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Binding Quantitative Commitments: Some Technical Considerations

Making progress on the implementation of the Climate Convention and completing the "unfinished business" of the Kyoto Protocol requires much discussion -- technical and political -- of all issues. Such progress requires not only an understanding of the problems but also an awareness of the options that are available for solving them. Kyoto potentially created new options for all Parties and we believe that they need to be discussed and understood. This paper focuses on some key technical issues. In particular, if a non-Annex I Party were to express interest in adopting a binding quantitative commitment for the 2008-2012 period, including for the purpose of participating in the international trading regime, how could it do so in a way that is consistent with the objectives of the Climate Convention and methodologically sound? Is there an objective basis for establishing whether a commitment -- or emissions "target" -- would entail a reasonable level of effort, consistent with the broad objectives of the Climate Convention, or whether it could be feasibly attained, consistent with the development objectives of the Party? To what extent can a target that entails a deflection from business as usual (BAU) emissions and provides the necessary room for a Party's continued growth, contribute to these multiple objectives? These technical considerations are addressed as follows:

I. Calculating baseline emissions

Commitments for Annex I Parties are expressed as a share of baseline emissions in Annex B of the Kyoto Protocol.[1] Calculations of baseline emissions involve base years, specific units of measure, and particular gases. For some Annex I Parties, they also involve sinks. The baselines for Annex I Parties are differentiated in so much as any Annex I Party may choose between 1990 and 1995 as its base year for synthetic gases (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) and some Annex I Parties, i.e., those with economies in transition, may use an historical year other than 1990 for all gases. Baselines are also differentiated with regard to sinks. For most countries, sinks are not included in the baseline, but are counted in later years. For some countries, however, net sinks are also included in the baseline. The baselines for Annex I Parties are uniform with regard to the unit of measure -- i.e., CO2 equivalent emissions -- and the basket of gases (listed in Annex A of the Protocol).

If a non-Annex I Party were to express interest in taking on a binding quantitative commitment to abate the increase in its greenhouse gas emissions, how would its baseline be calculated? For example, must such a country use 1990 as its base year, as would seem to be required under Article 3 of the Protocol? If so, this would constitute a stricter requirement than that now faced by some Annex I Parties that are given a "certain degree of flexibility" in

[1] Technically speaking, the Parties' "assigned amounts" are calculated pursuant to their quantified emissions limitation and reduction commitments expressed in Annex B as a "percentage of base year or period" greenhouse gas emissions, in accordance with the provisions of Article 3.

choosing different base years. Moreover, this would seem to run counter to the guidelines for Initial Communications of Parties not included in Annex I, which the COP adopted two years ago in its decision 10/CP.2 and which allows these Parties to use 1994 as their base year. Similar questions may arise as to units of measurement, gases, and other baseline elements.

II. Projecting business as usual emissions

The business as usual emissions projection provides a foundation for the analytical process. Once a country has determined what its emissions would have been otherwise, i.e. its *BAU* emissions, it can begin to assess the costs and benefits of policies to abate its emissions. The BAU projection provides a basis for a non-Annex I Party to establish whether a particular target will further the objectives of the Climate Convention and support its own environmental and economic objectives. No single methodology will be appropriate in all circumstances, but some common principles can guide the process. Developing the BAU emissions path for greenhouse gases involves a comprehensive understanding of a country's economy. This understanding could reflect both the sense of the trends in the macroeconomy, such as aggregate economic output, structural change over time, etc., as well as sector- and industry-specific trends, such as changes in production practices that affect energy consumption and energy mix, etc. The formulation of a BAU projection will require a substantial amount of data, some of which may already be found in a country's national communication.

Understanding economic growth, both in aggregate and by sector, is important for assessing the potential growth in a country's greenhouse gas emissions. Estimates of aggregate economic growth can be used to formulate a rough BAU emissions projection, reflecting a general relationship between aggregate output and emissions. Estimates of sectoral economic growth can be used to refine the BAU emissions projection, reflecting more specific relationships between sectoral output and emissions. Growth estimates for sectors that are major sources of emissions are especially important. Key sectors typically include electricity generation, transportation, industry, buildings, and agriculture.

A country's sectoral growth estimates should be consistent with its aggregate, or economy-wide, growth estimate. This does not imply, however, that each sector's growth rate would be the same as the economy-wide growth rate. Sectoral growth rates may differ from the aggregate growth rate for a number of reasons. For example, some sectors will likely grow more or less rapidly as the structure of the economy changes with continued development. In particular, the growth rate of the agricultural sector may begin to decline as the growth rates of industrial sectors increase. Eventually, the growth rates of some industrial sectors may decline as the growth rates of service sectors increase. These structural changes will affect the general relationship between aggregate output and emissions.

Other sector- and industry-specific information can assist in developing BAU projections,

by shedding light on the underlying relationship between output and emissions. Key characteristics of a particular sector or industry include its energy profile, production technologies and practices, role in international trade, age of capital stock, and projected investment demand. Detailed sectoral and industrial information can also highlight opportunities for emissions abatement. Further, recognizing potential growth in emerging sectors, for example, high-technology sectors, is important for projecting new sources of emissions, including the synthetic gases.

III. Deflections from business as usual

After formulating a BAU emissions projection, how would a Party interested in taking on a binding quantitative commitment to abate the increase in its greenhouse gas emissions develop a target that furthers the objectives of the Climate Convention and supports its own environmental and economic objectives? Once a Party has determined its BAU emissions path, how would it develop a target -- or a deflection from BAU -- that meets these objectives? Can these objectives be mutually supportive? As noted above, no single methodology will be appropriate in all circumstances, but some common principles can guide the process. For example, a Party would evaluate the costs and benefits, both environmental and economic, of any deflection from its BAU emissions. First, this evaluation would help the country determine its capacity to abate emissions and maintain economic development. Second, understanding what the costs and benefits of emissions abatement could be, and how they might vary with different approaches to abatement, would likely influence decisions about abatement policies.

Assessing the costs of abatement includes identifying the technologies, processes, and fuel-switching options that can curb emissions, the costs of switching to these climate-friendly options, and the policies necessary to stimulate their adoption. This involves the capacity to analyze how the economy responds to policies implemented to abate greenhouse gas emissions. Without an integrating tool such as an economy-wide model, it would be difficult to evaluate in a consistent manner the effects of abatement policies. Since so many sectors of the economy are intricately related to activities in other sectors, trying to assess the effects of policies on each sector independently without an economy-wide model could result in a misunderstanding of the potential effects of policies. An economy-wide model can reflect all of the feedbacks and relationships in an economy, both across end-use sectors as well as up and down the energy supply stream. Such a model also could be integrated with existing international models to evaluate the opportunities for participation in international trading.

Assessing the benefits of abatement includes identifying global and local effects.[2] If a non-Annex I country were to take on a binding commitment to abate the increase in its

[2] This discussion does not address the potential benefits of participation in international trading.

greenhouse gas emissions for the 2008-2012 period, the climate would benefit from lower global emissions than would otherwise have occurred. (Given the possibility of "leakage," i.e. the shift of some emissions from Annex I countries to non-Annex I countries, a non-Annex I country's commitment to abate the increase in its emissions -- even set *at* BAU -- could yield significant environmental gains.[3] A country's commitment to meet a BAU target would prevent leakage.) However, it is quite difficult to assess the long-term climate benefits associated with the actions undertaken by any one country. Apart from the direct effect on climate, there are other potential benefits of abatement. Some of these benefits, typically referred to as "ancillary" benefits, may be somewhat easier to assess. For example, in addition to the climate benefits, actions to abate greenhouse gas emissions can help improve local air quality.

A growing body of literature has examined the relationship between public health benefits and the abatement of carbon dioxide emissions. In addition to carbon dioxide, the combustion of fossil fuels results in the emissions of numerous local air pollutants, including sulfur dioxide, particulate matter, carbon monoxide, nitrogen oxides, and volatile organic compounds. Emissions of these pollutants, however, do vary by fuel type. Significant anthropogenic emissions of these local air pollutants can result in high pollutant concentrations causing serious morbidity and mortality effects. Efforts to abate carbon dioxide emissions would likely result in both a change in the fossil fuel mix as well as a reduction in total fossil fuel combustion. This change in both the composition and magnitude of fossil fuel combustion would lower the emissions of local air pollutants from what they would have been otherwise.

