initial rough analysis indicates that a strategy of reducing non-CO2 greenhouse gases by *more* than 7 percent below their 1990/1995 baseline levels while reducing CO2 by *less* than 7 percent below its 1990 level could reduce greenhouse gas emission permit prices by more than 10 percent. [This analysis is based on the integrated SGM/non-CO2 cost curve.] Thus allowing countries flexibility in what gases they reduce -- essentially trading emissions

reductions across gases -- can help lower significantly the costs of meeting their targets.

The second source of "what flexibility" is the treatment of sinks, i.e., land use activities that promote the removal of carbon from the atmosphere through the growth of plants. Promoting such sinks through afforestation and reforestation may reduce atmospheric concentrations of CO2 at much lower costs than reducing emissions of greenhouse gases.

3. "Where flexibility" (international)

The third type of flexibility, and perhaps the most important, is "where flexibility" (international). As I have already emphasized, emissions have the same environmental consequences regardless of where in the world they occur. Therefore, the least-cost approach to controlling climate change is to reduce emissions wherever such reductions are cheapest. The Kyoto agreement includes two important cost-saving provisions of this nature. First, it provides for industrial countries to trade rights to emit greenhouse gases with each other. This market in emissions permits will ensure that emission reductions occur where they are least expensive within the industrial countries. In particular, U.S. companies could purchase emissions reductions in other participating countries when doing so would reduce their costs -- lowering costs without affecting the level of environmental protection.

Second, the agreement allows industrial countries to invest in "clean development" projects in the developing world and use these projects' certified emissions reductions toward meeting their targets. Many such clean-development projects may be quite cheap in terms of the cost per ton of emissions avoided, as has been illustrated by the joint implementation pilot program that is already in place in the U.S. Details of these provisions will be worked out in negotiations in Buenos Aires later this year.

IV. Difficulties of Economic Analysis of Kyoto Agreement

Now that we have a Protocol -- even if it is not yet fully complete nor ready for the President's submission to the Senate -- it is possible to examine it in somewhat more detail from an economic perspective. But I wish to emphasize once again the inherent limitations to any such estimates. Such limitations should not be surprising to you: economists have a difficult enough time projecting the behavior of the economy over the next quarter or year, let alone over the next two decades. The scale of the forecasting exercise is therefore daunting, and any specific results should be treated with substantial caution.

The difficulties associated with economic analysis of climate change fall into three broad categories. First is the uncertainties that still remain over the terms of the ultimate treaty. Second is the inherent limitations of available models to analyze even short-term costs and benefits. And finally is a topic I discussed earlier: the impossibility of putting a single monetary number on the long-term benefits of climate change mitigation.

Uncertainties over Certain Provisions in International Effort to Combat Climate Change

The Kyoto Agreement was an historic accomplishment, delineating the broad terms of the international effort to address climate change. But although we know a lot more than we did before Kyoto about how that international system will work, there is still much that we don't know.

First, as is often the case in a legal document of the length and complexity of the Kyoto Protocol, there are some provisions that require further clarification and interpretation. Of particular concern here is the treatment of so-called sinks -- activities that affect the rate at which carbon is removed from the atmosphere and "sequestered," specifically by the planting of trees.

Second, the details of a number of items -- primarily concerning international trading and developing countries -- are the subject of further negotiations in Buenos Aires next fall, because they had not been definitively settled by the end of the last all-night session of the Kyoto talks.

Finally, and most importantly, we have not yet negotiated international agreements to limit emissions beyond the 2012 window. The emission cuts agreed upon at Kyoto are only a first step on a long journey. The first step that we propose to take over the next 15 years is critical. But the reason it is critical is *not* that, by itself, it will solve the climate change problem -- emissions during any given decade are small compared to the cumulative concentrations in the atmosphere. Rather, the first step is critical because we can't take the second and third steps until we have taken the first. At the same time, any analysis is complicated by the lack of knowledge over what the subsequent steps will be.

Inherent Limitations of Models

In addition to these uncertainties about the details of the international effort to address climate change, I must also note the inherent limitations of the models used to evaluate that effort. Even within a given model, answers depend critically on the precise nature of the question asked. For example, the costs of emissions reductions depend critically on the extent of global participation and international trading that a treaty is assumed to feature. But in addition to the dependence of the results from a given model on the precise assumptions, different models can give different answers even when all the assumptions are specified to be the same -- a concrete illustration of the range of uncertainty to which we must assign the predictions of any one individual model.

One area in which the uncertainty is particularly large is the pace of technological progress, and the extent to which it will accelerate in response to government programs for R&D and dissemination. Economics does not offer a good understanding of how technological

progress is determined, in part because it is the stuff of experimentation, brainstorms, genius, breakthroughs, perceptions and habits. Invention is largely determined by inspiration -- notwithstanding Edison, who assigned a 99 percent share to perspiration -- and inspiration, in my experience, is difficult to fit into mathematical formulae or economic models. Models and experts on climate change policy tend to have a wider range of disagreement on the speed with which technology can be changed than on any other single issue.

Furthermore, each model has strengths and weaknesses; each has questions to which it is better or worse suited to answer. Some, for example, model the energy sector in detail. Some allow for the fact that a coal-fired power plant cannot costlessly be converted to one that runs on natural gas. Some have enough policy detail to distinguish alternative ways of redistributing revenues that would result if emission permits were to be auctioned. Some are capable of showing short-term macroeconomic disequilibria. Some include a long-term "carbon cycle" model that can keep track of the accumulation of greenhouse gas concentrations in the atmosphere and their climatological effects. Some break down the rest of the world into regions and so can model international trade. No one model does everything, and therefore we must not rely blindly on the results of any one model or set of models. Professional judgement and economic intuition are also crucial.

Benefits of Averting Climate Change

As I discussed above, it is evident that the benefits of averting climate change are potentially immense. But I have chosen not to try to quantify them in monetary terms for you , in light of the difficulties I have enumerated -- including the quantitative uncertainty of these benefits, and their timing and therefore the extreme sensitivity of the results to the chosen discount rate.

Instead, what I will do is draw upon a variety of sources in an attempt to add up the various possible costs and benefits of emissions policy *excluding* climate change. To give away the punch line, my conclusion is as follows: the net costs of our policies to reduce emissions are likely to be small, if those reductions are undertaken in an efficient manner, *even before taking into account the benefits of averting climate change itself.* That small net impact excluding the benefits of mitigating climate change, in effect, provides a partial insurance policy against the threats.

V. Models of the Kyoto Agreement

The existence of modeling difficulties means that I would recommend treating any model results with the caution that is warranted. With the appropriate caveats in mind, I have examined a broad set of economic tools available to analyze the policy options. Such tools include models of the energy sector and economy over the next 25 years, including but not limited to the results of the Stanford Energy Modeling Forum exercises, the IPCC's review of the

economic and social dimensions of climate change, and the staff-level Interagency Analytical Team effort last year. Other tools include simple relevant statistics, "meta-analyses" of existing models, historical and sectoral examples, and basic economic reasoning. Drawing on this broad array of analytical tools is crucial to an intelligent evaluation of the policy alternatives.

To my knowledge, as of December, no model -- whether used inside the government or not -- had been set up precisely to analyze the parameters of the agreement that was reached in Kyoto.Most of the model-builders outside the government tend to take a lag as long as several years to incorporate changes in policy parameters into their models. And no model is currently designed to assess sinks, or all six greenhouse gases included in the treaty.

One of the leading models in the field is the Second Generation Model of Battelle Laboratories. The SGM is one of the models best positioned to analyze the role of international trade in emission permits, which we consider to be a critical element of the Kyoto Treaty. I would therefore like to share with you some of the analyses based on the SGM model that have been developed over the past two months to reflect what was agreed to in Kyoto. To do so, several modifications to the original SGM results are necessary. For example, the SGM does not cover all six gases included in the Kyoto agreement. We therefore integrated the SGM model results with cost analyses of the other gases by EPA.

Mindful of the limitations that any one model has, however, I am eager to see the Kyoto parameters fed into other models, to get a better feel for the range of possible effects. Much of this work will continue to go on outside the government. For example, we have had discussions with the Energy Modeling Forum, based at Stanford University. The EMF is a long-running exercise involving many of the leading climate models. We have given the EMF advice on how features of the Kyoto legal language can be translated into terms recognizable to an economist. Unfortunately, the Energy Modeling Forum believes that its members will need at least until mid-year to produce reliable results.

VI. Economic Analysis

With all of that as important background, let us now turn to the task at hand. As we do so, let me emphasize once again that the figures presented below do <u>not</u> incorporate the benefits of starting to mitigate climate change.

I said in Congressional testimony last July that we can do this smart or we can do this dumb. I was referring to the point that the costs of cutting emissions can be much reduced if flexible, market mechanisms are used. Our economic analysis highlighted the importance of such flexible, market-based mechanisms -- which are therefore reflected, at the President's insistence, in the Kyoto Agreement and our approach to the effort.

Within the Kyoto agreement, this means an insistence on international trading, joint

implementation, and, ultimately, on full developing country participation. Domestically, this means that we implement any emissions reductions through a maket-based system of *tradeable* emissions permits, which ensures that we achieve reductions wherever they are least expensive. But this also means taking serious and responsible steps in the short run to prepare us to meet our obligations in the longer term.

The first such step is the inclusion in this year's budget of an aggressive, $6.3 billion program of tax cuts and R&D -- $1.3 billion more than the $5 billion package the President promised in his October 22 speech on this issue. The goal is both to stimulate the development of new energy-saving and carbon-saving technologies and to encourage the dissemination of those that exist already. The proposed package contains $3.6 billion over the next 5 years in tax cuts for energy efficient purchases and renewable energy, including tax credits of $3,000 to $4,000 for consumers who purchase highly fuel efficient vehicles, a 15 percent credit (up to $2,000) for purchases of rooftop solar equipment, a 20 percent credit (subject to a cap) for purchasing energy-efficient building equipment, a $2,000 credit for purchasing energy-efficient new homes, an extension of the wind and biomass tax credit, and a 10 percent investment credit for the purchase of combined heat and power systems. The package also contains $2.7 billion over the next 5 years in additional research and development spending -- covering the four major carbon-emitting sectors of the economy (buildings, industry, transportation, and electricity), plus carbon removal and sequestration, Federal facilities, and crossing cutting analyses and research. One example of the R&D effort is the Partnership for a New Generation of Vehicles (PNGV). PNGV is a government-industry effort to develop attractive, affordable cars that meet all applicable safety and environmental standards and get up to three times the fuel efficiency of today's cars. In FY99, the combined proposal for PNGV is $277 million, up from $227 million appropriated in FY98. Similar government-industry efforts are proposed to develop more efficient diesel engines for both light trucks and heavy trucks.

The second such step is the promotion of an environmentally-responsible electricity restructuring bill, which the President identified as part of his domestic climate change package in his address to the National Geographic Society on October 22. An electricity sector freed from government regulation would be a more efficient energy sector. Costs to consumers would fall. A reasonable overall estimate of the effects of adding federal electricity restructuring to the rest of the President's program to address climate change is to achieve the same environmental goals at a cost saving of roughly $16 billion per year.

[I'D LIKE TO TAKE THE FOLLOWING PARA. OF P.O.'S OUT (JF):]

And, if done right, electricity restructuring will also mean reductions in the emissions of greenhouse gases by this sector. Retail competition will free the electricity market to reward improved generation. Moreover, in a deregulated environment, consumers will pay more attention to energy efficiency, since the competing providers of electricity services will bundle energy efficiency services with the sale of electricity generation. And the Administration's position is that electricity restructuring legislation should also include specific provisions to promote environmental benefits.

Estimated Reduction in Costs from Annex I Trading

In the language of the treaty, "Annex I," you will recall, is the set of countries that have agreed to take on binding limitations in emissions of greenhouse gases. Even without developing country participation -- which, again, the President has emphasized as essential before the treaty could be ratified -- costs can be reduced substantially by trading among the Annex I countries. To provide some indication of the possible efficiency improvements, Russia and the Ukraine consume six times as much energy per dollar of output as does the United States.

The estimate derived from the SGM model is that, under certain base-case assumptions, trading among Annex I countries reduces the cost to the United States of achieving its targets for 2008-2012 emissions by about half relative to a situation in which such trading was not available. This concept of costs is meant to capture aggregate resource costs to the US economy, including the cost to domestic firms of purchasing emission permits from Russia and other countries where emission reductions are cheaper than in the United States. The dramatic reduction in costs available from Annex I trading within the SGM model -- cutting by half the costs involved -- highlights why the President insisted that international trading be part of the Kyoto Agreement.

A useful rough check on this estimate can be obtained from other model[s], notwithstanding that they are likely to be more distant approximations to the parameters of the Kyoto Treaty. **The G-cubed model, for example, says that trading among Annex I countries reduces reduces overall costs by roughly 20 percent** [CHECK]. **[The G-cubed model is better designed than most to analyze trading of permits in a system where the usual international trade in goods and services is also important.]** Twelve leading models that participate in the Stanford Energy Modeling Forum show that trading among industrialized countries reduces estimated costs -- defined as lost consumption -- by an average of 56 percent, although the results vary from model to model.

Estimated reduction in costs from umbrella trading

One possibility that emerged in Kyoto, which none of us foresaw, was the idea that the United States might undertake trading with a subset of Annex I countries, dubbed the "umbrella," that would exclude the European Union. The initial list of proposed participants in the umbrella includes the United States, Australia, Canada, Japan, New Zealand and Russia, with strong indications of interest from some others. The motivation for this idea was that the Europeans have been reluctant to agree to the sort of international trading that we want (preferring that they achieve their goals collectively in a group of their own, called the "EU bubble").

It is too early to say whether the umbrella concept will in fact be accepted by the parties. But it is an important concept to consider, for three reasons. First, it is conceivable that it will

be formally agreed to in future negotiations. Second, even if the final treaty does not explicitly include the umbrella, but rather allows trading among all signatories (as the United States has proposed all along), it is conceivable that umbrella countries will agree, outside the treaty, to trade only among themselves. Third, the aversion toward international trading that the Europeans have expressed suggests that they might refrain from making the trades to which they would be entitled -- which would mean that the umbrella would operate in practice, if not in formal international agreement.

The significance of the umbrella idea in the present context is that it has the potential to further reduce costs to the United States. The reason is that if the Europeans are not bidding against us for the cheap emission rights that the Russians and other Eastern Europeans have to sell, then the price will be even lower. The SGM results suggest that, relative to the situation in which there is no trading at all, the umbrella arrangement would reduce costs by an estimated 61-75 per cent, depending on whether the former Warsaw Pact countries are classed with the EU, or are instead assumed to fall within the umbrella. Thus, the umbrella arrangement raises the benefit to international trading significantly relative to full Annex I trading, reducing costs from roughly half their no-trading level to as low as one-quarter their no-trading level.

Estimated reduction in costs from LDC participation

The next consideration is participation by developing countries. The President has said that he will not submit the treaty for ratification without such participation -- which would further reduce the costs involved.

A moderate version of developing country participation is the Clean Development Mechanism, modelled after Joint Implementation (JI). JI cannot realistically be expected to yield all the gains of binding targets for developing countries, but it might shave costs by roughly another 20 to 25 percent from the reduced costs that result from trading among Annex I countries.

Another possibility is that we persuade some of the key developing countries that are the largest emitters to commit to targets, and allow us to buy emission reductions from those paths. The model estimate is that this would cut roughly 55 percent off the reduced costs that result from Annex I trading. [The four countries included in this particular estimate are China, India, Brazil and Korea.] Once these savings have been attained, the estimated reductions to US costs from persuading the rest of the developing world to go along with full commitments are relatively small.

The single combination that is most advantageous for the United States would be an umbrella that excludes the EU, but that otherwise includes full worldwide participation and trading. In this case, admittedly one that is not particularly likely, the cumulative reduction in costs relative to obtaining all reductions domestically is an estimated 88 percent.

I offer these numbers because they show the potential effectiveness of trading in reducing costs dramatically. But it is important that I repeat three caveats: First, as always, there is a wide range of uncertainty around all these estimates. Second, they apply to an idealized version of trading, one that assumes no problems of enforcement or transactions costs. Third, it seems unlikely that we will get all our partners to agree in Buenos Aires to the very most optimistic or ambitious case. Nonetheless, despite these caveats, the numbers do show major savings even without getting the most optimistic case. And if we don't get enough of what we want, we won't submit the treaty for ratification to the Senate.

VII. Non-Climate Benefits

The costs of undertaking greenhouse gas emission reductions must be compared to the benefits. As I have indicated, for various reasons our analysis does not quantify the benefits from averting climate change itself. But the relative price shifts that are necessary to reduce emissions should produce benefits in three areas: air pollution, traffic congestion, and highway accidents. These benefits are quantifiable.

