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**Summary of Project 88/Round II
Workshop Proceedings**

**Market-Based Mechanisms for
Addressing Global Climate Change**

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Washington, DC**

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**PROJECT 88 — ROUND II
Environment and Natural Resources Program**

JOHN F. KENNEDY SCHOOL OF GOVERNMENT

Harvard University



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This workshop was part of Project 88/Round II, co-chaired by Senator Timothy Wirth and the late Senator John Heinz, directed by Professor Robert Stavins, and dedicated to the memory of John Heinz and his vision of improving environmental policy through the application of economics. The project focuses on the design and implementation of incentive-based environmental policies in three areas: global climate change; hazardous and solid waste problems; and resource management issues. In addition to this workshop, the project includes a seminar series, three other policy workshops, a public affairs forum, policy reports, and student internships.

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WELCOME: *Senator Timothy Wirth, Colorado*

Given the high level of attention market-based approaches to environmental protection command these days, it is easy to forget that not long ago these ideas were rarely considered in policy debates. Indeed, the very notion of economic incentives to environmental protection was quite controversial four years ago when we released the first Project 88 report. But since that time we have made considerable progress, due in large part to the efforts of many of you in this room.

The transformation brought about by these ideas has been truly remarkable. Beginning with the Clean Air Act's tradeable permit program for sulfur dioxide emissions - which helped break a ten-year political logjam -- market-based policies for environmental protection have taken off. For example, new energy legislation that has recently passed the House and Senate represents a significant departure from our traditional policy in that area. These bills recognize that a price of ninety-seven cents a gallon does not reflect the true social costs of gasoline; they recognize that conservation and efficiency as well as alternative fuels cannot compete when our policy is so biased towards oil.

Today's workshop on climate change brings us to another policy arena where the market-based policies of Project 88 are being carefully considered. I think these ideas have a great deal to offer as we prepare for the United Nations Conference on Environment and Development in Brazil this June. Certainly any actions that the United States takes to combat climate change will have important consequences for our economy. Rather than looking at the Rio conference as a set of economic liabilities, though, we should look at it as an opportunity to modernize our economy with market-based incentives that better reflect the realities of our global environment.

OVERVIEW: *Robert N. Stavins, Assistant Professor of Public Policy, John F. Kennedy School of Government, Harvard University*

This workshop explores market-based policy mechanisms for addressing global climate change. Held at the Hart Senate Office Building in Washington, D.C., the workshop is part of Project 88/Round II, a two-year, multi-faceted program undertaken by Harvard University's John F. Kennedy School of Government. It focuses on the design and implementation of incentive-based environmental policies. The overall project is co-chaired by Senator Timothy Wirth and the late Senator John Heinz and dedicated to the memory of John Heinz and his extraordinary commitment to utilizing sound economics as a means of improving environmental policy.

In the past three years, there has been greatly heightened interest by political leaders on both sides of the Atlantic Ocean in new approaches to environmental protection. In particular, there is a growing recognition that the forces of the marketplace, obviously a source of many environmental problems, also have great potential to be part of the solution to these problems. In Washington, the debate has evolved rapidly, culminating in the fall of 1990 with the President's signature on the Clean Air Act Amendments, which

incorporate a market-based tradeable permit program for the control of sulfur dioxide emissions, a precursor of acid rain.

One catalyst for these changes was the bipartisan study initiated and sponsored by Senator Timothy Wirth of Colorado and the late Senator John Heinz of Pennsylvania. Their original "Project 88" report was the product of a team effort by fifty persons from government, business, environmental organizations, and academia. In fact, a number of the people who helped develop the report's recommendations for enlisting the forces of the marketplace to deter pollution or reduce natural resource degradation are participating in today's workshop.

As the first Project 88 report served to facilitate some initial steps towards reform of environmental policies, the Project 88/Round II report, to which over one-hundred individuals nationwide contributed, takes the next step of investigating design and implementation issues of market-based approaches to three significant environmental problem areas: (1) global climate change; (2) solid and hazardous waste management; and (3) natural resource management. This workshop is one element of the ongoing Project 88/Round II effort, which also involves seminars and workshops on a variety of issues, as well as student internships.

The possibility of global climate change due to the greenhouse effect is potentially one of the most important, and certainly one of the most controversial, environmental threats we may face. Given the high degree of uncertainty prevailing within the scientific community, the Project 88/Round II report did not attempt to draw any conclusions about the likely magnitude of global warming damages, or the level of appropriate controls, if any. Instead, the report focused on how governments can best achieve their goals if they decide that action to combat climate change is warranted. Similarly, our focus today will be to investigate a variety of market-based policy mechanisms to address climate change.

Our purpose is not to sell these ideas, but to examine them critically -- to find out *if* they apply, *where* they apply, and *how* they might be used. The workshop begins by examining the role of revenue-neutral carbon taxes in achieving national greenhouse gas goals. A subsequent session focuses on the potential of using an international greenhouse gas tradeable permit program for allocating responsibility among nations. Finally, we will end by looking closely at the electrical utility industry and examining alternative approaches for integrating environmental costing into the industry's regulatory framework.

SESSION I: ACHIEVING NATIONAL GREENHOUSE GOALS -- THE ROLE OF REVENUE-NEUTRAL CARBON TAXES

INTRODUCTION: Joseph P. Kalt, Professor of Political Economy, John F. Kennedy School of Government, Harvard University

At some point in time, whether this June in Brazil or ten or twenty years from now in Geneva, we may get an international agreement which allocates greenhouse gas goals to individual nations. The question we will have to face domestically at that time is how to achieve our national goals, one of which might be to reduce our net contribution of carbon dioxide to the atmosphere. It is in that context, that the idea of a carbon charge - a tax on fossil fuels proportional to their carbon content -- has been advanced and studied. On the positive side, a revenue-neutral carbon tax can send the appropriate price signals while replacing economically distortionary taxes with corrective taxes. On the negative side, a carbon charge could have potentially adverse affects on certain domestic industries and on the domestic economy. This session examines these trade-offs.

ADDRESSING CLIMATE CHANGE THROUGH REVENUE-NEUTRAL CARBON TAXES: Darius Gaskins, High Street Associates

An evaluation of market-based policy mechanisms for addressing climate change reveals the four broad themes I will address.