Finally, in evaluating potential non-Annex I targets, it could be useful to consider the "progressivity" of existing Annex I targets. In particular, how do existing Annex I targets vary with income? Measured in terms of deflections from BAU emissions level over the 2008-2012 period, the Annex I commitments appear to be progressive. In general, wealthier Annex I countries have agreed to make more significant reductions below BAU than less wealthy Annex I countries. Consistent with the principle of differentiated but common commitments, non-Annex I targets could be set at levels that reflect the progressive nature of Annex B.

IV. Risk and uncertainty

Even under the best analytical circumstances, e.g., where accurate data and integrating tools are widely available, much uncertainty surrounds BAU emissions projections and estimates

[3] Several recent economic analyses indicate that for every 3 to 5 tons of carbon abated in Annex I countries, emissions in non-Annex I countries could increase by 1 ton. Often referred to as "leakage," this shifting in emissions reflects two economic impacts of abating greenhouse gas emissions in Annex I countries: (1) world oil market price effects and (2) energy-intensive industry migration. While these results represent a wide range, they all reflect significant increases in emissions above BAU for non-Annex I countries. Thus, commitments from non-Annex I countries to meet BAU targets would yield significant environmental benefits.

of the costs and benefits of deflecting from those projections. A country that takes on a fixed commitment for the 2008-2012 period *now*, faces the risk, for example, that its economy will grow more rapidly than expected, resulting in an inadvertently stringent target. Alternatively, a country's economy could grow less rapidly than expected, resulting in an inadvertently lax target. There are, however, ways of designing targets to reduce uncertainty and mitigate these risks. In particular, targets could be *indexed* to *future* values of economic and other, possibly demographic, variables. The following discussion explores this approach.[4]

Rather than establish a fixed target for 2008-2012 *now*, a target could, for example, be *indexed* to a country's economic performance between now and the start of the 2008-2012 commitment period. This approach is commonly used in the private sector, where contracts are similarly indexed. This approach is also used in the public sector (e.g., the USG provides cost-of-living adjustments for social security recipients). A target could then be specified in a way that depends on the *future* values of economic variables, such as GDP.[5] Such targets would avoid the risk of inadvertent stringency associated with higher than projected economic growth between now and the beginning of the commitment period in 2008. Non-Annex I countries would face only the much smaller risk that emissions would be higher than expected, *given* the economic conditions realized in 2007. Similarly, such targets would also avoid the risk of inadvertent laxness associated with lower than expected economic growth between now and the start of the commitment period.

Basic principles for implementing such an approach are:

- **"Reasonable" Forecasts**: The relationship between the target and chosen variables, when applied to emissions and the same variables during recent years, should predict emissions reasonably well and be without demonstrable statistical biases. Relationships that give reasonably reliable predictions reduce the risk of either inadvertent stringency or paper tons which could increase global emissions.

- **No "Perverse" Incentives:** The target should depend on values of economic and other variables only indirectly or generally related to emissions, to avoid creating incentives for countries to increase emissions so as to have higher targets in the commitment periods. Moreover, the chosen variables should not be susceptible to intervention, for purposes of manipulating the target. For example, the target should not depend on energy consumption in 2007, but could reflect GDP in 2007.

- **Predetermined Targets:** To avoid uncertainty during the commitment period about the

[4] Most of the following discussion features examples of economic variables.

[5] Other demographic factors may also be relevant.

country's target, the target should not depend on contemporaneous values of economic and other variables. For example, the target generally should not vary with 2008 or 2010 GDP levels, but rather with 2006 or 2007 GDP. Eliminating this uncertainty would increase the opportunities for participation in international emissions trading.

This approach could take two basic forms. Both of these forms could address equally well the risks associated with uncertain economic performance over the coming decade. First, would be to establish a target, of the form "X%" below BAU, where BAU would be indexed to a set of economic and demographic variables that explain greenhouse gas emissions well. While the concept of a target and the X% deflection from BAU would be agreed to in the near term, the actual BAU, hence, the emissions level of the target, would not be set until these economic and demographic variables were known for, say, 2006 or 2007. The relationship between the BAU and these variables (e.g., GDP, carbon intensity, population, etc.) would be made explicit now, so there would be more certainty at the time the target is announced. For instance, it could be agreed that if GDP grew at a 5.7% annual rate between now and 2007, then the BAU would be "Y" and the target would be X% below Y. Moreover, given existing projections for these economic and demographic variables, an estimate of the BAU and target could be made now.

Second, would be to establish a target now and revisit it later based on specified economic conditions. For example, the target would be specified as 100 MMTCE, but reflect an estimate comparable to X% below BAU, where a BAU projection would be used to arrive at the target. At the time of setting the target, one or a small set of parameters would be established for evaluating the target just before the commitment period. For example, if the economy performed beyond a pre-specified rate between now and the beginning of the commitment period, then the target could be readjusted to reflect this additional growth. Conversely, if the economy performed at less than what was expected, the target could be readjusted downward.

QUANTITATIVE COMMITMENTS:

SOME TECHNICAL CONSIDERSATIONS

Making progress on the implementation of the Climate Convention and completing the unfinished business of the Kyoto Protocol requires much discussion—technical and political—of numerous issues. Such progress requires not only an awareness of the problems but also a firm technical understanding of the many options that are available for solving them. The Annex I Experts Group (AIXG) has served to improve that understanding of technical issues. This paper focuses on another such technical issue that the AIXG might usefully consider.

There are many ways in which all Parties can contribute to the goals of the Climate Convention, e.g., Annex I and non-Annex I Parties can participate in the Clean Development Mechanism, etc. If, among these many options, a non-Annex I Party were to express an interest in adopting a quantitative commitment – an emissions target – how could it do so in a way that is consistent with its sustainable development objectives and with the objectives of the Climate Convention? To what extent can a target that entails a deflection from business as usual (BAU) emissions contribute to these multiple objectives? Is there an objective basis and sound methodology for establishing whether a quantitative commitment could be feasibly attained, consistent with the development objectives of the Party? These technical considerations include the following:

I. Calculating Baseline Emissions

- If a Non-Annex I Party were to express interest in taking on a quantitative commitment to abate the increase in its greenhouse gas emissions, how would its baseline be calculated?
- How might Non-Annex I Parties' baselines be differentiated from other non-Annex I Parties or from Annex I Parties? By unit of measurement, year, or basket of gases?
- What, if any, sinks would be included?
- What are the environmental and economic implications of various baselines?

II. Projecting BAU Emissions

The BAU projection provides a foundation for the analytical process. Once a country has determined what its emissions would otherwise have been, it can begin to assess the costs and benefits of policies to abate its emissions.

- What methodology for this projection will be most appropriate in different circumstances?
- If no one methodology is always appropriate what common principles can guide the process?
- How can the projection incorporate a comprehensive view of the economy?
- How will it reflect trends in the macroeconomy, such as aggregate economic output, structural change over time, etc. as well as sector- and industry-specific trends, such as technological improvements or other changes in production practices that affect energy consumption and energy mix?
- Where are the greatest potentials for growth, and how will that affect the structure of the economy?
- How can the sectoral and industry projections be made consistent with the overall economy projections?
- What are the data requirements for the formulation of a BAU projection?

III. Deviations from the Baseline

After formulating a BAU emissions projection, how would Party elaborate alternative possible targets that further the objectives of the Climate Convention and support its own environmental and economic objectives? How can these objectives be met in a mutually supportive manner?

- What is the range of possible abatement measures available?
- How can a Party identify the technologies, processes, and policy options that can curb emissions?
- How can the costs and benefits of these actions be estimated?

- Which abatement measures are likely to provide a net economic benefit (i.e., no regrets measures), which are likely to provide local environmental (ancillary) benefits and what is the cost-effectiveness of other potential actions?
- How can these measures be considered in an integrated manner?

A. No Regrets Measures

- What do the industry and sector specific emissions projections tell us about the underlying relationships between output and emissions?
- What specific characteristics of each sector or industry – e.g. energy profile, production technologies and practices, role in international trade, regulatory framework, pricing structure, age of capital stock, and projected investment demand – are most influential on that relationship between output and emissions?
- What specific measures are suggested by this relationship?
- What other distortions or inefficiencies exist that might provide both economic and environmental benefits? For example, elimination of subsidies on fossil fuel consumption or production.