Reductions in carbon emissions also lead to reductions in emissions of pollutants that contribute to excess concentrations of fine particulate matter and low-level ozone. **[FORTHCOMING FROM (EPA +) RANDY.]**

Traffic congestion hurts motorists by causing delays and inconvenience. More efficient pricing -- which recognizes the externalities involved -- should lead to reductions in congestion as motorists choose other means of travel, share rides, or even forgo less important trips. . **[PETER TOOK THE BENEFIT NUMBERS OUT, I SUPPOSE IN RESPONSE TO WHAT LARRY SAID. I AM INCLINED TO PUT THEM BACK IN:]**
We estimate that higher fuel prices resulting from carbon permit prices of $20/ton will reduce travel delays associated with congestion, and that the value of such time savings to consumers would be about $0.4 billion per year. **AND**

Vehicle use also leads to costly accidents and to highway injuries including fatalities. Assuming that accidents fall proportionately with vehicle use, more efficient pricing will also create savings from reduced accidents and resultant mortality. **the savings from reduced accidents and the value of reduced mortality risk is approximately $0.3 to $2.7 billion/ year [depending on whether lighter cars are less crashworthy] given a $20/ton carbon price.**

A variety of other benefits that are harder to quantify are likely to result from reductions in carbon emissions. With respect to transportation, reduced vehicle use will also reduce the cost of road repair and maintenance. Second, reduced coal use will reduce the cost of sulfur dioxide controls, as utilities switch to energy sources other than coal. Reduced coal use will also lower mercury emissions. Finally, reduced energy use will also increase U.S. energy

independence. Our inability to estimate these effects quantitatively does not imply that they are necessarily small or unimportant.

VIII. Estimated Net Effects For Two Illustrative Cases

NOTE: All numbers must be updated for case with US sinks of 50 MMTCE

We can now combine the various benefits and costs delineated above. By way of summary, it may be helpful to focus on two illustrative cases.

***Base** Case I: LDC Participation*

For our first example, we consider the case of trading under the umbrella, together with full participation by key LDCs. In this case, adding together the estimates derived from the SGM and other sources suggests that the net costs of attaining our Kyoto targets for emission reductions is $5 billion to $7 billion, or roughly 0.075 percent of projected GDP (i.e., net of ancillary non-climate benefits). And this estimate excludes the benefits from electricity restructuring and from beginning to reduce the threats of climate change. In fact, the savings to the economy from electricity restructuring by the 2008-2012 period would swamp these small net resource costs. **[I'M INCLINED TO DROP THE PRECEDING TWO SENTENCES, SINCE WE SAY IT TWO PARAGRAPHS DOWN, AND ELSEWHERE.]**

A more tangible measure of costs is the estimated effects on energy prices. Again excluding the impact of electricity restructuring, the SGM-based estimate is that the price of emissions would be in the range $12 to $16 per ton of carbon equivalent -- and that energy prices at the household level would rise by about 3 percent under the Kyoto accords [CHECK]. Fuel oil prices would rise by about 5 percent, natural gas prices by 4 percent, gasoline prices by 3 percent, and electricity prices by 2 percent. The 3 percent increase in energy prices at the household level would raise the average family's energy bill by about $75.

These estimates do *not* mean that households' energy expenses will in fact be higher in 2010 than today, however. In the first place, energy prices fluctuate year-by-year for all sorts of reasons. They could go either up or down. But even if we leave out unpredictable fluctuations, the energy price declines from Federal electricity restructuring would be enough to offset the impact estimated above. By 2008-2012, the projected 10 percent decline in electricity prices from the restructuring that is part of our climate change agenda will mean a net reduction in energy prices in the U.S., even accounting for the small increases noted above.

Base** Case II: No LDC Participation, **Moderate** Technological **Optimism

As highlighted earlier, estimates of the type that I am presenting are fraught with uncertainty. The estimate I just discussed was predicated on the developing country participation that we will insist upon in Buenos Aires as a condition for our ratifying the Kyoto Protocol, but which is not yet part of that Protocol. At the same time, the estimates above are quite conservative regarding the payoff to the President's $6.3 billion Climate Change Technology Initiative. The parameter that figures most prominently in analysis of technological progress in the energy field is the rate of improvement in the so-called Autonomous Energy Efficiency Index (AEEI), that is the rate at which the total use of energy falls relative to GDP. In the base-case analysis, the basis of the numbers I have reported to you, the AEEI improves by 1.0 percent per year. Reflecting a conservative interpretation of the 15-year impact of the technology initiative, this is only a small increase above the number in the Energy Information Administration's Annual Energy Outlook.

A little optimism regarding the effects on the discovery and adoption of new technologies would boost this number to 1.25 percent. As a second example, let us therefore consider the effects of boosting the AEEI parameter. At the same time, we use more conservative assumptions on LDC participation: instead of assuming that we get the full participation of key LDCs, we assume instead that we only get the benefits of joint implementation through the Clean Development Mechanism (as currently agreed to in the Kyoto Protocol). Under this set of assumptions, in fact, the costs to the U.S. are roughly similar .... [FILL IN NET COSTS, ALONG WITH ENERGY PRICE EFFECTS. **WHY DON'T WE DO SIMPLY ANNEX I TRADING HERE, WITHOUT JI, IF THE POINT IS THAT CASE II IS SUPPOSED TO GET MORE OF THE REDUCTIONS DOMESTICALLY?**].

This "technology optimism" case is far from the most optimistic outcome that might occur. Some estimates coming from engineering models predict even higher rates of AEEI improvement, and thus even lower costs. And, once again, these estimates do not account for the electricity restructuring proposal which is part of the President's package. And after taking into account the impact of electricity restructuring, the net impact on the typical family's energy bill would be to reduce it, and there would be net gains for the economy.

[MORE STUFF NEEDED HERE ON TECHNOLOGY OPTIMISM/WONDERS OF TECHNOLOGY - LOVINS STUFF? -- P.O.
IN MY VIEW, PETER HAS ALREADY PUT ENOUGH OF THOSE SPECIFICS IN, ABOVE. PLUS I ADDED ANOTHER SECOND TECHNOLOGY OPTIMISM PARAGRAPH IN PART VIII BELOW. -- JF]

Effects on employment and aggregate output

You may have noticed that I have said nothing about job losses resulting from climate change policy. That is because while there may be job gains in some sectors and job losses in others, I do not anticipate any significant aggregate effect. Some jobs may be lost in energy-intensive sectors, but a large number of jobs will be created in other sectors -- many of

them high-tech jobs paying high wages. The President is firmly committed to assisting any workers who are adversely affected during the transition to a climate-friendly economy.

The situation might be different if a large energy shock were to hit the economy with no warning, as happened in the oil crisis of 1973-74, when the real money supply, output and employment all contracted sharply. In addition to hitting with no warning, the oil shocks of the 1970s also entailed large transfers from the U.S. and other oil-importing countries to OPEC, thus depressing real income and spending in the former. A self-imposed shift in the relative price of carbon-intensive energy to address global climate change, on the other hand, need not entail such a transfer of purchasing power. Thus there are critical differences between the oil price shocks and the effort to reduce carbon emissions. Our reassuring conclusion regarding aggregate output might also be different if the policy were to be implemented inefficiently (by command-and-control style regulations of the sort put in place in that oil crisis) rather than efficiently (by market mechanisms of the sort that the President has proposed to use).

Consider for a moment the ability of U.S. industry to evolve to changes when there is sufficient lead time. [RANDY: COULD YOU ADD STUFF HERE THAT GENE WANTED??? CFC PHASEOUT?? SO2 EXAMPLE??]

I have seen one study that claims large losses in output and employment from climate change policy [EPI, 8/14/97]. But this study is misleading in three important ways. First, it did not in my view take into account the points I have made about the ability of the economy to adjust to structural change with a 15-year warning. In particular, a number of comentators on this specific model have highlighted that this is a model best designed to predict economic impacts in the very near future, two to three years from now, and that it is not useful for long term predictions of this type. Second, the model fully assumes that we "do this dumb", ignoring the efficiencies from international emissions trading, joint implementation, LDC participation. Third, the model ignores any of the benefits of reducing emissions noted above, as well as any benefits of averting climate change, and it does not embody any technological advance in response to our $6.3 billion technology package, nor any benefits to the economic from our electricity restructuring proposal. These results are therefore exaggerated and present a misleading portrait of the effects of our climate change plan.

VIII. Estimates Are Conservative in Several Ways

I should emphasize that the estimates I have presented are conservative in three very important ways: sinks, technology, and climate change benefits. The first point, sinks, concerns a provision of the Kyoto Protocol that has received less attention than it merits. It is only *net*

emissions -- emissions to the atmosphere minus sequestration -- that are to be reduced 7 percent below 1990 levels, not gross emissions. The United States plants many trees every year, and would receive credit for this activity under the Protocol. The estimates that I have cited for the effect of sinks are based on an assumption for sink activity in the U.S. over the 2008-2012 period, and no assumed benefits from sinks elsewhere in the world. Very preliminary estimates suggest that incorporating the gains from sinks *throughout the world* can reduce the costs of meeting the Kyoto target by half or more, on top of the gains from trading among Annex I countries. (Furthermore, no model has yet even tried to take into account that government policies can help raise the amount of tree-planting, possibly through some version of the Conservation Reserve Program, for example.) But neither we nor other analysts are yet sure exactly how to interpret the legal language of the Protocol. Because the quantitative uncertainty is still large, we have **been conservative in** considering an estimate of sinks for the U.S. only. But we do know that the effect of fully modelling sinks is likely to be both favorable and large -- so that, on this account, the numbers I have given you are likely to be conservative.

Our estimates are also conservative regarding the payoff to the President's Climate Change Technology Initiative. The logic is somewhat analogous to the rationale behind the macroeconomic assumptions that we feed into our budget forecasts: in the presence of uncertainty, we are conservative in our estimates of the speed with which the economy will grow, tax receipts will rise, and the budget will improve. That way, any revisions or surprises that occur are likely to be in the pleasant direction. The nature of our conservatism here is that we assume in our modeling that, because of lags, most of the payoff from new technology research and dissemination expenditures (as opposed to those in the past) comes after 2012. But some experts in the technology of climate change policy forecast more rapid technological progress, as reflected in the models by more favorable AEEI rates, for example. If they are right, costs will come down further.

The third, and most important, respect in which the estimates I have presented are conservative is that they leave out the benefits of mitigating climate change itself. A full cost-benefit analysis would include mitigation in the benefits column. The only reason we have not done so, as I have explained repeatedly above, is the difficulty in coming up with a number to capture the monetary benefits. But I trust that nobody will lose sight of our ultimate objective -- keeping our planet the hospitable home that we enjoy today.

CONCLUSION

In conclusion, the Kyoto Agreement and the President's general approach to climate change reflect the insight of economic analysis. The Kyoto Agreement includes key provisions on international trading and clean development projects. The President's approach relies on market incentives -- first, with a system of tax cuts and R&D, and then later with a market-based system of tradeable permits -- to ensure that our objectives are achieved as efficiently as possible.

I look forward to continuing to work with members of this Committee, as well as other interested parties, in further analyzing the Kyoto Agreement and evaluating the net effects of reducing greenhouse gas emissions. It is my hope that economic analysis will continue to play a key role in designing policies in this area.

I welcome your questions.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Peter R. Orszag (CN=Peter R. Orszag/OU=OPD/O=EOP [OPD])

CREATION DATE/TIME: 4-FEB-1998 17:11:00.00

SUBJECT: Social Security First

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Barbara Chow (CN=Barbara Chow/OU=OMB/O=EOP @ EOP [OMB])
READ:UNKNOWN

TO: DAVID.WILCOX (DAVID.WILCOX @ MS01.DO.treas.sprint.com @ INET @ LNGTWY [UNKNOWN])
READ:UNKNOWN

TO: Jacob J. Lew (CN=Jacob J. Lew/OU=OMB/O=EOP @ EOP [OMB])
READ:UNKNOWN

TO: Joseph J. Minarik (CN=Joseph J. Minarik/OU=OMB/O=EOP @ EOP [OMB])
READ:UNKNOWN

CC: Janet Himler (CN=Janet Himler/OU=OMB/O=EOP @ EOP [OMB])
READ:UNKNOWN

TEXT:
Clay Chandler's piece this morning, along with Speaker Gingrich's letter to the President today, highlights the need for more specificity about the Social Security First policy. In particular, questions are being asked about what will happen if the surpluses accrue before we get reform done, and how the transfers to Social Security -- if they were to occur -- would happen.

The attached bullets try to lay out a possible approach.

Let me know what you think.

Thanks,
Peter========== ATTACHMENT 1 ==========
ATT CREATION TIME/DATE: 0 00:00:00.00

TEXT:
Unable to convert ARMS_EXT:[ATTACH.D50]MAIL49292643I.026 to ASCII,
The following is a HEX DUMP:

President's Proposal on Save Social Security First

- The President's proposal on the surplus is quite simple: Until we have achieved Social Security reform, we should not spend the unified surpluses on anything else. That means that until we have put the Social Security system on a better financial footing, we must shun proposals that would reduce the projected unified surpluses (e.g., that are not revenue-neutral).

- The President intends to achieve Social Security reform before the end of FY 1999. Since FY 1999 is the first full fiscal year in which the Administration projects a unified budget surplus, we plan to get reform done before the first fiscal year surplus arises. The questions that are being posed about the precise mechanisms for transferring any surpluses to the Social Security system, or about current law impediments to doing so, would thus be addressed as part of broader Social Security reform legislation.

- Nonetheless, let me emphasize that if a surplus for FY 1998 looks likely, or if for some unforeseen reason it appears that reform will be delayed and a surplus will accrue before Social Security reform is accomplished, the President would be willing to consider legislation to create an explicit Social Security Reserve Fund to facilitate the "Save Social Security First" policy. In particular, the Reserve Fund could be credited with any reduction in publicly held debt that results from the unified surplus over a given fiscal year. The legislation could also clarify that the resources of the Reserve Fund could ultimately be transferred, if necessary, to the Old-Age Survivors and Disability Insurance Trust Funds.

- Furthermore, while the President's policy is that every penny of the projected surpluses should be reserved *until* we have addressed Social Security reform -- not that every penny must ultimately be used for Social Security -- I would certainly expect that the unified surpluses will play some role in the reform effort. But precisely how much of the surpluses should be used as part of Social Security reform, and how much should be devoted to other priorities *after* we have achieved that Social Security reform, is a question that should be at the center of the national discussion we will be engaging in over the coming year. The crucial point is that until we know how much of the surpluses are necessary to strengthen Social Security, we shouldn't use them for anything else.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Michele Jolin (CN=Michele Jolin/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 4-FEB-1998 18:12:06.00

SUBJECT: Re: Release of the 1998 Economic Report of the President

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
Amy (from the Press office) said that we could go with the NYT but that she'd still prefer Knight-Ridder. Sylvia seems to think that Knight-Ridder would be better. (see below)
Let me know what you'd like to do.
Thanks
---------- Forwarded by Michele Jolin/CEA/EOP on 02/04/98 06:10 PM ----------

Sylvia M. Mathews
02/04/98 06:03:51 PM
Record Type: Record

To: Amy W. Tobe/WHO/EOP
cc: Michele Jolin/CEA/EOP, Beverly J. Barnes/WHO/EOP
Subject: Re: Release of the 1998 Economic Report of the President

I think that Knight Ridder may be better.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Randall W. Lutter (CN=Randall W. Lutter/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 5-FEB-1998 14:36:48.00

SUBJECT: draft as of 2:35 Thursday

TO: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Joseph E. Aldy (CN=Joseph E. Aldy/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
========== ATTACHMENT 1 ==========
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TESTIMONY OF DR. JANET YELLEN
CHAIR, COUNCIL OF ECONOMIC ADVISERS
BEFORE THE SENATE FOREIGN RELATIONS COMMITTEE
ON THE ECONOMICS OF THE KYOTO AGREEMENT
FEBRUARY 11, 1998

Thank you, Mr. Chairman. The President has said that we can work to avert the grave dangers of climate change, while at the same time maintaining the strength in our economy. I am pleased to have this opportunity to appear before the Committee to elaborate on the President's statement.

The international agreement that was reached in Kyoto this past December is a crucial first step in addressing global climate change. But it is only a first step. Since the international effort to reduce greenhouse gas emissions is more of a work-in-progress than a completely finished product, it is not yet possible to provide a full authoritative analysis of it. Many of the specifics in several crucial areas are not completely resolved in the diplomatic arena, forcing analysts to make a variety of assumptions about the ultimate form of the international regime. In my testimony today, I will attempt to identify key elements of the agreement, such as global participation and reliance on flexible, market-based measures that ensure that reductions in global greenhouse gas emissions are consistent with continued strong economic growth. I will do my best also to provide some rough estimates of costs and benefits.

The Administration is strongly committed to ensuring that these critical elements are reflected in our domestic and international climate change policies. We are firmly committed to meaningful developing country participation, as well as emissions trading both domestically and internationally. And as you know, the President's FY 1999 budget includes a $6.3 billion package of tax cuts and R&D over the next 5 years to jumpstart our efforts.