(1) *A tax on carbon is better than a permit system for addressing climate change.* First, a tax offers policymakers greater flexibility in adjusting to new scientific assumptions about how much carbon should be reduced than does a permit scheme. In fact, the level of a carbon tax should be adjusted regularly in response to changing consumption patterns, inflation, and income levels. Although the amount of emissions allowed in a permit system can be adjusted to reflect changing assumptions about how much carbon should be reduced, experience with tradeable permits for sulfur dioxide in the Clean Air Act suggests that the initial emissions level established will take on the status of a property right and become politically difficult to change. Second, a tax makes the costs of limiting carbon emissions transparent to both American citizens and international observers, while a permit scheme does not. Third, there is a political tendency for taxes to broaden over time, and in the climate change case this is important so we can incorporate other greenhouse gases like methane into our taxation scheme.

(2) *A carbon tax should be harmonized across nations.* If any one country puts on a fairly stiff carbon tax, it will have a major impact on trade flows. For example, if the U.S. unilaterally instituted a carbon tax, we would have a tendency not to produce carbon-intensive goods but to import them. One study recently suggested that a carbon tax applied only on one country will have 100 percent leakage, meaning that there would be no global reduction in carbon dioxide because the production of carbon-intensive products would be shifted to other countries. While it is conceivable that tariffs could be adjusted to compensate for the carbon tax, such an effort would be a daunting, if not impossible,

task. More importantly, raising tariff rates might trigger a round of protectionism that could significantly reduce the level of international trade. On the other hand, if countries harmonize their carbon taxes, we can achieve global reductions in carbon emissions without fundamentally disturbing trade flows.

(3) *The carbon tax should be phased in.* In order to achieve any particular reduction in carbon dioxide, consumers and industries will have to invest in new technologies. A phased-in tax does not force them to replace their capital goods immediately, but allows them the opportunity to purchase less carbon dioxide producing technologies in the natural cycle of replacing their capital goods. Thus, a phased-in tax is far less costly than one which is not phased-in. But are we worse off for the delay? The available scientific evidence suggests we are not. Because climate change depends on carbon dioxide concentrations and because carbon dioxide remains in the atmosphere for 100-200 years, it does not make much difference in the long run whether we reduce our carbon emissions this year or next year. Ultimately, we get to more or less the same point in terms of reversing a carbon dioxide build-up by phasing in the tax, but at considerably lower cost.

(4) *A carbon tax should be revenue-neutral.* In this case, the carbon tax proposed is intended to incorporate the social cost of carbon dioxide emissions into the price of those activities which create them. Economists suggest that revenues from such corrective taxes -- those that discourage fundamentally *undesirable* activities like polluting -- should be recycled into the economy by replacing distortionary taxes -- those that discourage fundamentally *desirable* activities, such as labor and capital generation. Using carbon tax revenues to lower the corporate income tax, enhance investment tax credits, and reduce the social security tax are examples of where we could replace revenues from distortionary taxes with those from a corrective tax. The broad goal behind a revenue-neutral tax scheme is to lower the overall cost of the corrective tax to the private sector, which in the case of a carbon tax will be very high.

THE IMPORTANCE OF PRICE SIGNALS: George Eads, Vice President, General Motors Corporation

Because considerable scientific uncertainty about global warming still remains, we at General Motors are not prepared to acknowledge that the phenomenon has been proven. But we are at the point of saying that if the U.S. government decides that we should reduce greenhouse gas emissions, then we should do this through some form of price mechanism. We can pass all the laws we want about technology mandates, but the evidence is pretty strong that unless those are somehow backed up with price signals they will not have much impact. In addition, we would recommend that any pricing mechanism be as broad-based as possible to include all greenhouse gases. There is no point to taxing carbon if reductions in carbon dioxide lead to increases in other greenhouse gases.

The automobile business offers a clear explanation for why any tax on greenhouse gas emissions should be phased-in. The average car lasts about fifteen years and represents a significant capital investment by consumers. A large, unexpected increase in the gasoline tax could make some cars obsolete overnight and result in a substantial

sunk cost to our economy. Likewise, General Motors engineers currently are designing the basic engines that will be used in the first decade of the next century. Because they base their designs on a set of assumptions about what consumers will want, they need to be aware of how government policies may affect consumer choices.

That long-term signals sent by prices are important both for consumers and industry can be illustrated historically. In 1980, the price of gasoline was roughly equivalent in both the United States and Canada and the mix of cars sold in both countries was virtually identical: 44% of the cars General Motors sold in Canada were economy, small and compact compared with 45% in the U.S. Over the last decade, however, the real price of gasoline has held steady in Canada while it has declined considerably in the U.S. Not surprisingly, the mix of cars sold in both countries has deviated: 61% of cars General Motors now sells in Canada are economy, small, and compact versus only 43% in the U.S. The automobile fleet for sale in both countries is identical and so is the technology used to produce them; the difference in sales can be attributed to the price of gasoline in the two countries. The same comparison can be made between the sales of General Motors cars in Europe and the United States. Because fuel taxes in the European Community are substantially higher than those in the U.S., 90% of the cars that General Motors sells are of the size of a Cavalier or Sunbird versus only 19% here.

A tax on greenhouse gas emissions would have a significant effect on the way the automobile business is run. If such a tax is enacted, our government should follow the model of European countries who have announced that energy prices will be rising consistently over time and provided both consumers and industry with the long-term price signals needed for an effective, least-cost response.

***WHAT AN EFFECTIVE CARBON TAX MIGHT COST: Richard Richels, Director,
Energy Analysis and Planning Department, Electric Power Research Institute***

If we decide we want to address climate change, if we decide that we want to reduce carbon dioxide emissions, and if we decide that we want to do it through a carbon tax, the size of the carbon tax required to significantly reduce emissions will be substantial. Because demand for carbon emissions is relatively inelastic, a five dollar per ton tax on carbon would hardly reduce emissions. My estimates suggest that to reduce carbon emissions to 20% below current levels -- a target mentioned frequently in international meetings -- would require a tax of 200-300 dollars per ton on carbon. What would this mean for carbon-based products? A two-hundred dollar per ton tax on carbon would increase the price of a barrel of crude oil by about 146%, a gallon of gasoline by 54%, a gallon of heating oil by 65%, and electricity by more than 50%.

A carbon tax designed to bring about a particular emissions level should vary over time. In the short-term, the tax level will be relatively high because of the limited number of carbon-free energy substitutes -- both in terms of alternative energy sources on the supply side and conservation and energy efficiency measures on the demand side. Over the longer term, the size of the tax can be reduced if we develop the technical ability to reduce emissions at a lower cost. How long it takes before a carbon tax can be reduced

to zero depends upon how optimistic or pessimistic you are about our ability to develop technological innovations in the energy field.

A carbon tax designed to bring about a particular emissions level will also vary among regions. For example, some countries will find it easier to adapt to a 20% reduction in carbon dioxide emissions than others. As a result, a carbon tax may have significant implications in terms of competitiveness in international trade. In addition, the different costs of controlling carbon emissions suggest there may be significant gains from international trade in carbon emissions rights if a tradeable permit system is used to allocate national greenhouse gas goals.