B. Other Deviations

- In addition to no-regrets measures and measures that provide ancillary benefits, what other options for reducing emissions exist for non-Annex I Parties considering a quantitative commitment?
- What are the relative costs and benefits – both economic and environmental – of such options?
- What are the potentially offsetting benefits from participation in international emissions trading?

C. Ancillary Benefits

Apart from the direct effect on climate, there are other potential local benefits of abatement. For example, some actions to abate greenhouse gases can improve local air quality.

- What are the links between public health benefits and abatement of greenhouse gas emissions?
- How do those links vary by greenhouse gas? By fuel mix?
- What are the analytical tools and sources of data that a country can use to elaborate these specific benefits?

D. Integrated Analyses

Since so many sectors of an economy are intricately related to activities in other sectors, trying to assess the effects of policies on each sector independently without an integrating tool could result in a misunderstanding of the effects of potential abatement policies.

- How can all the feedbacks and relationships in an economy be modeled, both across end-use sectors as well as up and down the energy supply stream?
- How can such models be integrated with existing international models to evaluate the opportunities for participation in international trading?

IV. Risk and Uncertainty

Even under the best analytical circumstances, e.g., where accurate data and integrating tools are widely available, much uncertainty surrounds BAU emissions projections and estimates of the total costs and benefits of deflecting from these projections. A country that takes on a fixed commitment faces the risk, for example, that its economy will grow more rapidly than expected, resulting in an inadvertently stringent target. On the other hand, a country's economy could grow less rapidly than expected, resulting in an inadvertently lax target. Non-Annex I governments may be particularly averse to the former type of risk.

- How could quantitative commitments be designed to reduce uncertainty and mitigate these risks?
- Could targets be indexed to future values of economic or other, possibly demographic, values?

- Alternatively, could targets be made subject to later review based on specific changes in economic or other values?
- How could indexing be achieved without creating perverse incentives and in a manner that facilitates participation in international emissions trading?

V. Future Work

The AIXG could quickly review the literature on calculations of emission baselines and projections. Then it could work to develop in much more detail the analysis of potential deviations from baseline, adapting existing work to the specific characteristics of non-Annex I Parties.

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United States Department of State

Bureau of Oceans & Environmental
Science and Scientific Affairs

Washington, D.C. 20520

January 25, 1999

To: CEQ – David Sandalow
USAID – David Hales
CEA – Jeff Frankel
DOE – Mike Mazur
EPA – David Gardiner

From: OES/EGC – Nancy Checklick

Subject: Priority List of Developing Countries

Authored by Assistant Secretary Melinda L. Kimble

Pursuant to discussion of January 16

DRAFT – DO NOT CITE
FOR DISCUSSION PURPOSES ONLY ~ THIS LIST DOES NOT REPRESENT MEANINGFUL PARTICIPATION

PRIORITY LIST OF DEVELOPING COUNTRIES

Category A (intent to take targets)

Argentina
Kazakhstan

Category A1 (should have targets)

Mexico
Turkey
South Korea

Category B (could have targets)

Chile
Uruguay
AOSIS
Singapore
Israel

Category C (big emitters)

Brazil
China
India
Indonesia

Category D (should have more cooperation)

South Africa
SAADC
Tunisia
Egypt
Morocco
Singapore
Israel

Category E (allies on CDM)

Central America

Add

Econ benefits
- end distortions of fossil fuel subsidies
-
-

Enviro benefits
- LDC cell premix → drawback
- epsilon below MTR
- no leakage
- future flexibility

explain to states

Preliminary Draft, Close Hold, Do Not Cite, March 30, 1998+

A Proposal for Developing Countries: Participation in a "Target and Trade" System

I. This analysis demonstrates that the gains will be substantial if developing countries (a) accept binding targets at or slightly below their business as usual (BAU) emissions levels, and (b) trade from their respective targets. We believe that participation in a "target and trade" system should be the cornerstone of our international negotiations.

The economic and environmental rationale for such participation includes

- **Greater economic benefits to developing countries:** With targets at or only slightly below BAU, developing countries would enjoy net gains of many billions of dollars through the international sale of emission reductions achieved at lower cost than the world price.

- **Greater cost savings to the U.S.:** Participation by developing countries in international permit markets would greatly lower the costs to the U.S. of meeting its Kyoto target (as CEA testimony showed). In particular, costs would be lower than with trading among only Annex I countries.

- **Greater environmental benefits:** Targets at or slightly below business as usual would lower global emissions relative to a world with only Annex I targets. Further, reducing carbon dioxide emissions generates ancillary air quality benefits through lower particulate matter, sulfur dioxide, and nitrogen oxides emissions.

- **Target and trade yields greater benefits than CDM:** While the Clean Development Mechanism will likely result in cost savings to the U.S. relative to a world with only Annex I trading, a system including effective target and trade of developing countries' emissions would yield much greater cost savings to the U.S. and greater gains to developing countries than CDM. Further, target and trade could achieve environmental benefits not achievable by pursuing CDM, which only redistributes emissions geographically.

- **The principle of full participation:** Other rationale include the long-run benefits of including developing countries into global negotiations, for example, as required by the Byrd-Hagel resolution. By establishing participation now, further commitments might be feasible in future periods.

II. Problem: To persuade a developing country *voluntarily* to adopt a target and then to trade permits internationally, international agreements must be structured to reduce the risk of inadvertent stringency and in particular to reduce the possibility of a target so stringent as to cause large economic losses to the developing country.

Proposed Solution: Negotiations should focus on the estimated business as usual emissions level, where this level is expressed in a way that depends on the *future* values of economic variables, such as GDP.

Rationale: Such targets would avoid the risk of inadvertent stringency associated with higher than projected economic growth between now and the beginning of the commitment period in 2008. Developing countries would face only the much smaller risk that emissions would be higher than expected, *given* the economic conditions realized in 2007.

Basic principles for implementing such an approach are:

- **Reasonable Forecasts**: The relationship between the target (putting aside any real reductions in emissions) and the values of economic variables, when applied to emissions and such variables during recent years, should predict emissions reasonably well and be without demonstrable statistical bias. Relationships that give reasonably reliable predictions reduce the risk of either inadvertent stringency or paper tons which could increase global emissions.

- **No Perverse Incentives:** The target should depend on values of economic variables only indirectly related to emissions, to avoid creating perverse incentives for developing countries to increase emissions so as to have higher targets in the commitment periods. For example, the target should not depend on energy consumption in 2007, but could reflect pre-Kyoto emissions levels.

- **Predetermined Targets:** To avoid uncertainty during the commitment period about the country's target, the target should not depend on contemporaneous values of economic variables. For example, the target generally should not vary with 2008 or 2010 GDP levels, but rather with 2007 GDP.

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III. Illustration: One way of implementing the solution is described below. Other ways of implementing the solution may work as well or better. The conclusions are stated below; the details of our work follow in appendix 3.