I. Basic Economic Rationale of the Kyoto Treaty

To begin our analysis, it may be worth stepping back and examining the larger question of the basic rationale, from an economist's perspective, for the Kyoto Agreement.

The earth's surface is warming from the accumulation of greenhouse gases from myriad sources worldwide. None of these emitters presently pays the cost to others of warming's adverse effects -- a classic externality in the language of economists. As a result of these distorted incentives, disruption of the Earth's climate is likely to proceed at an excessive pace and if left uncontrolled may pose substantial costs in terms of disruption to commerce and the environment alike. The fundamental economic logic of the Kyoto agreement is thus that

without such an international agreement, individual nations will not have the proper incentives to address the threats from global climate change.

II. Costs of Climate Change

In evaluating efforts to mitigate global warming, the first step is to consider the costs that are likely if we fail to take any action -- for these costs provide the primary motivation for reducing greenhouse gas emissions. What, then, are the costs associated with allowing global climate change?

The Intergovernmental Panel on Climate Change (IPCC) jointly established by the World Meteorological Organization and the United Nations Environment Programme, concluded in 1995 that "the balance of evidence suggests that there is a discernible human influence on global climate." Current concentrations of carbon dioxide, methane, nitrous oxide, and the other so-called greenhouse gases have reached levels well above those of preindustrial times. Of these, carbon dioxide (CO_2) is the most important: net cumulative CO_2 emissions resulting from the burning of fossil fuels and deforestation account for about two-thirds of potential warming from changes in greenhouse gas concentrations related to human activity.

Climatic Impact

If growth in global emissions continues unabated, the atmospheric concentration of CO_2 will likely double relative to its preindustrial level by midway through the next century. As a result of the increased concentration of CO_2, the IPCC estimates that global temperatures will increase by between 2.5 to 6 degrees Fahrenheit in the next 100 years, with a best guess of about 3.5 degrees Fahrenheit. While scientists believe that human activites are leading to a gradual warming of the *average* temperature of the earth, the change in temperature in a given region at a given time may differ substantially from this average. Indeed, models predict warming will be greater in high latitudes than in the tropics, and greater over land than ocean. Many models predict larger increases in evaporation than in precipitation over midlatitude land areas, which would result in drier conditions in those regions, especially during summer in North America and Europe.

Potential consequences associated with this shift in climate include a rise in sea levels, greater frequency of severe weather events, shifts in agricultural growing conditions from changing weather patterns, threats to human health from increased range and incidence of diseases, changes in availability of freshwater supplies, and damage to ecosystems and biodiversity.

Economic and Monetary Damages

The derivation of quantitative or monetary estimates of the damages from such climate changes is extremely difficult given the capacity of today's forecasting models. Estimates of the economic damages from climate change fall into the following broad areas: agriculture, sea-level rise, air conditioning and heating, water supply, human life and health, air pollution, and other costs (hurricanes, migration costs, human amenity, construction, leisure activities, urban infrastructure, and ecological damages such as forest loss and species loss).

A subject of great uncertainty and sensitivity is the "discount rate" that is applied to the benefits of averting future climate change. Such a discount rate is needed if the analysis is to be expressed in monetary terms, because a dollar today is not worth the same as a dollar tomorrow. And since the benefits of stemming future climate change accrue over not only decades but centuries, small changes in the discount rate can produce substantial changes in the results. But the precise discount rate that should be used to evaluate questions as important as the future climate of the planet remains a subject of intense debate. It is safe to say that there is, as of yet, no professional consensus on the issue.

A similar point concerns risk aversion. To what extent are we willing to take chances with our planet? The point applies particularly to catastrophe scenarios. Scientists have thought of many possible scenarios, most of which they are fortunately not yet prepared to pronounce as particularly likely based on current evidence, but which might be truly catastrophic for the planet if they were to occur. There is a strong argument for the Kyoto agreement as a form of planet insurance. But what numerical weight should one assign to these catastrophic risks? In other words, what is the value of the insurance policy? It is difficult for an economist, or anyone, to know.

Despite these shortcomings and potential problems, respected researchers have developed estimates of the monetary damages expected from an average worldwide temperature increase of approximately 4.5 degrees Farenheit (corresponding to, roughly, a doubling of pre-industrial carbon dioxide concentrations). For example, William Cline, then a Senior Fellow at the Institute for International Economics, estimated that such a temperature change would impose annual damages of more than $70 billion per year on the U.S. economy in today's terms. These damages include $22 billion in lost agricultural production, $13 billion in additional electricity costs, and $8 billion in new costs to maintain the existing supply of fresh water. (Cline's original estimates are quoted in 1990 dollars. The figures given above translated those numbers into 1997 dollars using the annual GDP price index.) William Nordhaus of Yale University has likewise computed estimates of the dollar loss attributable to a doubling of carbon dioxide concentrations. He finds that the Cline estimate is in the center of three estimates for the U.S., and that the high estimate is only 1.3 times greater than the low estimate.

It must be noted, however, that this similarity of aggregate estimates masks the true uncertainty associated with forecasts of the damages from given increases in global warming --

the estimates are all fundamentally based on extrapolations from current and past experience, and may not fully incorporate effects that will unfortunately become apparent only with future experience. In particular, the estimates may not fully reflect potential non-linearities in the relationships between carbon dioxide concentrations and temperature, between temperature and economic damages, or in the various other complicated relationships governing interactions between greenhouse gas emissions, the climate, and the economy. Current quantitative analyses do not, and cannot, accurately reflect the small and unknown possibility of large-scale and potentially irreversible discrete events with potentially catastrophic consequences.

Two such possibilities serve as illustrations. Warming of Northern tundra may release very large amounts of methane from the subarctic permafrost, thereby leading to potentially devastating acceleration of an otherwise controllable global warming process. We do not know at what point, if any, such unstable activity would be triggered. Second, evidence from climate models suggests that some types of climate change may lead to displacement of the Gulf Stream that warms Western Europe. Evidence from ocean core samples suggests that such reversals of ocean currents have occurred in previous ice ages. Reductions in the risk of such catastrophic outcomes must be considered in addition to the costs and benefits that can be reasonably quantifiable. Since human beings are typically averse to risk, such possibilities are especially important in evaluating whether the benefits of a particular climate control policy justify the costs. One must have at least some sympathy with those who criticize economists on the grounds that the effects of climate change are extremely difficult to quantify in a single monetary number.

III. Addressing Global Climate Change in an Efficient Manner

The costs of unabated climate change may thus be difficult to quantify, but they are nonetheless real and provide the motivation for reducing greenhouse gas emissions. In taking action to reduce those emissions, economic analysis suggests that two elements are absolutely essential:

- The effort must be <u>global</u>, to address the global externality inherent in the nature of the problem.

- The effort must be <u>flexible and market-based</u>, to ensure that we achieve our objectives in the most efficient manner possible.

Need for Global Action

Climate change is a global problem requiring a global solution. As I mentioned earlier, no single country has an incentive to reduce emissions sufficiently to protect the global environment against climate change. Each has an economic incentive to "free ride" on the efforts of others. Even if the United States sharply reduced its emissions unilaterally, greenhouse gas emissions from all other countries would continue to grow, and the risks posed by climate change would not be significantly abated. It is important to emphasize that emissions of different gases anyplace in the world have very similar effects on global climate.

The threat of disruptive climate change has led to coordinated international efforts to reduce the risks of global warming by reducing emissions of greenhouse gases. The first international agreement to address global warming was the Framework Convention on Climate Change signed during the Earth Summit in Rio de Janeiro in 1992. This convention established a long-term objective of limiting greenhouse gas concentrations and encouraged the established industrial countries to return their emissions to 1990 levels by 2000. Since then, it has become clear that the United States and many other participating countries will not meet this voluntary goal.

To address the lack of progress among many industrialized countries toward meeting the Rio objective, the United States and approximately 160 other nations agreed in negotiations held in Kyoto, Japan, last December, to take substantial steps to stabilize atmospheric concentrations of greenhouse gases. The Kyoto Agreement, which requires the advice and consent of the Senate, would place binding limits on industrial countries' emissions of the six principal categories of greenhouse gases: CO_2, N_2O, methane, sulfur hexafluoride, perfluorocarbons, and hydrofluorocarbons. These limits apply to the 38 so-called Annex I countries, which are the industrialized countries, defined to include Russia, Ukraine, and most Eastern European countries.

Under the Kyoto agreement, each industrial country's "1990 baseline" is actually based on its 1990 emissions of CO_2, methane, and N_2O and its choice of 1990 or 1995 levels of the other three categories of gases. The United States agreed to a target of 7 percent below 1990 levels by the period between 2008 and 2012. To meet that target, net U.S. emissions of greenhouse gases -- all emissions minus removals of CO_2 by certain forestry-related activities -- must average no more than 1,484 million metric tons of carbon equivalent per year during that period. The targets for the European Union and Japan are 8 percent and 6 percent below 1990 levels, respectively. Australia, New Zealand, Norway, Russia and Ukraine all have limits somewhat less ambitious when phrased as cuts relative to

their 1990 levels. In sum, over the period from 2008 to 2012, the industrial countries are expected to reduce their average emissions of greenhouse gases to about 5 percent below their 1990 levels.

The President has made clear that his support of the Kyoto Agreement is dependent on meaningful participation from key developing countries (who are not included in Annex I). The President has also made clear that he will not submit the treaty to the Senate without such participation.

There are several reasons why meaningful participation from developing countries is essential. First, developing countries are projected to contribute a majority of total emissions by 2030 under a continuation of business-as-usual. Without the participation of developing economies, emissions reductions by the industrialized countries will therefore not achieve necessary protection from climate change. Indeed, if developing countries do not participate in the international regime, their emissions could potentially increase by *more* than under their business-as-usual baselines. One mechanism for such an unintended consequence is as follows. As Annex I countries comply with their targets, their demand for oil will fall, which will probably work to reduce the price of oil on world markets, and and perhaps to encourage non-participating countries to use more oil and emit more carbon than they otherwise would have.

Second, developing country participation is crucial because it would permit relatively low-cost emissions reductions to be internationally recognized as a substitute for more expensive emissions reductions that might otherwise by achieved by U.S. companies domestically. Again, greenhouse gas emissions have the same basic impact on the climate regardless of where they occur. So reductions in developing countries have the same environmental benefit as reductions domestically. But these reductions are much less costly than reductions in the U.S. or in other developed nations, because of the very inefficient and carbon-intensive uses of energy in these countries today. It thus makes sense, from both an environmental and an economic perspective, to incorporate emissions reductions in developing countries into the international system.

Third, principles of basic fairness suggest all countries should do their part, depending on their ability to contribute to the solution. Thus even poor countries should contribute, although the existence of more pressing social needs in such countries will inevitably limit the magnitude of their contributions.

So far I have not mentioned the word "competitiveness." One of the difficulties in analyzing concerns related to competitiveness is that the term itself is used to mean many different things. I have seen at least one study that uses "loss of competitiveness" to refer to predictions of negative effects on the *aggregate* trade balance. As a professional economist, I do not accept the logic upon which that particular argument is predicated: the aggregate trade

balance is determined by macroeconomic forces -- the difference between saving and investment -- and not by our environmental policies.

On the other hand, if competitiveness refers to adverse effects on a few specific manufacturing industries -- those that are especially energy-intensive, such as aluminum, paper, and chemicals -- the situation may be more complicated. It is difficult to undergo a significant structural change in the economy without having the effect of expanding some sectors and contracting others. But to provide some perspective on this issue, consider the following facts. First, on average, energy constitutes only 2.2 percent of total costs to U.S. industry. Second, energy prices already vary significantly across countries. According to the *1997 Statistical Abstract,* for example, in 1996 premium gasoline cost $1.28 per gallon in the United States -- but only 8 cents in Venezuela. Yet U.S. industry is not moving en masse to Venezuela. Third, roughly two-thirds of all emissions are not in manufacturing at all, but in transportation and buildings. I therefore believe it more accurate to say that we need developing country participation for the reasons I outlined above, than to say that we need it to avoid adverse effects on competitiveness.

Flexibility and Market Mechanisms

A global solution is thus critical to the global problem of climate change. Globalizing the solution is not, however, enough by itself. We must also ensure that our efforts achieve their objectives in the most efficient manner possible. The nature of the climate change problem suggests three basic methods to lower costs of achieving given levels of environmental protection. They can be characterized in terms of three categories of flexibility: (1) "when" flexibility; (20) "what" flexibility; and (3) "where" flexibility, which may be the most important of all. Such methods have long been championed by economists interested in increasing the efficiency of protection. Indeed 2,600 economists urged such approaches in a letter they signed last year urging action on climate change:

> "Economic studies have found that there are many potential policies to reduce greenhouse gas emissions for which the total benefits outweigh the total costs...The most efficient approach to slowing climate change is through market-based policies."

1. "When flexibility" (timing)

First is "when flexibility" or timing. Since climate change is a long-term problem, the exact timing of emissions reductions is in some sense not of primary importance. Thus the freedom to delay or accelerate reductions within an agreed upon time frame -- while ensuring credibility of emissions reductions -- lowers costs.

The Kyoto Protocol incorporates this principle of "when flexibility" in four ways:

- First, the cuts to be made in the first period are less severe, and the first period ends much later, than what had been proposed by many other countries, most notably the Europeans. By adopting a gradual and credible path of reductions in the early years, we can greatly reduce costs such as those from prematurely scrapping coal-fired electricity plants still in the prime of their operating lives, while attaining the same ultimate environmental goals.

- Second, under the Kyoto agreement, the emissions target is not specified in terms of a specific year, but rather in terms of an average over a five-year period (2008-2012). Averaging over five years, instead of requiring countries to meet a specific target each year, can lower costs, especially given an uncertain future. The averaging can smooth out the effects of short-term events such as fluctuations in the business cycle and energy demand, or hard winters and hot summers that would increase energy use and emissions.

- Third, there is allowance for "banking" emission reductions within the 2008-2012 commitment period, for use in a subsequent commitment period [although the emission targets of the next period have not yet been specified].

2. "What flexibility" (gases and sinks)

The second type of flexibility is "what flexibility", along two dimensions. The first is the inclusion in the agreement of all six greenhouse gases. Emissions of different kinds of gases, not just carbon dioxide, contribute to the greenhouse effect. Since the IPCC has developed conversion factors for all greenhouse gases by estimating their global warming potentials, reductions in emissions of one pollutant can be used to substitute for increases in emissions of another by an amount that has equivalent environmental effects. The Kyoto Protocol stipulates that countries with binding targets are expected to reduce their *total* greenhouse gas emissions by certain percentages, but does not require specific reductions for specific gases. Since a molecule of sulfur hexafluoride is 23,900 times more potent over 100 years than a molecule of CO2, it may be cheaper to achieve the same environmental benefit by eliminating one molecular unit of SF6 than nearly 24,000 units of CO2.

Some initial rough analysis indicates that a strategy of reducing non-CO2 greenhouse gases by *more* than 7 percent below their 1990/1995 baseline levels while reducing CO2 by *less* than 7 percent below its 1990 level could reduce greenhouse gas emission permit prices by more than 10 percent. [This analysis is based on the integrated SGM/non-CO2 cost curve.] Thus allowing countries flexibility in what gases they reduce -- essentially trading emissions reductions across gases -- can help lower significantly the costs of meeting their targets.

The second source of "what flexibility" is the treatment of sinks, i.e., land use activities that promote the removal of carbon from the atmosphere through the growth of plants. Promoting such sinks through afforestation and reforestation may reduce atmospheric

concentrations of CO2 at much lower costs than reducing emissions of greenhouse gases.

3. "Where flexibility" (international)

The third type of flexibility, and perhaps the most important, is "where flexibility" (international). As I have already emphasized, emissions have the same environmental consequences regardless of where in the world they occur. Therefore, the least-cost approach to controlling climate change is to reduce emissions wherever such reductions are cheapest. The Kyoto agreement includes two important cost-saving provisions of this nature. First, it provides for industrial countries to trade rights to emit greenhouse gases with each other. This market in emissions permits will ensure that emission reductions occur where they are least expensive within the industrial countries. In particular, U.S. companies could purchase emissions reductions in other participating countries when doing so would reduce their costs -- lowering costs without affecting the level of environmental protection.

Second, the agreement allows industrial countries to invest in "clean development" projects in the developing world and use these projects' certified emissions reductions toward meeting their targets. Many such clean-development projects may be quite cheap in terms of the cost per ton of emissions avoided, as has been illustrated by the joint implementation pilot program that is already in place in the U.S. Details of these provisions will be worked out in negotiations in Buenos Aires later this year.