The recent proposal for a carbon and energy tax being considered by the European Community offers a case study of how different policies can affect carbon emissions and national welfare. The proposed ten dollar a barrel tax on oil (equivalent to an 85 dollar per ton tax on carbon) might significantly reduce carbon dioxide emissions, but would not meet the EC's objectives of stabilizing carbon emissions. When combined with the proposal to tax non-carbon fuels like nuclear power at half the rate of carbon-intensive fuels, however, about half the reduction in carbon dioxide emissions from the tax on oil is lost as fuel switching becomes less attractive. In essence, the broad energy tax makes reducing carbon dioxide emissions -- our goal in addressing climate change -- more expensive. Finally, it is worth noting that a carbon tax equivalent to the one proposed by the EC would hit the United States far harder than European countries because of the energy-intensive nature of American industry.

The carbon dioxide emissions targets that have been suggested thus far have ranged from slowing the rate of growth below the current level to cutting them to half their current level. Rather than trying to meet some arbitrary target with a carbon tax, a sensible greenhouse gas policy should involve balancing benefits and costs, and particularly balancing marginal benefits and marginal costs. To date, insufficient effort has been made to derive emissions targets that reflect such a balance.

DISCUSSION:

a. International trade and the need for tax harmonization

One participant suggested that if all countries adopt measures to reduce carbon dioxide emissions, the need to harmonize carbon taxes across nations to avoid trade disruptions becomes less important. Assuming the United States will not be controlling greenhouse gas emissions unilaterally, he argued, it will not be the only country that faces rising costs for energy-intensive or carbon-based products and the effectiveness of its carbon tax will not be significantly eroded because of changes in trade flows. To illustrate this point, the participant explained that non-tax policies to reduce carbon dioxide emissions, whether tradeable permit or command-and-control systems, create shadow prices which influence economic activity in ways equivalent to taxes.

b. Avoiding trade disruptions with end-use taxes

Another participant proposed that an end-use tax could be employed to achieve greenhouse gas reductions without causing disruptions in trade patterns if a multi-lateral agreement to harmonize carbon taxes cannot be reached. Assessing the tax at the point of consumption, he explained, would allow exports to go untaxed while imports would be taxed at the same rate as domestically-produced products. Because of the complexity of enacting an end-use tax on carbon, he suggested that an end-use tax on energy-content, or BTUs (British Thermal Units), might be more administratively feasible.

A number of participants took issue with both the suggestion that an end-use tax was administratively feasible in any form and the suggestion that an end-use tax on BTUs made sense. With regard to administrative feasibility, many argued that it would be far too complex to trace carbon or energy-content back through the stages of production. With regard to assessing the end-use tax on BTUs, one participant argued that taxing all products which have energy embodied in them internalizes far more than the costs of the particular environmental externality -- greenhouse gas emissions -- that the policy should be designed to address. The result of an end-use BTU tax would be higher cost of reducing carbon dioxide emissions.

c. Taxes versus tradeable permits at the international level

Noting the uncertainty about the magnitude of climate change that might result from any given level of emissions, one participant suggested that fixing the global amount of emissions through a tradeable permit scheme inappropriately places all the risks on the cost side. If there is uncertainty both about the costs and benefits of a greenhouse gas policy, he explained, then a pricing system should be used to balance the risks on both sides. The participant also suggested that verifying international compliance with a carbon tax may be administratively easier than monitoring each country's carbon dioxide emissions. Nevertheless, he recognized that adopting a global carbon tax instead of an international tradeable permit scheme may make North-South distributional issues harder to resolve by forcing the negotiators to debate cash transfers rather than initial permit allocations.

d. Taxes versus tradeable permits at the national level

Some participants suggested that a tradeable permit scheme which appears costless to the public may be more politically-palatable to Congress than a new tax on carbon. Another participant argued that because tradeable permit schemes offer greater certainty about total emissions levels than do taxes, they would be preferable to an American public that remains highly skeptical of market-based incentives. Several participants agreed, but suggested that since a carbon tax had other advantages over a permit system, its consideration should be promoted in order to reframe the policy debate. A number of other participants extended this argument, contending that the differences between taxes and permits, while important, should not overshadow the fundamental differences between these market-based approaches and their costly command-and-control alternatives.

e. Revenue-neutrality

Many participants argued that any revenues from a carbon tax should be recycled into the economy, but their reasoning differed. Some argued that revenue-neutrality should be achieved by replacing distortionary taxes like the social security payroll tax with carbon tax revenues. A few suggested that replacing distortionary taxes with corrective taxes might yield net gains to our society, although others disputed the likelihood that such a "no regrets" possibility existed. Other participants argued that while reducing distortionary taxes is a worthy goal, more important in terms of getting a carbon tax implemented would be to use its revenues to reduce the tax burdens on particular constituencies which might otherwise oppose its enactment.

f. Adopting a comprehensive approach

A number of participants noted that the imposition of a carbon tax might result in greater climate change rather than less if reductions in carbon dioxide emissions lead to increases in the emissions of other greenhouse gases. For example, if a carbon tax leads to fuel switching from coal to natural gas, the result might be a net increase in global warming due to the leakage of methane -- another greenhouse gas -- that occurs in natural gas transmission, an especially common problem in Eastern Europe and the former Soviet Union. They therefore stressed that a comprehensive approach should be followed to reduce overall greenhouse gas emissions. One participant expanded on this idea, noting that each country has a different portfolio of greenhouse gas emissions and sequestration options, and argued that our international policies should paint with a brush broad enough to allow each country to address greenhouse warming in its own least-cost fashion.

g. Marginal damages of climate change

A participant who had examined the damages associated with climate change argued that they did not justify the \$200 per ton carbon tax being proposed to reduce them. Instead, he explained, the marginal damages justify at most a \$10-12 per ton carbon tax. Another participant took issue with these claims, arguing that if the initial participant's model had included ecological damage in addition to agricultural damage, a much higher carbon tax would be justified. Several others pointed out that such disagreements were common in the debate over climate change goals because of the high levels of scientific and economic uncertainty which surround it. They suggested that we need a broad social debate in order for the public to develop a sense of the risks they are willing to take -- both scientifically and financially -- and a broadly-shared view about the appropriate goals for our climate change policy.