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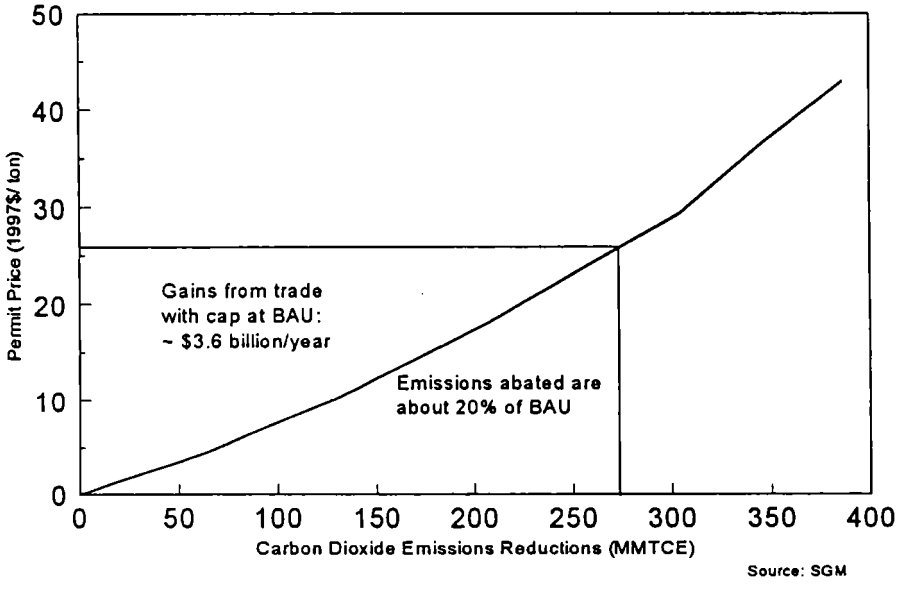

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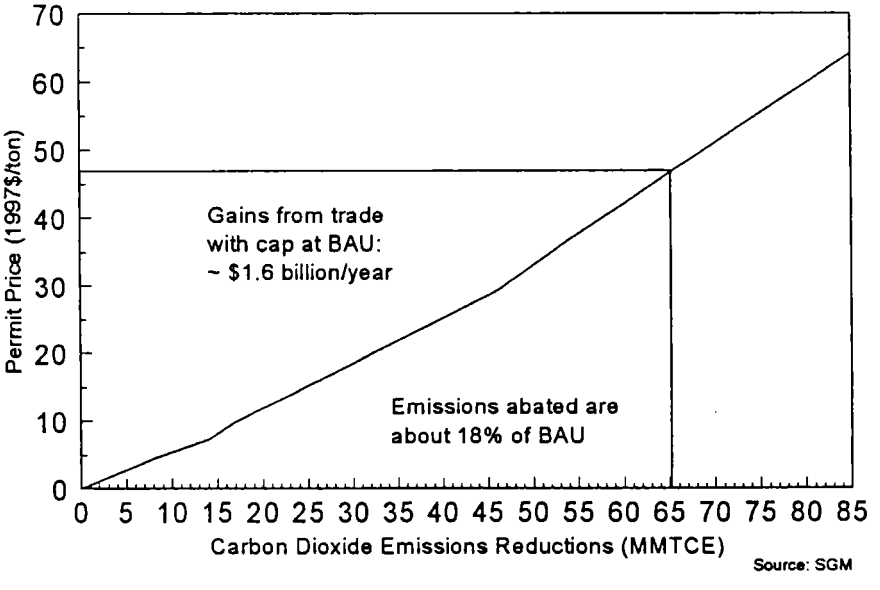

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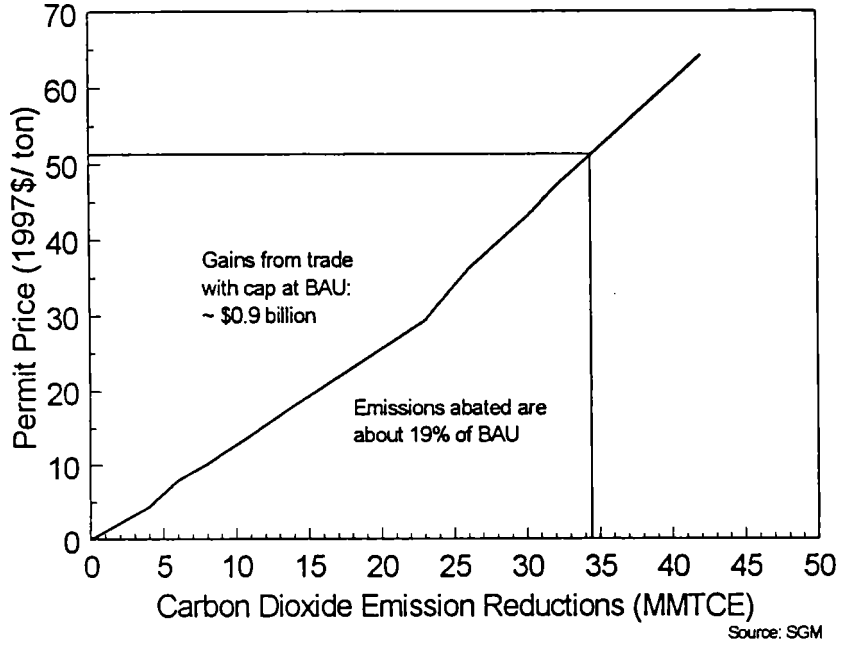

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The environmental gains from emissions reductions below BAU come at the price not only of economic costs incurred by a developing country that adopts the below-BAU target, but also economic costs by Annex I. More stringent developing country targets raise U.S. costs by restricting the supply of permits in world markets and so raising the price of permits.

To assess the magnitude of this effect consider the target which just leaves a country no better off than no target at all. This "indifference" target is where the costs of meeting the target just equal the net gains from selling permits in world markets. Chart 4 illustrates

gains from trade for a small country. For a target that is equivalent to a reduction from BAU of 17 MMTC, net gains from foreign exports are B, and the cost of meeting the target is C. Since B = C in this example, the net gains from trade are nil.

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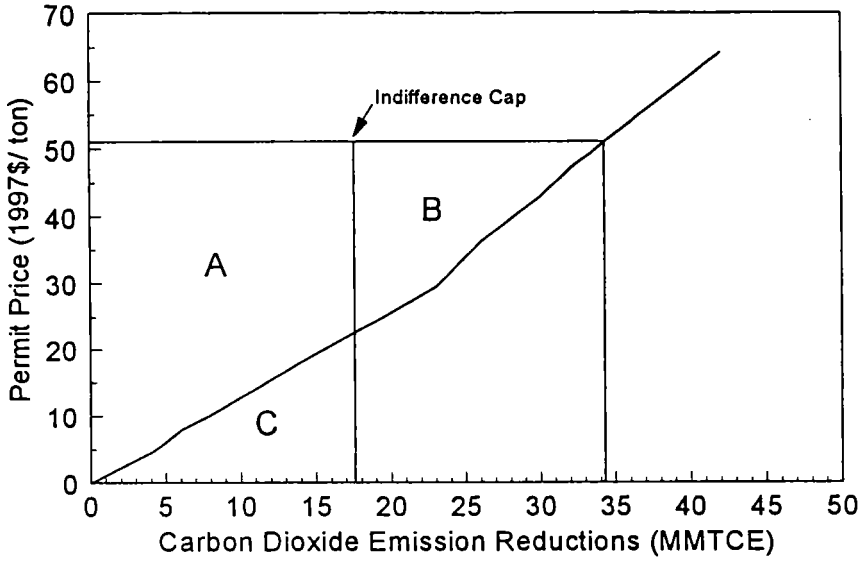

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Table 2 provides an illustration of the effects of emissions targets more stringent than BAU on China with Annex I plus China trading. Note that a small reduction below BAU has no real effect on the Annex I trading price, and thus no economic effects on the U.S. However, as the target becomes more stringent, the Annex I trading price increases, resulting in higher total costs of compliance for the U.S. If China accepts a target below BAU, the cost of this additional stringency to the U.S. -- essentially, the cost of supplying the environmental benefits associated with these emissions reductions -- can become significant. Thus developing country participation in the form of acceptance of targets more stringent than business as usual will raise costs to the U.S.

Table 2. Effects of Various Chinese Emissions Targets with Annex I Trading

Emissions Target[1]	Permit Price (1997$/ ton)	Chinese Emissions Reductions (MMTC)	Chinese Emissions Sales (MMTC)[2]	Total Cost to U.S. of Complying with Kyoto	Cost to U.S. of Additional Stringency
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BAU - 5%	$29	304	235	$14.9 b	$22/ton
Indifference	$36	343	172	$17.9 b	$26/ton

[1] We employ the SGM BAU for China for the purposes of these calculations.
[2] Reductions in Chinese emissions less Chinese emissions sales yields net global reductions.

Imposing this "indifference" target on China, given that its participation lowers world permit prices, leads to the following conclusions.

- An indifference target for China increases annual U.S. costs by $4.5 billion or 33% relative to a BAU target for China.

- If China accepts an emissions target requiring reductions of approximately 170 MMTC below BAU, the average cost to the U.S. would be $26/ton. This is <u>not</u> the average cost of a ton of emissions purchased from China, but the average cost to the U.S. of the environmental benefits associated with China complying with a more stringent target.