IV. Difficulties of Economic Analysis of Kyoto Agreement

Now that we have a Protocol -- even if it is not yet fully complete nor ready for the President's submission to the Senate -- it is possible to examine it in somewhat more detail from an economic perspective. But I wish to emphasize once again the inherent limitations to any such estimates. Such limitations should not be surprising to you: economists have a difficult enough time projecting the behavior of the economy over the next quarter or year, let alone over the next two decades. The scale of the forecasting exercise is therefore daunting, and any specific results should be treated with substantial caution.

The difficulties associated with economic analysis of climate change fall into three broad categories. First is the uncertainties that still remain over the terms of the ultimate treaty. Second is the inherent limitations of available models to analyze even short-term costs and benefits. And finally is a topic I discussed earlier: the impossibility of putting a single monetary number on the long-term benefits of climate change mitigation.

Uncertainties over Certain Provisions in International Effort to Combat Climate Change

The Kyoto Agreement was an historic accomplishment, delineating the broad terms of

the international effort to address climate change. But although we know a lot more than we did before Kyoto about how that international system will work, there is still much that we don't know.

First, as is often the case in a legal document of the length and complexity of the Kyoto Protocol, there are some provisions that require further clarification and interpretation. Of particular concern here is the treatment of so-called sinks -- activities that affect the rate at which carbon is removed from the atmosphere and "sequestered," specifically by the planting of trees.

Second, the details of a number of items -- primarily concerning international trading and developing countries -- are the subject of further negotiations in Buenos Aires next fall, because they had not been definitively settled by the end of the last all-night session of the Kyoto talks.

Finally, and most importantly, we have not yet negotiated international agreements to limit emissions beyond the 2012 window. The emission cuts agreed upon at Kyoto are only a first step on a long journey. The first step that we propose to take over the next 15 years is critical. But the reason it is critical is *not* that, by itself, it will solve the climate change problem -- emissions during any given decade are small compared to the cumulative concentrations in the atmosphere. Rather, the first step is critical because we can't take the second and third steps until we have taken the first. At the same time, any analysis is complicated by the lack of knowledge over what the subsequent steps will be.

Inherent Limitations of Models

In addition to these uncertainties about the details of the international effort to address climate change, I must also note the inherent limitations of the models used to evaluate that effort. Even within a given model, answers depend critically on the precise nature of the question asked. For example, the costs of emissions reductions depend critically on the extent of global participation and international trading that a treaty is assumed to feature. But in addition to the dependence of the results from a given model on the precise assumptions, different models can give different answers even when all the assumptions are specified to be the same -- a concrete illustration of the range of uncertainty to which we must assign the predictions of any one individual model.

One area in which the uncertainty is particularly large is the pace of technological progress -- including diffusion of existing energy-efficient technologies, as well as research and development of new technologies -- and the extent to which the pace will accelerate in response to government programs. Economics does not offer a good understanding of how technological progress is determined, in part because it is the stuff of experimentation, brainstorms, genius, breakthroughs, perceptions and habits. Invention is largely determined by inspiration -- notwithstanding Edison, who assigned a 99 percent share to perspiration -- and inspiration, in my

experience, is difficult to fit into mathematical formulae or economic models. Models and experts on climate change policy tend to have a wider range of disagreement on the speed with which technology can be changed and the scope for speeding the diffusion of existing energy efficient technologies than on any other single issue.

Furthermore, each model has strengths and weaknesses; each has questions to which it is better or worse suited to answer. Some, for example, model the energy sector in detail. Some allow for the fact that a coal-fired power plant cannot costlessly be converted to one that runs on natural gas. Some have enough policy detail to distinguish alternative ways of redistributing revenues that would result if emission permits were to be auctioned. Some are capable of showing short-term macroeconomic disequilibria. Some include a long-term "carbon cycle" model that can keep track of the accumulation of greenhouse gas concentrations in the atmosphere and their climatological effects. Some break down the rest of the world into regions and so can model international trade. No one model does everything, and therefore we must not rely blindly on the results of any one model or set of models. Professional judgement and economic intuition are also crucial.

Benefits of Averting Climate Change

As I discussed above, it is evident that the benefits of averting climate change are potentially immense. But I have chosen not to try to quantify them in monetary terms for you, in light of the difficulties I have enumerated -- including the quantitative uncertainty of these benefits, and their timing and therefore the extreme sensitivity of the results to the chosen discount rate.

Instead, what I will do is draw upon a variety of sources in an attempt to add up the various possible costs and benefits of emissions policy *excluding* climate change. To give away the punch line, my conclusion is as follows: the net costs of our policies to reduce emissions are likely to be small, if those reductions are undertaken in an efficient manner, *even before taking into account the benefits of averting climate change itself.* That small net premium excluding the benefits of mitigating climate change, in effect, purchases a partial insurance policy against a serious environmental threat.

V. Models of the Kyoto Agreement

The existence of modeling difficulties means that the results from any model must be treated with caution. We have therefore employed a broad set of economic tools to assess the Kyoto agreement. We have drawn on the insights of a wide range of models of the energy sector and economy over the next 25 years, including but not limited to the results of the Stanford Energy Modeling Forum exercises, the IPCC's review of the economic and social dimensions of climate change, and the staff-level Interagency Analytical Team effort last year. Other tools include simple relevant statistics, "meta-analyses" of existing models, historical and sectoral

examples, and basic economic reasoning. Drawing on this broad array of analytical tools is crucial to an intelligent evaluation of the policy alternatives.

To my knowledge, as of December, no model -- whether used inside the government or not -- had been set up precisely to analyze the parameters of the agreement that was reached in Kyoto.Most model-builders outside the government tend to take as long as several years to incorporate changes in policy parameters into their models. And no model is currently designed to assess sinks, or all six greenhouse gases included in the treaty.

One of the leading models in the field is the Second Generation Model of Battelle Laboratories. The SGM is one of the models best positioned to analyze the role of international trade in emission permits, which we consider to be a critical element of the Kyoto Treaty. However, the SGM does not cover all six gases included in the Kyoto agreement or include a role for sinks. We have used the SGM model as a starting point for a preliminary assessment of the treaty, but have attempted to supplement its results with additional analysis to account for such special features of the agreement as the inclusion of six gases, sinks and a possible Annex I trading that could exclude the EU. I will share with you today some preliminary results of this analysis.

Mindful of the limitations that any single model, we are eager to see features of the Kyoto agreement assessed by other models to obtain a better feel for the range of possible effects.

Much of this work will continue to go on outside the government. For example, we have had discussions with the Energy Modeling Forum, based at Stanford University. The EMF is a long-running exercise involving many of the leading climate models. We have given the EMF advice on how features of the Kyoto legal language can be translated into terms recognizable to an economist. Unfortunately, the Energy Modeling Forum believes that its members will need at least until mid-year to produce reliable results.

VI. Economic Analysis

With all of that as important background, let us now turn to the task at hand. As we do so, let me emphasize once again that the figures presented below do <u>not</u> incorporate the benefits of starting to mitigate climate change.

I said in Congressional testimony last July that we can do this smart or we can do this dumb. I was referring to the point that the costs of cutting emissions can be much reduced if flexible, market mechanisms are used. Our economic analysis highlighted the importance of such flexible, market-based mechanisms -- which are therefore reflected, at the President's insistence, in the Kyoto Agreement and our approach to the effort.

Within the Kyoto agreement, this means an insistence on international trading, joint

implementation, and, ultimately, on full developing country participation. Domestically, this means that we implement any emissions reductions through a maket-based system of *tradeable* emissions permits, which ensures that we achieve reductions wherever they are least expensive. But this also means taking serious and responsible steps in the short run to prepare us to meet our obligations in the longer term.

The first such step is the inclusion in this year's budget of an aggressive, $6.3 billion program of tax cuts and R&D -- $1.3 billion more than the $5 billion package the President promised in his October 22 speech on this issue. The goal is both to stimulate the development of new energy-saving and carbon-saving technologies and to encourage the dissemination of those that exist already. The proposed package contains $3.6 billion over the next 5 years in tax cuts for energy efficient purchases and renewable energy, including tax credits of $3,000 to $4,000 for consumers who purchase highly fuel efficient vehicles, a 15 percent credit (up to $2,000) for purchases of rooftop solar equipment, a 20 percent credit (subject to a cap) for purchasing energy-efficient building equipment, a $2,000 credit for purchasing energy-efficient new homes, an extension of the wind and biomass tax credit, and a 10 percent investment credit for the purchase of combined heat and power systems. The package also contains $2.7 billion over the next 5 years in additional research and development spending -- covering the four major carbon-emitting sectors of the economy (buildings, industry, transportation, and electricity), plus carbon removal and sequestration, Federal facilities, and cross-cutting analyses and research. One example of the R&D effort is the Partnership for a New Generation of Vehicles (PNGV). PNGV is a government-industry effort to develop attractive, affordable cars that meet all applicable safety and environmental standards and get up to three times the fuel efficiency of today's cars. In FY99, the combined proposal for PNGV is $277 million, up from $227 million appropriated in FY98. Similar government-industry efforts are proposed to develop more efficient diesel engines for both light trucks and heavy trucks. [ADD SOMETHING MORE ABOUT INDUSTRY-GOVERNMENT DIALOG. PERHAPS A CONCRETE EXAMPLE OF IDENTIFYING AN INDUSTRY REGULATION THAT COULD BE REMOVED.]

The second such step is the promotion of an environmentally-responsible electricity restructuring bill, which the President identified as part of his domestic climate change package in his address to the National Geographic Society on October 22. An electricity sector freed from government regulation would be a more efficient energy sector. Costs to consumers would fall. A reasonable overall estimate of the effects of adding federal electricity restructuring to the rest of the President's program to address climate change is to achieve the same environmental goals at a cost saving of roughly $16 billion per year.

Estimated Reduction in Costs from Annex I Trading

In the language of the treaty, "Annex I," you will recall, is the set of countries that have agreed to take on binding limitations in emissions of greenhouse gases. Even without developing country participation -- which, again, the President has emphasized as essential before the treaty could be ratified -- costs can be reduced substantially by trading among the

Annex I countries. To provide some indication of the possible efficiency improvements, Russia and the Ukraine consume six times as much energy per dollar of output as does the United States.

Estimates derived from the SGM model suggest that trading among Annex I countries is likely to reduce the cost to the United States of achieving its targets for 2008-2012 emissions by about half relative to a situation in which such trading was not available. This concept of costs is meant to capture aggregate resource costs to the US economy, including the cost to domestic firms of purchasing emission permits from Russia and other countries where emission reductions are cheaper than in the United States. The dramatic reduction in costs available from Annex I trading within the SGM model -- cutting the costs involved by half -- highlights why the President insisted that international trading be part of the Kyoto Agreement.

Estimated reduction in costs from umbrella trading

One possibility that emerged in Kyoto, which none of us foresaw, was the idea that the United States might undertake trading with a subset of Annex I countries, dubbed the "umbrella," that would exclude the European Union. The initial list of proposed participants in the umbrella includes the United States, Australia, Canada, Japan, New Zealand and Russia, with strong indications of interest from some others. The motivation for this idea was that the Europeans have been reluctant to agree to the sort of international trading that we want (preferring that they achieve their goals collectively in a group of their own, called the "EU bubble").

It is too early to say whether the umbrella concept will in fact be accepted by the parties. But it is an important concept to consider, for three reasons. First, it is conceivable that it will be formally agreed to in future negotiations. Second, even if the final treaty does not explicitly include the umbrella, but rather allows trading among all signatories (as the United States has proposed all along), it is conceivable that umbrella countries will agree, outside the treaty, to trade only among themselves. Third, the aversion toward international trading that the Europeans have expressed suggests that they might refrain from making the trades to which they would be entitled -- which would mean that the umbrella would operate in practice, if not in formal international agreement.

The significance of the umbrella idea in the present context is that it has the potential to further reduce costs to the United States. The reason is that if the Europeans do not bid against us for the relatively abundant low-cost opportunities to reduce emissions in Russia and Eastern Europe, then the price of emissions reductions will be even lower. Results that we have derived from various SGM simulations suggest that, relative to the situation in which there is no trading at all, the umbrella arrangement would reduce costs by an estimated 61-75 per cent, depending on whether the former Warsaw Pact countries are classed with the EU, or are instead assumed to fall within the umbrella.

Estimated reduction in costs from LDC participation

The next consideration is participation by developing countries. The President has said that he will not submit the treaty for ratification without such participation -- which would further reduce the costs involved.

A moderate version of developing country participation is the Clean Development Mechanism, modelled after Joint Implementation (JI). JI cannot realistically be expected to yield all the gains of binding targets for developing countries, but it might shave costs by roughly another 20 to 25 percent from the reduced costs that result from trading among Annex I countries.

Another possibility is that we persuade some of the key developing countries that are the largest emitters to commit to targets, and allow us to buy emission reductions from those paths. We estimate that this could cut roughly 55 percent off the reduced costs that result from Annex I trading. [The four countries included in this particular estimate are China, India, Brazil and Korea.] Once these savings have been attained, the estimated reductions to US costs from persuading the rest of the developing world to go along with full commitments are relatively small.

I offer these numbers because they show the potential effectiveness of trading in reducing costs dramatically. But it is important that I repeat three caveats: First, as always, there is a wide range of uncertainty around all these estimates. Second, they apply to an idealized version of trading, one that assumes no problems of enforcement or transactions costs. Third, it seems unlikely that we will get all our partners to agree in Buenos Aires to the very most optimistic or ambitious case. Nonetheless, despite these caveats, the numbers do show major savings even without getting the most optimistic case. And if we don't get enough of what we want, we won't submit the treaty for ratification to the Senate.

VII. Non-Climate Benefits

The costs of undertaking greenhouse gas emission reductions must be compared to the benefits. As I have indicated, for various reasons our analysis does not quantify the benefits from averting climate change itself. But the relative price shifts that are necessary to reduce emissions should produce benefits in three areas: air pollution, traffic congestion, and highway accidents. These benefits are quantifiable.

Reductions in carbon emissions also lead to reductions in emissions of pollutants that contribute to excess concentrations of fine particulate matter and low-level ozone. Conservative estimates suggest that given a price of carbon of $20/ton, such ancillary emissions reductions could be well in excess of a half million tons of pollutants per year, and entail cost savings of about $0.9 billion per year. These cost savings could be even larger if carbon emissions reduction efforts could be carefully coordinated with the implementation of the national ambient

air quality standards.

Traffic congestion hurts motorists by causing delays and inconvenience. More efficient pricing -- which recognizes the externalities involved -- should lead to reductions in congestion as motorists choose other means of travel, share rides, or even forgo less important trips. . We estimate, for example, that higher fuel prices resulting from carbon permit prices of say $20/ton would reduce travel delays associated with congestion, and that the value of such time savings to consumers would be about $0.4 billion per year.

Vehicle use also leads to costly accidents and to highway injuries including fatalities. Assuming that accidents fall proportionately with vehicle use, more efficient pricing will also create savings from reduced accidents and resultant mortality. We estimate that the savings from reduced accidents and the value of reduced mortality risk corresponding to a $20/ton carbon price is approximately $0.3 to $2.7 billion per year [depending on whether lighter cars are less crashworthy].

A variety of other benefits that are harder to quantify are likely to result from reductions in carbon emissions. With respect to transportation, reduced vehicle use will also reduce the cost of road repair and maintenance. Second, reduced coal use will lower mercury emissions. Finally, reduced energy use will also increase U.S. energy independence. Our inability to estimate these effects quantitatively does not imply that they are necessarily small or unimportant.

VIII. Preliminary Estimate of the Net Effects of the Kyoto Agreement

We can now combine the various benefits and costs delineated above to provide a preliminary assessment of the net impact of the Kyoto agreement, excluding, however, the beenfits of averted damage from climate change. This assessment relies on SGM model results along with additional Administration analysis. It accounts for the impact of trading under the umbrella, and assumes full participation by four LDCs. We find that the net resource costs of attaining our Kyoto targets for emission reductions are $7 to $9 billion. Thus the net costs are $5 billion to $8 billion, or roughly 0.08 percent of projected GDP (i.e., net of ancillary non-climate benefits, predicted from a permit price of $12-$16 per ton, depending on which umbrella definition is used).

A more tangible measure of costs is the estimated effects on energy prices. Excluding the impact of electricity restructuring, the SGM-based estimate is that the price of emissions would be in the range $12 to $16 per ton of carbon equivalent -- and that energy prices at the household level would rise by about 3 percent under the Kyoto accords. Fuel oil prices would rise by about 6 percent, natural gas prices by 4 percent, gasoline prices by 3 percent, and electricity prices by 3 percent. The 3 percent increase in energy prices at the household

level would raise the average family's energy bill by about $75 per year.

These estimates do *not* mean that households' energy expenses will in fact be higher in 2010 than today, however. In the first place, energy prices fluctuate year-by-year for all sorts of reasons. They could go either up or down. But even if we leave out unpredictable fluctuations, the energy price declines from Federal electricity restructuring would be enough to offset the impact estimated above. By 2008-2012, the projected 10 percent decline in electricity prices from the restructuring that is part of our climate change agenda will mean a net reduction in electricity prices in the U.S., even accounting for the small increases noted above.