SESSION II: ALLOCATING RESPONSIBILITY AMONG NATIONS -- INTERNATIONAL TRADEABLE GREENHOUSE GAS PERMITS

INTRODUCTION: Henry Lee, Executive Director, Program on Environment and Natural Resources, John F. Kennedy School of Government, Harvard University

The United States is unlikely to adopt stringent greenhouse gas control policies unilaterally, but might do so as part of an international agreement. That raises the question of how the burden of greenhouse gas reductions should be allocated internationally among nations. Some allocations would be more costly in the aggregate than others; some are likely to be more politically acceptable than others. One approach, which some analysts and observers have said could help with both considerations, would be a system of international tradeable permits. Such a system would be considerably more complex than the tradeable permit schemes we have used to address domestic environmental problems in recent years. This session focuses on some of the difficult design and implementation problems which must be resolved before a successful international tradeable permit system could be implemented.

LINKING ENVIRONMENTAL GOALS AND MARKET-BASED POLICIES: Daniel Dudek, Senior Economist, Environmental Defense Fund

The important battle is not between tradeable permits and taxes, but between market-based and command-and-control policies for achieving environmental goals. While there are important differences among market-based policies, these should not overshadow the extraordinary flexibility and cost-savings that differentiate them from their command-and-control cousins. Unfortunately, the battle between market-based and command-and-control environmental policies has not been won. Part of the reason command-and-control policies remain popular is because they provide certainty about environmental performance -- only so much pollution is allowed. Because tradeable permits also provide such quantity-based certainty, they represent an opportunity to link parties with particular environmental goals with those who seek market-based public policy reform.

My comments address the relative advantages of a tradeable permit scheme over other command-and-control policies and relative to a carbon tax approach for addressing climate change.

Why should we trade emissions? First, not all sources have the same technical possibilities for reducing emissions. Emissions trading allows each of these varied sources to determine whether it is cheaper to reduce emissions or to buy emissions permits from someone else, a process that results in the specified reduction of emissions at the least cost in aggregate. Second, the flexibility of a quantity-based standard rather than a technology-based standard encourages innovations in operational processes and technological development. Third, tradeable permit systems focus government and industry on their respective comparative advantage -- government on determining the

appropriate level of control and industry on finding the most cost effective way of reaching it.

What are the advantages of a tradeable permit system for greenhouse gases? First, the sulfur dioxide trading program established in the Clean Air Act has provided a number of building blocks for the development of a comprehensive tradeable permit scheme for greenhouse gases. We have created the world's largest environmental commodities market. In addition, the Clean Air Act contained a carbon dioxide monitoring and reporting program which will enable us to develop baselines to help us know how much and by whom carbon dioxide is currently being emitted. We also have a new bilateral agreement between the United States and Canada which sets an important precedent for addressing the transfer of sulfur dioxide between countries. Finally, the freedom of the emissions trading program itself offers us the opportunity to reduce carbon dioxide emissions as a byproduct of the sulfur dioxide control program.

There are other advantages of a tradeable permit system for reducing greenhouse gases. First, it provides maximum flexibility and creates incentives for efficiency by counting both reductions in carbon dioxide emissions and carbon sequestration efforts. A recent National Academy of Sciences study suggested that we have some 3.8 billion metric tons in carbon dioxide equivalent -- from such activities as tree planting -- available to us annually at a cost of \$9 per ton. While we have yet to develop effective mechanisms for incorporating these sources for carbon dioxide reductions, we should not develop a system for controlling greenhouse gases that ignores their promise. A start has been made by a number of states through voluntary offset programs which allow utilities to get credit for carbon dioxide reductions from their carbon sequestration efforts. Furthermore, a tradeable permit system also offers the possibility of trades between stationary and mobile sources, something which has received close attention recently.

A number of building blocks for an international greenhouse gas trading program have also been established in recent years. The Intergovernmental Panel on Climate Change has strongly endorsed comprehensive greenhouse gas trading. In addition, at their 1990 Houston Summit the G-7 countries committed themselves to adopting a forest protocol designed to bring tropical forests -- so-called carbon sinks -- into the international debate about climate change. Furthermore, a carbon dioxide trading workshop has been conducted by the OECD countries, and the United States and Canada have embarked on their own study of carbon dioxide trading possibilities. Lastly, the negotiation process on a climate change treaty which may incorporate greenhouse gas trading has begun.

It is likely that an international treaty on climate change will have national obligations for each country but will allow flexibility for how each country meets its obligations. Some might use taxes or permits, others command-and-control. It is also likely that a treaty would promote international trading. Thus, processes for national certification for trading, national reporting of compliance, international recording of compliance, international assessment, and international reporting of national compliance must be developed. This scientific oversight and review process will lead to the development of some very precise rules, mapping, and particular strategies for forest development and conservation investments. The process should also be open-ended to

allow for the development of new technologies or demonstration projects for greenhouse gas sequestration. With all new developments, the burden of proof should be placed on those parties seeking credit for greenhouse gas offsets. Finally, an international clearinghouse on crediting strategies should be established to disseminate information about the tools available.

The acid rain provisions of the Clean Air Act made clear the critical difference between market-based and command-and-control approaches in terms of their relative effects on the economy. The United States should educate the rest of the world about the significant savings that can be achieved through a tradeable permit system relative to the traditional regulatory approach. If we can share with others our successful experiences in developing environmental commodity markets, we can avoid creating the same type of inflexible trading system that characterizes the Montreal Protocol for chloroflourocarbons (CFCs) when we address climate change.

QUESTIONS ABOUT THE DISTRIBUTION OF RISKS AND RESOURCES: Howard Gruenspecht, Associate Deputy Undersecretary for Program Analysis, U.S. Department of Energy

I thought it might be useful to frame two questions for discussion by the group.

(1) How should the regulatory uncertainty between emissions objectives and other goals be weighed? By their very nature, tradeable permit schemes make quantities the absolute goal. Cost-effectiveness is guaranteed, but total cost is open-ended. In the acid rain context, the cost uncertainty was tightly bounded by well-known strategies for compliance, but establishing bounds for the expected costs of greenhouse gas reductions would be considerably more difficult. In contrast, an action-oriented greenhouse gas tax approach offers much greater certainty on costs but does not necessarily fix emissions levels. From an environmental perspective, that could be either good or bad. A tax may reduce greenhouse gas emissions more or less than was expected, so the claim that a tax is economically superior and environmentally inferior is suspect.

(2) How will distributional or fairness considerations implicit in a tradeable permit scheme affect the prospects for a workable international agreement on climate change? We can consider the initial allocation of valuable emissions rights as a form of wealth transfer to those who receive them. What does this imply for the initial allocation of emissions rights? Would the American public rather see us reduce emissions to a certain level or buy permits from China? The OECD countries have suggested that the transfers involved in an international tradeable permit scheme might amount to \$80 billion annually. Not surprisingly, many developing countries have made clear that these distributional aspects of the program are far more important than the environmental aspects.