Appendix 2. Ancillary Environmental Benefits of Target and Trade in Developing Countries

The voluntary reduction of greenhouse gas emissions by developing countries under a target and trade system will simultaneously reduce emissions of several pollutants, producing ancillary environmental and human health benefits in those countries. The environmental and health benefits that accrue to those developing countries are unlikely to be offset by decreases in environmental quality in the United States because of our stringent health-based air quality standards.

A recent study in *Lancet* examines the emissions of one pollutant that are reduced along with carbon emissions: airborne particulate matter (PM). The study projects that by 2020, a climate change policy scenario in which developing countries reduce emissions to 10% below their BAU could produce an annual reduction of 563,000 statistical deaths.

The analysis below adapts the predictions in the *Lancet* study to estimate the mortality risk reduced from participation by three developing countries (China, India, and Mexico) in a target and trade system. These illustrative calculations take as given the emissions reductions from BAU resulting from permit sales that are predicted by SGM. It suggests that significant public health gains could result from developing country participation in international carbon permit markets.

Table 3. The Effects of International Carbon Permit Trading on Mortality Risk Associated with Particulate Matter Emissions

Country	Predicted carbon emissions reduction from international permit sales	Share of non-Annex I population in 2010	Annual PM statistical deaths avoided in 2010 by international carbon permit trading
China	20%	23.7%	136,700
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For developing countries that are too "small" to affect the world permit price, adopting a carbon target more stringent than BAU and participating in international trade does not yield additional ancillary benefits relative to a BAU target. Large countries, by adopting targets below BAU, would raise the world price relative to a BAU target, and thereby achieve greater carbon emissions reductions and ancillary benefits.

Caveats

Major assumptions beyond those in the *Lancet* article include:

- Deaths avoided in each non-Annex I country are proportional to the country's share of non-Annex I population.

- Deaths avoided are proportional to carbon emissions reductions.

- Each key developing country is the sole non-Annex I country to adopt a target and participate in international trading.

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A. Data

We have compiled data on 3 variables: emissions of carbon dioxide, GDP, and population for 117 countries for the time period 1970-1992. The carbon dioxide emissions data, measured in millions of metric tons of carbon, are from the Carbon Dioxide Information Analysis Center (Oak Ridge National Laboratory, DOE). The GDP data, measured in 1987 U.S. dollars, are from the World Bank. The population data, measured in thousands of individuals, are from the United Nations Population Division.

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The fixed effects regression we estimated is

$$\text{Emissions} = a\,GDP_{t-1} + b\,GDP_{t-2} + c\,\text{Population}_{t-1} + \gamma\,\text{trend}$$

Emissions are the natural logarithm of the five year non-overlapping average of carbon emissions. All independent variables are lagged. GDP_{t-1} is the log of the gross domestic product in the year prior to the first year in the emissions variable, GDP_{t-2} is GDP in the year two years prior to the first year included in the emissions variable, and population_{t-1} is the country's population in the year prior to first year included in the emissions variable. Trend is one in the first 5 year period, and 2, 3, and 4 respectively in the subsequent 5 year periods. The useable data included 376 cross-section time series observations. The fixed effects regression used 98 degrees of freedom. The R squared was in excess of 0.99.

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As one illustration of the model's accuracy in predicting emissions, consider the chart below that maps actual and predicted emissions using within sample data for ten selected developing countries. The predicted value is never more than 1/4 of one percent away from the actual emissions average for any of the five year intervals.

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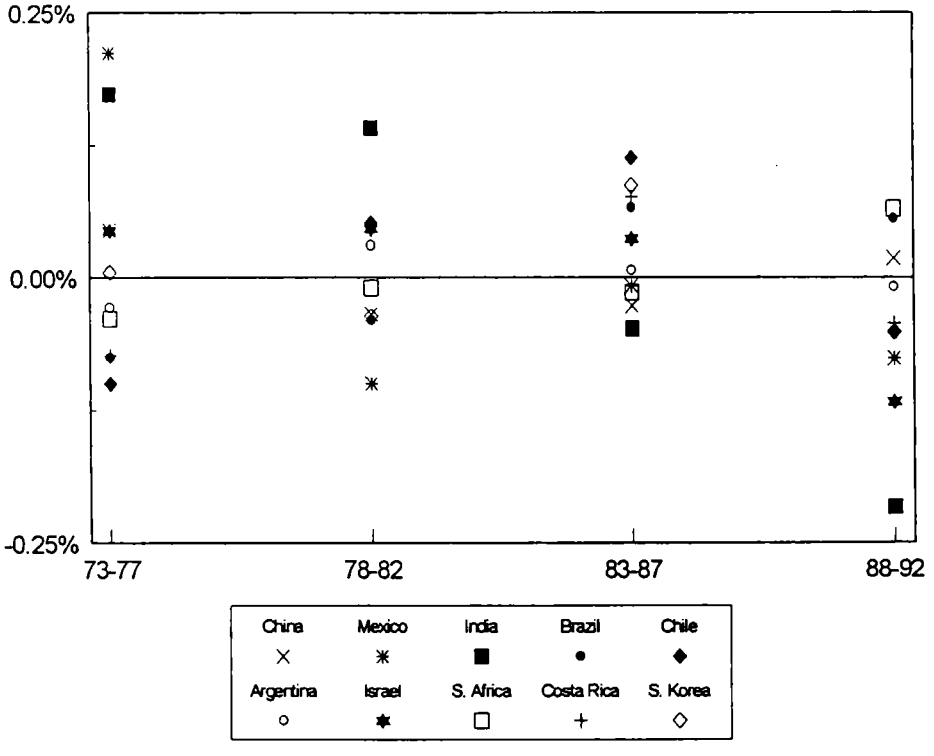

A Proposal for Developing Countries: Participation in a "Target and Trade" System

I. This analysis demonstrates that the gains will be substantial if developing countries (a) accept binding targets at or slightly below their business as usual (BAU) emissions levels, and (b) trade from their respective targets. We believe that participation in a "target and trade" system should be the cornerstone of our international negotiations.

The economic and environmental rationale for such participation includes

- **Greater economic benefits to developing countries:** With targets at or only slightly below BAU, developing countries would enjoy net gains of many billions of dollars through the international sale of emission reductions achieved at lower cost than the world price.

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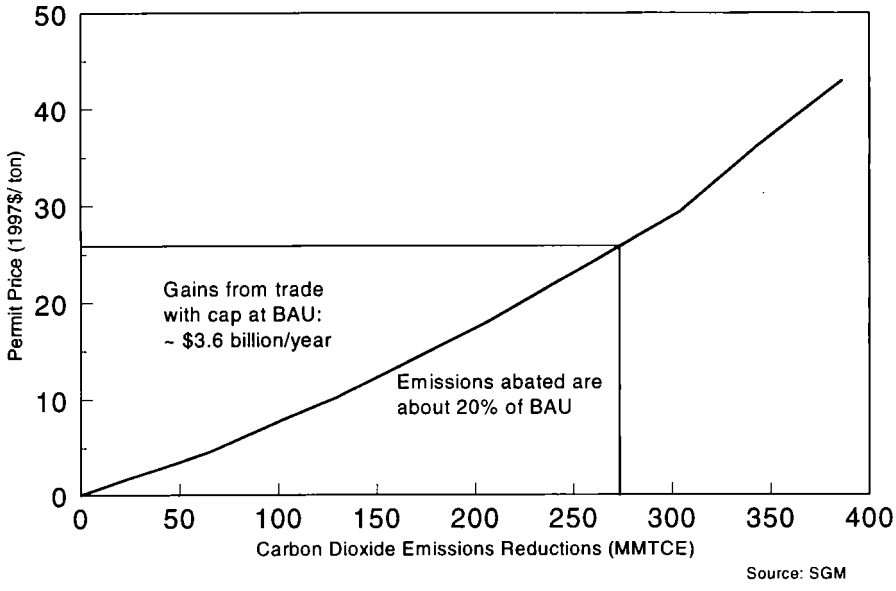