As highlighted earlier, estimates of the type that I am presenting are fraught with uncertainty. The estimate I just discussed was predicated on the developing country participation that we will insist upon in Buenos Aires as a condition for our ratifying the Kyoto Protocol, but which is not yet part of that Protocol. At the same time, the numbers I have cited are in several respects conservative: they leave out several factors, such as the role of sinks, that could further reduce costs. But before I bring these factors into the analysis, allow me to say a few words about macroeconomics.

Effects on employment and aggregate output

So far I have said nothing about job losses resulting from climate change policy. Although there may be job gains in some sectors and job losses in others, I do not anticipate any significant aggregate effect. Some jobs could be lost in energy-intensive sectors, although given the very small predicted change in energy prices, impacts in most such sectors are apt to be minimal. Furthermore, a large number of jobs will be created in other sectors -- many of them high-tech jobs paying high wages. The President is firmly committed to assisting any workers who are adversely affected during the transition to a climate-friendly economy.

The situation might be different if a large energy shock were to hit the economy with no warning, as happened in the oil crisis of 1973-74, when the real money supply, output and employment all contracted sharply. In addition to hitting with no warning, the oil shocks of the 1970s also entailed large transfers from the U.S. and other oil-importing countries to OPEC, thus depressing real income and spending in the former. A self-imposed shift in the relative price of carbon-intensive energy to address global climate change, on the other hand, need not entail such a transfer of purchasing power. Thus there are critical differences between the oil price shocks and the effort to reduce carbon emissions. Our reassuring conclusion regarding aggregate output might also be different if the policy were to be implemented inefficiently (by command-and-control style regulations of the sort put in place in that oil crisis) rather than efficiently (by market mechanisms of the sort that the President has proposed to use).

VIII. The Foregoing Estimates Are Conservative Along Several Dimensions

I should emphasize that the estimates I have presented are conservative in three very important ways: sinks, technology, and climate change benefits. The first omission, sinks, concerns a provision of the Kyoto Protocol that has received less attention than it merits. It is only *net* emissions -- emissions to the atmosphere minus sequestration -- that are to be reduced 7 percent below 1990 levels, not gross emissions. The United States plants many trees every year, and would receive credit for this activity under the Protocol. Very preliminary estimates of the implications for the United States of the Kyoto provision on sinks reduce the resource cost by about 17 per cent. This brings resource costs down to $15-$18 billion, depending on whether we count in no LDC participation at all or we count the benefits of joint implementation through the Clean Development Mechanism (as currently agreed to in the Kyoto Protocol). ***[Why in this first paragraph on conservative estimates are we presenting resource costs greater than in the illustrative case above?-RL]*** **These numbers translate into net costs of __ and energy prices of __.** If we get the full participation of LDCs, the costs come down further.

Even those estimates for the effect of sinks are conservative in one respect: they are based on an assumption for sink activity in the U.S. over the 2008-2012 period, and no assumed benefits from sinks elsewhere in the world. Very preliminary estimates suggest that incorporating the gains from sinks *throughout the world* can reduce the costs of meeting the Kyoto target by half or more, on top of the gains from trading among Annex I countries. (Furthermore, no model has yet even tried to take into account that government policies can help increase the amount of tree-planting, possibly through some version of the Conservation Reserve Program, for example.) But neither we nor other analysts are yet sure exactly how to interpret the legal language of the Protocol. Because the quantitative uncertainty is so large, we do not yet have an estimate with which I feel comfortable. But we do know that the effect of fully modelling the Kyoto provision on sinks is likely to be both favorable and large.

The estimates I have cited so far also make little allowance for the payoff to the President's $6.3 billion Climate Change Technology Initiative. The parameter that figures most prominently in analysis of technological progress in the energy field is the rate of improvement in the so-called Autonomous Energy Efficiency Index (AEEI), that is the rate at which the total use of energy falls relative to GDP. In the analysis on which the numbers I have reported to you is based, the AEEI improves by 1.0 percent per year. Reflecting a conservative interpretation of the 15-year impact of the technology initiative, this is only a small increase above the number in the Energy Information Administration's Annual Energy Outlook.

The logic with which one could justify such an assumption would be somewhat analogous to the rationale behind the macroeconomic assumptions that we feed into our budget forecasts: in the presence of uncertainty, we are conservative in our estimates of the speed with which the economy will grow, tax receipts will rise, and the budget will improve. That way, any

revisions or surprises that occur are likely to be in the pleasant direction. The nature of the conservatism here would be that we assume in our modeling that, because of lags, most of the payoff from new technology research and dissemination expenditures (as opposed to those in the past) comes after 2012.

If the Administration is successful in speeding the discovery and adoption of new technologies, the rate of improvement in energy efficiency could rise. As a second example, we therefore report results assuming that the AEEI parameter is boosted to 1.25 percent. This has the effect of reducing resource costs by 26 - 27 per cent, to $13 to $16 billion, again depending on whether we count no LDC participation at all or count the benefits of joint implementation. ***[Why in this first paragraph on conservative estimates are we presenting resource costs greater than in the illustrative case above?-RL]*** **These numbers translate into net costs of __ and energy prices of __.** If we were to get the full participation of some LDCs, the costs would again come down further.

This "technology case" is far from the most optimistic outcome that might occur. Some experts in the technology of climate change policy forecast more rapid technological progress. Estimates coming from engineering models predict even higher rates of AEEI improvement, and thus even lower costs.

Third, the preceeding estimates do not fully reflect the entrepreneurial response to approriate incentives. An instructive example of the ability of U.S. industry to perform beyond expectations when given appropriate economic incentives is EPA's highly acclaimed sulfur dioxide (SO_2) program, which relies, among other things, on a system of tradeable permits to reduce emissions of SO_2 from electric utilities. The SO_2 program has been successful in several ways: a large number of utilities participate, SO_2 emissions and ambient concentrations have fallen and the costs of reducing emissions are considerably lower than originally forecast.

As has been frequently noted, the average cost of SO_2 emissions reductions has recently been significantly lower than was originally forecast, in part due to the role of incentives in fostering innovation. Emission permit prices, currently at approximately $100 per ton of SO_2, are well below earlier estimates of around $250 to $350 per ton (See Chart 1.)

Trading programs may not always bring cost savings as large as those achieved by the SO_2 program; trading programs will not always be accompanied by the discovery of much cheaper control strategies. However, the SO_2 experience demonstrate clearly how programs that offer important market incentives to find cheaper ways of reducing emissions can lead to unexpectedly low prices.

Finally, and most important: the estimates I have presented are conservative is that they leave out the benefits of mitigating climate change itself. A full cost-benefit analysis would include mitigation in the benefits column. The only reason we have not done so, as I have

explained repeatedly above, is the difficulty in coming up with a number to capture the monetary benefits. But I trust that nobody will lose sight of our ultimate objective -- keeping our planet the hospitable home that we enjoy today.

CONCLUSION

In conclusion, the Kyoto Agreement and the President's general approach to climate change reflect the insight of economic analysis. The Kyoto Agreement includes key provisions on international trading and clean development projects. The President's approach relies on market incentives -- first, with a system of tax cuts and R&D, and then later with a market-based system of tradeable permits -- to ensure that our objectives are achieved as efficiently as possible.

I look forward to continuing to work with members of this Committee, as well as other interested parties, in further analyzing the Kyoto Agreement and evaluating the net effects of reducing greenhouse gas emissions. It is my hope that economic analysis will continue to play a key role in designing policies in this area.

I welcome your questions.

ADDENDUM. NOT FOR DISTRIBUTION ******** SAVE FOR Q AND A**

Q -- Senator Brown: I have seen one study that claims large losses in output and employment from climate change policy [EPI, 8/14/97].

A: This study is misleading in three important ways. First, it did not in my view take into account the points I have made about the ability of the economy to adjust to structural change with a 15-year warning. In particular, a number of comentators on this specific model have highlighted that this is a model best designed to predict economic impacts in the very near future, two to three years from now, and that it is not useful for long term predictions of this type. Second, the model fully assumes that we "do this dumb", ignoring the efficiencies from international emissions trading, joint implementation, LDC participation. Third, the model ignores any of the benefits of reducing emissions noted above, as well as any benefits of averting climate change, and it does not embody any technological advance in response to our $6.3 billion technology package, nor any benefits to the economic from our electricity restructuring proposal. These results are therefore exaggerated and present a misleading portrait of the effects of our climate change plan.

Q -- Senator Red-White-&-Blue: Your solution seems to be to buy all the reductions abroad. I can't see American taxpayers paying foreigners for the right to pollute. What share of reductions is done at home?

A: [Unspoken answer: a lot, in the base case...]
I believe the case where we rely heavily on international trading should be viewed as a safety-net case which puts an upper limit on possible increases in energy prices -- a backup if all else fails. Toward the end of my testimony, I discussed the cases where we make some allowances for the effects of sinks and for the payoff from the President's technology initiative. Under those assumptions, with simple Annex I trading, we can accomplish our Kyoto targets by making half our reductions at home: more precisely 52% in the sinks case and 48 percent in the technology case (or 53 % if we allow for *both* the U.S. sinks and the 1.25 AEEI). [If we allow for JI, then the percent of reductions accomplished at home falls into the 40s.]

Q -- Senator Green: What is the single trading combination that is most advantageous for the United States?

A: That would be an umbrella that excludes the EU, but that otherwise includes full worldwide participation and trading. In this case, admittedly one that is not particularly likely, the

cumulative reduction in costs relative to obtaining all reductions domestically is an estimated 88 percent. (And that's before we count accelerated technology or sinks!)

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Michele Jolin (CN=Michele Jolin/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 5-FEB-1998 16:35:48.00

SUBJECT: CNP Speech

TO: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
Attached is a DRAFT of the CNP speech. Sanders and Maria both have to fill in some information. And Chad needs to take a look at it. No need for you to read it. But just wanted to give you a sense that it is getting done.
Thanks.
========== ATTACHMENT 1 ==========
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The following is a HEX DUMP:

The 1998 Economic Report of the President

Dr. Janet Yellen
Chairman, President's Council of Economic Advisers
Center for National Policy
February 10, 1998

Thank you. It is a pleasure to be here. I want to thank the Center for National Policy for again hosting the release of the annual *Economic Report of the President.* In particular, I want to thank Mo Steinbruner and Mike Pietro (pronounced "Pee-tro")for all of their help in arranging the event.

I would also like to thank my colleagues--Jeff Frankel and Becky Blank--for all their hard work and dedication in producing this year's *Report.*

Finally, I want to thank the staff of the Council, many of whom are here with us today. During the past several months, the staff have been working long nights and weekends to produce the Economic Report. And, because the other work of the Council doesn't disappear, they are in effect working two jobs with two shifts. I appreciate all of their hard work, their thoughtful insights and their good spirits. Their dedication and professionalism do deserve special recognition.

As you probably know, the Employment Act of 1946, which created the Council of Economic Advisers, requires the President to submit an Economic Report to the Congress each year. The Employment Act, together with its later amendments, gave the Federal government responsibility for stabilizing short-run economic fluctuations, promoting balanced and noninflationary economic growth, and fostering low unemployment. One purpose of the Economic Report is to tell Congress whether we have met those responsibilities. I am happy to say, in this the fifty-second year after the Act, that the state of the economy is truly extraordinary.

I will elaborate on this point in a moment, but I would also like to note that the Report of the Council of Economic Advisers, has also traditionally been a vehicle for presenting a broad range of analyses of current economic policy issues. This year, in addition to a chapter on macroeconomic policy and performance, the Report contains a chapter on the economic well-being of families and children, and a chapter on racial and ethnic inequality--two central concerns of this Administration. The report also contains two chapters on microeconomic topics, one focusing on improving economic efficiency in the areas of health and environmental policy, and one discussing recent trends in antitrust policy. Finally, the international chapter focuses on the benefits of opening international markets.

In the remainder of my remarks I will touch briefly on the current state of the economy, and then discuss the broad and lasting benefits of a "high-employment economy" -- which is one of the key themes of this year's Economic Report. I will then talk about some of the key challenges that still face our nation as we move into the 21st Century.

STATE OF THE ECONOMY

Our Nation's economy is the strongest it has been in a generation. In 1997, growth was strong and job creation was vigorous while inflation declined. Real GDP grew 3.9 percent, and employment rose by 3.2 million, for an average rate of 267,000 jobs per month. The unemployment rate dropped below 5 percent for the first time in 24 years, yet core inflation rose just 2.2 percent. And, this occurred during a period of historic deficit reduction: the Federal budget deficit, which reached $290 billion in the 1992 fiscal year, declined to only $22 billion in fiscal 1997. And, as you know, the President recently submitted to Congress a budget for fiscal 1999 that projects a balanced budget for the first time since 1969.

As 1998 begins, the prospects for continued growth with high employment and low inflation are excellent. The economy is remarkably free of the symptoms that often presage an economic downturn -- that is, there are no signs of inflationary pressures, sales remain strong so inventories are not accumulating, and there is no evidence of financial imbalances. Our economy is in fundamentally sound shape and well-equipped to handle any unexpected bouts of rougher weather.

THE BENEFITS OF A HIGH EMPLOYMENT ECONOMY

The exceptionally strong economy that we are enjoying today is due in part to the sound and credible economic strategy put in place by the Clinton Administration. The Administration's strategy has focused on getting the fundamentals right -- reducing the budget deficit, investing in the American people, and opening markets at home and abroad. These were the right policies to stimulate the job creation needed to move the economy to full employment. And, they are the right policies for attacking the longer term problems of sluggish productivity growth and widening income inequality that had afflicted our nation's economy since the early 1970s.

There are enormous economic and social benefits to a "high-employment economy." An economy with strong job creation and low unemployment makes broad and lasting changes in our labor market and in the well-being of the American people. Let me talk briefly about some of these benefits:

First, a high employment economy produces certain *direct and measurable benefits.* Returning the economy to full employment yields a direct and measurable benefit to our nation by ensuring that the economy's resources--human and material--are not squandered by needless cyclical unemployment. On average, reducing the unemployment rate by a percentage point raises output by approximately 2 percent; in 1997, 2 percent of GDP was $160 billion, or roughly $600 for every American man, woman, and child. Wasted resources from not producing at potential, together with the human cost of unemployment, are intolerable; the elimination of this waste is the principal benefit of a sustained return to full employment.

Second, a high-employment economy can *reduce long-term joblessness.* A tight labor market encourages participation by those who might otherwise be forced to sit on the sidelines, and makes it easier to absorb less skilled or younger and more inexperienced workers into the labor force. These new labor market entrants gain much-needed job experience, building the skills they will need to hold down a job in the future. The experience of some European countries illustrates this point: in Europe, the prolonged stagnation or recession may have led to a permanent increase in unemployment there, as the unemployed and the never-employed have seen their skills atrophy or become obsolete. For this reason, running a high-employment economy, may be one of the surest ways to ensure that an unacceptably large fraction of our citizens are not consigned to long-term joblessness and economic marginalization.

Third, it will *help move welfare recipients into the workforce.* Keeping the unemployment rate low and job growth high is necessary if we are to move current welfare recipients into the work force. Early, indirect evidence on this point is encouraging: employment and labor force participation rates among single women who maintain families--about two-thirds of whom have children under 18--have increased in the past few years. This is probably in part the result of recent welfare reform: the greatest acceleration in employment rates has occurred among those single women most likely to be affected by welfare reform, namely, those with young children. Nevertheless, it is obvious that fostering an economy in which job opportunities are plentiful plays a crucial part in aiding the transition from welfare to work.

Fourth, it *enhances personal economic security.* Knowing that work is available to those who seek it, at wages sufficient to keep them and their families out of poverty, is a key to personal economic security. A tight labor market increases the confidence of job losers that they will be able to return to work, lures discouraged workers back into the labor force, enhances the prospects of those already at work to get ahead, enables those who want or need to switch jobs to do so without a long period of joblessness, and lowers the duration of a typical unemployment spell.

And, finally, a high-employment economy *may help reverse the trend toward greater economic inequality.* From the 1980s until the early 1990s, the economy's ability to reduce poverty through growth alone was hampered by a strong headwind: for the poorest Americans, the benefits of an expanding economy were offset by the sustained declines in wages at the low end of the earnings distribution. Since 1993, living standards for all Americans are on the rise, especially for those at the bottom of the income distribution. The poverty rate fell to 13.7 percent in 1996, from 15.1 percent in 1993; the poverty rate for black Americans is at a historical low, and in 1997 unemployment among blacks fell to its lowest rate since 1973. Since 1993, household income has grown in each quintile of the income distribution, with the largest percentage increase going to the poorest members of our society. Maintaining a full-employment economy is essential if this progress is to continue.

CHALLENGES IN A CHANGING ECONOMY

Yes, our economy is strong and Americans are working in record numbers. And there are broad and lasting benefits to sustaining a healthy economy with strong job creation and low unemployment.