In the Clean Air Act's acid rain program, pollution allowances were distributed carefully to those expected to bear the greatest control burden. Thus, those most likely to be hurt by the emissions limits would be able to obtain the financial resources necessary to continue operating or to upgrade their plants. In the climate change proposals

examined by the OECD, it appears that the biggest controllers are likely also to be the biggest buyers. Those countries expected to bear the greatest control burden will also be the ones forced to buy the most permits. It is not clear whether this characteristic will make it easier or more difficult to get an international tradeable permit program into place.

IMPEDIMENTS TO A COMPREHENSIVE GREENHOUSE GAS TRADING SYSTEM:

Boyden Gray, Counsel to the President

Many people have pointed out some of the problems that must be addressed before we can establish an international greenhouse gas trading system. There are several important ones. But these difficulties do not undermine the tradeable permit idea, they reinforce the need for us to be disciplined about how we trade.

Should we go beyond carbon dioxide and develop a system of trading among greenhouse gases? The Europeans appear hesitant to adopt a comprehensive trading system for a number of reasons. First, they are concerned about their methane leakage problem in the transportation of natural gas. That is, they plan to reach their targeted reductions for carbon dioxide by switching to natural gas and are worried that a comprehensive approach might make this more difficult by counting the increased methane emissions against the carbon dioxide reductions. That does not suggest we should abandon a comprehensive approach; it is evidence in support of one. Second, the Europeans also appear reluctant to include forests and other carbon sinks as part of the trading system. Why? They do not have many forests left. Since forests may account for two-thirds of the total carbon dioxide sink, they should be considered in any climate change treaty. Those countries who have forests and do not cut them down should get credit for the carbon dioxide they remove from the atmosphere.

One way to get our feet wet on the international scale is to start with a forestry convention like the one proposed at the Houston G-7 meeting in 1990. We could start addressing North-South issues with technology transfer programs and resource transfer programs. If we do not promote such transfers, how will we get countries like Saudi Arabia involved? It does not make sense for them to plant trees in the desert when they could buy forestry credits by investing in tropical rainforests in Brazil or elsewhere. And the Saudis should be part of this convention as should everyone else. A successful forestry convention could lay the groundwork for a comprehensive treaty on global warming.

We have our own problems getting support for a comprehensive trading program here in the United States. A friend of mine in the Senate explained that trees, crops, and forests are irrelevant to global warming. "How so," I asked, "when they are such important carbon dioxide sinks?" And he said, "they are under the jurisdiction of a different committee." Other domestic constituencies want to avoid doing anything more active or aggressive on forests because they believe that it would take too much pressure off the United States to be more aggressive in the short term on global warming. That is what I call the Pre-emptive Root Canal Theory of Regulation. Never get the early,

cheap, beneficial reductions first; always put those off until the end. They say we should start with the most expensive, most painful, solution -- the root canal!

DISCUSSION:

a. Effectiveness of the acid rain trading program

One participant explained that the Clean Air Act's tradeable permit system for reducing sulfur dioxide emissions had not yielded its predicted cost savings because the regulated utilities that should be trading do not operate in a competitive environment. Because the utilities were given the permits for free, they do not appreciate the opportunity cost -- the market value -- associated with them. Moreover, state regulators have disregarded their obligations to ensure that the permit system's goal of internalizing the cost of the acid rain externality is met and have focused instead on petty concerns. The participant suggested that unless this record could be improved, future support for tradeable permit systems would be jeopardized.

b. Offset investments in greenhouse gas sinks

Noting investments in forestry projects in Guatemala and Paraguay made by an American energy producer and conservation investments in Poland made by the Dutch electricity board, one participant argued that we should use these demonstration projects as case studies for developing a system for monitoring and evaluating the effectiveness of greenhouse gas offset programs. A number of participants voiced support for such offset investments in principle, but said that baseline information needed to be developed before the effectiveness of the investments could be determined. For example, one participant asked, how do we know that the forest in Paraguay would not have been preserved without the investment? Another participant predicted that we would not see many more offset investments until better systems for accounting for them are developed.

c. The domestic response to large resource transfers

One participant argued that resource transfers from North to South on the order of \$80 billion annually would be unsustainable. He suggested that American political support for such large payments to developing countries would be scanty, and therefore suggested that harmonizing international tax policies made more sense. In response, several participants contended that climate change would be nearly impossible to address without such transfers to the developing world. They explained that as developing countries experience economic growth, they will generate significant increases in greenhouse gas emissions unless OECD nations transfer technologies to them or provide them with resources to purchase new technologies. Another participant explained that because tradeable permits partially disguise the transfer payments, they may be more politically acceptable than direct subsidies to developing countries.

Noting that a \$40 per ton investment in carbon dioxide reduction in America was not equivalent to a \$30 per ton investment in Poland, one participant suggested that

benefit-cost analysis be used to determine the domestic net benefits of alternative policies in a tradeable permit system. Another participant suggested that economists undertake contingent valuation studies as a guide for policymakers to use in determining the value Americans place on the ecological damages that might result from climate change.

d. Implications of resource transfers for developing countries

Several participants voiced concerns that developing countries would be unable to absorb \$80 billion in annual transfer payments, saying most of the money would be reinvested in developed countries. Others suggested that corrupt public officials in some countries might siphon-off the funds, rather than invest them in productive enterprises or pollution-reducing technologies. One participant argued that the likelihood of such outcomes justified abandoning a tradeable permit approach for a direct technology transfer approach. In response, an advocate of an international tradeable permit system argued that the OECD countries faced a philosophical choice: Should we embark on a global industrial policy run by the OECD or should we establish a trading program which gives people in developing countries the right incentives to undertake market reforms in their own domestic economies? He suggested that the long-run implications made the tradeable permit program vastly preferable, while another participant argued that historically transfer payments have only delayed meaningful policy reform in developing countries.

e. Establishing a comprehensive greenhouse gas program

Noting the number of different greenhouse gases and their different relative warming effects, one participant pointed out the need to develop a comprehensive greenhouse gas accounting scheme. He explained that such a system must be simple to allow for easy calculations -- one ton of methane is worth four tons of carbon dioxide, for example -- and flexible to allow for changes in scientific information. Other participants admired these goals in principle, but were dubious about whether a greenhouse gas accounting system could be successfully implemented. One questioned whether changes in the accounting system that reflect new scientific information might be used retroactively to debit a country's accounts for projects that contributed fewer net reductions than had been predicted earlier.

Another participant voiced support for a comprehensive greenhouse gas policy, but argued that the need to develop one should not be used as an excuse to delay the introduction of measures to reduce carbon dioxide emissions sooner. Rather than waiting twenty years to iron-out all the details, he suggested that a comprehensive approach be adopted gas-by-gas beginning immediately with carbon dioxide.