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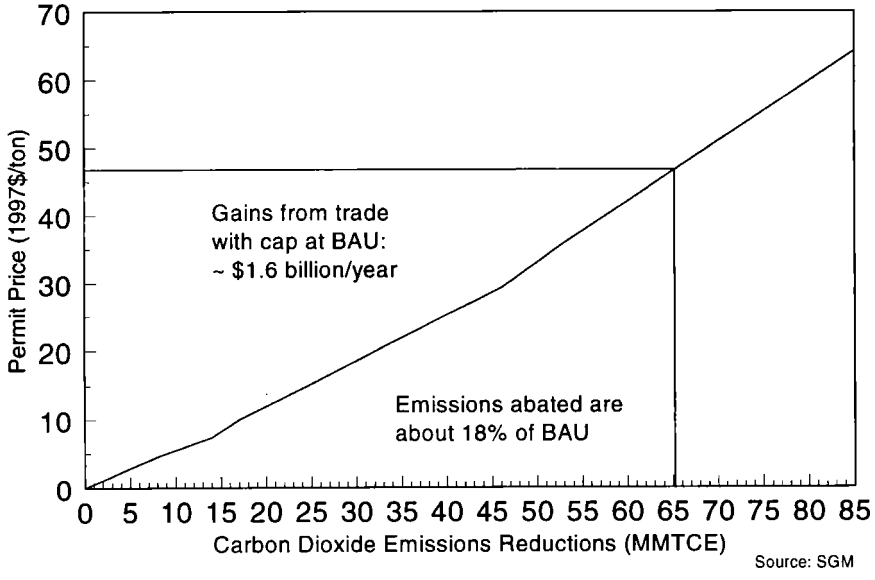

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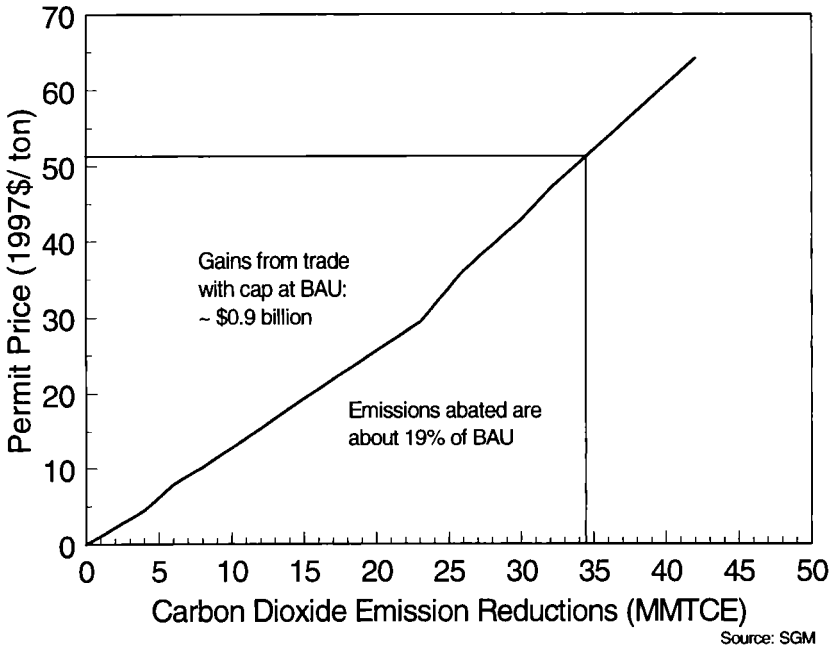

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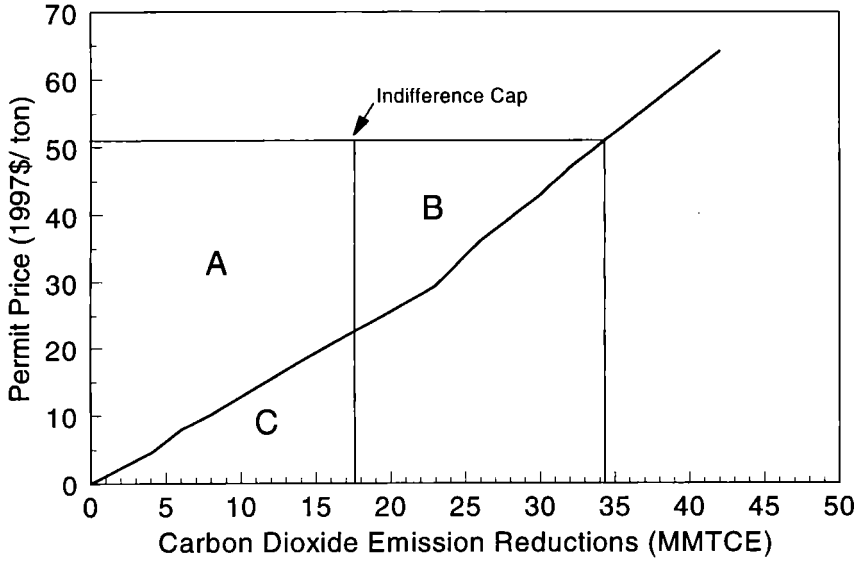

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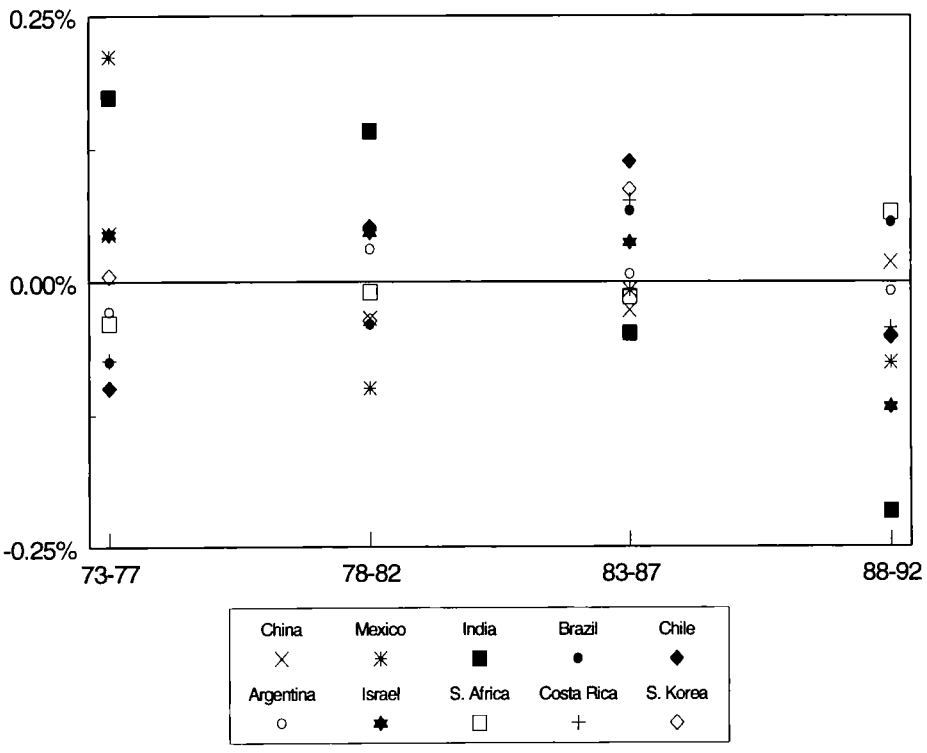

Preliminary, close hold

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QUESTIONS REGARDING TARGETS FOR DEVELOPING COUNTRIES

This note lists six questions that must be answered in considering alternative possible specific versions of the CEA proposal that LDCs be asked to accept emissions targets "at or near" their forecasted BAU paths.

To begin, it is important to acknowledge that :

- there is always a tradeoff between the environmental benefits of bigger cuts vs. the economic costs. More specifically,
- aggressive cuts relative to the expected pre-Kyoto BAU path will be even more firmly opposed by the LDCs than the BAU path itself; while
- increases relative to the pre-Kyoto BAU path (e.g., ratifying forecasted leakage from the Kyoto agreement) will be firmly opposed by environmentalists.

(1) Should the explicit goal (in the first commitment period) be:

- post-Kyoto BAU (including estimate of leakage)
- pre-Kyoto BAU, or
- pre-Kyoto BAU minus some percentage ?

(2) Should the goal be implemented in the form of:

- numbers negotiated internationally by diplomats over the next few years
- numbers produced by a body of "objective experts" over the next few years
- a formula agreed now, contingent on future data
- submissions from countries as to how they propose to determine their own BAU (including the possibility of a formula), subject to a process of expert review / international approval ?