But our Nation still faces other, broader challenges as we move into the 21st century. In many ways the U.S. economy today is very different from that in which our parents and grandparents lived and worked. Today, 24 percent of families are headed by a single parent, compared with 14 percent 25 years ago. Three in five married mothers with children under 6 are in the work force--twice as large a share as in 1970. And the U.S. population is aging-- in the next century there will be fewer workers for every retiree, making issues related to retirement security more and more important. The nature of the workplace also has changed significantly: few American workers expect to be working for the same employer--or even to be in the same career--when they retire. Information technology is dominating industry: in the 1950s the information technology industry barely existed; today it employs a larger share of the labor force than the automobile industry did in the 1950s and 1960s. Because information and technology and global commerce are leading the transformation of the global economy, the new strength of a nation will be found in the skills, know ledge and imagination of it's people.

The Clinton Administration's agenda is designed to deal with these changes and the challenges they pose. It is designed to equip the American people with the strength, the skills, the security and the flexibility needed to reap the rewards of our growing, changing economy. The President recently laid out this broad agenda in his State of the Union and again in his FY1999 budget In the remainder of my remarks, I will focus on 3 of the key agenda areas: retirement security, the challenges of childcare and racial and ethnic economic inequality.

First, let me talk about issues related to the aging of the population, which we address in Chapter 1 of the *Economic Report* -- reforming Social Security.

For almost 60 years, Social Security has provided Americans with income security in retirement and protection against loss of family income due to disability or death. A large share of elderly Americans, particularly those with low incomes, rely on Social Security as their primary source of pension income in retirement. The system has enjoyed dramatic success in reducing poverty rates among older Americans.

Today, however, many Americans fear that Social Security will not be there for them when they are ready to retire. This concern reflects the widespread recognition that, under current "intermediate" projections of the Social Security trustees, the system faces a long-term funding gap: beginning in 2012, unless the system is reformed by then, the government will be unable to pay current Social Security benefits in full out of current payroll taxes; it will then have to draw down the system's trust fund, and by 2029 those funds will be exhausted. If still nothing has been done, the government would then face several options which it could adopt singly or in combination: it could reduce benefits until they are in line with collections, raise payroll taxes to

cover an unchanged level of benefits, or finance the shortfall from other parts of the budget, by raising other taxes, cutting expenditures on other programs, or borrowing and allowing the budget deficit to increase. One or more of these measures will have to be taken so long as no changes are made to the present system.

Although the seriousness of the financial imbalance facing Social Security should not be downplayed, its magnitude is not so large as to be insurmountable, particularly if early action is taken. For example, even if nothing is done and the trust fund is exhausted, payroll taxes will still be sufficient to permanently finance roughly 75 percent of benefits. Put another way, the difference between the anticipated income and the anticipated expenditures of the OASDI (Old Age, Survivors', and Disability Insurance) program over the next 75 years amounts to around 2¼ percentage points of taxable payroll, or approximately 1 percent of GDP. These facts suggest that the problem of placing Social Security on a sound financial footing can admit of eventual resolution.

The President is committed to Saving Social Security First. He has proposed reserving 100 percent of any budget surplus until steps have been taken to reform Social Security. He has also proposed a process to devise an appropriate solution over the next 2 years.

A second major policy challenge involves chidren and issues related to childcare.

[MARIA -- PLEASE TO ADD TO AND REVISE . Chapter 3 of this *Report* shows that the last 3 years have witnessed notable improvements in children's well-being along several fronts, including decreases in child poverty, increases in consumption of basic health care services, and improvements in health status and in some measures of educational achievement. However, many children remain economically vulnerable. One in five children in the United States lives in a family whose income is below the poverty line, one in seven does not have access to health insurance, and a large proportion of children fail to achieve basic levels of proficiency in science, mathematics, and reading. Chapter 3 considers ongoing and proposed Administration initiatives that address these problems.]

Today, more American workers are faced with the need to juggle the demands of the workplace with the demands of family and home. Access to quality child care and health care is difficult. **[AMY -- PLEASE ADD TO AND REVISE. For this reason the President's 1999 budget includes a $21 billion increase in funding for child care, to make it accessible to more families and raise its quality. An important part of this proposal is increased tax credits for 3 million working families to help them pay for child care, as well as an increase in block grants to States that will directly subsidize child care for low-income families. In addition, the proposal calls for a new Early Learning Fund, along with support for the enforcement of State child care health and safety standards, scholarships for up to 50,000 child care providers per year, and funding for research and consumer education.**

[SANDY -- PLEASE ADD TO AND REVISE. Finally, this country's longstanding goal of achieving racial equality has not yet been attained. Chapter 4 of this

Report **reviews trends in racial and ethnic economic inequality. Although there has been progress in narrowing these gaps in the postwar period, it has been very uneven, with rapid progress in the 1960s and early 1970s followed by 20 years of stagnation from the early to mid-1970s to the early 1990s. For example, since the mid-1970s the wages of young black college graduates have fallen relative to those of their white counterparts. Although the current expansion has brought renewed progress, substantial racial and ethnic disparities in economic status persist. For example, the median wealth of white families is by some estimates 10 times that of black and Hispanic families. More clearly needs to be done to promote racial equality and equality of opportunity. Many of the Administration's current and proposed policies, such as those that encourage community empowerment and education, are intended to address these disparities. And this Administration has pledged itself to furthering a dialogue on race in America.**

CONCLUSION

Let me conclude by saying that over the past year the performance of the U.S. economy has been extraordinary: strong growth and low unemployment combined with low and stable inflation. And there are enormous social and economic benefits to our high-employment economy. But that success--and the economy's present strength--cannot be taken for granted. Rather, there are still long-term changes and challenges facing our nation as we enter the 21st Century. The Clinton Administration has an agenda for helping to equip the American people with the skills and flexibility and security to take advantages of the opportunities and possibilities in this new economic era. We must finish the job of balancing the budget while investing in people and opening markets at home and abroad. At the same time, we must ensure that all Americans, regardless of age or origin, have the skills they need to prosper in a world of change and opportunity.

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

CREATOR: Janet L. Yellen (CN=Janet L. Yellen/OU=CEA/O=EOP [CEA])

CREATION DATE/TIME: 5-FEB-1998 18:02:54.00

SUBJECT: Revised Climate change testimony

TO: jonathan.gruber (jonathan.gruber @ treas.sprint.com @ inet [UNKNOWN])
READ:UNKNOWN

TO: ORSZAG_P (ORSZAG_P @ A1 @ CD @ LNGTWY [UNKNOWN]) (OPD)
READ:UNKNOWN

TO: Gene B. Sperling (CN=Gene B. Sperling/OU=OPD/O=EOP @ EOP [OPD])
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TO: David B Sandalow (CN=David B Sandalow/OU=CEQ/O=EOP @ EOP [CEQ])
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TO: Todd Stern (CN=Todd Stern/OU=WHO/O=EOP @ EOP [WHO])
READ:UNKNOWN

CC: Adele C. Morris (CN=Adele C. Morris/OU=CEA/O=EOP @ EOP [CEA])
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READ:UNKNOWN

CC: Jeffrey A. Frankel (CN=Jeffrey A. Frankel/OU=CEA/O=EOP @ EOP [CEA])
READ:UNKNOWN

TEXT:
Attached is the revised version of my climate change testimony. Comments
are welcome. We are planning a conference call on Sunday at 1:00 to
discuss the testimony. ========== ATTACHMENT 1 ==========
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TEXT:
Unable to convert ARMS_EXT:[ATTACH.D49]MAIL412656535.026 to ASCII,
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TESTIMONY OF DR. JANET YELLEN
CHAIR, COUNCIL OF ECONOMIC ADVISERS
BEFORE THE SENATE FOREIGN RELATIONS COMMITTEE
ON THE ECONOMICS OF THE KYOTO AGREEMENT
FEBRUARY 11, 1998

Thank you, Mr. Chairman. The President has said that we can work to avert the grave dangers of climate change, while at the same time maintaining the strength of our economy. I am pleased to have this opportunity to appear before the Committee to elaborate on the President's statement.

The international agreement that was reached in Kyoto this past December is a crucial first step in addressing global climate change. But it is only a first step. Since the international effort to reduce greenhouse gas emissions is more of a work-in-progress than a completely finished product, it is not yet possible to provide a full authoritative analysis of it. Many of the specifics in several crucial areas are not completely resolved in the diplomatic arena, forcing analysts to make a variety of assumptions about the ultimate form of the international regime. In my testimony today, I will attempt to identify key elements of the agreement, such as global participation and reliance on flexible, market-based measures, that ensure that reductions in global greenhouse gas emissions are consistent with continued strong economic growth. I will do my best also to provide some rough estimates of costs and benefits.

The Administration is strongly committed to ensuring that these critical elements are reflected in our domestic and international climate change policies. We are firmly committed to meaningful developing country participation, as well as emissions trading both domestically and internationally. And as you know, the President's FY 1999 budget includes a $6.3 billion package of tax cuts and R&D over the next 5 years to jumpstart our efforts.

I. Basic Economic Rationale of the Kyoto Treaty

To begin our analysis, it may be worth stepping back and examining the larger question of the basic rationale, from an economist's perspective, for the Kyoto Agreement.

The earth's surface is warming from the accumulation of greenhouse gases from myriad sources worldwide. None of these emitters presently pays the cost to others of warming's adverse effects -- a classic externality in the language of economists. As a result of these distorted incentives, disruption of the Earth's climate is likely to proceed at an excessive pace and if left uncontrolled may pose substantial costs in terms of harm to commerce and the environment alike. The fundamental economic logic of the Kyoto agreement is thus that

without such an international agreement, individual nations will not have the proper incentives to address the threats from global climate change.

II. Costs of Climate Change

In evaluating efforts to mitigate global warming, the first step is to consider the costs that are likely if we fail to take any action -- for these costs provide the primary motivation for reducing greenhouse gas emissions.

The Intergovernmental Panel on Climate Change (IPCC) jointly established by the World Meteorological Organization and the United Nations Environment Programme, concluded in 1995 that "the balance of evidence suggests that there is a discernible human influence on global climate." Current concentrations of carbon dioxide, methane, nitrous oxide, and the other so-called greenhouse gases have reached levels well above those of preindustrial times. Of these, carbon dioxide (CO_2) is the most important: net cumulative CO_2 emissions resulting from the burning of fossil fuels and deforestation account for about two-thirds of potential warming from changes in greenhouse gas concentrations related to human activity.

Climatic Impact

If growth in global emissions continues unabated, the atmospheric concentration of CO_2 will likely double relative to its preindustrial level by midway through the next century. As a result of the increased concentration of CO_2, the IPCC estimates that global temperatures will increase by between 2.5 to 6 degrees Fahrenheit in the next 100 years, with a best guess of about 3.5 degrees Fahrenheit. While scientists believe that human activities are leading to a gradual warming of the *average* temperature of the earth, the change in temperature in a given region at a given time may differ substantially from this average. Indeed, models predict warming will be greater in high latitudes than in the tropics, and greater over land than ocean. Many models predict larger increases in evaporation than in precipitation over midlatitude land areas, which would result in drier conditions in those regions, especially during summer in North America and Europe.

Potential consequences associated with this shift in climate include a rise in sea levels, greater frequency of severe weather events, shifts in agricultural growing conditions from changing weather patterns, threats to human health from increased range and incidence of diseases, changes in availability of freshwater supplies, and damage to ecosystems and biodiversity.

Economic and Monetary Damages

The derivation of quantitative or monetary estimates of the damages from such a change

in the climate is extremely difficult given the capacity of today's forecasting models. Estimates of the economic damages from climate change fall into the following broad areas: agriculture, sea-level rise, air conditioning and heating, water supply, human life and health, air pollution, and other costs (hurricanes, migration costs, human amenity, construction, leisure activities, urban infrastructure, and ecological damages such as forest loss and species loss).

A subject of great uncertainty and sensitivity is the "discount rate" that is applied to the benefits of averting future climate change. Such a discount rate is needed if the analysis is to be expressed in monetary terms, because a dollar today is not worth the same as a dollar tomorrow. And since the benefits of stemming future climate change accrue over not only decades but centuries, small changes in the discount rate can produce substantial changes in the results. But the precise discount rate that should be used to evaluate questions as important as the future climate of the planet remains a subject of intense debate. It is safe to say that there is, as of yet, no professional consensus on the issue.

A similar point concerns risk aversion. To what extent are we willing to take chances with our planet? The point applies particularly to catastrophe scenarios. Scientists have thought of many possible scenarios, most of which they are fortunately not yet prepared to pronounce as particularly likely based on current evidence, but which might be truly catastrophic for the planet if they were to occur. There is a strong argument for the Kyoto agreement as a form of planet insurance. But what numerical weight should one assign to these catastrophic risks? In other words, what is the value of the insurance policy? It is difficult for an economist, or anyone, to know.

Despite these shortcomings and potential problems, respected researchers have developed estimates of the monetary damages expected from an average worldwide temperature increase of approximately 4.5 degrees Fahrenheit (corresponding to, roughly, a doubling of pre-industrial carbon dioxide concentrations). For example, William Cline, then a Senior Fellow at the Institute for International Economics, estimated that such a temperature change would impose annual damages of more than $70 billion per year on the U.S. economy in today's terms. These damages include $22 billion in lost agricultural production, $13 billion in additional electricity costs, and $8 billion in new costs to maintain the existing supply of fresh water. (Cline's original estimates are quoted in 1990 dollars. The figures given above translated those numbers into 1997 dollars using the annual GDP price index.) William Nordhaus of Yale University has likewise computed estimates of the dollar loss attributable to a doubling of carbon dioxide concentrations. He finds that the Cline estimate is in the center of three estimates for the U.S., and that the high estimate is only 1.3 times greater than the low estimate.

It must be noted, however, that this similarity of aggregate estimates masks the true uncertainty associated with forecasts of the damages from given increases in global warming -- the estimates are all fundamentally based on extrapolations from current and past experience, and

may not fully incorporate effects that will unfortunately become apparent only with future experience. In particular, the estimates may not fully reflect potential non-linearities in the relationships between carbon dioxide concentrations and temperature, between temperature and economic damages, or in the various other complicated relationships governing interactions between greenhouse gas emissions, the climate, and the economy. Current quantitative analyses do not, and cannot, accurately reflect the small and unknown possibility of large-scale and potentially irreversible discrete events with potentially catastrophic consequences.

Two such possibilities serve as illustrations. Warming of Northern tundra may release very large amounts of methane from the subarctic permafrost, thereby leading to potentially devastating acceleration of an otherwise controllable global warming process. We do not know at what point, if any, such unstable activity would be triggered. Second, evidence from climate models suggests that some types of climate change may lead to displacement of the Gulf Stream that warms Western Europe. Evidence from ocean core samples suggests that such reversals of ocean currents have occurred in previous ice ages. Reductions in the risk of such catastrophic outcomes must be considered in addition to the costs and benefits that can be reasonably quantifiable. Since human beings are typically averse to risk, such possibilities are especially important in evaluating whether the benefits of a particular climate control policy justify the costs. One must have at least some sympathy with those who criticize economists on the grounds that the effects of climate change are extremely difficult to quantify in a single monetary number.

III. Addressing Global Climate Change in an Efficient Manner

The costs of unabated climate change may thus be difficult to quantify, but they are nonetheless real and provide the motivation for reducing greenhouse gas emissions. In taking action to reduce those emissions, economic analysis suggests that two elements are absolutely essential:

- The effort must be <u>global</u>, to address the global externality inherent in the nature of the problem.

- The effort must be <u>flexible and market-based</u>, to ensure that we achieve our objectives in the most efficient manner possible.

Need for Global Action

Climate change is a global problem requiring a global solution. As I mentioned earlier, no single country has an incentive to reduce emissions sufficiently to protect the global environment against climate change. Each has an economic incentive to "free ride" on the efforts of others. Even if the United States sharply reduced its emissions unilaterally, greenhouse gas emissions from all other countries would continue to grow, and the risks posed by climate change would not be significantly abated. It is important to emphasize that emissions of different gases anyplace in the world have very similar effects on global climate.

The threat of disruptive climate change has led to coordinated international efforts to reduce the risks of global warming by reducing emissions of greenhouse gases. The first international agreement to address global warming was the Framework Convention on Climate Change signed during the Earth Summit in Rio de Janeiro in 1992. This convention established a long-term objective of limiting greenhouse gas concentrations and encouraged the established industrial countries to return their emissions to 1990 levels by 2000. Since then, it has become clear that the United States and many other participating countries will not meet this voluntary goal.