SESSION III: WHAT'S HAPPENING NOW -- ENVIRONMENTAL COSTING FOR ELECTRICAL UTILITIES

INTRODUCTION: *William W. Hogan, Thornton Bradshaw Professor of Public Policy and Management, John F. Kennedy School of Government, Harvard University*

In recent years, a significant number of state public utilities commissions (PUCs) have been developing and enacting so-called environmental costing programs, borrowing an idea from economics that the social costs of pollution should be reflected in the price of electricity. What might be the good news, from some people's perspective, is that the PUCs are finally trying to get prices right by internalizing the environmental externalities associated with generating electricity. The bad news, others might add, is that the PUCs are inevitably getting it wrong. The result has been a very lively debate involving state regulators, electrical utilities, consumer groups, environmental organizations, and even academics. We will continue that debate in this session.

**THE APPROPRIATE ROLE FOR STATE PUBLIC UTILITIES COMMISSIONS IN
SOCIAL COSTING:** *Alan Krupnick, Senior Fellow, Resources for the Future*

There is an economic incentive-based movement led by state PUCs that is sweeping the country and operating quite independently of the federal government. Its goal is to incorporate the environmental costs of producing electricity into utility investment decisions by adding a premium -- in dollars per pound of pollutant -- to the bid price of new generation technologies. By using these so-called "adders," the attractiveness of relatively dirty but inexpensive technologies -- such as coal -- is reduced relative to cleaner but more expensive technologies. This movement was preceded by some seventy years by a broader movement of economists, led by Pigou, to price all commodities according to their social costs -- their private costs plus environmental and other costs "external to or outside of" the factors incorporated into business decisions. The point of both movements is to improve the allocation of scarce labor, capital, and natural resources to maximize society's well-being.

Unfortunately, the social costing movement among PUCs has gotten off to a poor conceptual start. The purpose of my talk is to address key issues in this new movement and set it on a better course.

Is it appropriate for PUCs to be engaged in social costing? PUCs have traditionally addressed the effect of utility operations on their communities, including compliance with environmental laws. Addressing externalities is appropriate because utilities have been granted an exclusive franchise, giving them a commensurate obligation to serve their communities. PUCs' involvement in social costing is particularly justified because national environmental legislation emphasizes uniformity in treatment of polluters and setting emissions and ambient standards. The Federal laws do not acknowledge that location matters a great deal in terms of the impact of externalities. An equivalent amount of pollution causes different damage in Boston than it does in Las Vegas. Some people have

argued that PUCs lack the expertise to set appropriate adders, but there is no reason they cannot obtain such expertise.

At this point, whether PUCs have the mandate and expertise to engage in social costing is somewhat irrelevant; they are already doing it and show no signs of stopping. A more important concern is making sure they go in the right direction.

How should environmental damages (the benefits of pollution control) be measured? The right approach to this problem involves estimating the actual damage caused by the pollution. But believe it or not, most states have adopted or are considering adopting measures that equate environmental damages with pollution abatement costs. In other words, they have assumed that the cost of reducing emissions by a certain amount must be equal to the monetary damages that would have been created by that amount of pollution. Proponents at the PUCs have suggested that their approach appropriately reflects the fact that Congress and regulators set standards that balance social costs and benefits. In fact, this is not the way standards are set. The Clean Air Act, for example, specifically excludes consideration of costs in setting ambient air quality standards.

Undoubtedly, the PUCs have adopted their misdirected approach because it is easier to measure the costs of controlling pollution than it is to measure the damages that pollution might have inflicted. Estimating the public's willingness to pay to avoid the damages associated with pollution will always be less precise and more difficult than estimating the costs of various pollution control technologies. But it would be much better to use an imprecise estimate of the right measure for pollution damages than a precise estimate of the wrong measure. If the knowledge and data necessary to estimate damages are not available, PUCs should choose an admittedly arbitrary adder rather than one that is dressed-up by analysis but fundamentally wrong-headed.

If PUCs have estimates of damage, are they justified to consider them as externalities? Just because damage is observed does not mean it is an externality that needs to be incorporated in utility pricing. It depends upon whether the policy used for regulating the pollutant has already incorporated the externality. For example, because sulfur dioxide emissions are already regulated through a tradeable permit program under the Clean Air Act, the PUCs should not assign them an additional adder. In contrast, though, externalities associated with pollutants controlled under some command-and-control approaches -- such as the setting of emissions standards -- may not have been internalized and should be assigned adders by PUCs. In sum, the policy being used to control a pollutant affects the extent to which it imposes an externality. Simply equating the adder to observed damage is not enough.

If PUCs have estimates of externalities, how should these values be used by utilities? At Resources for the Future, we have examined three regimes for a midwestern-type utility system: least social cost planning (which addresses investment decisions), social cost dispatch (dispatching plants according to their social costs but not reflecting these social costs in customer prices), and social cost pricing (integrating full social costs into electricity prices). There are important tradeoffs that result from moving to more complete social costing regimes. For instance, confining social costing to the investment

decision -- even with high adders -- would probably have little effect on investment decisions and rates. In contrast, social cost pricing will have the greatest effect on rates and may lead to serious distortions in the allocation of resources among the public. Nevertheless, other things equal, consumers should see the full social costs in the prices of products they use.

Finally, I believe the large environmental externalities associated with carbon dioxide emissions due their global warming potential should not be addressed by PUCs through adders. The externality imposed is global, not local. It can only be addressed consistently at the global, or at least national, level. Thus, it is ironic that much of the impetus for the new social costing movement has come from those wanting to deemphasize fossil fuel technologies on the grounds of global warming concerns, because carbon dioxide emissions are those least appropriate for social costing by PUCs.

Social costing of electricity by PUCs is not a first-best solution to the problem of appropriately pricing use of the environment, and efforts to reform our environmental laws should therefore continue. But, in the mean time, the efforts by PUCs to move social costing into the forefront are welcome and we should work with them to develop policies which reflect the sound economics that originally inspired them.

THE VIEW OF A STATE REGULATOR: Stephen Wiel, Commissioner, Nevada Public Service Commission

The involvement of state PUCs in the long range planning and resource selection of utility companies began in 1975. Since then, through a process known as integrated resource planning, we have attempted to influence the long-range planning decisions of the investor-owned utilities we regulate to ensure that they will meet the energy needs of our constituents in an economical and safe manner. Although environmental impact has always been one factor that PUCs have considered, it was not until 1989 that New York took the bold step and monetized the values of pollutants to be used in evaluating the resource acquisition choices made by its utilities. A year later, in 1990, Massachusetts followed suit, but chose different numbers for its "adders." And in 1991, Nevada and California joined the movement to internalize externalities. All four states have included adder values for both carbon dioxide and sulfur dioxide. Right now some two dozen more states are considering adding this market mechanism to their integrated resource planning requirements for utilities.