(3) If it is to be a formula, should it be:

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- with numbers determined contemporaneously in 2008-2012 ?

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- GDP
- population
- pre-Kyoto emission levels
- time trend
- all of the above ?

(5) If it is to be a formula, how should the weights on the variables be determined?

- chosen by international body of "objective experts"
- pure cross-section statistical estimates using past data
- time-series or panel-data statistical estimates using past data
- negotiated common formula
- negotiation of different formulas for different countries ?

(6) Should there be any general presumption that the approach (e.g., the choice of variables to enter the formula) might be applied not only to LDCs in 2007-2012, but also to

- LDCs in subsequent commitment periods (presumably with further cuts) ?
- Annex I countries in the future as well, with a goal in the (very) long run of a common formula to apply to all countries ?

Preliminary, close hold

JF, 6/12/98

TARGETS FOR DEVELOPING COUNTRIES

This note lists six questions that must be answered in considering alternative possible specific versions of the CEA proposal that LDCs be asked to accept emissions targets "at or near" their forecasted BAU paths.

To begin, it goes without saying that :

- there is always a tradeoff between the environmental benefits of bigger cuts vs. the economic costs. More specifically,
- aggressive cuts relative to the expected pre-Kyoto BAU path will be even more firmly opposed by the LDCs than the BAU path itself; while
- increases relative to the pre-Kyoto BAU path (e.g., ratifying forecasted leakage from the Kyoto agreement) will be firmly opposed by environmentalists.

(1) Should the explicit goal (in the first commitment period) be:

- post-Kyoto BAU (including estimate of leakage)
- pre-Kyoto BAU, or
- pre-Kyoto BAU minus some percentage?

(2) Should the goal be implemented in the form of:

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Preliminary, close hold

JF, 4/12/98

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GCC

David Wilcox

G7 London July 17

mtdg.

Kinnock declares Party delegtn.

THE WHITE HOUSE

WASHINGTON

June 8, 1998

MEMORANDUM FOR DISTRIBUTION

FROM: JEFF FRANKEL
DAVID SANDALOW

SUBJECT: CLIMATE CHANGE

There will be a meeting on Thursday, June 11 from 11 AM - 12 PM in OEOB 472 to discuss strategies for engaging developing country finance ministries and economists on climate change.

For questions concerning clearance, please contact David Spielfogel at 456-6540.

LDC targets

Name	agency	tel	Fax
Jeff Frankel	CEA	395-5046	
David Wilcox	Treasury	622-2200	622-2633
Joe Aldy	CEA	395-1455	395-6870
Randy Lutter	CEA	395 3142	395 6877
Mark Mazur	DOE	586-7700	586-9626
Peter Backlund	OSTP	456-6081	6025
Jim Rubin	WHCCTF	395-2343	52542
Ben Jones	Treasury	622-4447	-9373
Pam Pearson	State	647-1113	647-5947
Helen Walsh	Treas	622-1265	622-1228
Rob Wolcott	EPA	260-4332	260-0725
Ellie KAPLAN	TREASURY	622-0409	622-9373
AL McGARTLAND	EPA	260-3354	260-6406
Anne Pence	State	6477513	6479763
DAVID HALES	USAID	712 1750	
RAY SQUITIERI	Treasury	622-1301	-2633
Adele Morris	CEA	395-5012	395-6870
Matt Weinzierl	CEA	395-4563	
David Sandalow	CEQ		

Economics Ministries on the pro side.

Env. benefits
- slightly below
- no leakage
- paid for further reductions) in those countries
- future reductions

B C2

name sheet

WH JY 90.04

Preliminary, close hold

JF, 6/11//98+

QUESTIONS REGARDING TARGETS FOR DEVELOPING COUNTRIES

This note lists six questions that must be answered in considering alternative possible specific versions of the CEA proposal that LDCs be asked to accept emissions targets "at or near" their forecasted BAU paths.

To begin, it is important to acknowledge that :

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Developing Country Participation in International Emissions Trading

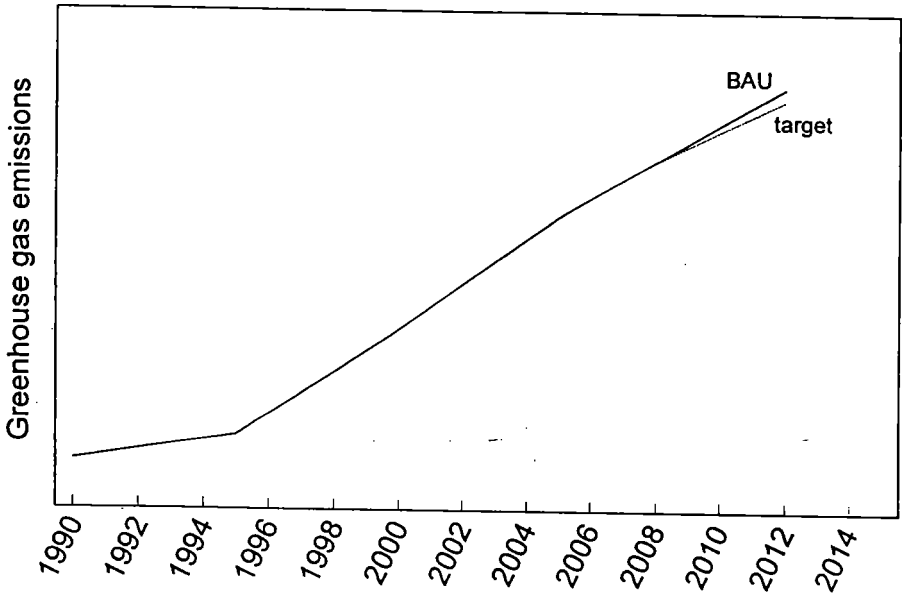
If a developing country (a) chooses to adopt a growth target slightly below its business as usual (BAU) emissions, and (b) trades its emissions allowances internationally, it could enjoy substantial economic and environmental gains.

- **Economic Benefits.** As potential sellers, developing countries with targets slightly below BAU projections could enjoy net gains from participation in international emissions trading, because they can achieve emissions reductions relatively "cost-effectively" (i.e., at a cost per metric ton of carbon equivalent that is less than the world trading price). Even with this participation, a country's emissions could continue to grow above current levels (see figures below).

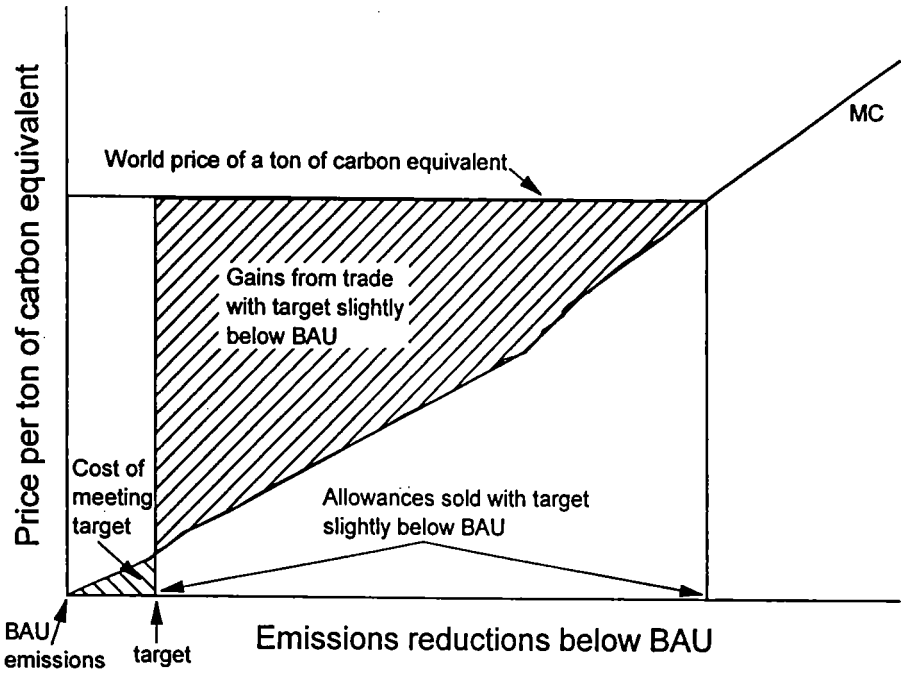
- **Environmental Benefits.** A world with broad-based participation in international emissions trading, including participation by countries with growth targets slightly below their BAU projections, could result in lower global greenhouse gas emissions relative to a world with narrow participation. Moreover, reductions in greenhouse gas emissions would generate ancillary air quality benefits through reductions in sulfur dioxide, nitrogen oxides, and particulate matter emissions.