To address the lack of progress among many industrialized countries toward meeting the Rio objective, the United States and approximately 160 other nations agreed in negotiations held in Kyoto, Japan, last December, to take substantial steps to stabilize atmospheric concentrations of greenhouse gases. The Kyoto Agreement, which requires the advice and consent of the Senate, would place binding limits on industrial countries' emissions of the six principal categories of greenhouse gases: CO_2, N_2O, methane, sulfur hexafluoride, perfluorocarbons, and hydrofluorocarbons. These limits apply to the 38 so-called Annex I countries, which are the industrialized countries, defined to include Russia, Ukraine, and most Eastern European countries.

Under the Kyoto agreement, each industrial country's "1990 baseline" is actually based on its 1990 emissions of CO_2, methane, and N_2O and its choice of 1990 or 1995 levels of the other three categories of gases. The United States agreed to a target of 7 percent below 1990 levels by the period between 2008 and 2012. To meet that target, net U.S. emissions of greenhouse gases -- all emissions minus removals of CO_2 by certain forestry-related activities -- must average no more than 1,484 million metric tons of carbon equivalent per year during that period. The targets for the European Union and Japan are 8 percent and 6 percent below 1990 levels, respectively. Australia, New Zealand, Norway, Russia and Ukraine all have limits somewhat less ambitious when phrased as cuts relative to their 1990 levels. In sum, over the period from 2008 to 2012, the industrial countries are

expected to reduce their average emissions of greenhouse gases to about 5 percent below their 1990 levels.

The President has made clear that his support of the Kyoto Agreement is dependent on meaningful participation from key developing countries (who are not included in Annex I). The President has also made clear that he will not submit the treaty to the Senate without such participation.

There are several reasons why meaningful participation from developing countries is essential. First, developing countries are projected to contribute a majority of total emissions by 2030 under a continuation of business-as-usual. Without the participation of developing economies, emissions reductions by the industrialized countries will therefore not achieve necessary protection from climate change. Indeed, if developing countries do not participate in the international regime, their emissions could potentially increase by *more* than under their business-as-usual baselines. One mechanism for such an unintended consequence is as follows. As Annex I countries comply with their targets, their demand for oil will fall, which will probably work to reduce the price of oil on world markets, and perhaps to encourage non-participating countries to use more oil and emit more carbon than they otherwise would have.

Second, developing country participation is crucial because it would permit relatively low-cost emissions reductions to be internationally recognized as a substitute for more expensive emissions reductions that might otherwise by achieved by U.S. companies domestically. Again, greenhouse gas emissions have the same basic impact on the climate regardless of where they occur. So reductions in developing countries have the same environmental benefit as reductions domestically. But these reductions are much less costly than reductions in the U.S. or in other developed nations, because of the very inefficient and carbon-intensive uses of energy in these countries today. It thus makes sense, from both an environmental and an economic perspective, to incorporate emissions reductions in developing countries into the international system.

Third, principles of basic fairness suggest all countries should do their part, depending on their ability to contribute to the solution. Thus even poor countries should contribute, although the existence of more pressing social needs in such countries will inevitably limit the magnitude of their contributions.

So far I have not mentioned the word "competitiveness." One of the difficulties in analyzing concerns related to competitiveness is that the term itself is used to mean many different things. I have seen at least one study that uses "loss of competitiveness" to refer to predictions of negative effects on the *aggregate* trade balance. As a professional economist, I do not accept the logic upon which that particular argument is predicated: the aggregate trade balance is determined by macroeconomic forces -- the difference between saving and investment -- and not by our environmental policies.

On the other hand, if competitiveness refers to adverse effects on a few specific manufacturing industries -- those that are especially energy-intensive, such as aluminum, paper, and chemicals -- the situation may be more complicated. It is difficult to undergo a significant structural change in the economy without having the effect of expanding some sectors and contracting others. But to provide some perspective on this issue, consider the following facts. First, on average, energy constitutes only 2.2 percent of total costs to U.S. industry. Second, energy prices already vary significantly across countries. According to the *1997 Statistical Abstract,* for example, in 1996 premium gasoline cost $1.28 per gallon in the United States -- but only 8 cents in Venezuela. Yet U.S. industry is not moving en masse to Venezuela. Third, roughly two-thirds of all emissions are not in manufacturing at all, but in transportation and buildings. I therefore believe it more accurate to say that we need developing country participation for the reasons I outlined above, than to say that we need it to avoid adverse effects on competitiveness.

Flexibility and Market Mechanisms

A global solution is thus critical to the global problem of climate change. Globalizing the solution is not, however, enough by itself. We must also ensure that our efforts achieve their objectives in the most efficient manner possible. The nature of the climate change problem suggests three basic methods to lower costs of achieving given levels of environmental protection. They can be characterized in terms of three categories of flexibility: (1) "when" flexibility; (2) "what" flexibility; and (3) "where" flexibility, which may be the most important of all. Such methods have long been championed by economists interested in increasing the efficiency of protection. Indeed, the 2,600 economists urged such approaches in a letter they signed last year advocating action on climate change:

> "Economic studies have found that there are many potential policies to reduce greenhouse gas emissions for which the total benefits outweigh the total costs...The most efficient approach to slowing climate change is through market-based policies."

1. "When flexibility" (timing)

First is "when flexibility" or timing. Since climate change is a long-term problem, the exact timing of emissions reductions is in some sense not of primary importance. Thus the freedom to delay or accelerate reductions within an agreed upon time frame -- while ensuring credibility of emissions reductions -- lowers costs.

The Kyoto Protocol incorporates this principle of "when flexibility" in four ways:

- First, the cuts to be made in the first period are less severe, and the first period ends much later, than what had been proposed by many other countries, most notably the Europeans.

By adopting a gradual and credible path of reductions in the early years, we can greatly reduce costs such as those from prematurely scrapping coal-fired electricity plants still in the prime of their operating lives, while attaining the same ultimate environmental goals.

- Second, under the Kyoto agreement, the emissions target is not specified in terms of a specific year, but rather in terms of an average over a five-year period (2008-2012). Averaging over five years, instead of requiring countries to meet a specific target each year, can lower costs, especially given an uncertain future. The averaging can smooth out the effects of short-term events such as fluctuations in the business cycle and energy demand, or hard winters and hot summers that would increase energy use and emissions.

- Third, there is allowance for "banking" emission reductions within the 2008-2012 commitment period, for use in a subsequent commitment period [although the emission targets of the next period have not yet been specified].

2. "What flexibility" (gases and sinks)

The second type of flexibility is "what flexibility", along two dimensions. The first is the inclusion in the agreement of all six greenhouse gases. Emissions of different kinds of gases, not just carbon dioxide, contribute to the greenhouse effect. Since the IPCC has developed conversion factors for all greenhouse gases by estimating their global warming potentials, reductions in emissions of one pollutant can be used to substitute for increases in emissions of another by an amount that has equivalent environmental effects. The Kyoto Protocol stipulates that countries with binding targets are expected to reduce their *total* greenhouse gas emissions by certain percentages, but does not require specific reductions for specific gases. Since a molecule of sulfur hexafluoride is 23,900 times more potent over 100 years than a molecule of CO_2, it may be cheaper to achieve the same environmental benefit by eliminating one molecular unit of SF_6 than nearly 24,000 units of CO_2.

Some initial rough analysis indicates that a strategy of reducing non-CO_2 greenhouse gases by *more* than 7 percent below their 1990/1995 baseline levels while reducing CO_2 by *less* than 7 percent below its 1990 level could reduce greenhouse gas emission permit prices by more than 10 percent. Thus allowing countries flexibility in what gases they reduce -- essentially trading emissions reductions across gases -- can help lower significantly the costs of meeting their targets.

The second source of "what flexibility" is the treatment of sinks, i.e., land use activities that promote the removal of carbon from the atmosphere through the growth of plants. Promoting such sinks through afforestation and reforestation may reduce atmospheric concentrations of CO_2 at much lower costs than reducing emissions of greenhouse gases.

3. "Where flexibility" (international)

The third type of flexibility, and perhaps the most important, is "where flexibility" (international). As I have already emphasized, emissions have the same environmental consequences regardless of where in the world they occur. Therefore, the least-cost approach to controlling climate change is to reduce emissions wherever such reductions are cheapest. The Kyoto agreement includes two important cost-saving provisions of this nature. First, it provides for industrial countries to trade rights to emit greenhouse gases with each other. This market in emissions permits will ensure that emission reductions occur where they are least expensive within the industrial countries. In particular, U.S. companies could purchase emissions reductions in other participating countries when doing so would reduce their costs -- lowering costs without affecting the level of environmental protection.

Second, the agreement allows industrial countries to invest in "clean development" projects in the developing world and use these projects' certified emissions reductions toward meeting their targets. Many such clean-development projects may be quite cheap in terms of the cost per ton of emissions avoided, as has been illustrated by the joint implementation pilot program that is already in place in the U.S. Details of these provisions will be worked out in negotiations in Buenos Aires later this year.

IV. Difficulties of Economic Analysis of Kyoto Agreement

Now that we have a Protocol -- even if it is not yet fully complete nor ready for the President's submission to the Senate -- it is possible to examine it in somewhat more detail from an economic perspective. But I wish to emphasize once again the inherent limitations to any such estimates. Such limitations should not be surprising to you: economists have a difficult enough time projecting the behavior of the economy over the next quarter or year, let alone over the next two decades. The scale of the forecasting exercise is therefore daunting, and any specific results should be treated with substantial caution.

The difficulties associated with economic analysis of climate change fall into three broad categories. First are the uncertainties that still remain over the terms of the ultimate treaty. Second are the inherent limitations of available models to analyze even short-term costs and benefits. And finally is a topic I discussed earlier: the impossibility of putting a single monetary number on the long-term benefits of climate change mitigation.

Uncertainties over Certain Provisions in International Effort to Combat Climate Change

The Kyoto Agreement was an historic accomplishment, delineating the broad terms of the international effort to address climate change. But although we know a lot more than we did before Kyoto about how that international system will work, there is still much that we

don't know.

First, as is often the case in a legal document of the length and complexity of the Kyoto Protocol, there are some provisions that require further clarification and interpretation. Of particular concern here is the treatment of so-called sinks -- activities that affect the rate at which carbon is removed from the atmosphere and "sequestered," specifically by the planting of trees.

Second, the details of a number of items -- primarily concerning international trading and developing countries -- are the subject of further negotiations in Buenos Aires next fall, because they had not been definitively settled by the end of the last all-night session of the Kyoto talks.

Finally, and most importantly, we have not yet negotiated international agreements to limit emissions beyond the 2012 window. The emission cuts agreed upon at Kyoto are only a first step on a long journey. The first step that we propose to take over the next 15 years is critical. But the reason it is critical is *not* that, by itself, it will solve the climate change problem -- emissions during any given decade are small compared to the cumulative concentrations in the atmosphere. Rather, the first step is critical because we can't take the second and third steps until we have taken the first. At the same time, any analysis is complicated by the lack of knowledge over what the subsequent steps will be.

Inherent Limitations of Models

In addition to these uncertainties about the details of the international effort to address climate change, I must also note the inherent limitations of the models used to evaluate that effort. Even within a given model, answers depend critically on the precise nature of the question asked. For example, the costs of emissions reductions depend critically on the extent of global participation and international trading that a treaty is assumed to feature. But in addition to the dependence of the results from a given model on the precise assumptions, different models can give different answers even when all the assumptions are specified to be the same -- a concrete illustration of the range of uncertainty to which we must assign the predictions of any one individual model.

One area in which the uncertainty is particularly large is the pace of technological progress -- including diffusion of existing energy-efficient technologies, as well as research and development of new technologies -- and the extent to which the pace will accelerate in response to government programs. Economics does not offer a good understanding of how technological progress is determined, in part because it is the stuff of experimentation, brainstorms, genius, breakthroughs, perceptions and habits. Invention is largely determined by inspiration -- notwithstanding Edison, who assigned a 99 percent share to perspiration -- and inspiration, in my experience, is difficult to fit into mathematical formulae or economic models. Models and experts on climate change policy tend to have a wider range of disagreement on the speed with which technology can be changed and the scope for speeding the diffusion of existing energy-efficient technologies than on any other single issue.

Furthermore, each model has strengths and weaknesses; each has questions to which it is better or worse suited to answer. Some, for example, model the energy sector in detail. Some allow for the fact that a coal-fired power plant cannot costlessly be converted to one that runs on natural gas. Some have enough policy detail to distinguish alternative ways of redistributing revenues that would result if emission permits were to be auctioned. Some are capable of showing short-term macroeconomic disequilibria. Some include a long-term "carbon cycle" model that can keep track of the accumulation of greenhouse gas concentrations in the atmosphere and their climatological effects. Some break down the rest of the world into regions and so can model international trade. No one model does everything, and therefore we must not rely blindly on the results of any one model or set of models. Professional judgement and economic intuition are also crucial.

Benefits of Averting Climate Change

As I discussed above, it is evident that the benefits of averting climate change are potentially immense. But I have chosen not to try to quantify them in monetary terms for you, in light of the difficulties I have enumerated -- including the quantitative uncertainty of these benefits, and their timing and therefore the extreme sensitivity of the results to the chosen discount rate.

Instead, what I will do is draw upon a variety of sources in an attempt to add up the various possible costs and benefits of emissions policy *excluding* climate change. To give away the punch line, my conclusion is as follows: the net costs of our policies to reduce emissions are likely to be small, if those reductions are undertaken in an efficient manner, *even before taking into account the benefits of averting climate change itself.* That small net premium excluding the benefits of mitigating climate change, in effect, purchases a partial insurance policy against a serious environmental threat.

V. Assessing the Kyoto Agreement

The existence of modeling difficulties means that the results from any model must be treated with caution. We have therefore employed a broad set of economic tools to assess the Kyoto agreement. We have drawn on the insights of a wide range of models of the energy sector and economy over the next 25 years, including but not limited to the results of the Stanford Energy Modeling Forum exercises, the IPCC's review of the economic and social dimensions of climate change, and the staff-level Interagency Analytical Team effort last year. Other tools include simple relevant statistics, "meta-analyses" of existing models, historical and sectoral examples, and basic economic reasoning. Drawing on this broad array of analytical tools is crucial to an intelligent evaluation of the policy alternatives.

To my knowledge, as of December, no model -- whether used inside the government or

not -- had been set up precisely to analyze the parameters of the agreement that was reached in Kyoto. Most model-builders outside the government tend to take as long as several years to incorporate changes in policy parameters into their models. And no model is currently designed to assess sinks, or all six greenhouse gases included in the treaty.

One of the leading models in the field is the Second Generation Model of Battelle Laboratories. The SGM is one of the models best positioned to analyze the role of international trade in emission permits, which we consider to be a critical element of the Kyoto Treaty. However, the SGM does not cover all six gases included in the Kyoto agreement or include a role for sinks. We have used the SGM model as a starting point for a preliminary assessment of the Kyoto treaty, but have attempted to supplement its results with additional analysis to account for such special features of the agreement as the inclusion of six gases, sinks and a possible Annex I trading scheme that could exclude the EU. I will share with you today some preliminary results of this analysis.

Mindful of the limitations of any single model, we are eager to see features of the Kyoto agreement assessed by other models to obtain a better feel for the range of possible effects. Much of this work will continue to go on outside the government. For example, we have had discussions with the Energy Modeling Forum, based at Stanford University. The EMF is a long-running exercise involving many of the leading climate models. We have given the EMF advice on how features of the Kyoto legal language can be translated into terms recognizable to an economist. Unfortunately, the Energy Modeling Forum believes that its members will need at least until mid-year to produce reliable results.

VI. Economic Analysis

With all of that as important background, let us now turn to the task at hand. As we do so, let me emphasize once again that the figures presented below do <u>not</u> incorporate the benefits of starting to mitigate climate change.

I said in Congressional testimony last July that we can do this smart or we can do this dumb. I was referring to the point that the costs of cutting emissions can be much reduced if flexible, market mechanisms are used. Our economic analysis highlighted the importance of such flexible, market-based mechanisms -- which are therefore reflected, at the President's insistence, in the Kyoto Agreement and our approach to the effort.

Within the Kyoto agreement, this means an insistence on international trading, joint implementation, and, ultimately, on full developing country participation. Domestically, this means that we implement any emissions reductions through a market-based system of *tradeable* emissions permits, which ensures that we achieve reductions wherever they are least expensive. But this also means taking serious and responsible steps in the short run to prepare us to meet our obligations in the longer term.