At the Nevada hearings, when we considered our rule, I heard all of the same arguments that I have subsequently heard about why we should not adopt adders. Quite frankly, I have to admit that many of the criticisms are true. States are not the right place to do it; it should be done at the federal level. If Nevada uses adders and other states do not, we may get trans-boundary dislocations where all the new facilities are located out-of-state. We also might get inter-fuel dislocations -- inadvertently promoting the use of the same dirty fuel technologies we were trying to discourage. For example, if we increase the price of electricity too much we may encourage some customers to bypass the regulated system and generate their own electricity using a different fuel.

Nevertheless, not all the criticisms are valid. First, regulatory commissions are an appropriate forum for addressing environmental problems. To the degree that environmental externalities in the utility industry can be addressed at the state level, then the best place to do it is before the PUCs. Second, we may not have the expertise we might like to have for addressing this issue, but we have the expertise we need -- the ability to judge between the various technical experts and make the right political decisions. In fact, in Nevada we did not establish a methodology for internalizing environmental externalities; rather, we evaluated the alternatives put before us and chose the one we thought would best accomplish our policy goals.

It is important to understand environmental costing from the point of view of a state regulatory commission. There are a number of factors which led our PUC and others to move forward on this issue. First, many of us have recognized, or at least believed, that the wrong resources were being selected by the utility companies. They were underinvesting in energy efficiency and renewable fuel sources. This prompted us to evaluate whether there was something wrong with the selection process which could be fixed. Our adders may not justify different resource selection, but will at least ensure that environmental considerations are duly considered in the process. Second, we have recognized that people are willing to pay more for a cleaner environment. That is a political judgement we have made. Finally, we have decided that the absence of federal leadership on this issue should no longer be a reason for delay. In fact, state initiatives often provide the impetus for federal action. We had an example of this most recently when the federal government adopted appliance standards that had percolated out of a patchwork quilt of state regulations. I expect federal action will soon follow the various state efforts to establish environmental costing in the utility industry. And when the federal government has all the numbers correct, we will adjust our adder values to zero to reflect that all the externalities have been internalized.

A BALKANIZATION OF THE ENVIRONMENTAL REGULATORY PROCESS: Paul Joskow, Professor of Economics, Massachusetts Institute of Technology

To understand why PUCs should not be involved in pricing environmental externalities, all we need to do is examine the assumptions made by those who think PUCs can and should continue their attempts. None of their assumptions are true in reality.

The first assumption is that PUCs will calculate the adders right. Every responsible economist who has looked at the cost of control approach the state PUCs have adopted has indicated it is wrong. That approach yields numbers that have absolutely no relationship to environmental damages. Not surprisingly, the numbers proposed in different states have varied in absurd ways. In Massachusetts, where we have clean air, the numbers adopted are very high; in southern Illinois, where the air is filthy, the adders are only a third as high! California's PUC has taken this process one preposterous step further: They have concluded that the place to measure environmental externalities is where the electricity is *consumed* rather than where it is *produced*. This leads to the rather bizarre situation in which two utilities using the same fuel in the same location must use two different adder values depending on whether they happen to sell electricity

in southern California or northern California. If you look across the states, it is quite clear that the adder values they have come up with are completely arbitrary, generally too high, and bearing no relationship to what they are intended to measure. The adders for carbon dioxide and sulfur dioxide vary by a factor of ten, nitrogen oxides by a factor of five.

Not only have PUCs gone wrong with their initial forays into pricing environmental externalities, but it is almost inevitable that they will go wrong. Why? Because the decisions will be made by imperfectly informed regulators who are under pressure from a variety of powerful interest groups. This phenomenon is well documented in scholarly research and is easily observed in practice. For example, the Massachusetts PUC adopted as its standard the highest cost of control without public hearings, without cross-examination of the witnesses, without considering alternative values. By their nature, PUCs are the wrong place for this type of environmental regulation. Every special interest group has its own special list of adders or subtractors that they want placed on their competitors' supplies, and they are lined-up outside the PUCs' doors. It is no accident that the adders adopted so far to do not reflect solid evaluation of environmental damages, but instead reflect the priorities of special interest groups.

The second assumption is that there are no distortions associated with applying the adders to new electric facilities while ignoring the operation of existing facilities. In fact, making it more difficult to site new facilities may lead to greater environmental damages by putting up barriers to entry that protect older, dirtier plants.

The third assumption is that there are no distortions associated with some states doing it and other states not doing it. If one state includes adders in its utility planning process, it may encourage utilities to locate across state lines in order to sell electricity to the state with adders. The overall environmental situation will probably not change much, but the economic consequences could be dramatic.

A fourth assumption is that there are no distortions from applying adders exclusively to new facilities developed by investor-owned utilities. Obviously, such a practice biases the playing field in favor of municipal facilities and those who can bypass the system and generate electricity themselves. In Massachusetts, the legislature is considering adding Independent Power Producers (IPPs) to the list of those who are exempted from the adder system.

A fifth assumption is that there are no distortions from the asymmetric treatment of environmental damages associated with electricity while ignoring the same emissions produced by other fuels and other products. Why should we address environmental externalities which come from electrical utilities but not from other manufacturers?

A sixth assumption is that the use of adders will not distort other regulatory objectives, in particular the efforts to introduce more competition in the electrical power generating system. State PUCs already have very broad responsibilities for regulating price levels, price structures, the quality of service, and investment decisions for a number of different industries including electrical utilities. Their historical responsibility is to protect

consumers from exploitation from legal monopolies. If they want to add environmental protection to their list of priorities, then they should be beating the drums for environmental regulations that get more protection for less money. The Clean Air Act offers a number of opportunities for PUCs to harmonize the goals of protecting consumers from exploitation and developing cost-effective environmental regulations. By focusing on adders, the PUCs ignore these important opportunities to initiate new policies that would generate significant benefits for both consumers and the environment.

A seventh assumption is that the infatuation with adders will not retard the introduction of sound, comprehensive models at the federal level. Our goal should be the establishment of federal policies to internalize environmental externalities. This piece-by-piece approach being developed at the state level will make it more difficult to develop a comprehensive approach at the national level.

The attempts to internalize environmental externalities with adders made by state PUCs represent a Balkanization of the environmental regulatory process. We should address the environmental problems created by electricity generation through a comprehensive approach. In such a system, the PUCs would have an important role to play in harmonizing the interests of the rate payers and their concerns for the environment through the promotion of broad-based, incentive-based schemes to achieve the highest level environmental protection at the lowest cost. They should not, however, be going off in their own directions and creating their own environmental regulations.