Benefits of Trade: The following example illustrates (i) a potential growth target, set slightly below a developing country's BAU projection, and (ii) the economic benefits available to this developing country through international emissions trading.

(i) Illustration of a Developing Country Growth Target



(ii) Marginal Abatement Cost Curve and Gains from Trade in 2010



These gains from trade represent revenue from sales of emissions allowances less the cost to the developing country of reducing emissions.

Financial Working Group -- Briefing Points on Climate Change

- Climate change presents one of the greatest threats to our global environment and prosperity. To address this problem, the nations of the world negotiated the Framework Convention on Climate Change in 1992, and agreed to the Kyoto Protocol in 1997.

- The Kyoto Protocol sets out binding targets and timetables for countries listed in Annex 1 of the Framework Convention, often referred to as "developed" countries, to reduce their emissions of greenhouse gases (CO2, methane, nitrous oxides, sulfur hexafluoride, hydrofluorocarbons and perfluorocarbons). These countries include the U.S., Japan, the E.U., Russia, Australia and virtually all members of the OECD. Countries outside of Annex 1, often referred to as "developing countries," did not agree to targets, but did agree to other commitments under the Protocol.

- Mexico, which is a member of the OECD, is not an Annex 1 country and, like other non-Annex 1 countries, did not agree to take on a target. Mexico has, however, taken significant steps to assess and reduce its greenhouse gas emissions and increase its energy efficiency.

- The Kyoto targets are based on 1990 emissions and are differentiated to take into account national circumstances. For example, the U.S. target is 7% below 1990 levels; Russia's target is stabilization at 1990 levels; and Australia's target is 8% above 1990 levels.

- Rather than imposing mandatory policies and measures, the Kyoto Protocol allows a Party to meet its target in a manner it considers appropriate. The Protocol does establish a number of flexible, market-based mechanisms to allow parties to seek cost-effective reductions wherever they may be found. These mechanisms include international emissions trading, joint implementation and the clean development mechanism. Only countries with targets can participate in international emissions trading and joint implementation.

- Through these flexibility mechanisms, the Kyoto Protocol will create an international market for greenhouse gas emissions. Upon the Protocol's entry into force, countries with binding targets will be able to trade officially in emissions allowances.

- Developing countries, such as Mexico, that can reduce their greenhouse gas emissions at relatively low cost would be well-positioned to benefit -- both environmentally and *economically* -- from their participation in this market.

  --A developing country could, for example, take on a growth target or "moving cap" that is slightly below its business-as-usual emissions. Such a target would not place the country's prosperity at risk, but would enable it to participate in the trading regime.

  --If the country were able to reduce its emissions below that target, it could sell the

excess allowances internationally, potentially at a substantial net gain. (That gain would be determined by the amount of the excess and the difference between the cost of making the reductions and the price obtained on the world market.)

- We have been discussing methods of reducing greenhouse gas emissions and increasing energy efficiency with your Environment and Energy Ministers, and we will continue to do so. But we believe the Ministry of Finance (Hacienda) may want to participate in the Mexican government's discussions of climate change policy, given its economic and financial aspects, including analysis of the net benefits of international emissions trading.

- We want to leave you with these ideas and invite your future participation in the dialogue between our two countries.

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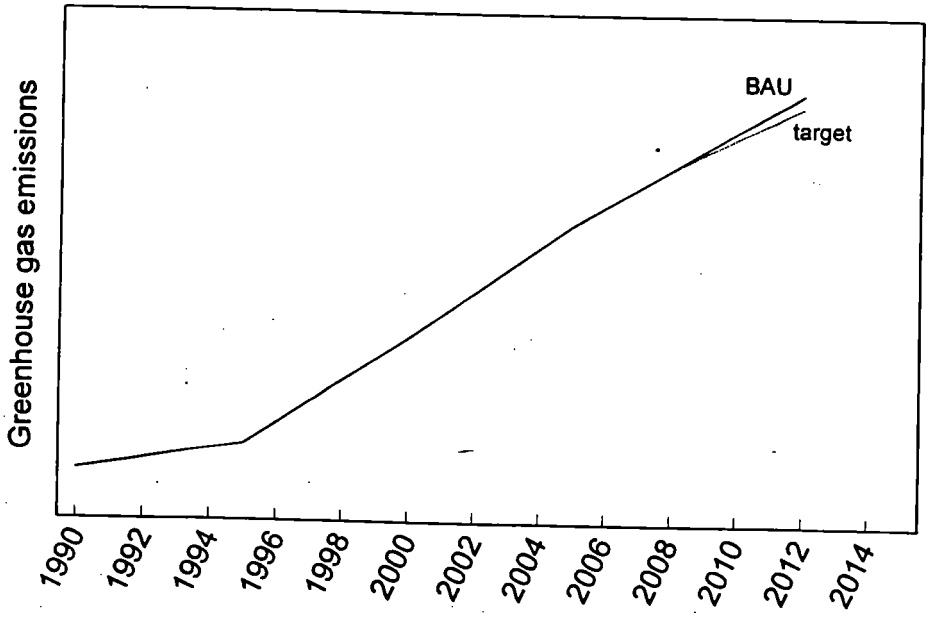

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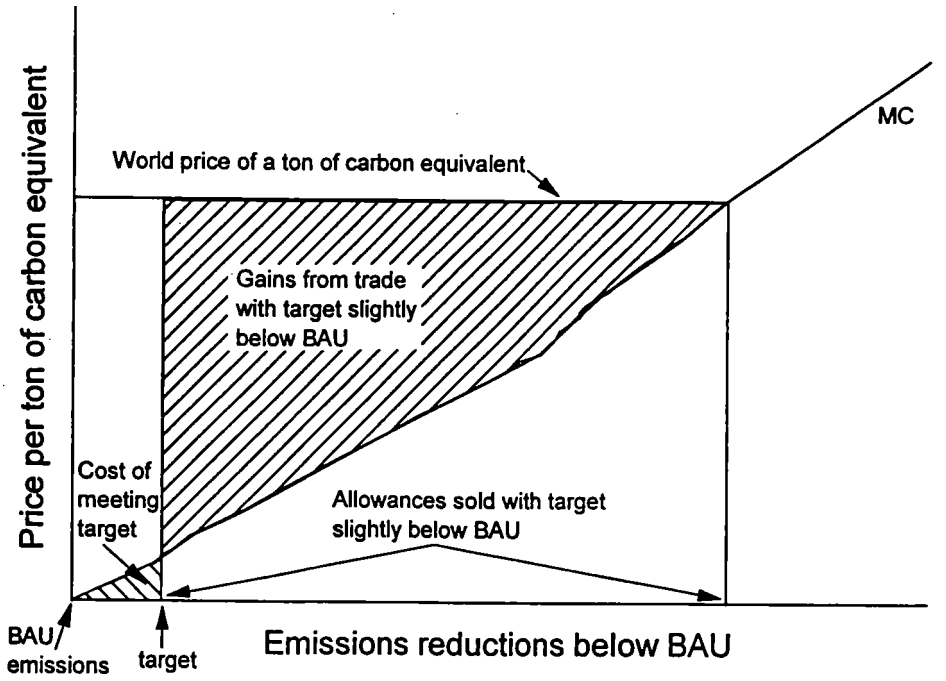

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LDC targets mtg. 6/12/98

Sandalow technical assistance
K, Mex...

UNCTAD
W, BK Prototype carbon fund Backing off now.

G8 CC wkg. group
July 17 M. Kimble mtg. 6 UK host in London?
lead. + Treas + DoE..

Wilcox K School
Harvard July curriculum

USIS Future leaders

Korea Janet stop off on way back ☆
Mex, Arg., Chile
+2nd tier

LDC Energy subsidies - e.g. China. Save them from own distortns.
K plans to sign K Protocol when Kim visits China