The first such step is the inclusion in this year's budget of an aggressive, $6.3 billion program of tax cuts and R&D -- $1.3 billion more than the $5 billion package the President promised in his October 22 speech on this issue. The goal is both to stimulate the development of new energy-saving and carbon-saving technologies and to encourage the dissemination of those that exist already. The proposed package contains $3.6 billion over the next 5 years in tax cuts for energy efficient purchases and renewable energy, including tax credits of $3,000 to $4,000 for consumers who purchase highly fuel efficient vehicles, a 15 percent credit (up to $2,000) for purchases of rooftop solar equipment, a 20 percent credit (subject to a cap) for purchasing energy-efficient building equipment, a $2,000 credit for purchasing energy-efficient new homes, an extension of the wind and biomass tax credit, and a 10 percent investment credit for the purchase of combined heat and power systems. The package also contains $2.7 billion over the next 5 years in additional research and development spending -- covering the four major carbon-emitting sectors of the economy (buildings, industry, transportation, and electricity), plus carbon removal and sequestration, Federal facilities, and cross-cutting analyses and research. One example of the R&D effort is the Partnership for a New Generation of Vehicles (PNGV). PNGV is a government-industry effort to develop attractive, affordable cars that meet all applicable safety and environmental standards and get up to three times the fuel efficiency of today's cars. In FY99, the combined proposal for PNGV is $277 million, up from $227 million appropriated in FY98. Similar government-industry efforts are proposed to develop more efficient diesel engines for both light trucks and heavy trucks. [ADD SOMETHING MORE ABOUT INDUSTRY-GOVERNMENT DIALOG. PERHAPS A CONCRETE EXAMPLE OF IDENTIFYING AN INDUSTRY REGULATION THAT COULD BE REMOVED.]

The second such step is the promotion of an environmentally-responsible electricity restructuring bill, which the President identified as part of his domestic climate change package in his address to the National Geographic Society on October 22. An electricity sector freed from government regulation would be a more efficient energy sector. Costs to consumers would fall. A reasonable overall estimate of the effects of adding federal electricity restructuring to the rest of the President's program to address climate change is to achieve the same environmental goals at a cost saving of roughly $16 billion per year.

Estimated Reduction in Costs from Annex I Trading

In the language of the treaty, "Annex I," you will recall, is the set of countries that have agreed to take on binding limitations in emissions of greenhouse gases. Even without developing country participation -- which, again, the President has emphasized as essential before the treaty would be submitted for ratification -- costs would be reduced substantially by trading among the Annex I countries. To provide some indication of the possible efficiency improvements, Russia and the Ukraine consume six times as much energy per dollar of output as does the United States.

Estimates derived from the SGM model suggest that trading among Annex I countries is likely to reduce the cost to the United States of achieving its targets for 2008-2012 emissions by

about half relative to a situation in which such trading was not available. This concept of costs is meant to capture aggregate resource costs to the US economy, including the cost to domestic firms of purchasing emission permits from Russia and other countries where emission reductions are cheaper than in the United States. The dramatic reduction in costs available from Annex I trading within the SGM model -- cutting the costs involved by half -- highlights why the President insisted that international trading be part of the Kyoto Agreement.

Estimated reduction in costs from umbrella trading

One possibility that emerged in Kyoto, which none of us foresaw, was the idea that the United States might undertake trading with a subset of Annex I countries, dubbed the "umbrella," that would exclude the European Union. The initial list of proposed participants in the umbrella includes the United States, Australia, Canada, Japan, New Zealand and Russia, with strong indications of interest from some others. The motivation for this idea was that the Europeans have been reluctant to agree to the sort of international trading that we want (preferring that they achieve their goals collectively in a group of their own, called the "EU bubble").

It is too early to say whether the umbrella concept will in fact be accepted by the parties. But it is an important concept to consider, for three reasons. First, it is conceivable that it will be formally agreed to in future negotiations. Second, even if the final treaty does not explicitly include the umbrella, but rather allows trading among all signatories (as the United States has proposed all along), it is conceivable that umbrella countries will agree, outside the treaty, to trade only among themselves. Third, the aversion toward international trading that the Europeans have expressed suggests that they might refrain from making the trades to which they would be entitled -- which would mean that the umbrella would operate in practice, if not in formal international agreement.

The significance of the umbrella idea in the present context is that it has the potential to further reduce costs to the United States. The reason is that if the Europeans do not bid against us for the relatively abundant, low-cost opportunities to reduce emissions in Russia and Eastern Europe, then the price of emissions reductions will be even lower. Results that we have derived from various SGM simulations suggest that, relative to the situation in which there is no trading at all, the umbrella arrangement would reduce costs by an estimated 60-75 per cent, depending on whether the former Warsaw Pact countries are classed with the EU, or are instead assumed to fall within the umbrella.

Estimated reduction in costs from LDC participation

The next consideration is participation by developing countries. The President has said that he will not submit the treaty for ratification without such participation -- which would further reduce the costs involved.

A moderate version of developing country participation is the Clean Development Mechanism, modeled after Joint Implementation (JI). JI cannot realistically be expected to yield all the gains of binding targets for developing countries, but it might shave costs by roughly another 20 to 25 percent from the reduced costs that result from trading among Annex I countries.

Another possibility is that we persuade some of the key developing countries that are the largest emitters to commit to targets, and allow us to buy emission reductions from those paths. We estimate that this could cut roughly 55 percent off the reduced costs that result from Annex I trading. [The four countries included in this particular estimate are China, India, Brazil and Korea.] Once these savings have been attained, the estimated reductions to US costs from persuading the rest of the developing world to go along with full commitments are relatively small.

A useful rough check on our estimate of the gains from international emissions trading can be obtained from other modeling efforts, notwithstanding that they are likely to be more distant approximations to the parameters of the Kyoto Treaty. Recent results from six leading models that participated in the Stanford Energy Modeling Forum show that worldwide permit trading would reduce the estimated costs -- defined as lost consumption -- of a full, long-term, global program to stabilize atmospheric concentrations at 550 ppmv by an average of 56 percent, although the results vary from model to model.

I offer these numbers because they show the potential effectiveness of trading in reducing costs dramatically. But it is important that I repeat three caveats: First, as always, there is a wide range of uncertainty around all these estimates. Second, they apply to an idealized version of trading, one that assumes no problems of enforcement or transactions costs. Third, it seems unlikely that we will convince all of our partners to agree in Buenos Aires to the most complete and cost-effective international trading arrangements. Nonetheless, despite these caveats, the numbers do show major savings even without getting the most optimistic case. And if we don't get enough of what we want, we won't submit the treaty for ratification to the Senate.

Moreover -- and I can't highlight this enough -- these cost-saving features are fundamental tenets of the U.S. position for ratifying the Kyoto Protocol. If we do not get very solid provisions for international emissions trading and meaningful participation by key developing countries, we won't submit the treaty for ratification to the Senate. So, while our analysis may be predicated on some ambitious conditions concerning trading and developing country participation, it is exactly those conditions that form the foundation of the U.S. position going into Buenos Aires.

VII. Non-Climate Benefits

The costs of undertaking greenhouse gas emission reductions must be compared to the

benefits. As I have indicated, for various reasons our analysis does not quantify the benefits from averting climate change itself. But the relative price shifts that are necessary to reduce emissions should produce benefits in three areas: air pollution, traffic congestion, and highway accidents. These benefits are quantifiable. The magnitude of these projected benefits would vary with the permit price.

Reductions in carbon emissions also lead to reductions in emissions of pollutants that contribute to excess concentrations of fine particulate matter and low-level ozone. Conservative estimates suggest that, corresponding to an emission permit price of $20 per ton, such ancillary emissions reductions could be well in excess of a half million tons of pollutants per year, and entail cost savings of about $0.9 billion per year. These cost savings be even larger if carbon emissions reduction efforts could be carefully coordinated with the implementation of the national ambient air quality standards.

Traffic congestion hurts motorists by causing delays and inconvenience. More efficient pricing -- which recognizes the externalities involved -- should lead to reductions in congestion as motorists choose other means of travel, share rides, or even forgo less important trips. We estimate, for example, that higher fuel prices resulting from carbon permit prices of $20/ton would reduce travel delays associated with congestion, and that the value of such time savings to consumers would be about $0.4 billion per year.

Vehicle use also leads to costly accidents and to highway injuries including fatalities. Assuming that accidents fall proportionately with vehicle use, more efficient pricing will also create savings from reduced accidents and resultant mortality. We estimate that the savings from reduced accidents and the value of reduced mortality risk corresponding to a $20/ton carbon price is approximately $0.3 to $2.7 billion per year [depending on whether lighter cars are less crash worthy].

A variety of other benefits that are harder to quantify are likely to result from reductions in carbon emissions. With respect to transportation, reduced vehicle use will also reduce the cost of road repair and maintenance. Second, reduced coal use will lower mercury emissions. Finally, reduced energy use will also increase U.S. energy independence. Our inability to estimate these effects quantitatively does not imply that they are necessarily small or unimportant.

VIII. Preliminary Estimate of the Net Effects of the Kyoto Agreement

We can now combine the various benefits and costs delineated above to provide a preliminary assessment of the net impact of the Kyoto agreement, excluding, however, the benefits of averted damage from climate change. This assessment relies on SGM model results along with additional Administration analysis. It accounts for the impact of trading under the

umbrella, and assumes full participation by four key LDCs. We find that the resource costs of attaining our Kyoto targets for emission reductions are approximately $7 to $9 billion. Adding in the ancillary, non-climate benefits results in a net cost estimate of $5 billion to $8 billion, or roughly 0.08 percent of projected GDP.

A more tangible measure of costs is the estimated effects on energy prices. Excluding the impact of electricity restructuring, our SGM-based estimate is that the price of emissions would be in the range $12 to $16 per ton of carbon equivalent -- and that energy prices at the household level would rise by about 3 percent under the Kyoto accord. Fuel oil prices would rise by about 6 percent, natural gas prices by 4 percent, gasoline prices by 3 percent, and electricity prices by 3 percent. The 3 percent increase in energy prices at the household level would raise the average family's energy bill by about $75 per year.

These estimates do *not* mean that households' energy expenses will in fact be higher in 2010 than today, however. In the first place, energy prices fluctuate year-by-year for all sorts of reasons. They could go either up or down. But even if we leave out unpredictable fluctuations, the energy price declines from Federal electricity restructuring would be enough to offset the impact estimated above. By 2008-2012, the projected 10 percent decline in electricity prices from the restructuring that is part of our climate change agenda will mean a net reduction in electricity prices in the U.S., even accounting for the small increases noted above.

As highlighted earlier, estimates of the type that I am presenting are fraught with uncertainty. The estimate I just discussed was predicated on the developing country participation that we will insist upon in Buenos Aires as a condition for our ratifying the Kyoto Protocol, but which is not yet part of that Protocol. At the same time, the numbers I have cited are in several respects conservative: they leave out several factors, such as the role of sinks, that could further reduce costs. But before I bring these factors into the analysis, allow me to say a few words about macroeconomics.

Effects on employment and aggregate output

So far I have said nothing about job losses resulting from climate change policy. Although there may be job gains in some sectors and job losses in others, I do not anticipate any significant aggregate effect. Some jobs could be lost in energy-intensive sectors, although given the very small predicted change in energy prices, impacts in most such sectors are apt to be minimal. Furthermore, a large number of jobs will be created in other sectors -- many of them high-tech jobs paying high wages. The President is firmly committed to assisting any workers who are adversely affected during the transition to a climate-friendly economy.

The situation might be different if a large energy shock were to hit the economy with no

warning, as happened in the oil crisis of 1973-74, when the real money supply, output and employment all contracted sharply. In addition to hitting with no warning, the oil shocks of the 1970s also entailed large transfers from the U.S. and other oil-importing countries to OPEC, thus depressing real income and spending in the former. A self-imposed shift in the relative price of carbon-intensive energy to address global climate change, on the other hand, need not entail such a transfer of purchasing power. Thus there are critical differences between the oil price shocks and the effort to reduce carbon emissions. Our reassuring conclusion regarding aggregate output might also be different if the policy were to be implemented inefficiently (by command-and-control style regulations of the sort put in place in that oil crisis) rather than efficiently (by market mechanisms of the sort that the President has proposed to use).

IX. The Foregoing Estimates Are Conservative Along Several Dimensions

I should emphasize that the estimates I have presented are conservative in the sense that they do not include three factors: the potential cost reductions resulting from the inclusion in the Kyoto treaty of carbon sinks, the potential payoffs to the President's technology or energy efficiency initiatives, or the benefits of mitigating climate change itself. The first omission, sinks, concerns a provision of the Kyoto Protocol that has received less attention than it merits. It is only *net* emissions -- emissions to the atmosphere minus sequestration -- that are to be reduced 7 percent below 1990 levels, not gross emissions. The United States plants many trees every year, and would receive credit for this activity under the Protocol. Very preliminary estimates of the implications for the United States of the Kyoto provision on sinks indicates that carbon sinks could comprise nearly 10% of total required emissions reductions. Decreasing the required emissions reduction by 10% would likely result in cost-savings greater than 10%.

Even this estimate of the effect of sinks is conservative in one respect: it is based on an assumption for sink activity in the U.S. over the 2008-2012 period, and no assumed benefits from sinks elsewhere in the world. Very preliminary estimates suggest that incorporating the gains from sinks *throughout the world* can reduce the costs of meeting the Kyoto target by half or more, on top of the gains from trading among Annex I countries. (Furthermore, no model has yet even tried to take into account that government policies can help increase the amount of tree-planting, possibly through some version of the USDA's Conservation Reserve Program, for example.) But neither we nor other analysts are yet sure exactly how to interpret the legal language of the Protocol. Because the quantitative uncertainty is so large, we do not yet have an estimate with which I feel comfortable. But we do know that the effect of fully modelling the Kyoto provision pertaining to sinks is likely to be both favorable and large.

The estimates I have cited so far also make little allowance for the payoff to the President's $6.3 billion Climate Change Technology Initiative. The parameter that figures most prominently in analysis of technological progress in the energy field is the rate of improvement in the so-called Autonomous Energy Efficiency Index (AEEI), that is the rate at which the total use of energy falls relative to GDP. In the SGM model analysis that underlies our assessment, the

AEEI is assumed to improve by 1.0 percent per year. Reflecting a conservative interpretation of the 15-year impact of the technology initiative, this is only a small increase above the 0.9 percent number in the Energy Information Administration's Annual Energy Outlook.

Our justification for incorporating into our assessment such a small assumed impact of Administration technology policies is somewhat analogous to the Administration's rationale for employing mainstream economic assumptions in our budget forecasts: in the presence of uncertainty, we are conservative in our estimates of the speed with which the economy will grow, tax receipts will rise, and the budget will improve. That way, any revisions or surprises that occur are likely to be in the pleasant direction. In this instance, we have conservatively assumed that there will be substantial lags in producing payoffs from new technology research and dissemination expenditures.

Clearly, this is neither the best outcome the Nation *can* attain nor the best outcome the Administration *expects* to attain as a consequence of our climate change strategy over the next decade. Many energy technology experts forecast more rapid technological progress; and engineering models suggest that some energy improving technologies are available now at negative costs.

If the Administration is successful in speeding the discovery and adoption of new technologies, the rate of improvement in energy efficiency could rise and such improvements would lower the cost of meeting our Kyoto target. For example, published results based on SGM model simulations with different assumed rates of AEEI improvement suggest an increase in the AEEI from 1.0 to 1.25 would be reflected in about a 40% decrease in the permit price.

Our preliminary estimates do not fully reflect potential entrepreneurial response to appropriate incentives. An instructive example of the ability of U.S. industry to perform beyond expectations when given appropriate economic incentives is EPA's highly acclaimed sulfur dioxide (SO_2) program, which relies, among other things, on a system of tradeable permits to reduce emissions of SO_2 from electric utilities. The SO_2 program has been successful in several ways: a large number of utilities participate, SO_2 emissions and ambient concentrations have fallen and the costs of reducing emissions are considerably lower than originally forecast.

As has been frequently noted, the average cost of SO_2 emissions reductions has recently been significantly lower than was originally forecast, in part due to the role of incentives in fostering innovation. Emission permit prices, currently at approximately $100 per ton of SO_2, are well below earlier estimates of around $250 to $350 per ton.

Trading programs may not always bring cost savings as large as those achieved by the SO_2 program; trading programs will not always be accompanied by the discovery of much cheaper control strategies. However, the SO_2 experience demonstrates clearly how programs that offer important market incentives to find cheaper ways of reducing emissions can lead to

unexpectedly low prices.

The final, and most important factor that has been left out of the estimates I have presented is the benefit of mitigating climate change itself. A full cost-benefit analysis would include mitigation in the benefits column. The only reason we have not done so, as I have explained repeatedly above, is the difficulty in coming up with a number to capture the monetary benefits. But I trust that nobody will lose sight of our ultimate objective -- keeping our planet the hospitable home that we enjoy today.

CONCLUSION

In conclusion, the Kyoto Agreement and the President's general approach to climate change reflect the insight of economic analysis. The Kyoto Agreement includes key provisions on international trading and clean development projects. The President's approach relies on market incentives -- first, with a system of tax cuts and R&D, and then later with a market-based system of tradeable permits -- to ensure that our objectives are achieved as efficiently as possible.

I look forward to continuing to work with members of this Committee, as well as other interested parties, in further analyzing the Kyoto Agreement and evaluating the net effects of reducing greenhouse gas emissions. It is my hope that economic analysis will continue to play a key role in designing policies in this area.

I welcome your questions.