DISCUSSION:

a. Cost of control methodology

One participant argued that PUCs' adoption of a cost of control methodology for evaluating environmental externalities was a historical accident. Economists were not around at the right time in the debate, he explained. He suggested that when the \$1.7 million study being undertaken by the New York Public Services Commission is completed, a transition toward PUCs using the appropriate cost of environmental damages method will occur.

Other participants were skeptical about this line of reasoning. They asserted that PUCs are the province of special interests and that it came as no surprise that consulting firms representing utilities had outshone economists before the PUCs. One participant argued that rent-seeking was inevitable in a regulatory process. A participant from California noted that efforts to switch from a cost of control to a cost of damages methodology have met strong opposition from the many parties who have a stake in maintaining the current system. The cost of control methodology has already become a sacred cow, he noted.

b. The proper role of PUCs

There was considerable debate over the proper role of state PUCs and about

whether PUC involvement in environmental costing was a positive or negative development. One participant argued that PUCs should attempt to minimize consumer costs, not global environmental damage. Several participants expanded on this notion, saying that the proper role of PUCs was to promote such market-based environmental policies as emissions taxes, emissions trading programs, and regional trading bubbles. They suggested that PUC efforts to influence the utility planning process with adders did more harm than good by focusing attention away from more appropriate regulatory initiatives.

Other participants noted that there has been little popular support for either emissions fees or cost-effective environmental policy and welcomed PUC efforts to address environmental externalities through the utility planning process. They acknowledged that current efforts were conceptually-flawed, though. Rather than ignore the "train at the station," one suggested, interested observers should attempt to redirect the PUCs efforts toward proper environmental costing, not tell the PUCs to get out of the business. It is time to accept the reality that PUCs are committed to exercising influence over environmental policy through the planning process, he said. Several other participants agreed, but urged that the best advice to the PUCs is to exercise caution so as not to cause major disruptions that they might later regret.

c. The need for federal action

Various arguments were put forth about whether actions by PUCs would promote or delay action at the federal level, something which most participants supported. Several complained that state-by-state efforts would only make it more difficult to get federal action to address the environmental damages caused by electricity generation. Other participants suggested that the impetus for much federal legislation is the need to make sense out of a patchwork of state regulations and that the PUCs would encourage federal action. Still another argued that the strong debate over environmental costing in the electrical utility industry is likely to lead to concentrated federal efforts even without more state PUCs getting involved.

One participant countered the suggestion that a national approach is necessary for addressing global environmental externalities. In the absence of national leadership, he argued, it may be appropriate for the State of California -- with 30 million people -- to address the issue of climate change.

d. Market distortions

A number of participants agreed that market distortions were likely to be created by the adder system developed by the PUCs. They pointed out that the current regulations favored independent producers, would lead to bypass, and would promote competition between utilities from different states. But one participant pointed out that the ramifications of these impacts depended considerably on the state, noting that his state did not risk interstate competition.

**MARKET BASED POLICY MECHANISMS
FOR ADDRESSING GLOBAL CLIMATE CHANGE**

**A Project 88/Round II Workshop
Hart Senate Office Building, Room 216, March 12, 1992**

8:30 AM Continental Breakfast

**9:00 AM Welcome: Timothy Wirth, Colorado
U.S. Senate**

**Overview: Robert Stavins
John F. Kennedy School of Government, Harvard**

**9:30 AM Session I: Achieving National Greenhouse Goals -- The Role of Revenue-
Neutral Carbon Taxes**

**Chair: Joseph Kalt
John F. Kennedy School of Government, Harvard**

**Presenter: Darius Gaskins
High Street Associates**

**Responses: John Boatwright
Exxon Corporation**

**Richard Richels
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Discussion

11:15 AM Coffee Break

**11:30 AM Session II: Allocating Responsibility Among Nations -- International
Tradeable Greenhouse Gas Permits**

**Chair: Henry Lee
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**Presenter: Daniel Dudek
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**Responses: Howard Gruenspecht
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Discussion

Market Based Policy Mechanisms for Addressing Global Climate Change

AGENDA (Continued)

- 1:00 PM Lunch**
- 2:15 PM Session III: What's Happening Now -- Environmental Costing for
Electrical Utilities**
- Chair: William Hogan**
John F. Kennedy School of Government, Harvard
- Presenter: Alan Krupnick**
Resources for the Future
- Responses: Stephen Wiel**
Nevada Public Service Commission
- Paul Joskow**
Massachusetts Institute of Technology
- Discussion**
- 4:00 PM Adjourn**

This workshop is part of Project 88/Round II, co-chaired by Senator Timothy Wirth and the late Senator John Heinz, and dedicated to the memory of John Heinz and his vision of improving environmental policy through the application of economics. In addition to this workshop, the project includes a seminar series, three other policy workshops, a public affairs forum, policy reports, and student internships.

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**HARVARD UNIVERSITY
JOHN F. KENNEDY SCHOOL OF GOVERNMENT**

**MARKET-BASED POLICY MECHANISMS
FOR ADDRESSING GLOBAL CLIMATE CHANGE**

A Project 88/Round II Workshop

March 12, 1992

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March 12, 1992

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The Environment and Natural Resources Program (ENRP) provides a locus at Harvard for interdisciplinary research on domestic and international environmental policy issues. ENRP's research agenda covers a broad spectrum of issues including: market-oriented approaches to environmental problems, natural resource and lands policy, global climate change, sustainable development and environmental risk analysis.

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Inquiries should be directed to:

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PROJECT 88

Project 88/Round II focuses on the design and implementation of incentive-based environmental policies in three areas: global climate change; hazardous and solid waste problems; and resource management issues. The project includes a seminar series, a set of policy workshops, public policy reports, and student internships. Project 88/Round II is sponsored by CSIA's Environment and Natural Resources Program, Henry Lee, Executive Director. Financial support is provided by the W. Alton Jones Foundation, the Pew Charitable Trusts, the Surdna Foundation, and the U.S. Environmental Protection Agency. This series of Discussion Papers consists of revised versions of papers presented at the seminar series. For a copy of the full report of Project 88 or Project 88/Round II, contact: Professor Robert Stavins, John F. Kennedy School of Government, Harvard University, 79 John F. Kennedy Street, Cambridge, MA 02138 (617-495-1820).

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Robert N. Stavins
Assistant Professor of Public Policy
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Project 88/Round II is dedicated to the memory of Senator John Heinz and his vision of improving environmental policy through the application of economics.

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